

# TECH 646 Analysis of Research in Industry and Technology

## Experiments

Lecture note based on the Ch. 9 of the text book and supplemental materials:

Cooper, D.R., & Schindler, P.S., *Business Research Methods* (12th edition), McGraw-Hill/Irwin

Paul I-Hai Lin, Professor  
<http://www.etcs.pfw.edu/~lin>  
A Core Course for M.S. Technology  
Purdue University Fort Wayne

## Experiment – Learning Objectives

### Understand ...

1. The uses for experimentation
2. The advantages and disadvantages of the experimental method
3. The seven steps of a well-planned experiment
4. Internal and external validity with experimental research designs
5. The three types of experimental designs and the variations of each.

## Pull Quote

**“This is a time of [e-book app] experimentation. I’d be really disappointed if we weren’t seeing both successes and failures. I do think that everyone seems to be looking at these differently.”**

***Barbara Marcus, consultant and adviser,  
Open Road Integrated Media***

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## PulsePoint: Research Revelation

**45**

**The percent of smartphone users who checked their e-mail before they get dressed.**

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## What is Experimentation?

- **Experiments** are studies involve interventions by the researcher beyond that required for measurements
  - **The usual Interventions:** manipulate some variables in a setting and observe how it affects the subjects being studied (e.g. people or physical entities)
  - **Researcher:** manipulate some Independent Variable or Explanatory Variable and then Observe whether the Hypothesized Dependent variable is affected by the intervention

## Causal Evidence



**Agreement between  
IVs and DVs**

**Time order of occurrence**

**Extraneous variables  
did not influence DVs**

## Causal Evidence

- **Causal methods** – research method, accept the world as it is
  - Why do events occur under some conditions and not under others?
- Three types of evidence necessary to support causality (IV and DV)

Agreement between IVs and DVs

Time order of occurrence

Extraneous variables did not influence DVs

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## Causal Evidence?



Now let's talk about software support. If the software hiccups or takes an unscheduled break, the wrong questions can get answered. Only nonstop support can keep that from happening.

That's why the world's top research organizations rely on CMC - the only nonstop in the business.



Nonstop Support

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## Evaluation of Experiments

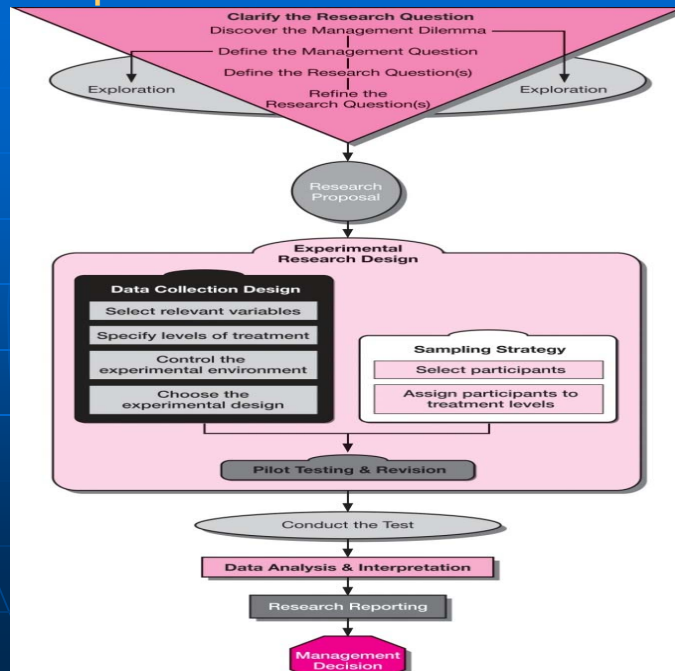
### Advantages

- Ability to manipulate IV
- Use of control group
- Control of extraneous variables
- Replication possible
- Field experiments possible

### Disadvantages

- Artificiality of labs
- Non-representative sample
- Expense
- Focus on present and immediate future
- Ethical limitations

