Two-Group Design

Texting: I Can’t Get You Out of My Mind

LEARNING OUTCOMES
After reading this chapter, you should be able to:
• Provide operational definitions for key variables.
• Identify key design issues with two-group research.
• Identify factors involved in establishing causation.
• Explain how control is established in an experiment.
• Discuss the importance of group independence and random assignment.
• Write a results section for an independent samples t-test.

Something to Think About...

You have probably found yourself sitting in class dutifully trying to pay attention, but distracted by a window, people passing by the door, someone tapping a pen, a classmate with a cold, or some idiosyncrasy of the professor. Really, how many times can one person say “alrighty then” in one class? To be sure, these are all distractions, but many people view technology as the biggest distraction of all. At this point, it is common knowledge that texting while driving this behavior. If your syllabi are any indication, it seems professors are equally concerned about how technology can distract your learning. Whether you are checking Facebook on your laptop, tweeting from your tablet, texting from your smartphone, or doing all three, your professor probably does not condone this behavior. If you think about it, you can understand your professor’s perspective. These forms of technology can lead you to miss course material, or worse, can distract other students, leading them to miss things. You and your classmates pay a lot of money for the classroom experience, so students and professors should lament anything that undermines that experience. Then again, it is all too easy to blame technology as the problem. After all, distractions have been part of the classroom experience since classrooms came into existence. You play with your cell phone; your parents passed notes. So technology-based classroom distractions are not a “new” problem, but rather the latest version of a long-standing issue. Besides, before we worry too much about cell phones’ potential classroom harm, we would need to see some proof that cell phone use is actually distracting.
In order to combat the perceived evils of technology, many professors craft highly restrictive course policies that treat using portable technology as a form of high treason. However, is it possible that by invoking an absolute ban, those professors are creating more of a distraction? We will answer that question with another question: Have you ever been hungry and tried to avoid thinking about food? As soon as you tell yourself to not think about being hungry, what do you feel? Hungry. Clearly this does not work very well. By trying to avoid thinking about food, you tend to think about that exact thing even more. Are you still not a believer? Try this: Right now, no matter what, do not under any circumstance think of Barack Obama naked.

Yikes! See that? You thought about exactly what we asked you to not think about. Sorry about that, but next we’d like you to not think about a cute puppy playing with a ball. That image should make it all better. This little exercise helps us demonstrate a point: not thinking about something is really hard. If we are truly “addicted” to our technology, or perhaps just really attached to it, a rule that forbids us to use our devices essentially asks us to not think of them. Ironically, this could create a major distraction that may also inhibit learning. Wouldn’t it be something to discover that those well-intentioned, antitechnology professors are actually inhibiting your learning? It would be great if someone could design a study to test this out and see if it is true. Well . . . that someone is you.

Introduction to Our Research Question

If we are going to design a study to test our idea, we should state our key question a bit more clearly. Ultimately, cell phones allow us to do many different things, but let’s focus on texting because that seems to be the number one offender on professors’ lists. We want to answer the general question, "Can trying to ignore a text message lead to distraction?"

Compared to our research questions from previous chapters, this one seems to make a more specific prediction about a type of behavior that leads to a specific outcome. As a result, our focus has moved beyond merely describing what is taking place to identifying how one factor (ignoring text messages) leads to changes in another factor (distraction). To answer this type of question, we will need to use experimental research to help us determine cause and effect. But let’s not get too far ahead of ourselves just yet. If professors have these antitexting classroom policies, there must be research on the detrimental effects of using technology. Let’s see some evidence.

Reviewing the Literature: What Do We Already Know About This Topic?

If we are going to conduct a well-designed study, we should familiarize ourselves with the existing research. It would be useful to know the answer to a few key questions: How prevalent is student texting in class? Does texting have any detrimental effects? What is the evidence that texting is distracting while driving? What about for learning or thinking more generally? Are there any
benefits to texting? Has anyone looked at the consequences of preventing texting? Based on a literature search, we have summarized a few relevant studies that will be helpful to familiarize ourselves with.

**Prevalence of Texting**


This study examined 269 college students to determine the extent to which students used their cellular devices in class. An overwhelming majority (95%) of students brought their cellular devices to lectures on a daily basis, though 91% said they had it set on “vibrate.” Of these students, most (92%) used their cellular devices in order to send SMS (short message service) messages during lectures at some point, 97% said they were aware of other students doing it, and a small number (10%) reported that they used their cellular device during a test. A majority of students (61.6%) agreed with the statement, “Yes, I see no problem with using a cell phone to text in class as long as I am not disturbing other students,” while some (31.5%) believed that sending texts negatively influenced students “through loss of attention and/or poor grades.”

**The Influence of Texting on Driving**


Researchers studied data on driving fatalities in the United States from 1999 through 2008 to determine how they related to texting and cell phone use. Their analysis indicates that distracted driving fatalities decreased from 1999 to 2005, but rose (up 28%) from 2005 to 2008. The researchers’ analyses led them to conclude that texting was responsible for an additional 16,000 fatalities over a 6-year period from 2001 to 2007.

**The Negative Impact of Technology on Learning and Cognition**


This study wanted to determine if using laptop computers in class had detrimental effects for the users or for those around them. To test this, 137 students in a live lecture class were told they could use laptops during class, though there was no need to do so. Researchers then collected weekly surveys regarding students’ attendance and laptop use (their own and others). Results indicated that laptop use interfered with learning (as measured by grades in class) for the laptop user and for those in the presence of the laptop. Importantly, 68% of the students with a laptop reported using it for instant messaging.


To determine whether texting has an effect on memory recollection of classroom material, researchers assigned 185 undergraduate students to one of three groups: no texting, medium texting (8–15 texts), and excessive texting (16 or more). Researchers
manipulated texting by sending messages to participants while participants watched a 30-minute video of a class, and then gave participants a memory test based on the video. The excessive texting group had the worst test scores of the three experimental groups. Those who typed more in their text messages and received longer messages also did worse than those sending/receiving shorter messages.


This study tested if distractions from a cellular device and texting could inhibit college students’ ability on a cognitive identification task (i.e., memory of words). Researchers randomly assigned 64 college students to one of three groups: a no distraction, distraction (answered their phones if they rang), or different distraction (answered their phones using a text message). Groups reviewed two sets of 24 related words (e.g., diaper, crib), then took an identification exam to test their recall of the words. Results indicated that participants in the no distraction group performed best, while both distraction groups had worse performance.

**Potential Benefits of Texting**


It might be possible that text messages can promote students’ learning in educational settings through texting with tutors. To test this, researchers asked 1,121 students questions about texting behavior, then transcribed their responses. Students viewed text messages from tutors as intrusive, mainly because they viewed cell phones as being used for primarily personal reasons (i.e., texting friends and family). Students did acknowledge that texting kept them in constant contact with the tutor, which they saw as beneficial if it was consistent with students’ perceived needs.


To determine if texting and the use of textese (e.g., “LOL” or “IMO”) hindered literacy skills, researchers had 152 undergraduate students take literacy (reading and spelling) tests, then answer questions about texting behavior and use of textese. Students reported frequent use of texting and use of textese, though use was primarily in the context of texts or e-mails to friends, not professors. Results of the analysis showed that, contrary to previous studies, more self-reported texting was associated with greater literacy. However, participants who reported using more textese in e-mails to professors or on social networking sites had poorer reading accuracy scores.

**The Consequences of Preventing Texting**


This study examined texting behaviors, including the restriction of texting, among 23 psychology students (age 18–23). Results found that texting was the most frequent way students kept in touch. Both frequent and infrequent texters reported difficulty with limiting
their texting and higher levels of anxiety when cell use was restricted. The researchers suggest that texting is a norm for this age group, and having texting limited throughout the day may hinder social relationships.

