

Experimental Design

General Control Procedures

- Control over subject and experimenter effects
- Control through the selection and assignment of participants
- Control through specific experimental design

Logic of Experimental Control

- Simple randomized design
 - Experimental group
 - Control group
- Inferring causation in simple randomized designs
 - Method of agreement
 - Method of difference

Method of Agreement

- If **X**, then **Y**
 - **X** = presumed cause
 - **Y** = presumed effect
- **X** is a sufficient condition of **Y**
 - **X** is adequate to bring about effect **Y**
 - **Y** will be present if **X** is present

Method of Difference

- If **not-X**, then **not-Y**
- **X** is a necessary condition of **Y**
 - **X** is essential to bringing about effect **Y**
 - **Y** will NEVER be present if **X** is absent
- Demonstrating a causal relationship between **X** and **Y**
 - **X** is both necessary AND sufficient to cause **Y**

Aromatherapy Candles CAUSE Reduction in Tension

- Method of agreement
 - Burning candle leads to reduced tension
 - Sufficient
- Method of difference
 - Burning candle WITHOUT essential oils does not lead to reduced tension
 - Necessary



Experimental Designs

- Pre-experimental designs
 - Lack random assignment and a control group
- Experimental designs
 - Randomly assign participants to treatment conditions
- Quasi-experimental designs
 - Partial control over independent variables
 - Lacking random assignment

Pre-experimental Designs

- Do not include the critical controls of experimental designs
 - May still be used, but caution is necessary
- Designs
 - One-shot case study
 - One-group, pre-post design

One-shot Case Study

- Expose treatment group to event or experimental variable
 - Measure effect
- Example
 - Sit in room for 1 hour next to aromatherapy candle that improves intellectual functioning
 - Measure success at solving word problems
- Controls none of the potentially confounding variables

One-Group, Pre-Post Design

- Measure subjects before treatment
 - Expose treatment group to event or experimental variable
 - Measure subjects after treatment
- Example
 - Measure success at solving word problems
 - Sit in room for 1 hour next to aromatherapy candle that improves intellectual functioning
 - Measure success at solving word problems

Experimental Designs

- Two essential components
 - Random assignment to condition
 - Methods of agreement and difference
- Designs
 - Posttest-only, control-group design
 - Pretest-posttest, control-group design
 - Solomon's four-group designs
 - Multilevel, between-subjects designs

Posttest-Only, Control-Group Design

- Participants randomly assigned to condition
- Two groups
 - Experimental group (method of agreement)
 - Receive treatment
 - DV measured
 - Control group (method of difference)
 - Receive no treatment
 - DV measured

Posttest-Only, Control-Group Design

- Simple experimental design allowing you to infer causation
- Random assignment
 - Control for selection
- Experimental and control groups
 - Allows comparison
 - Controls other confounding variables

Pretest-Posttest, Control-Group Design

- Advantages
 - Quantifies amount of change following treatment
 - Verifies that the groups were equal initially
- A strong basic research design, with excellent control over confounding

Solomon's Four-Group Design

- 4 groups
- Combines two basic experimental designs
 - Pretest-Posttest, Control-Group Design
 - Posttest-Only, Control-Group Design
- Assess interaction between the treatment and the pretest

Pretest and Treatment Interaction Example

- Attitudes about police officers following positive information about police officers' community service work
- Pretest
 - Answer questions about attitudes towards police officers
- Treatment
 - Read articles
- Posttest
 - Answer questions about attitudes towards police officers

Pretest and Treatment Interaction Example

- Group 1
 - Treatment, Pretest
- Group 2
 - Treatment, no pretest
- Group 3
 - No treatment, Pretest
- Group 4
 - No treatment, no pretest

		Pretest?	
		YES	NO
Treatment?	YES	Group 1	Group 2
	NO	Group 3	Group 4

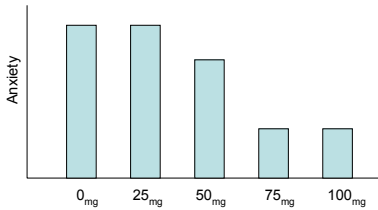
One-way versus Factorial Designs

- Distinguished by the number of independent variables
- One independent variable
 - One-way design
- More than one independent variable
 - Factorial design

One-way Design

- Examine effect on DV of variations on one IV
 - Independent variable has more than two levels
- Example: Ideal dosage of anti-anxiety medication
 - 0 mg (placebo), 25 mg, 50 mg, 75 mg, 100 mg
 - O, X1-O, X2-O, X3-O, X4-O

Advantages and Disadvantages

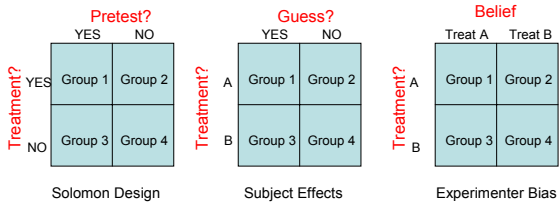


- Can reveal effects missed in a two-groups design
- Costly (time, resources, participants)

