What Will I Learn About Experiments and Experimental Design?

When we think about experiments, we typically imagine people in labs wearing white coats and tinkering with flammable liquids and chemicals. We all have images of such experiments. We have seen them in movies and television, and maybe even conducted a few experiments in a physics or chemistry class. The purpose of such experiments is to test the effects of one or more variables on another variable (when you mix chemical X with chemical Y, what happens?). While such experiments typify the “average” science experiment, they are not the only kinds of experiment on the block.

Conducting an experiment is a process. To perform an experiment, you should consider various questions. 1) What variables are under investigation? 2) What data are being collected and analyzed? 3) Where is the source of your data? 4) How is the experiment being conducted? 5) How will the experimental data be analyzed? We explore these questions and others in Chapter 18 on experimental research.
What is Experimental Design in Communication Research?

Experiment

The focus of this chapter is on experimental design. An experiment is a methodological design process to show how one or more variables that have been manipulated by a researcher influence another variable. A researcher should attempt to control any other variables that might affect the relationship between the variables. The purpose of an experiment is to identify any causal relationships between the variables. We know there is a lot to digest in this definition. Don’t worry, we are going to break down all the elements in this chapter.

Causality

An experiment is a process where a researcher investigates a possible cause-and-effect relationship between variables. A causal argument is not an easy thing to make. In order to make a causal argument you must meet the following three criteria. First, there must be a manipulation of an independent variable before a change happens in the dependent variable. Second, changes in the dependent and the independent variables must be correlated (happen together). When the independent variable changes, the dependent variable should change soon afterward. Third, any change in the dependent variable should be explainable only by the independent variable, and not by any other intervening variable or alternate factor or explanation.

Let’s consider the following example: when an anesthesiologist gives a patient anesthesia for a surgery (independent variable), the intended effect is for the patient to go to sleep for the surgery (dependent variable). The amount of anesthesia given depends on a lot of factors: the patient, the type of surgery, etc. Before and during the procedure, the anesthesiologist is careful to monitor the level of anesthesia to make sure the patient has the right amount for the desired duration of unconsciousness. We trust anesthesia will knocks us out and the effect is not caused by some other intervening variable. Through numerous trials and experiments, researchers have proven the reliability and “safeness” of anesthesia.

When conducting experiments to make causal claims, researchers follow a careful step-by-step process. We will outline this process in Figure 18.1 and then describe in more depth each aspect of the process.
Experiment Preparation

Before conducting an experiment, you must consider two main questions. First, what is the broad research problem (issue)? Second, what hypotheses or research questions are you interested in studying? In Chapters 3–9 we discussed various issues related to how you formulate and generate hypotheses or research questions. Before you begin an experiment you need to know what you want to study.

Second, ask if an experiment is necessary. After you have done some preliminary research and determined the general topic(s) of interest, you must ask a very important question: is an experiment necessary? Remember, an experiment helps us determine causality. Causality means one or more variables cause or lead to a change in another variable. In many research studies you want to show causality, while in other studies you are not interested in showing causality.

Flip back a few pages to Chapter 17 on inferential statistics. In that chapter we referenced various studies. One study that did use an experimental design was by Yanovitzky, Stewart, and Lederman (2006). The authors were interested in sampling college students for their perceptions about alcohol use based on distant versus proximate peers in predicting college students’ drinking behavior. The study used a cross-sectional design. In Yun, Costantini, and Billingsley’s (2012) study on the effects of taking a public speaking class on writing abilities, the researchers used a longitudinal experimental design.
The researchers were interested in the effects of taking a university public speaking course on a student’s writing abilities. Thus, testing the students’ writing abilities was essential at the start of the course (a pretest) and then at the end of the course (a posttest).

Think about any medicine you have taken in your life . . . aspirin, ibuprofen, a prescription from a physician. All of these medications have gone through what we call a clinical trial. To test the safety, governments require drug developers to strictly test medications. The first step is for the developers of the medications to state what the medications will do (their intended purpose). The second step is a clinical trial (and experiment). We will outline the next steps later in this chapter.

Variable and Method Selection/Definition

You need to define your independent and dependent variables in many studies. With experiments in particular, you may also need to identify intervening variables. You must also choose appropriate measures to explore those variables.

