CHAPTER 9: Producing Data—Experiments

Basic Practice of Statistics
7th Edition

Lecture PowerPoint Slides

In Chapter 9, we cover …

- Observation versus experiment
- Subjects, factors, and treatments
- How to experiment badly
- Randomized comparative experiments
- The logic of randomized comparative experiments
- Cautions about experimentation
- Matched pairs and other block designs

Observation versus experiment

- In contrast to observational studies, experiments don't just observe individuals or ask them questions. They actively impose some treatment in order to measure the response.

OBSERVATION VERSUS EXPERIMENT

- An observational study observes individuals and measures variables of interest, but it does not attempt to influence the responses. The purpose of an observational study is to describe some group or situation.
- An experiment, on the other hand, deliberately imposes some treatment on individuals to observe their responses. The purpose of an experiment is to study whether the treatment causes a change in the response.

- When our goal is to understand cause and effect, experiments are the preferred source for fully convincing data.
- The distinction between observational study and experiment is one of the most important in statistics.

Table 1: Observational study vs. Experiment

	Observational study	**Experiments**
How to do	Observer **observes** individuals and measures variables of interest but does not attempt to influence the responses.	Experimenter deliberately imposes some **treatment** on individuals to measure their responses.
Purpose	to describe some group or situation.	to study whether the treatment causes a change in the response.
Examples	• sample surveys • to observe the behavior of animals in the wild • to observe the interactions between teacher and students in the classroom	Experiments can answer questions such as • "Does aspirin reduce the chance of a heart attack?" • "Do a majority of college students prefer Pepsi to Coke when they taste both which they are drinking?"

When our goal is to understand **cause and effect**, **experiments** are the only source of fully convincing data.

Observation vs. Experiment (1 of 3)

An advantage of experiments over observational studies is:

a) an experiment can provide evidence of cause and effect.

b) an experiment can compare two or more groups.

c) an experiment can include explanatory variables and response variables.

Observation vs. Experiment (1 of 3) (answer)

An advantage of experiments over observational studies is:

a) **an experiment can provide evidence of cause and effect.**
b) an experiment can compare two or more groups.
c) an experiment can include explanatory variables and response variables.

The correct answer is A.

Observation vs. Experiment (2 of 3)

The Minnesota Study of Twins Reared Apart investigated whether attributes of twins are related to heredity or to environment. The researchers assessed 56 pairs of identical twins reared apart, as well as several hundred pairs of identical twins reared together. They compared the similarities of the twins in both groups. Is this an experiment or an observational study?

a) an experiment

b) an observational study

Observation vs. Experiment (2 of 3) (answer)

The Minnesota Study of Twins Reared Apart investigated whether attributes of twins are related to heredity or to environment. The researchers assessed 56 pairs of identical twins reared apart, as well as several hundred pairs of identical twins reared together. They compared the similarities of the twins in both groups. Is this an experiment or an observational study?

a) an experiment

b) an observational study

The correct answer is B.

Observation vs. Experiment (3 of 3)

In an experiment, researchers decide how subjects are placed in different groups, whereas in an observational study, the subjects themselves select which group to join.

a) true

b) false

Observation vs. Experiment (3 of 3) (answer)

In an experiment, researchers decide how subjects are placed in different groups, whereas in an observational study, the subjects themselves select which group to join.