From Ideas to Innovation

Ok, we have to hand it to the antitexting professors of the world. Though it may be tough to admit, they seem to be right about texting’s negative consequences. However, just because actively texting on the road can make you a worse driver (Benedetto, Calvi, & D’Amico, 2012) and texting in class can lower test scores (Rosen, Lim, Carrier, & Cheever, 2011) does not automatically mean that a total and absolute classroom texting ban is best. After all, preventing texting might create unintended consequences. Remember that researchers have a number of strategies for coming up with interesting research ideas and hypotheses, one of which is looking for the exception to the rule. Texting has negative consequences, but a complete ban on texting in classrooms may introduce problems as well.

However, that exact study does not seem to exist. In spite of the downsides to texting, there is some research showing that texting may lead to greater literacy (Drouin, 2011), that it can have some benefits in an academic context (Brett, 2011), and that restricting texting may provoke anxiety in some students (Skierkowski & Wood, 2012). These findings suggest that our research question may be onto something new, and, perhaps more importantly, our literature search did not reveal any studies that directly examined how trying to ignore text messages may create a distraction. The next time your professor gets annoyed by in-class texting, it would be nice to be able to provide scientific evidence that banning cell phone use has consequences.

Research Spotlight

Are Cell Phones Good for Friendships?

Cell phones have revolutionized the ways we stay in touch. However, do our mobile phones affect our relationships, even when we’re not using them? Findings from two new studies suggest they do. Pairs of strangers discussed assigned topics in the presence or absence of a phone (Przybylski & Weinstein, 2013). Specifically, these “stranger-pairs” sat in a room with either a nondescript mobile phone or an old-fashioned pocket notebook placed unobtrusively on a desk to the side. The simple presence of a phone (vs. notepad) resulted in lower levels of closeness and relationship quality after their discussion. Further, when specifically asked to talk about meaningful topics, the presence of a mobile phone resulted in lower levels of trust and empathy.

Defining Key Terms: What Do You Mean By ___?

Before we can develop a study, we need to be more specific about the key parts of our research question. Specifically, we should determine what we mean by
“trying to ignore” and “distraction.” While at least one previous study looked at not using one’s cell phone (Skierkowski & Wood, 2012), that may not be the same as ignoring it. We all know the concept of ignoring something; we need to determine how psychologists define “trying to ignore something.”

One way to ignore something is to engage in selective attention, where you purposefully focus on important information while screening out or ignoring distractions (e.g., Posner, 1982). Selective attention is responsible for what psychologists call the “cocktail party effect,” or your ability to focus on one conversation in a noisy environment while ignoring everything else taking place (Bronkhorst, 2000). Selective attention requires something to focus on and some distraction to ignore. In a classroom setting, selective attention would involve your ability to pay attention to the lecture amid ongoing distractions. Receiving a text message does not really qualify as an ongoing distraction. Rather, it is an intrusion that enters your awareness when you hear the ping or feel the vibration. These experiences are short-lived, but they may trigger a cascade of thoughts about the text message. In this context, to effectively ignore the text requires thought suppression, the process of deliberately trying to stop thinking about certain thoughts (Wegner, Schneider, Carter, & White, 1987). At the beginning of the chapter, when we asked you to avoid thinking about President Obama naked, we activated a thought suppression scenario.

This conceptualization fits in with our original idea about the distraction of ignoring texts. When we try to ignore a text message, we must suppress a variety of thoughts surrounding the text. We might wonder who sent the text, whether it is about an important matter that needs a response, or whether the sender will be angry if we do not respond. Still, there is more to ignoring a text than simply not thinking about it. We have to avoid acting on it, too. Psychologists call this impulse control, a process that involves any attempt to suppress a desired but inappropriate behavior (Baumeister, Bratslavsky, Muraven, & Tice, 1998). When you receive a text in class or while driving, you need to suppress the urge to pick up the phone and read the message. So it seems from digging into the psychological literature that we can use existing conceptual definitions for “trying to ignore” that combine thought suppression and impulse control.

We also need to determine a conceptual definition for “distraction.” Obviously we are not the first to explore the topic of distraction, so again the literature can help us clarify what we mean in terms that concur with other psychologists. Distraction occurs when something captures our attention, drawing us away from the focal task or any task that should get our full attention (Parmentier, Elsley, & Ljungberg, 2010). Typically, we are trying to focus on one focal event or object (e.g., a class lecture), when another event or object (e.g., a text, phone call, etc.) grabs our attention and then requires us to divide our attention between the two.
We could get distracted either because the focal event is not sufficiently interesting, or because the distractor is especially intriguing. This explanation of distraction fits perfectly with the notion that ignoring a text may be a distraction. After all, the sound or buzz of an incoming text can pull your attention from focal tasks, like listening to a dull professor, because the distracting text is potentially more appealing.

**Weighing Our Options: Picking a Design**

Next, we need to choose our study’s design. We should let our question guide our design choice, so let’s refer back at our research question: “Can trying to ignore a text lead to distraction?” From Chapter 2, we know there are two main design types: nonexperimental designs, which focus on determining what happens, and experimental designs, which focus on determining why something happens. In our case, the research question makes a prediction about how one factor causes the other, rather than merely trying to describe what takes place. As a result, the nonexperimental research designs (interviews, observation, surveys) are not appropriate ways to answer this particular question. Instead, our question requires an experimental design.

**Benefits of Experimental Designs**

A major benefit of experimental designs is the ability to identify cause-and-effect relations between variables. That is, we can infer that one variable actually creates or enacts a change in another variable. For an experiment to establish causation, it must meet three specific criteria.

Let’s assume that you want to determine whether different body postures or poses can change levels of hormones, such as testosterone or cortisol (Carney, Cuddy, & Yap, 2010). To establish causation, you must first establish that body posture relates to hormone levels, or that there is covariation between these two variables. For covariation to exist, you must demonstrate that two variables vary or change together in a systematic way. If participants’ body poses varied, but you found no difference in hormonal levels, then you would not have covariation. If hormonal levels systematically varied with changes in participants’ body positions, then you would have covariation. For example, participants’ testosterone levels could be higher when they are standing in a dominant position and lower when standing in a submissive position. A correlational study cannot establish causation, but it can establish covariation.

As you may have realized, covariation alone cannot establish causality. Covariation tells us that two variables relate to each other, but unfortunately we do not know the direction of this relation. This is why we have the mantra that correlation does not equal causality. While it is possible that people have higher levels of testosterone after standing in a dominant position, it is also possible that having higher testosterone levels leads people to stand in a dominant position.
temporal precedence
when changes in the suspected cause (treatment) occur before changes in the effect (outcome).

extraneous variable
a factor other than the intended treatment that might change the outcome variable.

internal validity
the degree to which we can rule out other possible causal explanations for an observed relationship between the independent and dependent variables.

position. If you believe that body posturing causes a change in hormone levels, you have to establish that body posture changes occur before hormone level changes. That is, you must demonstrate temporal precedence by showing that changes in the suspected cause occur before the changes in the effect or outcome. It is easy to establish temporal precedence in an experimental design because you establish the study’s order and can be sure to manipulate your independent variable (body posturing) before you measure the dependent variable (hormone level). Without temporal precedence, you cannot determine which variable is the cause and which is the effect.