You need to define your variables of interest. With experiments you are exploring the effects of one or more independent variables on a dependent variable. You may need to consider any potential intervening variables that may affect the causal relationship between the independent and the dependent variables. In Yun et al.’s (2012) study of the effects of taking a public speaking class on writing abilities, the following five hypotheses were posed (p. 287):

\[ H1: \text{Individuals exposed to a public speaking class will have greater gains in their writing skills of writing context than those not exposed to a public speaking class.} \]
\[ H2: \text{Individuals exposed to a public speaking class will have greater gains in their writing skills of content development than those not exposed to a public speaking class.} \]
\[ H3: \text{Individuals exposed to a public speaking class will have greater gains in their writing skills of writing structure than those not exposed to a public speaking class.} \]
\[ H4: \text{Individuals exposed to a public speaking class will have greater gains in their writing skills in use of sources and evidence than those not exposed to a public speaking class.} \]
\[ H5: \text{Individuals exposed to a public speaking class will have greater gains in their writing skills in control of syntax than those not exposed to a public speaking class.} \]
In each hypothesis, exposure or not to a public speaking class is the independent variable. The dependent variable in each hypothesis has been italicized; the dependent variable for each hypothesis focuses on an aspect of writing ability. You will find that in well-written experimental studies the researchers take care to clearly identify and explain their variables in the “Method” section of the article.

Yun et al. (2012) did not identify any potential intervening variables in the Method section or in the Review of Literature. However, as only two of their hypotheses were supported (we will talk more about data analysis shortly), the researchers offered a potential intervening variable in the Discussion section. The researchers noted that the outcomes of public speaking and writing classes were different, and thus future studies should take into consideration the different outcomes. Therefore, if they conducted another experiment on the same topic, the researchers may alter their materials to consider the pedagogical differences between public speaking and writing courses.

Think back to Chapter 15 on surveys and Chapter 7 on data. One of the issues discussed in both chapters was the different methods available for collecting data using a survey. You have many tools at your disposal if you want to conduct an experiment: self-report or other-report surveys, observations, and other codeable forms of data. Many researchers collect self-reports or other-reports from participants at various points in time (longitudinal data). Some prefer to observe human behavior. Yun et al. (2012) had students write a 3–5 page paper at the start and the end of the semester (about 12 weeks apart). The papers were on a variety of topics. The papers were then graded based on a standardized writing rubric by trained coders. You have many experimental measures available in a study. The key is to choose the most appropriate ones for your study. The choice will be based on your literature review of what other researchers have done and on your knowledge of the subject.

When conducting a clinical trial to determine the effectiveness and safety of a new medication, researchers have to ask themselves a few questions related to variables. What independent, dependent, and intervening variables could affect our understanding of how the medication affects the human body? Let’s say researchers are testing a new headache pill. The researchers assert: patients exposed to “Headache Pill X” will have less headache pain than patients exposed to other headache pills. The independent variable is “Headache Pill X” exposure and the dependent variable is the level of headache pain. When doing the trials, the researchers must determine if any intervening variables could affect their causal argument that “Headache Pill X” reduces headache pain. We will talk more about how researchers do this shortly. Finally, the
Types of Experiments (Design)

Experimental Control

So, you’ve decided to conduct an experiment. You’ve defined your variables, and chosen the appropriate measures for the experiment. The next step is to choose the design of your experiment. You can conduct an experiment in myriad ways. The purpose of an experiment is to establish a causal relationship between variables. To do this, the independent variable must be manipulated in some way. Experimental design is the key because causality cannot be established without experimental control. Experimental control is evaluating the manipulation of the independent variable for effectiveness and to ensure you have controlled for (removed the effects of) alternative variables. You can take multiple steps to check for effective manipulation of the independent variable(s). The options are called manipulation checks. These steps, often statistical procedures, check (test) if the participants perceived the independent variable(s) the way a researcher intended. In Ivanov, Parker, and Pfau’s (2012) examination of inoculation, the researchers conducted t-tests as manipulation checks of their inoculation messages (the independent variables).

To achieve experimental control, three things are essential (Rashotte, 2007): comparison groups, random assignment of participants to independent variable conditions, and pretest-posttest testing.