a) true

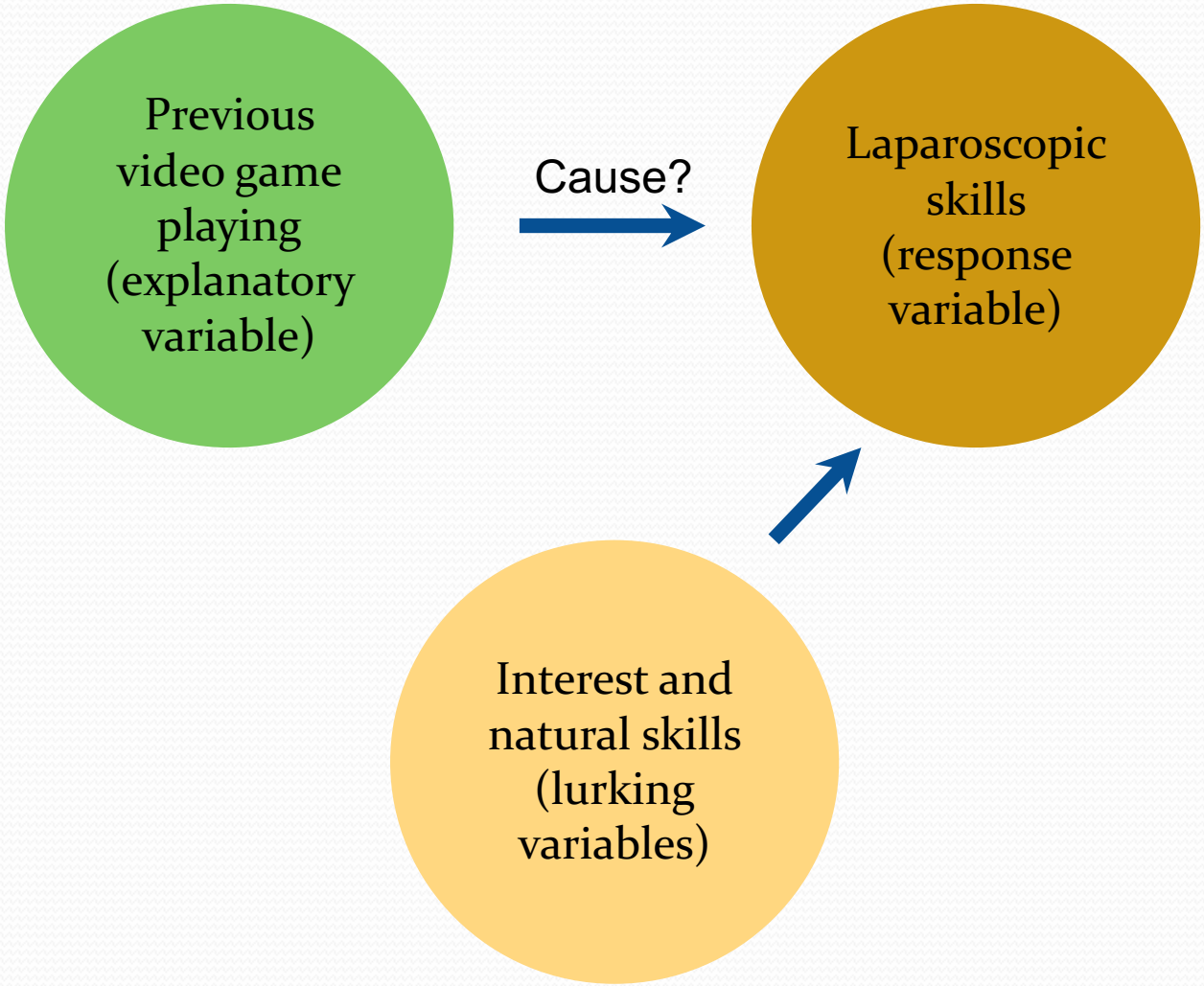
b) false

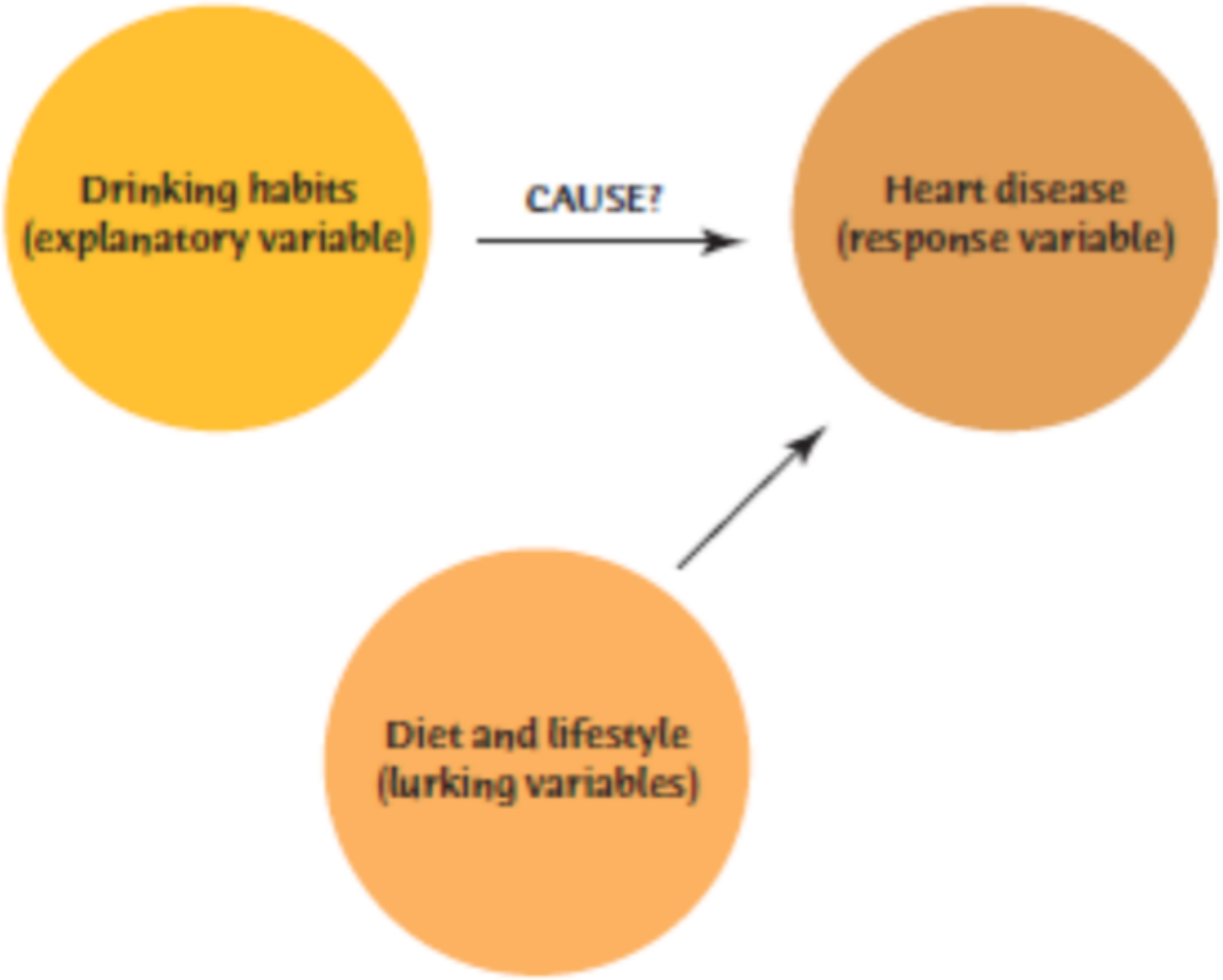
The correct answer is A.