The final step to establish causality is to show that covariation between variables is only due to the independent variable and not due to an extraneous variable, which is any other factor separate from the independent variable that could account for variations in the dependent variable. To determine causality, you need to eliminate or control any extraneous variables that could serve as an alternative explanation for the observed changes in the dependent measure. The extent to which you can do this has implications for the internal validity of your experiment. Internal validity refers to the degree to which you can rule out other possible or alternate causal explanations for an association between the independent and dependent variables in your experiment. To show that body posturing causes changes in hormone levels, you must demonstrate that everything except for body posture is the same throughout your experiment.

Ensuring that our text-messaging study has good internal validity may be challenging. After all, it may be difficult to identify and subsequently control every possible extraneous variable that could also account for our results. The fact is that some things may vary in a study even when we attempt to control them, but strong experimental design and procedures can eliminate most of the problems with extraneous variables. Because we want to establish a cause-and-effect relationship, we will use an experimental design to answer our research question.

Operationally Defining the IV: Manipulating Ignoring Text Messages
As we design our text-messaging experiment to establish cause and effect, we should figure out which of our key concepts, “trying to ignore” or “distraction,” causes the other. Our research question implies that we want to see how ignoring a text message impacts our ability to avoid distraction. Therefore, trying to ignore the text is our independent variable (IV), as we want to examine if ignoring texts causes or alters something else. The result or outcome of ignoring the text is our dependent variable (DV), or, in this case, the amount of distraction. Based on this, we will eventually want to manipulate the independent variable and measure the dependent variable. Now that we have a clear conceptualization for both of our key concepts (“trying to ignore” and “distraction”) and have identified our independent and dependent variables, we are ready to operationalize each variable in our study.

When you set out to define variables in an experiment, you can operationally define either the independent or dependent variable first. As the researcher, it is
your judgment call based on what you learned from your literature search or how you think about the research question (e.g., which variable feels like the most natural place to start for you?). In our case, the research question that got us started emanates from our interest in the potential consequences of professors forcing students to ignore text messages. These consequences are a good place to begin. Based on the conceptual definition we established earlier, ignoring should involve deliberately trying to suppress thoughts about texting.

Since ignoring texts is our independent variable, we will need to devise a way of manipulating the “ignoring” part of our experiment. We have to ignore cell phones all the time. We ignore others’ cell phones when they are actively texting or when we hear others’ cell phones signaling an incoming call or new text. While these are potential distractions, trying to ignore our own phone is potentially more distracting. Whenever our cell phone makes a noise, we cannot help but wonder who is trying to contact us and why. However, we also know that there are some situations in which it is not permissible to check our cell phone, such as while driving or sitting in a classroom. In fact, we imagine that many professors are not too pleased when they see students texting during class. Some may even have stated course policies that strictly forbid cell phone usage during lectures.

The easiest way to manipulate our independent variable may be to simply mimic the types of policies professors use in their courses. That is, we can create a “forbidden phone checker” group by forcing participants to ignore their phones by strictly forbidding them to check their phones. Mimicking actual course policies with our manipulation also has the benefit of increasing our study’s mundane realism, or how closely our study parallels the real world. The trick will be to make the participants’ task in our experiment as similar to a classroom experience as possible.

Experiments are essentially about comparing groups to determine how those groups may differ. To do that in our study, we need to identify another group to which we can compare our “forbidden phone checker” group. Given that we are one of the first studies (or perhaps the first) to examine this research question, we should keep things simple. Though it may be tempting to design a study that tests a multitude of factors at once, it is often better to start with a more focused study. That way we can see if ignoring one’s phone has any effect on learning before we devote additional time and energy (our own and our participants’) to studying how other factors may relate to this research question. We will use a two-group design, or simple experiment, which is an experimental design that compares two groups or conditions and is the most basic way to establish cause and effect.

Weighing Our Options: Identifying the Best Groups for Our Study

Next we need to determine the best two groups to use for our simple experiment. We refer to these groups as the experimental and control groups.
The **experimental group** is whichever group gets the key treatment, and the **control group** is the comparison group that gets less of the treatment. When choosing groups we can start with the most obvious comparison, which is an **all-or-nothing** comparison. Think of this as a comparison where in one group a light switch is on (all) and in the other group the light switch is off (nothing). In the context of our study, we could have a high-restriction group, which is strictly forbidden to use or check their phones in any way, while the no-restriction group has free and complete use of their phones with no restrictions.

However, this all-or-nothing approach leads to several potential differences between the groups. For example, compared to those in the high-restriction group, participants in the no-restriction group have full use of their phones and may keep them in view, pick them up to check for messages, respond to text messages or e-mails, send new texts or e-mails, check Twitter, check Facebook, book a trip for spring break... you get the idea. There are lots of differences between the two groups. In fact, there are so many differences that if we were to compare groups and find that the no restriction group was more distracted, we would not know why. Was it because their phones were visible and usable, because they sent more messages, or because they received more messages? With these two groups it is impossible to know, which makes it difficult to have any confidence in a conclusion. Ultimately, the quality of the manipulations we use to create groups plays a major role in determining the quality of our study.

To create quality groups, we want to be sure we have a high degree of **experimental control**, which is the ability to keep everything between groups the same except for the one element you want to test. The element you want to test, sometimes called the treatment, is the factor you think makes a difference in the outcome variable. This approach makes intuitive sense. If you want to determine if 8 hours of sleep helps students’ alertness the next morning, you tell one group to go home and sleep 8 hours that night, while you tell the other group to sleep 5 hours. That is not so hard, and the groups certainly seem very similar, with the 3 hours of sleep as the only difference. However, assuring experimental control is harder than it seems. If you let participants sleep at home, there can be a near endless number of differences in the study that could affect alertness, besides number of hours slept. For example, the participants’ beds may be different, their pillows may be different, some may have roommates while others do not, some may sleep in a warm room while others prefer cold, not to mention that what the participants do before going to bed will vary considerably. For instance, even if everyone watches TV, what they watch may be different and may influence sleep and next-day alertness. The most common solution to these types of issues is to bring participants into a laboratory where experimenters can control many factors to help keep participants’ experiences similar.

Rather than strictly forbidding participants to use or look at their phones in any way, we could allow participants to have their phones out, facing down, and in “silent mode,” where it does not make any noise or vibration. Participants...
If these two pictures were stimuli for two different conditions, what did the experimenter control? What did the experimenter fail to control? (a: Bevan Goldswain/Getty Images; b: Fuse/Getty Images)

**Thinking Like a Scientist in Real Life**

**Determining the Quickest Way to Go**

As you commute to school or to work, you likely have several possible routes you could take to get to your destination, but most of us want to take the quickest route. After narrowing down all of the possibilities to your two favorites, you could just flip a coin. Yet, as a scientist, you know the better way to make a final choice is with scientific testing. The easiest test would be to take Route A one day, and Route B the next, while timing how long it takes each day. However, even in that simple comparison, there are lots of factors that could vary from day to day, such as the weather, the time of day, and the day of the week. In this situation, you want a fair test in which the only difference between Routes A and B is the roads you take. To test fairly, you should keep everything else as similar as possible by controlling those other factors. For example, you would want to make sure you left at exactly the same time and on the same day of the week, always drove the speed limit, and did all of this under similar weather conditions. Only once you have utilized these types of experimental controls and replicated your findings can you be confident that one route is truly faster than the other.
would still not be allowed to use their phones or pick them up to check them.
We could keep the same “no restriction” control group. Although this is better
because we have now controlled the presence of the phones across groups, the
groups are still different in a way that makes it difficult for us to draw conclu-
sions about distraction. Compare the two groups:

**Group A:** *Not allowed* to know about incoming messages; *Not allowed* to
use the phone

**Group B:** *Allowed* to know about incoming messages; *Allowed* to use the
phone

In this setup, we have two key differences between the groups: knowing about
incoming messages and being allowed to use the phone. As we said, the goal of
experimental control is to have only one element vary between groups, and that
element should be whatever the researcher considers the “key ingredient,” the
factor the researcher wants to test.