## Experimentation in the Research Process



## Conducting an Experimentation

Specify treatment variables

Specify treatment levels

Control environment

Choose experimental design

Select and assign participants

Pilot-test, revise, and test

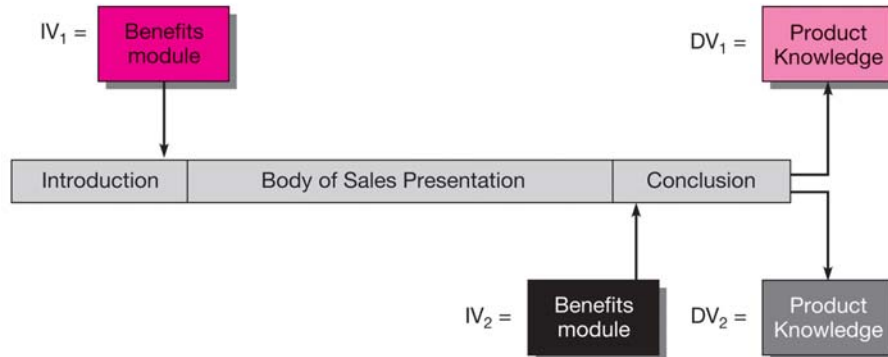
Collect data

Analyze data

## Experimentation: Exhibit 9-2 Placement of Benefits Module (Test Order-of-Presentation Effects)

**Hypothesis:** Sales presentations in which the benefits module is placed in the introduction of a 12-minute message produce better retention of product knowledge by the customer than those in which the benefits module is placed in the conclusion.

$$\text{Effect} = DV_1 - DV_2$$



## Selecting and Assigning Participants

Random  
assignment

Matching



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## Random Assignment

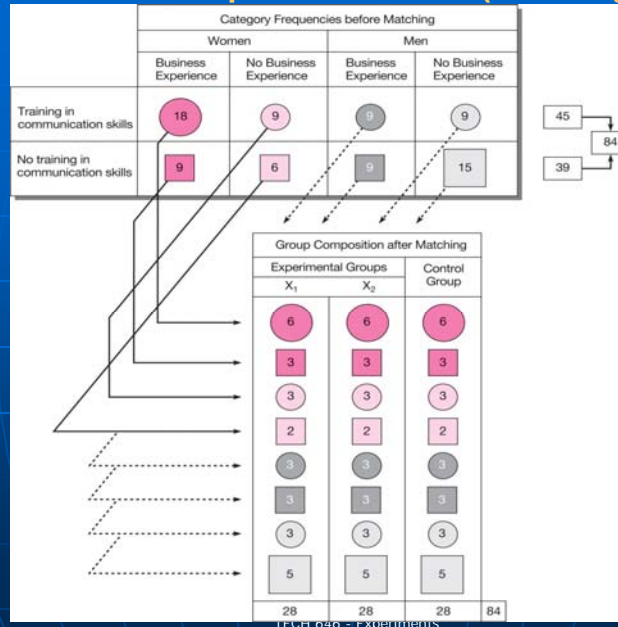


Equal and known  
chance of being  
assigned to any  
group in the  
experiment



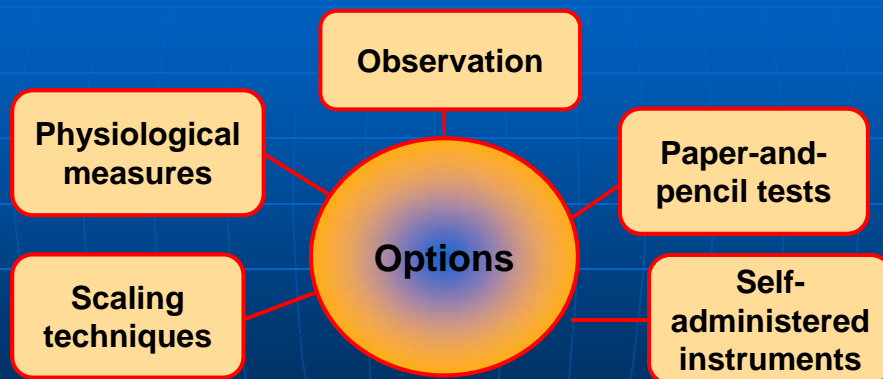
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## Quota Matrix Example – Exhibit 9-3 (Matching Process)



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## Measurement and Instrument Options



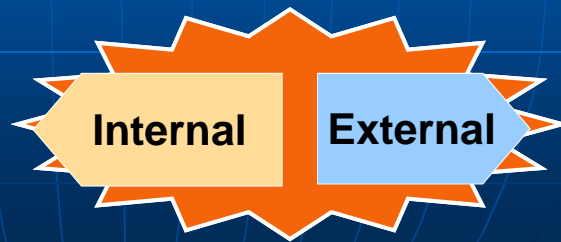
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## Validity in Experiment