Confounding

- A lurking variable is a variable that is not among the explanatory or response variables in a study but that may influence the response variable.
- Two variables (explanatory variables or lurking variables) are confounded when their effects on a response variable cannot be distinguished from each other.
- Observational studies of the effect of one variable on another often fail because of confounding between the explanatory variable and one or more lurking variables.
- Well-designed experiments take steps to avoid confounding.

Confounding illustration




Drinking habits
(explanatory variable)
CAUSE?
Heart disease
(response variable)
Diet and lifestyle
(lurking variables)

- **Example 9.4: An uncontrolled experiment** A college regularly offers a review course to prepare candidates for the Graduate Management Admission Test (GMAT), which is required by most graduate business schools. This year, it offers only an online version of the course. The average GMAT score of students in the online course is 10% higher than the longtime average for those who took the classroom review course. **Is the online course more effective?**

  - **Confounding factors (lurking variables)** may be involved:

    * The students in the online were older and more likely to be employed. An online course appeals to these mature people which is a lurking variable.

Subjects, factors, and treatments

- An experiment is a statistical study in which we actually do something (a **treatment**) to people, animals, or objects to observe the **response**. Here is the basic vocabulary of experiments.

- The individuals studied in an experiment are often called subjects, particularly when they are people.
- The explanatory variables in an experiment are often called factors.
- A treatment is any specific experimental condition applied to the subjects. If an experiment has more than one factor, a treatment is a combination of specific values of each factor.

- **Example 9.2: Foster care vs orphanages**

Do abandoned children placed in foster homes do better than similar children placed in an institution? The Bucharest Early Intervention Project found that the answer is a clear "Yes." There were 136 young children abandoned at birth and living in orphanages in Bucharest, Romania. Half of the children, chosen at random, were placed in foster homes. The other half remained in the orphanages.

1. **Subjects:** 136 young children abandoned at birth
2. The experiment compared these **two treatments:**
   (a) placed in foster homes
   (b) remained in the orphanages
3. There is a **single factor**, type of care, with two values, foster and institutional care.

- **Example 9.3:Effects of TV advertising**

What are the effects of repeated exposure to an advertising message? The answer may depend both on the length of the ad and on how often it is repeated. An experiment investigated this question using undergraduate students. All students in the experiment viewed a 40-minute television program that included ads for a digital camera. Some students saw a 30-second commercial; others, a 90-second version. The same commercial was shown either 1, 3, or 5 times during the program.

1. **Subjects:**undergraduate students who participate in the experiment
2. There are **two factors**
   (a) length of the commercial, with 2 values
   (b) repetitions, with 3 values.
3. 6 treatments

Subjects, Factors, Treatments (1 of 7) (answer)

Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

What is the explanatory variable?

a) the amount of scent
b) **the presence or absence of floral scent**
c) the time to complete the mazes
d) whether the subject was able to complete the mazes quicker while wearing a floral-scented mask

The correct answer is B.

Subjects, Factors, Treatments (2 of 7)

Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

What is the response variable?

a) the amount of scent
b) the presence or absence of the floral scent
c) the time to complete the mazes
d) whether the subject was able to complete the mazes quicker while wearing a floral-scented mask

Subjects, Factors, Treatments (2 of 7) (answer)

Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

What is the response variable?

a) the amount of scent
b) the presence or absence of the floral scent
c) **the time to complete the mazes**
d) whether the subject was able to complete the mazes quicker while wearing a floral-scented mask

The correct answer is C.

Subjects, Factors, Treatments (3 of 7)

Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

What are the individuals?

a) the masks (floral-scented or unscented)
b) the 22 subjects
c) the mazes

Subjects, Factors, Treatments (3 of 7) (answer)

Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

What are the individuals?

a) the masks (floral-scented or unscented)
b) the 22 subjects
c) the mazes

The correct answer is B.