Because the differences between groups in an all-or-nothing approach are
so drastic, there are inevitably many unintended differences between groups. To
have more control in our study, we can use the *a-little-more-versus-a-little-less*
approach, in which the experimental group gets a little bit more of the treatment
(in our case, cell phone restrictions), while the control group gets a little less.
Before we set up these groups, let’s step back a minute to consider whether our
groups will vary by the “key ingredient” according to our research question. We
want to know whether trying to ignore text messages creates a distraction in the
classroom. Thus, the key factor to manipulate is the degree to which participants
have to ignore text messages on their cell phones. We will require one group to
ignore their phones by forbidding them to check their phones when they hear a
text, while the other group can check their phones to see who the text is from
and what the message says. Ultimately, we will have the following differences
between the groups:

**High-Restriction “Forbidden Phone” Group:** *No Phone Checking*

**Low-Restriction “Phone Checker” Group:** *Phone Checking Allowed*

Our groups will vary in terms of phone checking, but we must make sure
these groups are otherwise similar. We already decided that both groups of
participants should have the phones out of sight and set on silent. Students use
their phones for other potentially distracting things like e-mail, games,
phone calls, and checking Facebook or Twitter. Although these are poten-
tial distractions, they are not our central interest at this point. Yet, we can-
not ignore them either. We will keep these aspects consistent in both groups
by telling everyone these uses are not allowed and that the only notification
they should enable on their phones is the vibration for texts.

Ultimately, there should only be one key difference: phone checking
forbidden versus allowed. In looking at our groups, the experimental group
should be the one that we think will be more distracted. Our exploration of
this topic started with the premise that overly restrictive classroom cell phone
policies are actually more distracting than less restrictive policies. Based on
this, the “forbidden phone” group is more restrictive, and since we think being overly restrictive is the key factor in distraction, that makes it the experimental group, while the less restrictive “phone checker” group is our control group.

**Operationally Defining the DV: Measuring Distraction**

We think that overly restrictive cell phone policies can create distraction, but we still need to determine how we will know whether a participant becomes distracted. That is, we need to find a way to capture or measure our dependent variable. It sounds simple, but distraction is a mental process that we cannot see directly. Because the participant is the only person privy to that information, we could ask our participants to self-report their levels of distraction. There are many times when a self-report is appropriate, but this is not one of those times. Due to social desirability concerns, participants may be reluctant to admit to succumbing to distraction. It is also possible that part of experiencing distraction is that you do not realize you are distracted. Even if we could be sure that participants were completely forthcoming about their levels of distraction and accurate in their accounts, asking them to reflect on their distraction may lead them to wonder why we are asking about distraction, all of which may ultimately make them less distracted. As a result, any self-report of distraction may not accurately describe the participant’s natural distraction experience. Given the limitations of self-report for this particular dependent variable, we need to consider other alternatives. As we discussed in Chapter 4, mental processes have behavioral manifestations. Feeling sad coincides with certain facial expressions and, on occasion, crying. Similarly, feeling distracted will manifest in certain behaviors, so it is possible that a behavioral measure is more appropriate for our study.

**Weighing Our Options: Identifying Key Behaviors**

If we are going to examine behaviors that indicate distraction, we need to be relatively sure that the behavior actually indicates distraction and not some other mental process. Otherwise we run the risk of inferring too much based on the observed behavior. For example, if a participant plays with her hair, is that an indicator of distraction? It could just as easily indicate nervousness or boredom. The easiest way to avoid inferring too much is to use previous research to identify behaviors that other researchers have already used as indicators of distraction. By mirroring previous research as much as possible, we will have more confidence in our measurement.

Since our goal is to test the idea that bans on texting can be as distracting as texting, showing similar effects on measures used in texting studies would be convincing. Although previous research has not focused specifically on distraction resulting from restrictive cell phone policies, texting research has examined behaviors that texting influences. As we learned from our literature review, texting can influence driving ability (Benedetto et al., 2012), memory of a video (Rosen et al., 2011), and memory for a word list (Smith et al., 2011). Of these, the studies on memory are most similar to the type of distraction students might experience in class.
Memory tests are similar to learning in a classroom, but we may be able to improve on them. We could, for example, measure distraction by observing students’ natural reactions in class. However, it would also be hard to know exactly what we observe. For example, some people may stare or “zone out” when distracted. Others may do the exact same thing when they are thinking deeply about a difficult problem. Our measure of distraction should be more direct.

Given that other research used tests to measure distraction, we could use students’ quiz or test performance as our measure, under the assumption that greater distraction will lead to poorer performance.

**Research Spotlight**  
**Driven to Distraction**

Driving is full of distractions. There are pedestrians, other drivers, the radio, and making sure we finish our drive-thru fries before they get cold. Then there are cell phones. Nearly every American driver owns one and can be distracted from the roadway. While some states have yet to pass any laws about cell phone use, others have restricted cell phone use to situations that are “hands free.” These laws imply that the danger of cell phone use while driving is more about not having your hands on the wheel and less about the distraction of talking. Does hands-free cell phone use eliminate the danger of using your phone while driving? To find out, researchers had 30 participants use a driving simulator (Benedetto, Calvi, & D’Amico, 2012). During the simulated driving experience participants used a cell phone while encountering a critical stopping decision. Participants repeated each road scenario four times without calls and while answering a call in one of the following ways: hands-free voice activated device, hands-free cell phone, or handheld cell phone. It turns out that using a cell phone of any kind slowed drivers’ reaction times and decreased driving performance equally across all cell phone modes. States that encourage the use of hands-free phones may not be making their roads any safer than those without cell phone restrictions.

**Focus on Ethics: Should We Really Do That?**

There are both practical problems and ethical issues to consider with this proposed measure of distraction. One practical problem is that our presence in the classroom to do the observation may itself be a distraction. Also, if our study undermines students’ learning or their actual quiz or test performance in the class, there are ethical implications. If we have reason to suspect that cell phone use can hurt test performance, we should not expose our participants to a potentially harmful situation. Through our literature search, we learned that cell phone use while studying can undermine performance (e.g., Rosen et al., 2011; Smith et al., 2011). If we conduct our study in a real classroom setting, poor test performance could hurt students’ overall course grade, which could then hurt
their GPA, which could then influence their acceptance into a desired graduate school, and so on. This may sound extreme, but when doing research in a real-life setting, we need to consider the ethical implications of our design decisions.

Even if we are able to effectively resolve these ethical issues, there are too many factors in a natural classroom environment that are out of our control. These include things like the day’s lecture topic, who is sitting next to the student, where the student sits, other students’ behaviors that day, and so on. Any of these could lead to more or less distraction in a way that would make it hard to tell what type of influence a cell phone policy would have. Since these are not part of our intended manipulation, we want to control for them by keeping them constant across our two groups. To do that, we will want to measure distraction in a way that parallels how it occurs in a classroom setting, increasing our study’s mundane realism. We will also want to conduct our study in a laboratory setting where we can minimize outside influences. Thus, to assess participants’ distraction, we can measure test performance on material presented via a video lecture and a reading in a controlled situation. This addresses the ethical issues we identified, closely parallels a classroom setting, and borrows methods from previous research.