Comparison and Control Groups

When conducting an experiment, some of the participants need to be exposed to (given) the independent variable and some should not be exposed. The group exposed to the manipulated levels of the independent variable(s) are called the comparison group. In the Yun et al. (2012) study on the relationship between taking a public speaking class and writing ability, the comparison group was participants in the public speaking class. The participants completed the writing assignment at the start of the semester and then at the end of the semester so the researchers could see if the public speaking class had any effect on their writing abilities. The researchers then compared the scores of the comparison group to a separate group called the control group. A control
group is not exposed to the independent variable(s). In the case of Yun et al.,
the control group was students enrolled in a history class. The researchers
excluded history students who had already taken a public speaking class. The
control group completed the same writing assignments as the comparison
group. Comparing the control and the comparison groups allowed Yun et al.
to argue the effects of the public speaking class on writing ability.

In both of the Yun et al. (2012) groups, the participants knew they were
being measured for some kind of experiment. In some experiments the
participants do not know if they have been exposed to the independent
variable(s). A placebo is when an individual thinks they have received a
treatment, but have not. Often in medical studies, researchers will give vol-
unteers sugar pills. The pills, which have no effects on the body, are given
to help differentiate the true effects of medications. People often believe a
medication is working when in fact they are getting the placebo (and thus
the phrase “placebo effect”). Placebo groups are sometimes used in social
scientific and in communication research.

Random Assignment

Remember, one of the goals in an experiment is to compare the results of
the control and the comparison groups on some measures (generally pre- and
posttests, which we will discuss in a bit). To facilitate the most reliable and
valid comparison, and to ensure your groups are equivalent, you should
randomly assign participants. This is called random assignment. If your
groups are not equivalent, you could have selection bias or other character-
istics present in one group that are not present in another group. Think back
to the discussion of random sampling from Chapters 7 and 9. While random
assignment is slightly different, many of the same principles apply. You want
to be confident your groups represent your population as closely as possible.
The best way to do this is by randomly assigning.

Pre- and Posttests

Researchers often use pretests and posttests. A pretest is a measure (test) of
the dependent variable before the manipulated independent variable. A post-
test is the same exact measure (test) of the dependent variable after the
delivery of the manipulated independent variable. The purpose of giving a
pre- and posttest is to determine if a change has occurred in the participant
from the time of the pretest to the time of the posttest. If the participants
in the comparison group have been exposed to the manipulated independent
variable, the researchers can attribute the change in participant behavior to
the independent variable, causality (as long as a few other conditions are
met of course, which we talked about earlier). In the Yun et al. (2012) study,
the researchers had all the students in the comparison and the control groups
write a 3–5 page paper at the start of the class (pretest) and at the end of
the class (posttest). The researchers then analyzed the papers based on a writing rubric. They then compared the results for students in the history class (control group) and the public speaking class (comparison group) to see if there were improvements in student writing skills.

To show causality, researchers need to control the manipulation of the independent variable(s). Utilizing comparison and control groups, random assignment, and pre- and posttests, along with manipulation of the independent variable(s), helps researchers make causal claims. When studies are conducted with all of these elements, the studies are true experimental designs. If one or more of these elements are absent from the design the study is considered a pre-experimental or quasi-experimental design. We discuss these types of designs next.

Pre-Experimental Designs

Pre-experimental designs lack one of the three elements we listed above: comparison and control groups, random assignment of participants to groups, and/or pretests and posttests. We will outline two examples of pre-experimental design: the one-shot case study and the one-group pretest-posttest design.

One-Shot Case Study

The one-shot case study is a design where some manipulation of the independent variable occurs, and after the manipulation the measurement of the dependent variable is taken. For example, imagine you want to measure the effectiveness of a political campaign on voting behavior. After the election, you give a survey to a group of voters and you ask them about their perceptions of the candidate. Your research tries to argue, based on the results of the survey, that the campaign had an effect on the voters’ political opinions. However, without a measure of the voters’ opinions before the campaign, a researcher cannot show causality.