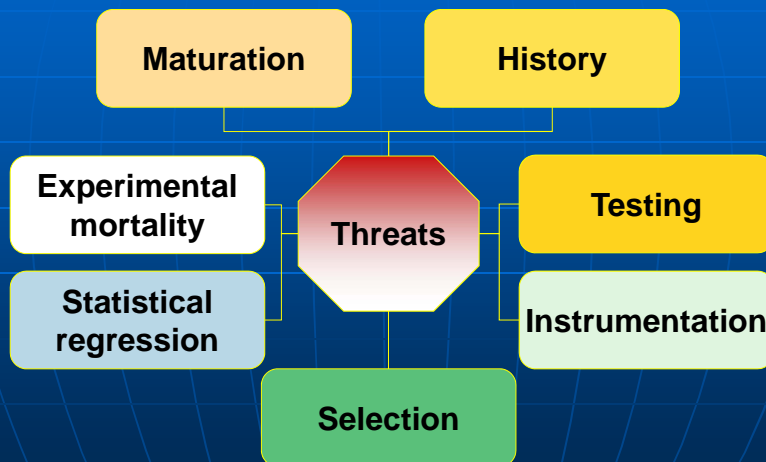
- Internal Validity
  - When the conclusion drawn about a **demonstrated experimental relationship** truly implies cause
- External Validity
  - When an **observed causal relationship** can be generalized across persons, setting, and times



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## Threat Factors to Internal Validity



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## Additional Threats to Internal Validity

Diffusion or imitation of treatment

Compensatory equalization

Compensatory rivalry

Resentful disadvantaged

Local history



## Major Threat to External Validity

Reactivity of testing on X

Interaction of selection and X

Other reactive factors

The merchandise was organized in a way that made it easy to find what I was looking for.

Does Not Describe At All                      Definitely Describes

(1) (2) (3) (4) (5)



Next Question

## Experimental Research Designs

Pre-experiment Designs

True experiment Designs

Field experiment Designs

## Pre-experimental Designs

- **After-Only Case Study**
  - X – treatment or manipulation of IV
  - O – observation/measurement of DV
- **One-Group Pretest-Post Test Design**
  - O<sub>1</sub> – Pretest observation/measurement of DV
  - X – treatment of IV
  - O<sub>2</sub> – Posttest observation/measurement of DV
- **Static Group Comparison (2 groups)**



## True Experimental Designs

- One Group Pretest-Posttest

$O_1$        $X$        $O_2$



Pre-experiment



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## True Experimental Designs

- Posttest-Only Control Group Design

- Experiment effect =  $O_2 - O_1$

$R$        $X$        $O_1$   
 $R$             $O_2$



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## Pretest-Posttest Control Group Design

R	O <sub>1</sub>	X	O <sub>2</sub>
R	O <sub>3</sub>		O <sub>4</sub>



True experiment

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## Static Group Comparison

X	O <sub>1</sub>
.....	.....
O <sub>2</sub>	



Pre-experiment

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## Nonequivalent Control Group Design

$O_1$        $X$        $O_2$   
 $O_3$                        $O_4$



Field experiment

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## Separate Sample Pretest-Posttest

$R$                $O_1$                $(X)$   
 $R$                                        $X$        $O_2$



Field experiment

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## Group Time Series Design

R	O <sub>1</sub>	O <sub>2</sub>	O <sub>3</sub>	X	O <sub>4</sub>	O <sub>5</sub>	O <sub>6</sub>
R	O <sub>7</sub>	O <sub>8</sub>	O <sub>9</sub>		O <sub>10</sub>	O <sub>11</sub>	O <sub>12</sub>



Field experiment

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## Field Experiments: Quasi – or Semi-Experiments

- Non-Equivalent Control Group Design (Quasi), 2 groups

O <sub>1</sub>	X	O <sub>2</sub>
.....	.....	.....
O <sub>3</sub>		O <sub>4</sub>

- Pretest results: (O<sub>1</sub> – O<sub>3</sub>)
- Posttest results: (O<sub>4</sub> – O<sub>2</sub>)

- Separate Sample Pretest-Posttest Design

R	O <sub>1</sub>	(X)	
R		X	O <sub>2</sub>

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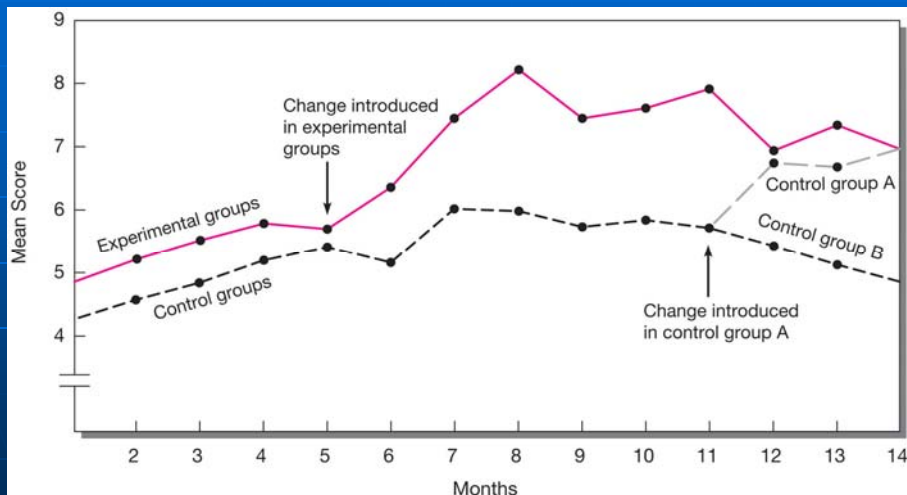
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## Field Experiments: Quasi – or Semi-Experiments