If our dependent variable is test performance, we want to be sure that we have a good way to measure it. Our test should be long enough that we get a variety of scores. That is, if we only have 5 questions, the top and bottom scores will only differ by 5 points, but if we have 40 questions (20 for the video and 20 for the reading), scores will be more spread out. This is important because it makes our measure more sensitive, which means we will be more likely to see potential differences between the two groups. We can also help ensure variation in our scores by making our questions moderately difficult. For example, if the questions are too easy, we may have a problem with a ceiling effect, in which most participants get high scores regardless of whether or not the phones were distracting. Finally, we need to determine the quiz format. Should we use multiple-choice or short-answer questions? Short-answer questions may provide more information, but the major advantage to multiple-choice questions is that they are more objective (i.e., it is easier to identify correct and incorrect answers), and participants will have had previous experience with multiple-choice questions. To keep our testing situation controlled, we will have participants record their answers on a Scantron bubble sheet. To make sure we have a high-quality test, we will be sure to pilot test the questions ahead of time.

Our Hypothesis

Our original research question has led us to think through a variety of issues to identify the best way to test our idea that overly restrictive cell phone use policies may be a distraction. While others may choose to tackle this question in a different way (which is the beauty of science), we have settled on a simple experiment where we will manipulate our independent variable of cell phone use policy. We will have two groups, as detailed in Table 8.1. The experimental group will have a high level of restriction. Participants in this “forbidden phone” group cannot use their phones in any way. The control group or “phone checkers” will have restrictions, but will be able to check their phones. To compare how distracting these two policies are, we will measure our dependent variable of distraction by examining test performance.
TABLE 8.1

<table>
<thead>
<tr>
<th>Cell Phone Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Restriction</td>
</tr>
<tr>
<td>Low Restriction</td>
</tr>
</tbody>
</table>

Based on these, we can formally state our experimental hypothesis, where we make a clear and specific prediction of how the independent variable will influence the dependent variable. We could test the following hypothesis:

*Those in the highly restricted cell phone use group will have different performance on the test than those in the group who are allowed to check their phones.*

With this prediction, we are making a nondirectional hypothesis that we expect the groups to be different, but without saying how they will differ. We make this type of prediction when we think that restricted cell phone use causes a difference on the test compared to the results of the nonrestricted group, but are unsure if the restriction will improve or hurt test performance.

Based on what we already know about impulse control and thought suppression, we have a theoretical reason to believe that restricting cell phone use will be more distracting than allowing the checking of phones. Therefore, we do not just want to predict a difference between our groups; we want to predict the direction of that difference. Specifically, we will test the following hypothesis:

*Those in the highly restricted cell phone use group will have worse test performance than those in the group who are allowed to check their phones.*

You will notice that we predicted a specific outcome by stating which of the two groups would perform worse. This is called a directional hypothesis because we specified which group would have higher (or lower) scores on the dependent variable.

Before we move on, let’s be sure we are clear on the experimental hypothesis, because it is a bit counterintuitive. One group is not allowed to check their phones, while the other group is. Common sense would suggest that the phone checkers would be more distracted. However, science suggests trying to suppress or ignore thoughts (in this case, thoughts about whether you are missing messages on your phone) is distracting. Thus, our experimental hypothesis predicts that being forced to not think about a cell phone will leave participants more distracted than if they were allowed to check it. This, in turn, will impede learning as measured by performance on the test.

**YOUR TURN 8.1**

1. Professor Dunphy does a study where two groups watch a 50-minute audio recording of a lecture. The first group listens to a lecture on art history and the second group listens to a lecture on Greek philosophy. After the lecture, each group completes a questionnaire that measures intellectual curiosity. In this study the independent variable is _____, while the dependent variable is _____.

---

**experimental hypothesis** a clear and specific prediction of how the independent variable will influence the dependent variable.
Design in Action

We know what we want to have in our study in terms of the manipulation and measures. We even have some of the basics in place for establishing experimental control and using appropriate measurements. Next, we need to turn our attention from the “what” of our study to the “how,” as in, “Just how are we going to carry out the study in a way that meets our goals?” The first decision we have to make is where to get our participants.

Weighing Our Options: Obtaining Participants

Generally speaking, it is best to use a random sample of the overall population as the participants in an experiment. In our case, that would mean the use of random selection on the entire population of college students who have cell
What Do You Think?

Is sampling only college students and not sampling other parts of the population such as older people who are not in college a problem? Why or why not?

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phones. In practice, obtaining a sample of that entire population is nearly impossible, not to mention prohibitively expensive. Instead, and especially for an initial study on this topic, a convenience sample of students at our own school makes the most sense. Convenience sampling has the benefit of being easier to carry out, and since students may need to participate in research as part of their classes, the sample is not expensive to obtain.

As with many things in research, there are trade-offs. On the positive side, our sample will be convenient and cheap, but a negative aspect is that we may lose some ability to generalize to other populations. That is, it may be that students at our school will react differently in the study than students at another school or students in another part of the country would. Although this is a possibility, any single study cannot adequately address every possible concern. We need to always remember that no study is 100% perfect. Your job as the researcher is to know enough about the relevant issues to make the choice that will best answer your research question. In our case, we need to first figure out whether restrictive cell phone policies actually create distraction. If we establish that it happens, then we can conduct follow-up studies to see if we can replicate our result in other groups of students.

We next need to determine how we will obtain our convenience sample. Importantly, we do not want just any student. Instead, we only want students who regularly use cell phones. While that may seem like everyone, we want to obtain the best sample possible, so we should be sure to screen out those who may not have a cell phone. Thus, when we recruit participants, we will tell them, “We are conducting a study of cell phone habits,” and then we can ask them to text us to set up an appointment. This way we can be reasonably sure they are highly familiar with texting. Also, by telling participants that the study is about cell phone habits, we can ask them to bring their phones to the study without arousing suspicion.

Weighing Our Options: Placing Participants in Groups

We want to make sure we have enough participants to reasonably determine whether or not the cell phone restrictions make a difference given all the other random factors that may also be influencing their ability to concentrate. Based on our previous planning, we know that we will have two groups (the “forbidden phone” group and the “phone checkers” group), and we should aim to have about 50 participants in each group. Collecting data from 100 participants will definitely take a lot of time.

The Importance of Independent Groups

One way to speed up data collection is by running several participants at a time. Our room holds up to eight people, so we can sign up that many participants for each of the study’s time slots. Once the eight participants arrive, we can tell them all which group they are in, making sure that we have equal numbers in each group. This approach has a downside. It is possible that participants will stop acting like eight individuals and start behaving as a single group. In research terms, this can compromise our study’s independence, which is the assumption that each participant represents a unique and individual data point. As we know
There is a danger in allowing the individuals in your study to think of themselves as a group. In doing so, individual participants may not represent their unique thoughts or behaviors. (The Catcher Photography/Getty Images)

from social psychology and the minimal groups paradigm (Struch & Schwartz, 1989; Tajfel, 1970), as soon as people know they are part of a particular group, they favor that group. As a result, in our study, participants in Group 1 will like their fellow Group 1 members more than they like those in Group 2. This seems innocent, but rather than being an individual autonomous person, the participant has become part of a group. The problem is that the group member participant may take cues from other group members in ways that make each individual participant act less naturally. For example, the behavior of others in the room may have more influence than experimental manipulation over whether or not participants look at their cell phones. In addition, those in experimental conditions may start complaining to each other about being forbidden to use their cell phones. Thus, it is important to minimize interactions between the participants. The simplest way to solve this problem is to run one participant at a time. Although this will take up more of your time as a researcher, it helps minimize the possibility that interactions between participants will undermine your study.