One-Group Pretest-Posttest

The one-group pretest-posttest design adds the element of a pretest to the one-shot case study. In this type of design, the researcher administers a pretest of the dependent variable, the independent variable is manipulated, and then the dependent variable is measured again (posttest). Take the study on the effectiveness of a political campaign on voting behavior. With a one-group pretest-posttest design you would measure individuals’ opinions about the political candidate before the start of the campaign (pretest), the campaign happens (the independent variable), and then you measure the opinions about the political candidate after the campaign (posttest). Finally, you compare the results of the pretest and the posttest for changes in political opinion, and attribute these changes to the manipulated independent variable. This type of design is a more sophisticated design than the one-shot case study.
design because it has the pretest component, which provides for a point of comparison. This is what happened in the Yun et al. (2012) study on the effects of taking a public speaking class on writing skills. See Figure 18.2 for a visual depiction of the pre-experimental designs.

While a pre-experimental design provides for statistical reliability and validity, it is difficult to absolutely state the independent variable caused a change in the dependent variable. Quasi-experimental designs take pre-experimental designs a step further in sophistication. We will outline two designs: the time-series design and the nonequivalent control group design.

**Quasi-Experimental Designs**

**Time-Series Design**

The time-series design measures the dependent variable at various points of time before and after the manipulation of the independent variable. The purpose of measuring the dependent variable at various points in time is to assess degrees of change in the dependent variable over time. This kind of design is needed or useful when you are interested in measuring the development or change in the dependent variable. Let’s return to the impact of a political campaign on voters’ opinions about a candidate. It would be advantageous to measure the voters’ opinions at various stages before a major debate (let’s say once a week before the debate) and then the debate takes place. After the debate, measure the opinions again (this time every three weeks). This type of measurement design may reveal changes in opinions toward the candidate before and after the debate. While this kind of design is more sophisticated than the pre-experimental designs, it is still subject to problems. The design lacks random assignment and a control group, and thus the researcher should not claim causality.

**Nonequivalent Control Group Design**

A nonequivalent control group design has two groups—a control and a comparison group. Both groups are given a pretest and a posttest. However, only the comparison group is exposed to the independent variable. In the Yun et al. (2012) study on the effects of taking a public speaking class on writing skills, the researchers used this kind of design. Both groups were
given a pretest and posttest (the writing assignment graded by independent coders). The comparison group was exposed to the independent variable (the public speaking class). The control group (the history class) was not exposed to the independent variable. This design, like the time-series design, is more sophisticated than pre-experimental designs. However, the approach lacks random assignment, which limits its ability to prove causality. See Figure 18.3 for a visual depiction of the quasi-experimental designs.

The quasi-experimental designs provide more evidence for causality than the pre-experimental designs. However, neither the pre- nor the quasi-experimental designs incorporate random assignments. The lack of random assignment threatens the reliability of the experiments and limits the causal argument. True experiments, on the other hand, incorporate all the necessary elements for the best cause-and-effect argument. We will outline three designs: the pretest-posttest control group design, the posttest-only control group design, and the Solomon four-group design.

True-Experimental Designs

Pretest-Posttest Control Group Design

The pretest-posttest control group design uses pretests and posttests, comparison and control groups, and random assignment to assess the effects of an independent variable(s) on a dependent variable. The design is identical to the nonequivalent control group, except that it includes random assignment of study participants into either comparison or control groups. Pieterse, van Dulmen, Beemer, Ausems, and Bensing (2006) used this design to assess communication messages during cancer genetic counseling. The study involved offering counselors feedback on counseling. However, not all the counselors (participants) received feedback during the study. Those who did not receive feedback were the control group. The purpose of giving some counselor feedback or training was to assess the effectiveness of the communication messages. A weakness of this experimental design is that, even though participants are randomly assigned to groups, the researchers may not know enough information about the participants to determine if differences in the group affected the outcomes.
The assignment of participants to groups, even random assignment, may lead to limited statistical power.

Posttest-Only Control Group Design

The posttest-only control group design includes random assignment, posttests, comparison and control groups, and random assignment. Beckie (1989) used this design in an analysis of the impact of an educative telephone program on levels of knowledge and anxiety of patients undergoing coronary artery bypass surgery after hospital discharge. With a posttest-only control group design, patients were randomly assigned to either an experimental or a control group. A significant difference between the state anxiety level of the experimental and the control group was evident. While this type of design does use random assignment, without a pretest it is impossible to measure a change in behavior due to the manipulation of the independent variable.