Subjects, Factors, Treatments (4 of 7)

In the Salk vaccine trial of 1954, almost 400,000 students (grades one to three) in 11 states participated. Students were randomly assigned to either a vaccine or a placebo injection. All students were observed for evidence of polio during the school year.

Who are the subjects?

a) the 400,000 children who participated in the study
b) the 200,000 children who received the vaccine
c) American children in grades one to three
d) all American children

Subjects, Factors, Treatments (4 of 7) (answer)

In the Salk vaccine trial of 1954, almost 400,000 students (grades one to three) in 11 states participated. Students were randomly assigned to either a vaccine or a placebo injection. All students were observed for evidence of polio during the school year.

Who are the subjects?

a) **the 400,000 children who participated in the study**
b) the 200,000 children who received the vaccine
c) American children in grades one to three
d) all American children

The correct answer is A.

Subjects, Factors, Treatments (5 of 7)

In the Salk vaccine trial of 1954, almost 400,000 students (grades one to three) in 11 states participated. Students were randomly assigned to either a vaccine or a placebo injection. All students were observed for evidence of polio during the school year.

What is the factor?

a) type of injection
b) vaccine
c) placebo
d) polio status

Subjects, Factors, Treatments (5 of 7) (answer)

In the Salk vaccine trial of 1954, almost 400,000 students (grades one to three) in 11 states participated. Students were randomly assigned to either a vaccine or a placebo injection. All students were observed for evidence of polio during the school year.

What is the factor?

a) **type of injection**
b) vaccine
c) placebo
d) polio status

The correct answer is A.

Subjects, Factors, Treatments (6 of 7)

In the Salk vaccine trial of 1954, almost 400,000 students (grades one to three) in 11 states participated. Students were randomly assigned to either a vaccine or a placebo injection. All students were observed for evidence of polio during the school year.

What are the treatments?

a) syringe, school nurse
b) polio, vaccine
c) polio status, state
d) vaccine, placebo

Subjects, Factors, Treatments (6 of 7) (answer)

In the Salk vaccine trial of 1954, almost 400,000 students (grades one to three) in 11 states participated. Students were randomly assigned to either a vaccine or a placebo injection. All students were observed for evidence of polio during the school year.

What are the treatments?

a) syringe, school nurse
b) polio, vaccine
c) polio status, state
d) vaccine, placebo

The correct answer is D.

Subjects, Factors, Treatments (7 of 7)

In the Salk vaccine trial of 1954, almost 400,000 students (grades one to three) in 11 states participated. Students were randomly assigned to either a vaccine or a placebo injection. All students were observed for evidence of polio during the school year.

What is the response variable?

a) type of inoculation
b) grade
c) polio status
d) state

Subjects, Factors, Treatments (7 of 7) (answer)

In the Salk vaccine trial of 1954, almost 400,000 students (grades one to three) in 11 states participated. Students were randomly assigned to either a vaccine or a placebo injection. All students were observed for evidence of polio during the school year.

What is the response variable?

a) type of inoculation
b) grade
c) **polio status**
d) state

The correct answer is C.

How to experiment badly (1 of 2)

- *Experiments don't guarantee good data.*
- Good designs are essential for effective experiments, just as they are for sampling.

Example: A college regularly offers a review course to prepare students for the GMAT. This year, it will offer only an online version of the course.

Students → Online Course → GMAT Scores

- Suppose the results were 10% higher than the long-time average for those who took the *classroom* review course.
- **Can we conclude that the online course is more effective?**

How to experiment badly (2 of 2)

- Many laboratory experiments use a design like the one in the online GMAT course example:

- In the laboratory environment, simple designs often work well.
- Field experiments and experiments with animals or people deal with more variable conditions.
- *Outside the laboratory, badly designed experiments often yield worthless results because of confounding.*

Randomized comparative experiments (1 of 2)

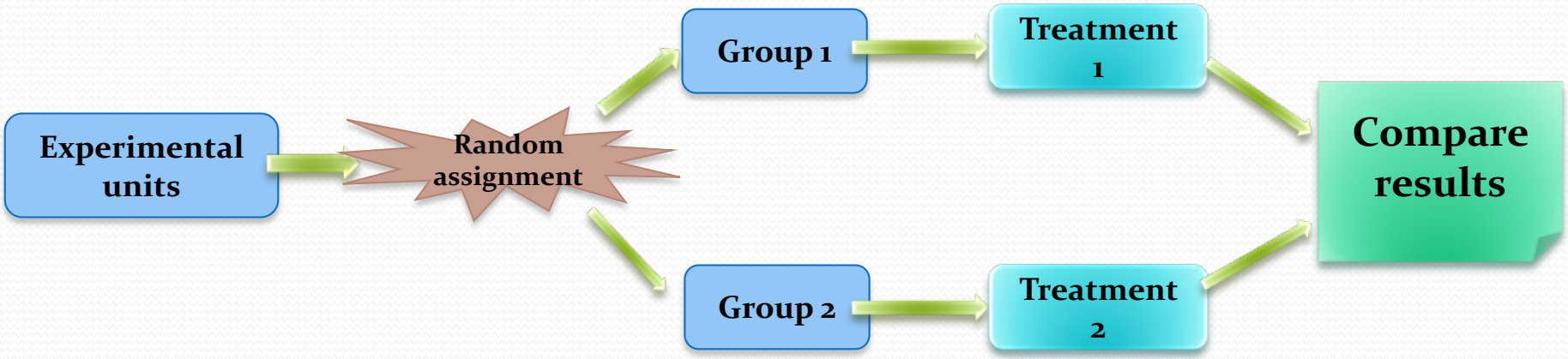
- The remedy for confounding is to perform a comparative experiment in which some individuals receive one treatment and similar units receive another. Most well-designed experiments compare two or more treatments.
- Some experiments may include a control group that receives an inactive treatment or an existing baseline treatment.
- An experiment that uses both comparison of two or more treatments and random assignment of subjects to treatments is a randomized comparative experiment.