**Problems with Nonrandom Assignment**

Even when collecting data from one participant at a time, we need to be careful about how we assign each participant to the experimental or control group. We could put participants in either group simply by letting them decide whether they prefer the high-restriction or low-restriction group. However, doing this creates two important problems. First, in order to choose, participants will need to know what both groups do in the study, which increases the chances that participants will try to guess the hypothesis and that they will guess accurately. Second, participants who pick the high-restriction group may do so because they naturally care less about monitoring their cell phones. Thus, if we found
that high restriction led to less distraction, it would be impossible to know if the finding was due to the restrictive policy or if it was due to the high-restriction group having more participants who cared less about monitoring their cell phones.

Okay, so letting participants choose is out. Perhaps it would be better if you, as the researcher, placed participants in groups. As the person who knows the study best, you seem like a natural choice. However, although you may believe you are assigning groups in a fair and ethical manner, there is always the chance that you may unknowingly bias your assignments. For example, what if you unknowingly tend to put participants with iPhones in the low-restriction group? That may not seem like a big deal, but then again it is possible that iPhone users are more addicted to their phones. If this were the case, you could find differences between your two groups that had nothing to do with your restriction manipulation.

The Importance of Random Assignment

To avoid these problems, we need to eliminate human choice and potential bias from the group assignment process. We can do that by using random assignment, which is any method of placing participants in groups that is nonsystematic and nonbiased, and that ensures each participant has an equal chance of being in any group. We could determine random assignment with a simple flip of a coin. When the coin is heads, we could assign that participant to our “forbidden phone” group. When it is tails, we could assign the participant to the “phone checkers” group. We could roll a die and designate odd rolls as one group and even rolls as the other. Or, we could place the name of each group into a hat and draw one out each time we have a new participant in our study. Better yet, we could use an online resource to help us out. There are websites such as http://www.randomizer.org that generate random numbers we could use to assign participants to groups.

Now you may be thinking, “What if there are some participants who are complete texting addicts, while there are others who just got their first phone?” As the researcher, you would obviously want to make sure all of the texting addicts are not in one group with all of the novices in the other, which theoretically could happen through random assignment. In cases where you can easily identify important differences like this, you can use a matched-pair design in which you create a set of two participants who are highly similar on a key trait and then randomly assign individuals in the pair to different groups.

What Do You Think?

What important traits would you match participants on given our research question?

The list of potential influences in any study is practically endless. For example, in our study, participants’ age, sex, ethnicity, socioeconomic
status, past experience with a cell phone, cell phone plan, number of friends, and so on might influence how our restriction manipulation affects participants. It is also possible that what happened earlier that day, current mood, typical attention span, tiredness, general disinterest, and so on can influence the participant’s distraction level. Thankfully, random assignment’s major benefit is that it accounts for all of these potential influences, plus all of the ones we did not think of. Notice that we say “accounts for” and not “eliminates.” There will always be factors that are unaccounted for that may have an influence, so the best we can do in an experiment is to have those factors influence both groups similarly. Provided you have enough participants (which is why we want 100 participants in our study rather than 10), random assignment will even out any variable’s influence. That is, because participants have an equal chance of being in any group, one group should not end up with a disproportionate number of tired, old, poor, disinterested, or text-obsessed participants.

So we will randomly assign our participants to either the “forbidden phone” group or the “phone checkers” group. Because we want to know how these two groups compare on test performance, we will use a between-subjects design, where we expose our participants to only one of the two groups. This means we will also only assess the dependent variable of test performance once for each participant.

Developing a Protocol

Now that we know how we are going to find participants and assign them to either the experimental or control group, we can start to make decisions about our procedure. As we do, we will want to maintain experimental control by keeping the procedure identical for everyone. We know that using a protocol will help us accomplish that goal. We decided earlier that having participants come to a laboratory would be better than an actual classroom setting, so we will plan on collecting data in a small classroom on campus.

When participants arrive for the study, we will first ask the individuals to read an informed consent form. Our informed consent will tell participants enough that they can make an informed decision about whether they want to be in our study, without revealing too many details that could cause participants to act unnaturally. In our case, we will let participants know, “We are conducting a study of cell phone habits that will require participants to watch a video, read a short passage, and complete a brief quiz.”

Following informed consent, we will direct each participant to sit at a desk in the middle of the room. Once the participant takes a seat, we will explain that his or her task is to watch a 30-minute video lecture on the nature of clouds. The participant will then read a textbook chapter section that is not too long or boring on the same topic. Clouds are a good topic because they should interest participants, but are also a topic that they should not know extremely well. Prior to putting on the video, we will ask the participant to switch his or her cell phone to vibrate and place it out of sight in a metal basket under the desk. This might seem like a silly thing to add to the protocol, but cell phones can vary in terms of their vibration intensity, which makes some easier to hear than others. A metal basket will ensure that the vibration is consistently audible. Never underestimate the importance of these types of details when designing a study!
Everything up to this point has been the same for all of our participants. Now we need to manipulate our independent variable. At this point we need to give participants slightly different instructions so participants know the “cell phone policy” they are to follow (i.e., allowed to check their phones vs. not allowed to look at them). Remember, we want to keep our instructions as similar as possible. As a result, everyone will hear the same first part of the instructions:

Please adjust your cell phone setting so that all sound effects are off. In case you get any texts, please leave your phone on vibrate for texts only. Once you have the settings adjusted, please place your cell phone out of sight in the basket below your desk. You should not, under any circumstances, use your cell phone to make a call, check e-mail, play games, or send any text messages.

These instructions help make sure participants all set up their phones the same way, and make sure that they all know not to actually use their phones. The second part of the instructions will vary depending on which group the participant is in:

**High-Restriction “Forbidden Phone” Group:** If your phone vibrates, you must ignore it and not think about it. Do not even pick up your phone to check who the message is from or to read the message. Leave your phone in the basket.

**Low-Restriction “Phone Checker” Group:** If your phone vibrates, you can check to see who the message is from and read the message. Once you are done, return your phone to the basket.

It is the second part of the instructions that establishes the key “ingredient” or difference between the groups: *No Phone Checking versus Phone Checking Allowed.*

We want to be sure the study feels as real as possible. In other words, we want to ensure that our study has *experimental realism* such that the participants become engrossed in the manipulation and feel like it influences them. So, rather than have participants sit at a desk by themselves, perhaps we should have others sitting at desks as well. Certainly in a class environment, there are other people sitting near you, but where are we going to get the extra people? One option would be to have other participants sitting in surrounding desks. The problem with this is that we will have less control over the situation. Participants may know each other, and different combinations of participants (e.g., all males or all females) may lead to different dynamics. A better solution is to use confederates, or accomplices who are part of the study, which means they will know to treat all participants the same. When the participant comes into the room, we can have five confederates already sitting at other desks. The major advantage is that we can be sure that our confederates always sit in the same spots and act in the exact same way for every participant.

In order to have participants either ignore their phones or check them, we need to be sure the phones actually vibrate during the study session. The only way to be absolutely sure that each participant receives a text is for us to be the ones who send it. To do that, we will need to have the participant’s cell number.

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**Virtual reality experiences** attempt to get people “lost” in the experience of the virtual world. In our experiments, we should also strive to recreate the experiences we want to study. If we want to know about reactions to fear, then our participants need to be afraid. (Russell Curtis/Getty Images)
Participants signed up for the study via text message. To get our participants’ phone numbers, following informed consent, we can ask them to provide their cell phone numbers so that we can allegedly check off who showed up to the study from our list of numbers.