Factorial Designs

- Contain two or more independent variables
 - Completely crossed
 - Every possible combination of all the levels of all the IV's
- Examples
 - Solomon design
 - Controlling subject effects
 - Controlling experimenter bias

Examples

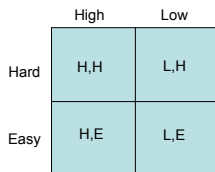


Simple Factorial Design

- Two-by-two (2X2) design
 - Most simple factorial design
 - Two independent variables
 - Two levels in each independent variable
- Numbers in the design
 - Refer to the number of levels in each IV
- Multiplication sign
 - Reminder that the variables are completely crossed
 - Reminder of the number of cells/conditions in the design

Examples of Factorial Designs

- Effects of anxiety and task difficulty on performance
 - High anxiety versus low anxiety
 - Difficult task versus easy task
 - Time to solve puzzle



Examples of Factorial Designs

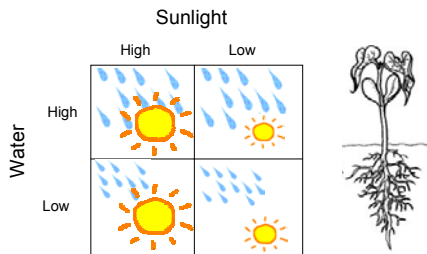
- Effects of room color and music on depression
 - Pink room versus White room
 - Rock music versus classical music versus no music
 - Self ratings of depression

	Pink Room	White Room
Rock music	P,R	W,R
Classical music	P,C	W,C
No music	P,N	W,N

Questions Answered

- Answer questions about more than one IV at a time
 - Main effect of IV
- Detect interactions between IVs
 - Effect of an IV depends on the level of the other IV

Main Effects and Interactions Example

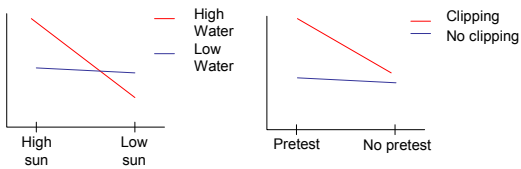


Main Effects and Interactions Example

Amount of Water Received	Amount of Sunlight Received		
	Low	High	Row Means
Low	22.4	25.6	24.0
High	10.8	37.2	24.0
Column Means	16.6	31.4	

- Plants receiving high sunlight grow taller than plants receiving low sunlight
- Plants that receive high water grow to the same height as plants receiving low water
- Plants receiving low sun did better with low water, plants receiving high sun did better with high water

Types of Interactions



- Crossover interactions
 - No main effect of either or both IVs
 - Effects of IV are opposite at different levels of other IV
- Spreading interactions
 - Effect of IV at one level of other IV but less or nonexistent at the other level(s) of other IV

Identify Examples

- What is the IV and the DV?
- Is there a comparison group?
- Are participants randomly assigned to condition?
- What is the design?

McClellan & Woods (2001)

- Wondered how salesclerks would react to customers with a disability.
- 77 Salesclerks randomly assigned to one of two groups
 - Hearing loss “customers”
 - Normal “customers”



McClellan & Woods (2001)

- Measured length of time
 - Initial eye contact to offering assistance
- Results
 - Hearing impaired customers
 - 3.9 minutes
 - Normal customers
 - 1.3 minutes

Questions

- What is the IV and the DV?
- Is there a comparison group?
- Are participants randomly assigned to condition?
- What is the design?

Wells (2001)

- Interest in effects of stress on the body
 - Mental arithmetic task used to induce stress
- Examined whether mental arithmetic task was stressful
- Task
 - Count backwards from 715 by 13
 - Told that most complete task in 4 minutes

Wells (2001)

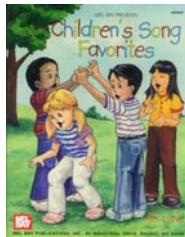
- 4 minutes of counting backwards
 - Measure heart rate and blood pressure
- 10 minutes completing questionnaire
 - Non-stressful rest period
- Measured heart rate and blood pressure
 - Found decrease in both heart rate and blood pressure
 - Mental arithmetic task is stressful

Questions

- What is the IV (levels) and the DV?
- Is there a comparison group?
- Are participants randomly assigned to condition?
- What is the design?

Jones (2001)

- Effect of noise on children's performance
 - 9 to 12 years old
- Noise
 - No noise, white noise, popular song
 - 74 dB
- Performance
 - Recall tasks
 - Spatial task (completing a block design)



Jones (2001)

- Performance with white noise significantly better than popular song
- No noise
 - Worse performance than white noise
 - Better performance than popular song
 - Not significantly different from either

Questions

- What is the IV (levels) and the DV?
- Is there a comparison group?
- Are participants randomly assigned to condition?
- What is the design?

