



## Lesson 30: Evaluating Reports Based on Data from an Experiment

### Student Outcomes

- Students critique and evaluate statements in published reports that involve determining if there is a significant difference between two treatments in a statistical experiment.

### Lesson Notes

In this lesson, students read and comment on examples from the media that involve statistical experiments that compare two treatments. For this lesson, students should work in small groups (two or three students per group). This allows students to discuss and evaluate the articles together. Students need to have access to the printed or online articles. This may be done by one of the following methods:

- Print a copy of the article for each student prior to class. Review the article before discussing with students. If using an online version, screen the links before distributing to students. In a few cases, the instructor is required to provide some background information in order to download the article.
- If there is access to a computer lab, students can read the articles online.
- Students may also use their personal electronic devices (laptop computer, smartphone, iPad, or tablet) to read the articles. Again, preview the article or the link before using this option.

Identifying relevant reports for students to review and evaluate poses challenges; however, the Common Core Standards explicitly states the importance of evaluating statistical studies by students at this grade level. The reports and examples in this lesson are identified by a link to a reliable source. These links, however, may change over time. Consider the source of the article and the general title to identify possible changes in the links.

### Classwork

#### Exercises 1–7 (15–20 minutes)

Before students begin working on the exercises, pose the following question to the class. Have students share and discuss ideas with their neighbors:

- Frequently, we read reports of studies and experiments, but it's important to know if we can trust the results. Based on what we've learned so far, what would be some good questions to keep in mind when evaluating a report on a statistical study?

Allow 10–15 minutes for students to read the article “A Randomized Trial of Colchicine for Acute Pericarditis” in *The New England Journal of Medicine* (October 2013) and answer Exercises 1–6. (*The New England Journal of Medicine* website requires some background information before the article can be downloaded. Only the teacher should provide this information.)

#### Scaffolding:

It may be useful to allow students to draw from resources that are in their first languages. Providing structured sentence frames and exemplars of solid commentaries may be useful as students work to create their own comments.

When students have finished answering Exercises 1–6, discuss the answers to the questions. Then, allow two to three minutes for students to answer Exercise 7.

**Exercises 1–7**

Pericarditis is an inflammation (irritation and swelling) of the pericardium, the thin sac that surrounds the heart. When extra fluid builds up between the two layers of the pericardium, the heart's actions are restricted. An experiment reported in the article "A Randomized Trial of Colchicine for Acute Pericarditis" in *The New England Journal of Medicine* (October 2013) tested the effects of the drug colchicine on acute pericarditis.

Read the abstract of the article, and answer the following questions:

Website: <http://www.nejm.org/doi/full/10.1056/NEJMoa1208536>

1. How many treatment groups are there?

*There are 2 treatment groups.*

2. What treatments are being compared?

*The two treatment groups are colchicine and a placebo with the standard anti-inflammatory treatment.*

3. Is there a placebo group? Explain.

*Yes, the second treatment group is a placebo in addition to an aspirin or an ibuprofen.*

4. How many subjects are in each treatment group?

*There are 120 subjects in each treatment group.*

5. Do you think that the number of subjects in each treatment group is enough? Explain.

*Yes; 120 subjects should be large enough to allow the researchers to see the variation in treatment effects.*

6. What method was used to assign the subjects to the treatment groups? Explain why this is important.

*The subjects were randomly assigned to the treatment groups. This is important because the random assignment evenly disperses the extraneous variables into both treatment groups.*

Suppose newspaper reporters brainstormed some headlines for an article on this experiment. These are their suggested headlines:

- A. "New Treatment Helps Pericarditis Patients"
- B. "Colchicine Tends to Improve Treatment for Pericarditis"
- C. "Pericarditis Patients May Get Help"

7. Which of the headlines above would be best to use for the article? Explain why.

*Headline A would be the best because this is a well-designed experiment. Therefore, a cause-and-effect relationship has been established. Headlines B and C talk about a tendency relationship, not a cause-and-effect relationship.*

**Exercises 8–10 (25–30 minutes)**

MP.3

In this set of exercises, students critique and evaluate statements in published reports that involve determining if there is a significant difference between two treatments in a statistical experiment. Below is a discussion for each criterion so that the class can have a discussion on the meaning of each criterion listed for evaluating experiments.

