Chapter 11
Factorial Designs
Factorial Designs

Foundational Concepts

Factorial Designs
Two or more independent variables are manipulated and studied

Factor
• Independent variable studied

Level
• Different values that exist for each factor

Example

Factor 1: Gender
Levels: Male/Female

Factor 2: Presentation Style
Level: Visual/Verbal

Labeling
• Factorial designs are labeled by the number of factors and levels

Factor: number of numbers listed
Levels: the value of the numbers
Labeling

This study used a 2x3 factorial design

- Two Numbers = Two Factors
- Factor 1 = Two Levels
- Factor 2 = Three Levels
Factorial Designs

Foundational Concepts

Class Activity

• How many Factors and Levels to the following studies have?
  • 3x3 Factorial Design
  • 2x3x2 Factorial Design
  • 4x2 Factorial Design
## Factorial Designs

### Foundational Concepts

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>• In real life variables rarely exist in isolation</td>
<td>Jones (2005)</td>
</tr>
<tr>
<td>• Capture real-life complex relationships between variables</td>
<td>• Can the use of humor influence audience perception of organization?</td>
</tr>
</tbody>
</table>
### Factorial Designs

#### Data Matrix

**Example**
Do different types of scent affect males and females differently?

**DV:** Words recalled

**Factors:** Scent type
**Levels:** Pine/Lavender

**Factor:** Gender
**Levels:** Female/Male

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Lavender</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

**Key Terms**

- Data is arrange in a matrix of cells

**Cell Mean**
- An average of all scores for one treatment condition

**Row Means**
- Add row cell means together – divide by number of row cells
- Indicate main effects

**Column Means**
- Add column cell means together – divide by number of column cells
- Indicate main effects
Factorial Designs

Foundational Concepts

Main Effect
- When there is a difference of overall means between the different levels of one factor (across all the conditions of the 2\textsuperscript{nd} variable)
- Column means are different
- Row means are different

Interaction
- When one factor modifies the effect of a second factor
- Look for mean differences in individual cells
Interpreting Main Effects and Interactions

**General Rule**

- First *always* look for interactions
- If there is an interaction, the main effects may present a distorted view of the outcome
How would you graph the following data?

<table>
<thead>
<tr>
<th>Factor A</th>
<th>Females</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Lavender</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

**Line Graphs**
- Dependent Variable: Y-axis
- **Factor A**: Different Lines
- **Factor B**: X-axis

**Bar Graphs**
- Dependent Variable: Y-axis
- **Factor A**: Different Bars
- **Factor B**: X-axis
Class Activity

Your goal is to create data matrixes and line graphs for each of the types of conditions of a 2x2 factorial design.

Do different medications have different types of effects on people who have Anxiety or people who have Depression?

**Factor A:** Drug Type  
**Levels:** Fixit/Zoloft

**Factor B:** Disorder Type  
**Levels:** Anxiety/Depression

**DV:** Drug effectiveness (high scores = more effective)
Rule For Interactions

- An interaction exists if the lines on a line graph cross or are not parallel to each other
Graphing Factorial Designs

Your goal is to create **data matrixes** and **line graphs** for each of the types of conditions of a 2x2 factorial design.

**Factor A:** Drug Type  
**Levels:** Prozac/Zoloft

**Factor B:** Disorder Type  
**Levels:** Anxiety/Depression

**DV:** Drug effectiveness (high scores = more effective)

**Data Set Must Include**
- Cell Means, Row Means, Column Means
- Hint: use easy numbers (multiples of 5 and 10)

**Graphs Must Include**
- Appropriate labels and clearly identifiable pattern of results

**Conditions**
1. Main Effect for Factor A, no main effect for Factor B, no interaction
2. Main Effect for Factor B, no main effect for Factor A, no interaction
3. Main Effect for Factor A and B, no interaction
4. Interaction + Main Effect of Factor A
5. Interaction + Main Effect for Factor B
6. Interaction, but no main effects
7. Interaction + Main Effect for Factor A and Factor B
Rule For Interactions
- An interaction exists if the lines on a line graph cross or are not parallel to each other.

Rules For Main Effects
1. If lines are parallel, yet separate
2. If the lines go significantly up or down from one level to another for factor B
Types of Factorial Designs

**Between-Subjects**
- Both factors are independent
- Different participants in each condition (each cell)

**Within-Subjects**
- Participants are measured in all conditions
- Rare, but possible

**Mixed-Design**
- One factor is between, one is within
- Two separate groups, each measured two times

**Shrauger (1972)**
*Is performance of people with high and low self-esteem affected by the presence of an audience?*
*P. 317, 318*

**Teasdale & Fogarty (1979)**
- Does mood affect the type of words you remember?
*P. 315*
Does the presence of an audience influence the performances on a word-scramble game of people who are novices or experts?

Factor B: Audience
Levels: Audience/No Audience

Factor A: Skill-level
Levels: Novice/Expert

DV: Performance on word task (out of 20)

For the following data sets, provide an explanation of the main effects and interactions. Also provide an interpretation of what the data mean.
### Interpreting Factorial Data

#### Between-Subjects Designs

<table>
<thead>
<tr>
<th></th>
<th>No audience</th>
<th>Audience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novice</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Expert</td>
<td>17</td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>No audience</th>
<th>Audience</th>
</tr>
</thead>
<tbody>
<tr>
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<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Expert</td>
<td>15</td>
<td>19</td>
</tr>
</tbody>
</table>

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<tbody>
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<td>8</td>
<td>13</td>
</tr>
<tr>
<td>Expert</td>
<td>13</td>
<td>18</td>
</tr>
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</table>
Mixed Design

Does mood (happy or sad) affect the recall of positive or negative words?
Factor A: Mood
Levels: Happy/Sad
Factor B: Word-type
Levels: Positive/Negative
DV: Number of words recalled (out of 20)

For the following data sets, provide an explanation of the main effects and interactions. Also provide an interpretation of what the data mean.
## Interpreting Factorial Data

### Mixed Designs

<table>
<thead>
<tr>
<th></th>
<th>Pos. Words</th>
<th>Neg. Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy Mood</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Sad Mood</td>
<td>12</td>
<td>13</td>
</tr>
</tbody>
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Jones (2005)

Research Article: “Persuasion 2x2 Factorial Humor and Speech Organization”
**Factorial Ideas**

**Scent and Memory (interaction)**
- **Factors**
  - Gender: Male/Female
  - Scent Type: Lavender/Pine

**Attitudes toward transgender individuals**
- **Factors**
  - School age group: High school/college
  - Type of material: persuasive/informative

**Coffee and Attention (main effect)**
- **Factors**
  - Age: 20, 40
  - Coffee: No Coffee/8oz

**Persuasion, confidence, and appearance**
- **Factors**
  - Confidence: High/Low
  - Appearance: Nice/Sloppy