Randomized comparative experiments (2 of 2)

- Comparison alone isn't enough. If the treatments are given to groups that differ greatly, bias will result. The solution to the problem of bias is *random assignment*.
- In an experiment, random assignment means that individuals are assigned to treatments at random, that is, using some sort of chance process.

COMPLETELY RANDOMIZED DESIGN

- In a completely randomized experimental design, all the subjects are allocated at random among all the treatments.



Randomized Experiments (1 of 2)

Comparative experiments are a remedy for _____.

a) confounding

b) randomization

c) correlation

Randomized Experiments (1 of 2) (answer)

Comparative experiments are a remedy for _____.

a) confounding

b) randomization

c) correlation

The correct answer is A.

Randomized Experiments (2 of 2)

Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

The researchers controlled influences of lurking variables by:

a) giving each subject a floral-scented mask and an unscented mask.
b) randomly assigning half of the subjects to wear a floral-scented mask only and the other half to wear an unscented mask only.
c) giving each subject two sets of mazes.

Randomized Experiments (2 of 2) (answer)

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c) giving each subject two sets of mazes.

The correct answer is A.

The logic of randomized comparative experiments (1 of 2)

- Random assignment of subjects forms groups that should be similar in all respects before the treatments are applied.
- A comparative experiment with randomization ensures that influences other than the experimental treatments operate equally on all groups.
- Differences in average response must be due either to the treatments or to the play of chance in the random assignment of subjects to the treatments.

The logic of randomized comparative experiments (2 of 2)

PRINCIPLES OF EXPERIMENTAL DESIGN

The basic principles of statistical design of experiments are:

1. **Control** the effects of lurking variables on the response, most simply by comparing two or more treatments.
2. **Randomize**—use chance to assign subjects to treatments.
3. **Replicate**—use enough subjects in each group to reduce chance variation in the results.

- An observed effect so large that it would rarely occur by chance is called statistically significant.
- A statistically significant association in data from a well-designed experiment ***does imply causation***.

Logic of Experiments (1 of 6)

In the Salk vaccine trial of 1954, almost 400,000 students (grades one to three) in 11 states participated. Students were randomly assigned to either a vaccine or a placebo injection. All students were observed for evidence of polio during the school year.

Which of the following might be a lurking variable?

a) area of residence

b) socioeconomic status

c) fear of needles

d) All of the answer options are correct.

Logic of Experiments (1 of 6) (answer)

In the Salk vaccine trial of 1954, almost 400,000 students (grades one to three) in 11 states participated. Students were randomly assigned to either a vaccine or a placebo injection. All students were observed for evidence of polio during the school year.

Which of the following might be a lurking variable?

a) area of residence
b) socioeconomic status
c) fear of needles
d) All of the answer options are correct.

The correct answer is D.

Logic of Experiments (2 of 6)

Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

If age affects whether the presence of a floral scent improves learning ability and age was not included among the variables studied in the experiment, then age is:

a) an explanatory variable.
b) a response variable.
c) a lurking variable.

Logic of Experiments (2 of 6) (answer)

Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

If age affects whether the presence of a floral scent improves learning ability and age was not included among the variables studied in the experiment, then age is:

a) an explanatory variable.
b) a response variable.
c) **a lurking variable.**

The correct answer is C.

Logic of Experiments (3 of 6)

Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

The researchers incorporated randomization by:

a) randomly selecting the subjects to participate in the study.
b) randomly assigning half of the subjects to wear a floral-scented mask and the other half to wear an unscented mask.
c) randomly assigning the order in which each subject received the floral-scented and unscented masks.

Logic of Experiments (3 of 6) (answer)

Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

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a) randomly selecting the subjects to participate in the study.
b) randomly assigning half of the subjects to wear a floral-scented mask and the other half to wear an unscented mask.
c) **randomly assigning the order in which each subject received the floral-scented and unscented masks.**

The correct answer is C.

Logic of Experiments (4 of 6)

- Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

The researchers reduced chance variation in the results by:

a) using two types of masks.
b) using different sets of mazes.
c) using 22 subjects.
d) randomizing the mask order.