- Were the subjects randomly assigned to treatment groups?

Students should look to see if the article explicitly states that the subjects were randomly assigned to each treatment group. This is important because random assignment negates the effects of extraneous variables that may have an effect on the response by evenly distributing these variables into both treatment groups. (Refer back to Lesson 23.)

- Was there a *control group* or a *comparison group*?
  - A *control group* is a group that receives either no treatment or a placebo. A *comparison group* is a group that receives the “standard treatment.” A *comparison group* is used when the context of the experiment requires a treatment (used especially in medical experiments when not giving a treatment would be unethical). The use of a control group or comparison group provides a baseline for the response in the experiment. This allows researchers to see how much of the response is due to the actual variable being tested.
- Were the sample sizes reasonably large?
  - The number of subjects in each treatment group should be large enough so that the variation in the response from one subject to another is evident. A small size ( $n < 50$ ) may not show all the variation that might exist in the subjects’ responses.
- Do the results show a cause-and-effect relationship?
  - If the first three criteria are met, then the results of an experiment can be interpreted as showing a cause-and-effect relationship.

Allow students 5–10 minutes to read the abstract of the article about exercise intervention with mild cognitive impairment (MCI) patients and to answer Exercise 8. When students have finished, discuss their answers. Note that students’ work should contain the underlined explanations in the sample responses.

**Exercises 8–10**

What you should look for when evaluating an experiment:

- Were the subjects randomly assigned to treatment groups?
- Was there a control group or a comparison group?
- Were the sample sizes reasonably large?
- Do the results show a cause-and-effect relationship?

Read the abstracts of the two articles below. Write a few sentences evaluating these articles using the guidelines above.

8. The study “Semantic Memory Functional MRI and Cognitive Function After Exercise Intervention in Mild Cognitive Impairment” (*Journal of Alzheimer’s Disease*, August 2013) was performed to see if exercise would increase memory retrieval in older adults with mild cognitive impairment (associated with early memory loss).

Website: <http://iospress.metapress.com/content/xm8t241628h37h7t/>

*While there was a control group of nonimpaired adults, the sample sizes are too small to demonstrate the variation in the responses. Also, the subjects were not randomly assigned to treatment groups. Therefore, no cause-and-effect relationship can be shown with this study. The authors correctly stated, “These findings suggest exercise may improve ... semantic memory retrieval in MCI...”*

Allow students 5–10 minutes to read the summary of the article about adolescent scoliosis patients wearing a brace and to answer Exercise 9. When students have finished, discuss their answers.

9. The article “Effects of Bracing in Adolescents with Idiopathic Scoliosis” (*New England Journal of Medicine*, October 2013) reports on the role of bracing patients with adolescent idiopathic scoliosis (curvature of the spine) for prevention of back surgery.

Website: [www.nejm.org/doi/full/10.1056/NEJMoa1307337](http://www.nejm.org/doi/full/10.1056/NEJMoa1307337)

*Researchers conducted a study of one hundred sixteen (reasonably large enough) adolescent patients with scoliosis in which each patient was randomly assigned to either a treatment where the patient wore a brace or a treatment where the patient’s progress was observed. The treatment where the patients’ progress was observed is a control group. Therefore, the conclusion that wearing a brace significantly decreased the progression of high-risk curves toward the need for surgery is accurate. The researchers also examined what the treatment effects were if the patients were allowed to choose their treatment (which is not an experiment).*

Have the class watch the video of the report by Tom Bemis. Allow students three to five minutes to answer Exercise 10. When students have finished, discuss their answers. Preview this website before showing it to students as there is a commercial preceding the video. Also, copy and paste the website into a browser to view the video.

10. View the report by Tom Bemis (Market Watch, *Wall Street Journal*, August 13, 2013) about the type of car driven by a person and the person’s driving behavior.