- Group Time Series Design
  - Repeated observations before and after the treatment
  - Allows subjects to act as their own controls

R	O <sub>1</sub>	O <sub>2</sub>	O <sub>3</sub>	X	O <sub>4</sub>	O <sub>5</sub>	O <sub>6</sub>
R	O <sub>7</sub>	O <sub>8</sub>	O <sub>9</sub>		O <sub>10</sub>	O <sub>11</sub>	O <sub>12</sub>

## Job Enrichment Quasi-Experiment (Assessment of Lab Technicians EOs Monthly Reports)





## Research Thought Leaders

**“There is no such thing as a failed experiment, only experiments with unexpected outcomes.”**

***Richard Buckminster Fuller,  
engineer and architect***

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## Research Thought Leaders

***“We need to keep an open mind and approach life as a series of experiments. We need to observe the experiments happening around us and create new ones. Instead of accepting the world as we think it is, we need to keep testing it to find out what it is and what works .”***

***Jerry Wind  
Wharton School of Business,  
University of Pennsylvania***

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## PulsePoint: Research Revelation

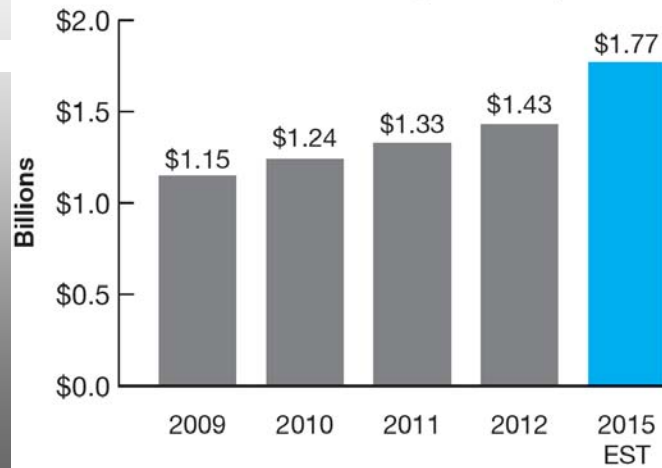
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The percent of smartphone users who check their e-mail before they get dressed.

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## Snapshot: Online Dating

Revenue Value of Dating Websites (in Billions)



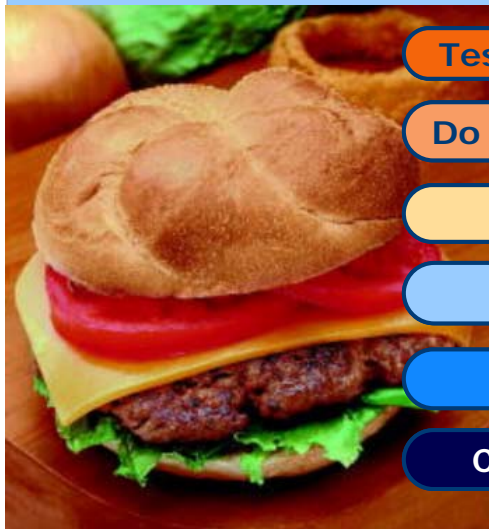
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## Snapshot: Email Subject Line



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## Snapshot: Wendy's Burger Test Market



Test market selection

Do you want average?

Diversity

Funky culture

Creativity

Corporate Culture

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## Snapshot: Power of Message on Beverage Consumption

Signs on beverage coolers

Did you know a bottle of soda or fruit juice . . .

Has about 250 calories  
(treatment #1)

Has 10% of daily calories  
(treatment #2)

Takes 50 minutes of running  
to work off (treatment #3)



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## Snapshot: Refining Store Design



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## Snapshot: The Right Size of Flavor



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### Summary

- This chapter presents the uses of experimentation and the various types of experimental designs. It also discusses the advantages and disadvantages of the experimental method.