Solomon Four-Group Design

The Solomon four-group design contains two extra control groups, comparison groups, random assignments, two pretests, and four posttests. The Solomon is the most sophisticated design possible in experimental designs. The Solomon eliminates many of the validity threats we will discuss in the next section of this chapter. The combination of comparison and control groups permits researchers to ensure rival variables have not affected the final results. Kvalem, Sundet, Rivo, Eilertsen, and Bakketeig (1996) studied adolescent condom use and employed this kind of design. They evaluated the effectiveness of a school sex education program in Norway. The results showed an interaction between the pretest and the intervention (independent variable) affected condom use (dependent variable). The Solomon’s main limitation is the amount of time and effort required compared with other designs. See Figure 18.4 for a visual depiction of the true-experimental designs.

<table>
<thead>
<tr>
<th>Pretest-Posttest Control Group Design</th>
<th>R</th>
<th>O₁</th>
<th>X</th>
<th>O₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posttest-Only Control Group Design</td>
<td>R</td>
<td>O₃</td>
<td>X</td>
<td>O₄</td>
</tr>
<tr>
<td>Solomon Four-Group Design</td>
<td>R</td>
<td>O₁</td>
<td>X</td>
<td>O₂</td>
</tr>
</tbody>
</table>

Figure 18.4 True-Experimental Designs

Notes: O = measurement of dependent variable; X = independent variable manipulation; R = random assignment.

Source: Campbell & Stanley (1963).
Evaluating Experiments

Since experiments are concerned with showing causality, researchers are particularly concerned with being sure that experiments have high validity and reliability. Reliability and validity are critical to accurately state that an independent variable(s) causes any change in a dependent variable. Look back to Chapter 8 and the discussion of reliability and validity. Reliability is the notion that instruments should perform the same way over time. Validity is the extent to which a test measures what it’s supposed to measure. The same threats to reliability that are present in other kinds of social scientific inquiry are present in experiments: 1) errors in data entry, 2) instrument confusion, and 3) random human differences.

Numerous threats to validity are unique to experiments. In order for a measure to have validity in an experimental design, you must be sure that the measures are not biased because you are trying to show causality. To show causality you must rule out rival or intervening variables that interfere with demonstrating the causal relationship. You should be aware of two kinds of bias that can affect an experiment’s ability to show causality (Cook & Campbell, 1979): time progression effects and reactivity effects.

Time Progression Effects

Experiments, unlike one-shot studies, take place over a period of time. The period of time can be short or long. As the study is taking place, time itself is a variable that must be considered. **Time progression effects** are the factors that act like separate independent variables as causes or effects because an experiment does take place during a period of time. We will identify six time progression effects: history, instrumentation, maturation, mortality, statistical regression, and testing.

**History** refers to an event(s) that happens during the experiment that is outside of the study, but may affect the outcome of the study. One way to try to counter for the history effect is to have a control-and-comparison group exposed to all the same elements or events. If an outside event happens and if differences exist between the groups, you can assess those
differences as caused by the independent variable(s) and not the outside events. Take the Yun et al. (2012) study on the relationship between taking a public speaking class and writing ability. Two of their five hypotheses were confirmed. It is possible that outside events in the students’ lives may have influenced the experiment: taking another course may have affected writing ability or some students in the control group may have joined a writing club or something.

**Instrumentation** is when the instrument (measure) is changed during the course of the experiment. Let’s say you give the pretest and then notice some things in the instrument you want to change. So, you change some of the questions and then give the posttest with the revised instrument. Can you adequately compare the results of the pretest and the posttest since you changed the instrument? The change brings into question issues of validity and reliability. If you notice something you MUST change, we recommend you change it and then test the group two more times. Let the first test serve as a pilot “dry run,” and not your pretest.

**Maturation** is a naturally occurring process in experiments. Participants develop mentally, physically, emotionally, etc. The developmental process itself thus serves as an independent variable when trying to argue that some trait, behavior, or process causes a change in another trait, behavior, or process. For example, let’s say you want to argue that an individual’s religiosity (religious devotion) causes them to use certain kinds of media. You may find religiosity is an evolving part of our lives. Thus, it would be very, very hard to show it causes media usage. If you want to show that exposure to violent media causes children to be violent you would need to consider how children’s minds and emotions develop rapidly. Therefore, some children will learn to understand the differences between fact and fiction faster than others. You will need to consider the developmental process in your study.

