Chapter Eight

Causal Research Design:
Experimentation
Focus of This Chapter

• Causality
• Experimentation
• Experimental Designs

Relationship to Previous Chapter

• Causal Research Design (Chapter 3)

Relationship to Marketing Research Process

1. Problem Definition
2. Approach to Problem
3. Research Design
4. Field Work
5. Data Preparation and Analysis
6. Report Preparation and Presentation

Figure 8.1  Relationship of Experimentation to the Previous Chapters and the Marketing Research Process
Figure 8.2  Experimentation: An Overview
Opening Vignette

Concept of Causality (Fig 8.3)

Conditions for Causality

What is Experimentation?

Definition of Symbols

Validity in Experimentation

- Internal Validity
- External Validity

Extraneous Variables

A Classification of Experimental Designs (Fig 8.4)

Application to Contemporary Issues

International    Social Media    Ethics

Be a DM! Be an MR! Experiential Learning

What Would You Do?

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Pre-Experimental Designs

True-Experimental Designs

Quasi-Experimental Designs

Statistical Designs (Table 8.1)

Laboratory Versus Field Experiments (Table 8.2)

Opening Vignette

Application to Contemporary Issues (Fig 8.5)

International | Social Media | Ethics

What Would You Do?

Be a DM! Be an MR! Experiential Learning

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Figure 8.3
Experimentation as Conclusive Research

- Conclusive Research
  - Descriptive
  - Causal
    - Experimentation
      - Field Experiments
      - Laboratory Experiments
## Concept of Causality

A statement such as "X causes Y" will have the following meaning to an ordinary person and to a scientist.

<table>
<thead>
<tr>
<th>Ordinary Meaning</th>
<th>Scientific Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>X is the only cause of Y.</td>
<td>X is only one of a number of possible causes of Y.</td>
</tr>
<tr>
<td>X must always lead to Y (X is a deterministic cause of Y).</td>
<td>The occurrence of X makes the occurrence of Y more probable (X is a probabilistic cause of Y).</td>
</tr>
<tr>
<td>It is possible to prove that X is a cause of Y.</td>
<td>We can never prove that X is a cause of Y. At best, we can infer that X is a cause of Y.</td>
</tr>
</tbody>
</table>
Conditions for Causality

- **Concomitant variation** is the extent to which a cause, X, and an effect, Y, occur together or vary together in the way predicted by the hypothesis under consideration.

- The **time order of occurrence** condition states that the causing event must occur either before or simultaneously with the effect; it cannot occur afterwards.

- The **absence of other possible causal factors** means that the factor or variable being investigated should be the only possible causal explanation.
Definitions and Concepts

- **Independent variables** are variables or alternatives that are manipulated and whose effects are measured and compared, e.g., price levels.

- **Test units** are individuals, organizations, or other entities whose response to the independent variables or treatments is being examined, e.g., consumers or stores.

- **Dependent variables** are the variables which measure the effect of the independent variables on the test units, e.g., sales, profits, and market shares.

- **Extraneous variables** are all variables other than the independent variables that affect the response of the test units, e.g., store size, store location, and competitive effort.
Experimental Design

An experimental design is a set of procedures specifying
- the test units and how these units are to be divided into homogeneous subsamples;
- what independent variables or treatments are to be manipulated;
- what dependent variables are to be measured; and
- how the extraneous variables are to be controlled.
Validity in Experimentation

- **Internal validity** refers to whether the manipulation of the independent variables or treatments actually caused the observed effects on the dependent variables. Control of extraneous variables is a necessary condition for establishing internal validity.

- **External validity** refers to whether the cause-and-effect relationships found in the experiment can be generalized. To what populations, settings, times, independent variables, and dependent variables can the results be projected?
Extraneous Variables

- **History** refers to specific events that are external to the experiment but occur at the same time as the experiment.

- **Maturation (MA)** refers to changes in the test units themselves that occur with the passage of time.

- **Testing effects** are caused by the process of experimentation. Typically, these are the effects on the experiment of taking a measure on the dependent variable before and after the presentation of the treatment.

- The **main testing effect (MT)** occurs when a prior observation affects a latter observation.
Extraneous Variables (Cont.)

- In the **interactive testing effect (IT)**, a prior measurement affects the test unit's response to the independent variable.

- **Instrumentation (I)** refers to changes in the measuring instrument, in the observers, or in the scores themselves.

- **Statistical regression effects (SR)** occur when test units with extreme scores move closer to the average score during the course of the experiment.

- **Selection bias (SB)** refers to the improper assignment of test units to treatment conditions.

- **Mortality (MO)** refers to the loss of test units while the experiment is in progress.
Controlling Extraneous Variables

- **Randomization** refers to the random assignment of test units to experimental groups by using random numbers. Treatment conditions are also randomly assigned to experimental groups.

- **Matching** involves comparing test units on a set of key background variables before assigning them to the treatment conditions.

- **Statistical control** involves measuring the extraneous variables and adjusting for their effects through statistical analysis.

- **Design control** involves the use of experiments designed to control specific extraneous variables.
A Classification of Experimental Designs

- **Pre-experimental designs** do not employ randomization procedures to control for extraneous factors. Examples are: the one-shot case study, the one-group pretest-posttest design, and the static-group.