Logic of Experiments (4 of 6) (answer)

Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

The researchers reduced chance variation in the results by:

a) using two types of masks.
b) using different sets of mazes.
c) **using 22 subjects.**
d) randomizing the mask order.

The correct answer is C.

Logic of Experiments (5 of 6)

Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

If there is a statistically significant difference between the average times to complete the mazes while wearing the floral-scented mask and while wearing the unscented mask, then the difference in average times to complete the mazes between the floral-scented mask and the unscented mask is:

a) too large to be due to chance alone.
b) too small to be due to chance alone.
c) so large that we can reasonably attribute it to chance.
d) so small that it is likely due to chance.

Logic of Experiments (5 of 6) (answer)

Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

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a) **too large to be due to chance alone.**
b) too small to be due to chance alone.
c) so large that we can reasonably attribute it to chance.
d) so small that it is likely due to chance.

The correct answer is A.

Logic of Experiments (6 of 6)

The basic principles of statistical design of experiments are _____.

a) control and randomization
b) control and using enough subjects
c) randomization and using enough subjects
d) control, randomization, and using enough subjects

Logic of Experiments (6 of 6) (answer)

The basic principles of statistical design of experiments are _____.

a) control and randomization
b) control and using enough subjects
c) randomization and using enough subjects
d) control, randomization, and using enough subjects

The correct answer is D.

Cautions about experimentation

- The logic of a randomized comparative experiment depends on our ability to treat all the subjects the same in every way, except for the actual treatments being compared.
- Many medical experiments are, for example, “placebo controlled.”
- A placebo is a dummy treatment that is as similar to the treatment as possible but contains no “active ingredient.”

DOUBLE-BLIND EXPERIMENTS

- In a double-blind experiment, neither the subjects nor those who interact with them and measure the response variable know which treatment each subject is receiving.
- Even these have been criticized for **lack of realism**.

Example. Sickle-cell disease is a painful disorder of the red blood cells that in the United States affects mostly blacks. To investigate whether the drug hydroxyurea can reduce the pain associated with sickle-cell disease, a study by NIH gave the drug to 150 sickle-cell sufferers and the placebo to another 150. Neither doctors nor patients were told who received the drug. The number of episodes of pain reported by each subject was recorded. This is an example of ( )

a. an observational study.
b. an experiment, but not a double-blind experiment.
c. a double-blind experiment.
d. a paired data experiment.

Matched pairs

- The idea of this experimental design is to create or use matching pairs of similar experimental units for comparing two treatments.
- A matched-pairs design is a randomized experimental design in which—within each matching pair of similar subjects—chance is used to determine which subject gets each treatment.
- Sometimes, a “pair” in a matched-pairs design consists of a single unit that receives both treatments. Since the order of the treatments can influence the response, chance is then used to determine which treatment is applied first for each unit.

Example.

Will a fluoride mouthwash used after brushing reduce cavities? Twenty sets of twins were used to investigate this question. One member of each set of twins used the mouthwash after each brushing, the other did not. After six months, the difference in the number of cavities of those using the mouthwash was compared with the number of those who did not use the mouthwash. This experiment uses ( )

a. random placeboes.
b. double-blinding.
c. double replication.
d. a matched pairs design.