**Mortality** is the simple fact that some participants will start an experiment but not finish. For a variety of reasons people drop out of experiments. Stephen started an experiment on cultural adaptation in 2006 in France. He had 529 Muslim immigrants complete a survey. In 2012, 398 of those 529 original participants completed the follow-up survey. He was unable to find some of the original participants: they moved, did not respond to phone calls or emails, did not want to participate, and a couple had died in those six years. Participants have the right to drop out of an experiment. In 2018 when Stephen returns to collect more data, he knows he will lose some participants, but hopes not too many.

**Statistical regression** is when your sample includes participants who represent the extremes of the dependent variable. Let’s say you have a measure ranging from 0 to 100. If a person scores a 0 on the pretest, where can they go on the posttest except for up? One could argue that in the Yun et al. (2012) study individuals who were extremely poor at writing at the start of the semester would only get better, no matter what class they were taking.
in college (public speaking, history, or English). Thus, statistical regression acts like another independent variable to consider.

The testing effect is more likely to happen when participants complete a pretest and a posttest. What happens is that participants become sensitized to the answers or procedure. As the participants have already taken the pretest, they know—or think they know—the “right answers.” Therefore, the participants can often get a higher or more appropriate score the second or subsequent time around because they already had practice taking the measure. Think about any time you have had the chance to retake an exam, particularly the same exam. Since you took the exam once before, you should have done better on it the second time around because you had a “trial run.”

Reactivity Effects

When people participate in an experiment they respond to many elements of the experiment’s conditions. People are asked to do all sorts of things they would not do in their normal everyday lives. Reactivity effects are a set of threats to an experiment’s validity that center on the participant’s responses to the design of an experiment. We will discuss six reactivity effects: compensation behavior, demand knowledge, experiment apprehension, researcher attributes, selection, and treatment diffusion.

Compensation behavior becomes a threat to validity when the control group finds the comparison group is being treated differently than they are. If the control group finds out the comparison group is getting paid more for the study, the control group may become angry and underperform, or the group may perform better to try to get the same kind of payment. Either way, this knowledge alters their natural experimental behavior. You can control by taking steps to make sure members of each group do not communicate with one another and/or share information about the study with each other.

Demand knowledge is a threat to a study because you may not want participants to know the goals of the study. If participants think they know the goals of a study, they may provide answers they think the researchers want or they may provide opposite answers to play with the research team. When trying to show causality, we do not want this kind of bias in a study. What we want is for the participants to answer questions as honestly as possible. However, when participants are aware of the goals of a study, or think they are, the answers are not going to be as honest. Research has demonstrated that when individuals know they are being watched in the workplace, their productivity goes up. This is known as the Hawthorne Effect.

Some people are also apprehensive about being in experiments. Experiment apprehension is when participants are nervous or excited about participating in an experiment. Along with being nervous or excited, some questions in experiments can be very personal. Many people will
alter their answers to appear more favorable to the experimenters. This process of altering answers to look more favorable is called the social desirability bias; we talked about it in Chapter 15 on surveys. Building trust with participants is key to help them feel comfortable in giving honest answers.

Sometimes the researchers have personal characteristics that can affect the data collection process; this is the threat of researcher attributes. For example, if conducting research among female rape victims then having female members on the research team would be advantageous. Survivors of sexual assault are generally more comfortable sharing personal or intimate details about such violence with individuals of the same sex.

The selection threat happens when a researcher is unable to randomly assign participants into comparison or control groups. Yun et al. (2012) were not able to randomly place students into a public speaking or a history class. The researchers were “stuck” with the students they had that semester in the different classes. Thus, as the authors pointed out, any potential differences between the students could be attributed to a selection bias.

Treatment diffusion, also known as contamination, happens when participants in the treatment group tell people in the control group about the treatment. The discussion of the treatment contaminates the control group. For example, the 1996 Kvalem et al. study on condom use in Norway had four groups: two control and two comparison. Two groups received the treatment (the training) and were then measured on their condom use. Discussions between the comparison group and the control group may have biased the study since the control group represented people not receiving condom use education.