During the 30-minute video lecture and subsequent reading, we will want to text the participant several times. In order to keep it the same for everyone, we will text a total of eight times, spaced out in a preplanned way. We could space the texts out so that we send them every 6 minutes, but that may seem too obvious. Instead, let’s plan on sending a text at the following minute marks during the video: 2, 9, 15, 20, and 26. We will then text participants three additional times while they are doing the reading, at the 1, 3, and 4 minute marks. When we send the texts, the participant should not know it is us, which means they will not recognize the sender. Rather than let the participant receive five texts from the same unknown number, we should mix it up by sending texts from three different phone numbers. The content of our texts should also be general so that they apply to all participants (e.g., “hey how r u?”), should use typical text formatting (e.g., “u” vs. “you”) to make them more authentic, and should be the same for each person in our study.

There is one potential problem. Some participants may get real texts while watching the video or reading the selection. Because we cannot do much about this problem, we will keep researcher notes, which allow us to keep track of anything out of the ordinary that happens during the study. For example, we would note if any of the participants in the high-restriction/forbidden cell phone group looked at their cell phone in violation of our “policy.”

After watching the video, the participant will start the reading portion of the lesson. To be sure that this portion of the procedure is also controlled, we will give all participants 5 minutes to read the short reading selection. They will be told that if they finish early, they should reread the passage until the 5 minutes are up. As we walk away, we will start a timer and stop the participants after 5 minutes. Once the participants complete the reading, we will administer the knowledge test.

Following the test, we will give each participant a manipulation check, which is a measure that helps determine whether the manipulation effectively changed or varied the independent variable across groups. Because we were manipulating whether participants could check their cell phones, we need to see if the two groups differed in their perceptions of the permissiveness to check their cell phones during the study. We can simply ask them to rate on a scale of 1 to 7 how permissible it was to check their cell phones. If we find that there is no difference between the high-restriction and low-restriction groups on this question, then we cannot be certain we adequately manipulated our independent variable. This is important information to have if we find no differences between the experimental and control groups on our dependent variable. It may help us decide whether a cell phone ban is distracting or whether there was a flaw in our study because the manipulation did not work. We will also want to check to see if participants noticed the cell phones vibrating by asking them to report the number of times they detected it going off. This is important because if participants in the highly restricted group did not hear the phones, then they were not actually ignoring it as we hoped.

**researcher notes** a place to keep track of anything out of the ordinary that happens during the study.

**manipulation check** a measure that helps determine whether the manipulation effectively changed or varied the independent variable across conditions.
Next, we will ask participants to answer a few demographic questions and several additional questions related to our study’s topic. For example, we should ask questions about the participant’s typical cell phone use, texting habits, GPA, and knowledge about clouds prior to the study. In each case, these variables may help us understand potential results. Finally, we will debrief participants and thank them for participating. Because we are using a number of different materials in our study (i.e., testing Scantron sheet, demographic sheet, manipulation check), we want to be sure we place a participant number on each piece of material. That way we can easily match all the materials associated with a particular participant when it comes time to enter our data.

**YOUR TURN 8.2**

1. Murray, a server in a restaurant, wonders if writing a simple “thank you” on the check as he delivers it will increase his tips compared to not writing anything at all. What he is most worried about is the individual difference between his patrons in tipping habits, as some people naturally tip at a higher percentage than others. How can Murray reduce this concern?
   a. By having patrons report their average tipping tendencies
   b. By using random assignment
   c. By using random sampling
   d. By only using patrons that are known to be bad tippers

2. Emily wants to know if mood impacts cooperation. She has half of her participants watch a slide show that shows sad images and half watch a slide show of neutral images. Afterward, she gives each participant the opportunity to cooperate on a game with a player in another room. At the end of the study, she collects demographic information and administers a measure of mood. Which element of her study was included as a manipulation check?
   a. The sad slide show
   b. The neutral slide show
   c. The opportunity to cooperate
   d. The mood measure

3. As an animal trainer, Melaine wants to test which type of reward (crab vs. fish) will work best in training otters for her new amusement park show. She creates sets of subjects based on both age and the level of previous training before she begins the training. What technique is Melaine using?
   a. random assignment
   b. random sampling
   c. matched pairs
   d. independence
Statistics: In Search of Answers

Assuming that we have now run the study and collected data from 100 participants, we need to enter our hypothetical data into the computer for analysis. Because we conducted an experiment, it is crucial that we identify each participant’s group or condition prior to entering their test scores, manipulation checks, and demographics. In our researcher notes, we should have a list of participant numbers that includes their groups and any notes that we made regarding each participant’s experience. (See Figure 8.1 as an example of researcher notes.) Prior to entering data, we will need to have the Scantron sheets scored so that we have the participants’ test scores. Once we have all of the information, we can enter the data into a statistical computer program, as shown in Figure 8.2.

<table>
<thead>
<tr>
<th>Participant Number</th>
<th>Condition</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>low</td>
<td>participant was 5 min late, received 3 real texts</td>
</tr>
<tr>
<td>2</td>
<td>low</td>
<td>none</td>
</tr>
<tr>
<td>3</td>
<td>high</td>
<td>had trouble finding cell phone, received 2 real texts</td>
</tr>
<tr>
<td>4</td>
<td>low</td>
<td>none</td>
</tr>
<tr>
<td>5</td>
<td>high</td>
<td>asked for clarification on 2 mc questions</td>
</tr>
<tr>
<td>6</td>
<td>high</td>
<td>received 1 real text</td>
</tr>
<tr>
<td>7</td>
<td>low</td>
<td>none</td>
</tr>
</tbody>
</table>

FIGURE 8.1 Example of Researcher Notes.

FIGURE 8.2 Example of SPSS Data Spreadsheet. (Source: SPSS)
Even though participants will be in different groups, any time we enter data, each participant’s information must appear on one row. The key difference with an experiment compared to a survey is that in one column we will have a variable for the independent variable (“Condition”) with numbers identifying each group (1 = Experimental Condition, 2 = Control Condition).

With the data entered, we can focus on answering our research question, “Can trying to ignore a text message lead to distraction?” Given our design, we will want to see if our high-restriction group had test scores that are significantly lower than the low-restriction group. That is, did the participants in the high-restriction group do worse on the test as hypothesized, and was it by enough for us to be relatively certain that it did not happen by chance?

Selecting the Proper Tool

To answer our research question, we need to accomplish three tasks during our data analysis:

1. Make sure our groups were similar on variables that may provide alternate explanations.
2. Make sure our manipulation was effective.
3. Test our hypothesis.

Our first set of analyses should focus on making sure that alternate explanations (e.g., number of actual texts received, GPA, familiarity with clouds, etc.) are not responsible for any potential findings. Random assignment should have ensured that those variables were controlled for or kept similar in both groups, but as the saying goes, “trust but verify.” We can verify that our two groups are similar by using statistics. We can determine the right statistic to use by considering key features of our study. We have a between-subjects design, two levels of the independent variable, and a continuous dependent variable. Based on these qualities, we should run a t-test for independent means (also known as an independent samples t-test), which is, generally speaking, a test to see if the two groups or conditions are different. The t-test, the anatomy of which is shown in Figure 8.3, determines this by comparing each group’s mean to see if they differ from one another to a degree that could not have just happened accidentally. Remember here that statistical significance (represented by $p$) is the probabilistic indication (really just a percent likelihood) of how much confidence we have that the two groups differ. If the t-test for independent means is significant ($p < .05$), we can be fairly confident that our results represent a real difference between the groups. If the t-test for independent means fails to reach significance ($p > .05$), there is not enough evidence to suggest that the groups are different.