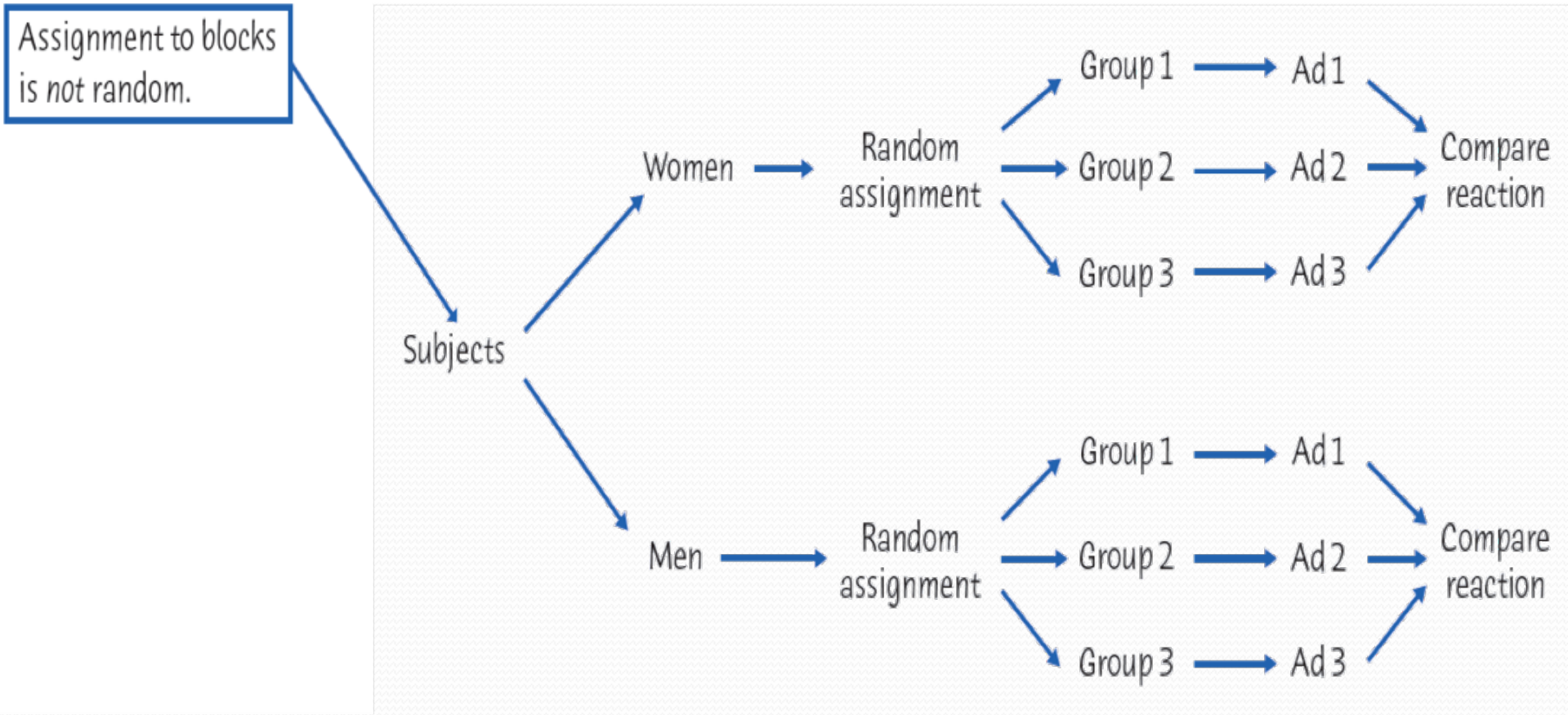
Block design

- Matched pairs are one kind of block design, with each pair forming a block.

- A block is a group of individuals that are known before the experiment to be similar in some way that is expected to affect the response to the treatments.
- In a block design, the random assignment of experimental units to treatments is carried out separately within each block.

- A wise experimenter will form blocks based on the most important unavoidable sources of variability among the subjects.
- Randomization will then average out the effects of the remaining lurking variables and allow an unbiased comparison of the treatments.

Blocked design—illustration



Cautions About Experiments (1 of 4)

A study claims that patients who receive surgery for intestinal cancer live much longer after treatment than patients who are treated without surgery. However, doctors performed surgery only on patients in relatively good condition, so we cannot conclude that surgery lengthens intestinal cancer patients' lives. This is an example of:

a) confounding.
b) a lurking variable.
c) a double-blind experiment.
d) the placebo effect.

Cautions About Experiments (1 of 4) (answer)

A study claims that patients who receive surgery for intestinal cancer live much longer after treatment than patients who are treated without surgery. However, doctors performed surgery only on patients in relatively good condition, so we cannot conclude that surgery lengthens intestinal cancer patients' lives. This is an example of:

a) **confounding.**
b) a lurking variable.
c) a double-blind experiment.
d) the placebo effect.

The correct answer is A.

Cautions About Experiments (2 of 4)

An active medicine and a placebo are put into identical bottles. The bottles are handed to subjects in the study at random, so that only a third party can later provide information on who got the medicine and who got the placebo. This is an example of _____.

a) confounding
b) a lurking variable
c) a double-blind experiment
d) the placebo effect

Cautions About Experiments (2 of 4) (answer)

An active medicine and a placebo are put into identical bottles. The bottles are handed to subjects in the study at random, so that only a third party can later provide information on who got the medicine and who got the placebo. This is an example of _____.

a) confounding
b) a lurking variable
c) **a double-blind experiment**
d) the placebo effect

The correct answer is C.

Cautions About Experiments (3 of 4)

In a famous randomized vitamin C study, most patients could tell from taste whether they were receiving vitamin C pills or placebo pills. The rate of cold and flu was lower in the vitamin C group. What do you conclude?

a) Vitamin C reduces the cold and flu rate.

b) Nothing—the difference could be due to vitamin C or to the placebo effect.

Cautions About Experiments (3 of 4) (answer)

In a famous randomized vitamin C study, most patients could tell from taste whether they were receiving vitamin C pills or placebo pills. The rate of cold and flu was lower in the vitamin C group. What do you conclude?

a) Vitamin C reduces the cold and flu rate.

b) Nothing—the difference could be due to vitamin C or to the placebo effect.

The correct answer is B.

Cautions About Experiments (4 of 4)

_____ is present when the subjects, treatments, or setting of an experiment cannot realistically duplicate the conditions we really want to study.

a) Confounding
b) Lack of realism
c) Statistical insignificance
d) None of the answer options is correct.

Cautions About Experiments (4 of 4) (answer)

_____ is present when the subjects, treatments, or setting of an experiment cannot realistically duplicate the conditions we really want to study.

a) Confounding
b) Lack of realism
c) Statistical insignificance
d) None of the answer options is correct.