Looking at the laundry list of validity threats to experiments, we can understand why it can take so long for new drugs to be tested. The Food and Drug Administration (FDA) is rigorous when it comes to verifying the safety of medicines. Whenever a medicine is put on the market we can be certain it will work for us about 99.9 percent of the time. We say 99.9 percent because there is always an element of error we talked about in earlier chapters. Error is present in experiments because of all of the threats to validity. We have all heard of medicines like Yaz or Vioxx being recalled because of consumer health threats. Some danger is almost always involved in medicines, and clinical trials often reveal some of these threats. However, the threats to experiments help us recognize the need for rigorous experimental design. In medical research and science, a failure to set up a valid and reliable design could lead to death. In communication and the social sciences such a failure could lead to poor results, misreporting, and even unethical reporting.
Summary

This chapter was a how-to guide to experiments. The focus of experiments is on showing causality. Experiments are a very social scientific way of doing research. Hopefully after reading the chapter you have a better understanding of experiments. While experiments are a tall order, maybe you feel comfortable enough to try one out after reading this chapter and the ones before it. The next chapter, Chapter 19, is a how-to guide to rhetorical criticism.

Key Steps & Questions to Consider

1. An experiment is a methodological process to test the effects of one or more variables that have been manipulated by a researcher on another variable.
2. You must meet three criteria to make a causal argument: manipulation of the independent variable before a change happens in the dependent variable, the changes in the dependent and the independent variables must happen together, and any change in the dependent variable should only be explainable by the independent variable, not by an intervening variable.
3. Before conducting an experiment, formulate the broad research problem and the hypotheses or research questions. Then ask yourself if an experiment is necessary.
4. Many tools are available if you want to conduct an experiment: self-report or other-report surveys, observations, and other codeable forms of data.
5. Experimental control is evaluating the manipulation of the independent variable for effectiveness and to ensure you have controlled for alternative variables.
6. Three things are needed for experimental control: comparison groups, random assignment of participants to independent variable conditions, and pretest-posttest.
7. The group of participants who are exposed to the manipulated levels of the independent variable(s) is called the comparison group.
8. A control group is not exposed to the independent variable(s).
9. A placebo is when an individual thinks they have received a treatment but have not.
10. A pretest is a measure (test) of the dependent variable before the manipulated independent variable. A posttest is the same exact measure (test) of the dependent variable given after the delivery of the manipulated independent variable.
11. A one-shot case study is a design where manipulation of the independent variable occurs, and after the manipulation the measurement of the dependent variable is taken.
12. A one-group pretest-posttest design is when the researcher administers a pretest of the dependent variable, the independent variable is manipulated, and then the dependent variable is measured again (posttest).

13. A time-series design measures the dependent variable at various points of time before and after the manipulation of the independent variable.

14. A nonequivalent control group design has a control and a comparison group. Both groups are given a pretest and a posttest. Only the comparison group is exposed to the independent variable.

15. A pretest-posttest control group design uses pretests and posttests, comparison and control groups, and random assignment to assess the effects of an independent variable(s) on a dependent variable.

16. A posttest-only control group design includes random assignment, posttests, comparison and control groups, and random assignment.

17. A Solomon four-group design contains two extra control groups, comparison groups, random assignments, two pretests, and four posttests. In experimental design, the Solomon is the most sophisticated design available.

18. Time progression effects are factors that act like separate independent variables as causes or effects because an experiment does take place over a period of time. The six time progression effects are: history, instrumentation, maturation, mortality, statistical regression, and testing.

19. Reactivity effects are a set of threats to an experiment’s validity that center on a participant’s responses to the design of an experiment. The six reactivity effects are: compensation behavior, demand knowledge, experiment apprehension, researcher attributes, selection, and treatment diffusion.

Activity

1. Major challenge! Develop a chart for easy reference of all the different experimental design options available to a communication researcher.

Discussion Questions

Pick one of the articles mentioned in the chapter. Look up the article in your library (your instructor or a reference librarian can help you find it). Your instructor may decide to divide up the class into groups with each group assigned a different article.

1. Consider how your article could be adapted to meet at least three different experimental designs.

2. Identify the specific strengths and weaknesses for your study in each of your three chosen experimental designs.

3. Which experimental design is the best option and why?
### Key Terms

<table>
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<tr>
<th>Causal argument</th>
<th>Nonequivalent control group</th>
<th>Random assignment</th>
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<td>Comparison group</td>
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<td>Reactivity effects</td>
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<td>Compensation behavior</td>
<td>One-shot case study</td>
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