Bonds-Raake, Wright & Nelson (2001)

- Examined student's attitudes towards animal behavior as a function of source and time
 - Expected source to matter
 - Expected sleeper effect
- 85 undergraduates randomly assigned to condition
 - 41 men, 44 women

Bonds-Raake, Wright & Nelson (2001)

- Source
 - Article on animal cognition from JEP
 - Article on animal cognition from National Enquirer
 - Article on gambling from unnamed source
- Measures attitudes towards locus of animal behavior
 - Immediately after reading article
 - One week after reading article



Bonds-Raake, Wright & Nelson (2001)

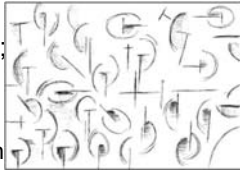
- Significant main effect of article type
 - JEP readers
 - More cognitive locus than National Enquirer or no source
- No main effect of time
- No interaction

Questions

- What is the IV (levels) and the DV?
- Is there a comparison group?
- Are participants randomly assigned to condition?
- What is the design?

Ishibashi & Okada (2004)

- Effect of copying masters on students creativity
- Day 1: Pepper & pinecone; Cocktail glass
- Day 2: Shell; Potted plant
 - Experimental: Copy modern artists' picture
 - Control: Draw own
- Day 3: Orange & shell



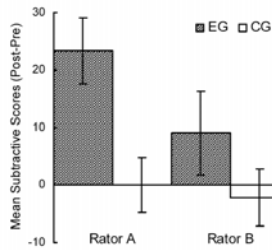
Ishibashi & Okada (2004)

- Pictures rated by 2 modern artists for creativity
 - Blind to condition and day of drawing



Ishibashi & Okada (2004)

- Difference between Day 1 and Day 3
 - EG were rated significantly more creative than those in CG
 - $F(1,16)=5.54, p<.05$



Questions

- What is the IV (levels) and the DV?
- Is there a comparison group?
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- What is the design?

Baerheim & Sandvik (1994)

- Effect of ale, garlic & soured cream on leech appetite
- Exposed leech to substance
 - Guinness (6), sour cream (6), garlic (2), nothing (6)
- Measured
 - Time from touching skin to first bite



Baerheim & Sandvik (1994)

- Beer
 - Swaying forebodies, losing grip, falling on back
- Garlic
 - Wriggle and crawl, couldn't feed.
 - Died within 2.5 hr
- Soured cream
 - Became ravenous sucking on beaker
 - Bit no sooner than unexposed leech

Questions

- What is the IV (levels) and the DV?
- Is there a comparison group?
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- What is the design?

Wallace & Menson (1972)

- Physiological changes during TM
- Measured relaxation
 - Before, during, after meditation
 - Oxygen consumption, and carbon dioxide elimination



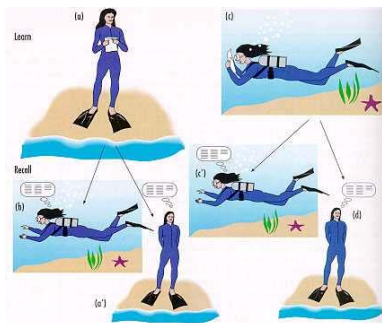
Wallace & Menson (1972)

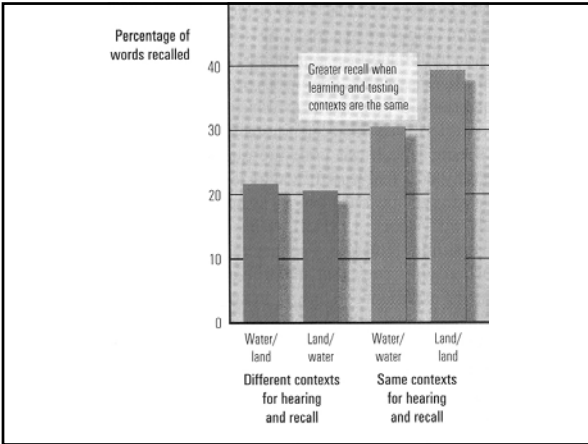
- Relaxation increased during TM compared to pre and post meditation states
 - Decreased heart rate, oxygen consumption and carbon dioxide elimination

Questions

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Godden & Baddeley (1975)



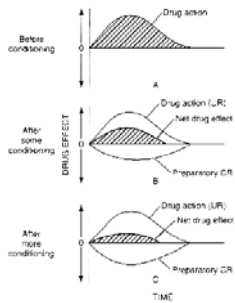


Questions

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Context & Heroin Overdose

- Context acts as CS
- Produces anticipatory CR
- Body attempts to maintain homeostasis
 - Lessens drug effects



- Three conditions
 - 2 conditions received daily injections of heroin
 - Amount increased over time
 - Developed tolerance
 - 1 condition received no heroin
- Testing (heroin injections – same amount as previous session for Cond1 & 2 rats)
 - Cond1: Heroin in same context
 - Cond2: Heroin in different context
 - Cond3: Heroin
- Results
 - Cond1: All survived
 - Cond2: Less than 50% survived
 - Cond3: All died

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