The correct answer is B.

Block Designs (1 of 8)

Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

This experimental design is:

a) a completely randomized design.

b) a matched pairs design.

Block Designs (1 of 8) (answer)

Researchers believed that floral scent can sometimes improve a person's learning ability. They set up an experiment in which each of 22 subjects completed sets of pencil-and-paper mazes. Each subject wore a floral-scented mask and an unscented mask, in random order. The researchers measured the time to complete the sets of mazes.

This experimental design is:

a) a completely randomized design.

b) a matched pairs design.

The correct answer is B.

Block Designs (2 of 8)

In the Salk vaccine trial of 1954, almost 400,000 students (grades one to three) in 11 states participated. Students were randomly assigned to either a vaccine or a placebo injection. All students were observed for evidence of polio during the school year.

This experimental design is:

a) a completely randomized design.

b) a matched pairs design.

Block Designs (2 of 8) (answer)

In the Salk vaccine trial of 1954, almost 400,000 students (grades one to three) in 11 states participated. Students were randomly assigned to either a vaccine or a placebo injection. All students were observed for evidence of polio during the school year.

This experimental design is:

a) a completely randomized design.

b) a matched pairs design.

The correct answer is A.

Block Designs (3 of 8)

An Austrian study investigated whether maintaining a surgery patient's body temperature close to normal during surgery decreases infection rates. Patients in the study were randomly assigned to one of two treatment groups: a normal thermic group or a hypothermic group.

This design is:

a) a completely randomized design (CRD).

b) a randomized block design (RBD).

c) a matched pairs design (MPD).

Block Designs (3 of 8) (answer)

An Austrian study investigated whether maintaining a surgery patient's body temperature close to normal during surgery decreases infection rates. Patients in the study were randomly assigned to one of two treatment groups: a normal thermic group or a hypothermic group.

This design is:

a) a completely randomized design (CRD).

b) a randomized block design (RBD).

c) a matched pairs design (MPD).

The correct answer is A.

Block Designs (4 of 8)

An Austrian study investigated whether maintaining a surgery patient's body temperature close to normal during surgery decreases infection rates. Patients in the study were randomly assigned to one of two treatment groups: a normal thermic group or a hypothermic group.

Both men and women were included in the study, although it was believed that men would react differently to the treatments than women. If the randomization to treatments was carried out separately for men and women, the design would be:

a) a completely randomized design (CRD).
b) a randomized block design (RBD).
c) a matched pairs design (MPD).

Block Designs (4 of 8) (answer)

An Austrian study investigated whether maintaining a surgery patient's body temperature close to normal during surgery decreases infection rates. Patients in the study were randomly assigned to one of two treatment groups: a normal thermic group or a hypothermic group.

Both men and women were included in the study, although it was believed that men would react differently to the treatments than women. If the randomization to treatments was carried out separately for men and women, the design would be:

a) a completely randomized design (CRD).
b) a randomized block design (RBD).
c) a matched pairs design (MPD).

The correct answer is B.

Block Designs (5 of 8)

In a randomized block design, a block contains:

a) individuals that are similar with respect to the characteristic that defines the block.

b) individuals that are assigned to the same treatment.

c) individuals that are similar with respect to the characteristic that defines the block and that are assigned to the same treatment.

Block Designs (5 of 8) (answer)

In a randomized block design, a block contains:

a) **individuals that are similar with respect to the characteristic that defines the block.**

b) individuals that are assigned to the same treatment.

c) individuals that are similar with respect to the characteristic that defines the block and that are assigned to the same treatment.

The correct answer is A.

Block Designs (6 of 8)

In a randomized block design:

a) all of the subjects are allocated at random to the treatments.

b) the random assignment of individuals to treatments is carried out separately within each block.

c) all of the individuals within one block are randomly assigned to one treatment.

Block Designs (6 of 8) (answer)

In a randomized block design:

a) all of the subjects are allocated at random to the treatments.

b) the random assignment of individuals to treatments is carried out separately within each block.

c) all of the individuals within one block are randomly assigned to one treatment.

The correct answer is B.

Block Designs (7 of 8)

An advantage of the randomized block design (RBD) over the completely randomized design (CRD) is that the RBD eliminates confounding between a lurking variable (blocking variable) and the response variable.

a) true

b) false

Block Designs (7 of 8) (answer)

An advantage of the randomized block design (RBD) over the completely randomized design (CRD) is that the RBD eliminates confounding between a lurking variable (blocking variable) and the response variable.

a) true

b) false

The correct answer is A.

Block Designs (8 of 8)

An advantage of the randomized block design (RBD) over the completely randomized design (CRD) is that the RBD eliminates the variation associated with the blocking variable and makes detection of statistical significance easier.

a) true

b) false

Block Designs (8 of 8) (answer)

An advantage of the randomized block design (RBD) over the completely randomized design (CRD) is that the RBD eliminates the variation associated with the blocking variable and makes detection of statistical significance easier.

a) true

b) false

The correct answer is A.