Website: <http://live.wsj.com/video/bmw-drivers-really-are-jerks-studies-find/29285015-BB1A-4E41-B0C0-0A41CB990F60.html>

Is the title “BMW Drivers Really Are Jerks” an accurate title for these reported studies? Why or why not? If not, suggest a better title.

*The title may imply that because a person drives a BMW, this causes the person to use bad driving habits. Since these studies are observational studies and not experiments, this is inaccurate. A more appropriate title would be “BMW Drivers Tend to Have Bad Driving Behaviors.”*

### Closing (2 minutes)

Ask students to summarize the main ideas of the lesson in writing or with a neighbor. Use this as an opportunity to informally assess comprehension of the lesson. The Lesson Summary below offers some important ideas that should be included.

#### Lesson Summary

- A cause-and-effect relationship can only be shown by a well-designed experiment.
- Randomly assigning the subjects to treatment groups evens out the effects of extraneous variables to create comparable treatment groups.
- A control group (which may be a placebo group) or a comparison group (a standard treatment) is sometimes included in an experiment so that you can evaluate the effect of the treatment.
- The number of subjects in each treatment group (sample size) should be large enough for the random assignment to experimental groups to create groups with comparable variability between the subjects.

### Exit Ticket (2–3 minutes)

Name \_\_\_\_\_

Date \_\_\_\_\_

## Lesson 30: Evaluating Reports Based on Data from an Experiment

### Exit Ticket

What are the aspects of a well-designed experiment that show a causal relationship?

## Exit Ticket Sample Solutions

What are the aspects of a well-designed experiment that show a causal relationship?

*The use of a control group or a comparison group sets a baseline for the treatment effect. The use of random assignment evenly spreads the effects of extraneous variables into the treatment groups. Thus, any significant difference between the treatment groups can be attributed to the treatment, and you can conclude that the treatment is the cause of the observed difference.*

## Problem Set Sample Solutions

Read the following articles and summaries. Write a few sentences evaluating each one using the guidelines given in the lesson.

1. The article “Emerging Technology” (*Discover Magazine*, November 2005) reports a study on the effect of “infomania” on IQ scores.

Website: [discovermagazine.com/2005/nov/emerging-technology](http://discovermagazine.com/2005/nov/emerging-technology)

*This article discusses two groups of people: one who had to check email and respond to IM while testing and the other who was not distracted by email or IM. It does not specify that subjects were randomly assigned to the 2 groups. Also, the sample sizes were not stated. Therefore, based on this article, it would not be reasonable to state a cause-and-effect relationship.*

2. In *The New England Journal of Medicine*, October 2013, the article “Increased Survival in Pancreatic Cancer with nab-Paclitaxel Plus Gemcitabine” reports on an experiment to test which treatment, nab-paclitaxel plus gemcitabine or gemcitabine alone, is the most effective in treating advanced pancreatic cancer.

Website: [www.nejm.org/doi/full/10.1056/NEJMoa1304369](http://www.nejm.org/doi/full/10.1056/NEJMoa1304369)

*The article states that pancreatic cancer patients were randomly assigned to the 2 groups. The sample sizes (431 and 430) were large enough to observe the variation in responses. The standard treatment of gemcitabine alone was the comparison group. The conclusion, that the treatment group of nab-paclitaxel plus gemcitabine significantly improved the overall survival rate, is accurate.*

3. Doctors conducted a randomized trial of hypothermia in infants with a gestational age of at least 36 weeks who were admitted to the hospital at or before six hours of age with either severe acidosis or perinatal complications and resuscitation at birth and who had moderate or severe encephalopathy. The trial “Whole-Body Hypothermia for Neonates with Hypoxic-Ischemic Encephalopathy” tested two treatments, standard care and whole-body cooling for 72 hours.

Website: [www.nejm.org/doi/full/10.1056/NEJMcp050929](http://www.nejm.org/doi/full/10.1056/NEJMcp050929)

*The article states that the infants were randomly assigned to usual care (the control group—106 infants) or whole-body cooling (102 infants). Thus, the sample sizes were large enough to observe the variation in responses. The conclusion, that whole-body cooling reduces the risk of death or disability in infants with moderate or severe encephalopathy, is accurate.*