- In **true experimental designs**, the researcher can randomly assign test units to experimental groups and treatments to experimental groups. Examples are: the pretest-posttest control group design, the posttest-only control group design, and the Solomon four-group design.
Quasi-experimental designs result when the researcher is unable to achieve full manipulation of scheduling or allocation of treatments to test units but can still apply part of the apparatus of true experimentation. Examples are: time series and multiple time series designs.

A statistical design is a series of basic experiments that allow for statistical control and analysis of external variables. Examples are: randomized block design, Latin square design, and factorial designs.
**Figure 8.4**
A Classification of Experimental Designs

**Pre Experimental**
- One-Shot Case Study
- One Group Pretest-Posttest
- Static Group

**True Experimental**
- Pretest-Posttest Control Group
- Posttest-Only Control Group

**Experimental Designs**
- **Statistical**
  - Factorial Design
- **Quasi-Experimental**
  - Time Series
  - Multiple Time Series
One-Shot Case Study

$X \ 0_1$

- A single group of test units is exposed to a treatment $X$.
- A single measurement on the dependent variable is taken ($0_1$).
- There is no random assignment of test units.
- The one-shot case study is more appropriate for exploratory than for conclusive research.
A group of test units is measured twice.
There is no control group.
The treatment effect is computed as
\[ 0_2 - 0_1. \]
The validity of this conclusion is questionable since extraneous variables are largely uncontrolled.
Static Group Design

EG: \( X \) \( 0_1 \)
CG: \( 0_2 \)

- A two-group experimental design.
- The experimental group (EG) is exposed to the treatment, and the control group (CG) is not.
- Measurements on both groups are made only after the treatment.
- Test units are not assigned at random.
- The treatment effect would be measured as \( 0_1 - 0_2 \).
Test units are randomly assigned to either the experimental or the control group.

A pretreatment measure is taken on each group.

The treatment effect (TE) is measured as: \((0_2 - 0_1) - (0_4 - 0_3)\).

Selection bias is eliminated by randomization.

The other extraneous effects are controlled as follows:

\[
0_2 - 0_1 = TE + H + MA + MT + IT + I + SR + MO \\
0_4 - 0_3 = H + MA + MT + I + SR + MO \\
= EV \text{ (Extraneous Variables)}
\]

The experimental result is obtained by:

\[(0_2 - 0_1) - (0_4 - 0_3) = TE + IT\]

Interactive testing effect is not controlled.
The treatment effect is obtained by
\[ TE = 0_1 - 0_2 \]

Except for pre-measurement, the implementation of this design is very similar to that of the pretest-posttest control group design.
Quasi-Experimental Designs: Time Series Design

There is no randomization of test units to treatments.

The timing of treatment presentation, as well as which test units are exposed to the treatment, may not be within the researcher's control.
Statistical Designs

**Statistical designs** consist of a series of basic experiments that allow for statistical control and analysis of external variables and offer the following advantages:

- The effects of more than one independent variable can be measured.
- Specific extraneous variables can be statistically controlled.
- Economical designs can be formulated when each test unit is measured more than once.

The most common statistical designs are the randomized block design, the Latin square design, and the factorial design.
### Table 8.1
An Example of a Factorial Design

<table>
<thead>
<tr>
<th>Amount of Brand Information</th>
<th>Amount of Humor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Humor</td>
</tr>
<tr>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>
## Table 8.2
Laboratory versus Field Experiments

<table>
<thead>
<tr>
<th>Factor</th>
<th>Laboratory</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Artificial</td>
<td>Realistic</td>
</tr>
<tr>
<td>Control</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Reactive error</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Demand artifacts</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Internal validity</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>External validity</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Time</td>
<td>Short</td>
<td>Long</td>
</tr>
<tr>
<td>Number of units</td>
<td>Small</td>
<td>Large</td>
</tr>
<tr>
<td>Ease of implementation</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Cost</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>
Limitations of Experimentation

- Experiments can be time consuming, particularly if the researcher is interested in measuring the long-term effects.

- Experiments are often expensive. The requirements of experimental group, control group, and multiple measurements significantly add to the cost of research.

- Experiments can be difficult to administer. It may be impossible to control for the effects of the extraneous variables, particularly in a field environment.

- Competitors may deliberately contaminate the results of a field experiment.
International Marketing Research

- Field experiments pose even greater challenges in international markets than those faced in the United States. The researcher might lack the flexibility to vary marketing content and expenditures.
- The internal and external validity of field experiments conducted overseas is generally lower than in the United States.
Laboratory type of experiments can also be conducted in virtual space such as Second Life (www.secondlife.com).

All of the experimental designs that we have discussed in this chapter can be implemented within the context of virtual world. This is also true of test marketing.

All of the experimental designs that we have discussed in this chapter can also be implemented within the context of the real social world.

As compared to the field, experimentation in social media (real and virtual) offers the advantages of ease of implementation and lower cost. The internal validity may be satisfactory but external validity will not be as high as that of field experiments.
Ethics in Marketing Research

- When disguising the purpose of the research, tell respondents about the existence of disguise at the start of the experiment and allow them to inquire about it at the conclusion of the experiment.

- Explaining the purpose and details at the conclusion of the experiment is called **debriefing**.

- The researcher should disclose to the client any problems that arise during the course of the experiment and jointly work out a solution.
The salient characteristics of experiments may be described by the acronym EXPERIMENT:

E xtraneous variables
X independent variable or treatment
P re-experimental, true experimental, quasi-experimental, and statistical designs
E ffect or dependent variable
R random assignment
I nternal validity
M easurement or observation
E xternal validity
N eutral or control group
T est units