A t-test only indicates the likelihood of there being a difference. Regardless of whether the difference is significant, we often want to know the effect size (represented by $d$), or the magnitude of the difference between the groups. The effect size allows us to evaluate the practical significance of our findings. For example, suppose we find that forbidding cell phone checking leads to students doing significantly worse on a test. Before we start advocating large educational

\section*{t-test for independent means}

A statistical test comparing the groups’ means to see if the groups differ to a degree that could not have just happened accidentally or by chance; also known as an independent samples t-test.

\section*{effect size}

A statistical measure of the magnitude of the difference between the groups.
reforms, we should evaluate how large of an impact this policy has on test performance. If the effect is small, we might want to direct our efforts improving student learning elsewhere. If it is large, we will want to consider how to minimize such distractions in the classroom.

Second, in order to be sure our manipulation did what we intended it to do, we need to make sure participants knew the instructions. We can do this by comparing the two groups on whether they thought cell phone checking was permissible. Related to the effectiveness of our manipulation, we should also verify that participants heard the texts, because if they did not hear the texts, there would not have been any thoughts for them to suppress. Similarly, we should also verify that the high-restriction group reported more distraction, because the logic of our hypothesis depends on restriction creating more distraction. We can run another set of t-tests for independent means to see if the groups were different in how well they heard the texts and in how much they felt distracted by their cell phones.

Finally, we need to test our hypothesis that those in the highly restricted cell phone use group will have worse test performance than those in the group who can check their phones. Since we are looking for differences in a between-subjects design with two groups on a continuous dependent variable, we will again use a t-test for independent means. Also, because we have a directional hypothesis, we are predicting how our groups will differ. In experiments, we rarely predict that there will be no difference. A “no difference” hypothesis, also known as a null hypothesis, is most often the hypothesis that we are trying to statistically reject. That is, we start out with the assumption that there is no difference between groups. Our goal is to then show that there is a difference between groups, by demonstrating that the assumption of no difference is wrong or at least unlikely given our results. The null hypothesis is an important part of the logic behind the statistics we use to test or analyze our hypothesis, but it is something that researchers naturally assume, and thus do not explicitly state when writing up the results.
Writing the Results in APA style

**Results**

Means and standard deviations for the two experimental groups on key variables appear in Table 8.2 (all analyses are two-tailed).

**Alternate Explanations**

To determine if the high- and low-restriction groups differ on several variables that could potentially serve as alternate explanations when testing our hypothesis, we conducted a series of t-tests for independent means. The results of those analyses were as follows: typical cell phone use, $t(98) = 1.31, p = .19, d = .27$; texting expertise, $t(98) = 0.29, p = .78, d = .16$; number of real texts during the study, $t(98) = 0.31, p = .75, d = .06$; grade-point average (GPA), $t(98) = 0.18, p = .86, d = .04$; and previous cloud knowledge, $t(98) = 0.67, p = .50, d = .14$. These analyses suggest that our two groups were not significantly different on these variables.

**Table 8.2**

<table>
<thead>
<tr>
<th>Variable</th>
<th>High Restriction</th>
<th>Low Restriction</th>
<th>t</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Cell Phone Use</td>
<td>6.12 (0.82)</td>
<td>6.34 (0.85)</td>
<td>1.31</td>
<td>.19</td>
<td>.27</td>
</tr>
<tr>
<td>Texting Expertise</td>
<td>6.36 (0.69)</td>
<td>6.32 (0.71)</td>
<td>0.29</td>
<td>.78</td>
<td>.16</td>
</tr>
<tr>
<td>Real Texts During Study</td>
<td>1.18 (1.24)</td>
<td>1.26 (1.31)</td>
<td>0.31</td>
<td>.75</td>
<td>.06</td>
</tr>
<tr>
<td>GPA</td>
<td>3.27 (0.58)</td>
<td>3.29 (0.64)</td>
<td>0.18</td>
<td>.86</td>
<td>.04</td>
</tr>
<tr>
<td>Cloud Knowledge</td>
<td>5.04 (2.59)</td>
<td>4.68 (2.76)</td>
<td>0.67</td>
<td>.50</td>
<td>.14</td>
</tr>
<tr>
<td>Distraction</td>
<td>5.54 (1.47)</td>
<td>4.08 (1.61)</td>
<td>4.72</td>
<td>&lt;.001</td>
<td>.95</td>
</tr>
<tr>
<td>Times Heard Phone</td>
<td>7.52 (1.07)</td>
<td>7.28 (1.37)</td>
<td>0.98</td>
<td>.33</td>
<td>.20</td>
</tr>
<tr>
<td>Quiz Score</td>
<td>28.88 (7.12)</td>
<td>32.10 (6.74)</td>
<td>2.32</td>
<td>.02</td>
<td>.47</td>
</tr>
</tbody>
</table>

*Note:* $n = 100$. Higher scores indicate a greater magnitude of each variable. All analyses are two-tailed.
Manipulation Check

To determine if the high- and low-restriction groups differed on how permissible it was to check their cell phones, we conducted a t-test for independent means comparing the groups. The analysis was significant and had a moderate effect size—$t(98) = 51.19$, $p < .001$, $d = 10.34$—suggesting that the manipulation was effective.

We also wanted to see if cell phone restriction influenced participants’ self-reported distraction. To do this, we conducted a t-test for independent means comparing the high- and low-restriction groups on distraction scores. The analysis was significant and had a moderate effect size: $t(98) = 4.72$, $p < .001$, $d = .95$. This suggests that those in the high-restriction group were significantly more distracted than those in the low-restriction group. We also conducted another t-test for independent means to determine if the groups differed on how often they heard the cell phone ring. Results of that analysis, $t(98) = 0.98$, $p = .33$, $d = .20$, suggest that the groups were not significantly different.

Hypothesis 1

To determine if cell phone restriction influenced participants’ quiz scores, we conducted a t-test for independent means comparing the high- and low-restriction groups on quiz scores. The analysis was significant and had a moderate effect size: $t(98) = 2.32$, $p = .022$, $d = .47$. As hypothesized, those in the high-restriction group had significantly lower quiz scores (an average of 28.88 points out of 40 total points, or 72.20% correct) than those in the low-restriction group (an average of 32.10 points out of 40 total points, or 80.25% correct). Results also appear in Figure 8.4.
Let’s Discuss What Happened

Our experiment attempted to figure out how course policies concerning students’ cell phone use influence students. Based on the premise that trying to not think about something makes you think about it more, we hypothesized that overly restrictive cell phone policies may create more distraction and undermine student learning. To test this, we conducted a two-group experiment where we randomly assigned students to a group that was forbidden to check their phones or to a group that was allowed to check their phones. With the results of our experiment in hand, we must now interpret our findings. As we do this below, be sure to notice how we place our findings in the context of previous research and theory, and how we identify the limitations of our design and make concrete suggestions for future research.

What Did We Find?

A series of analyses testing potential alternate explanations found no significant differences between the groups on typical cell phone use, texting expertise, the number of real texts the participant received during the study, grade point average (GPA), or previous cloud knowledge. The results of our study suggest that our manipulation was effective. Participants in both groups were aware of their group’s restrictions, both groups heard the cell phone a similar number of times, and, most importantly, for the assumption underlying our hypothesis, the high-restriction group reported feeling more distracted than the low-restriction group. The test of our hypothesis revealed a significant difference, such that participants in the high-restriction group had test scores that were 8% (nearly a full letter grade) lower on average than participants in the low-restriction group.

Why These Findings?

Participants who were forbidden to check their phones performed worse on the test and reported experiencing more distraction. Though people believe they have the ability to control their thoughts, our findings are consistent with previous research on thought suppression showing that attempting to control or suppress a thought is futile (Najmi, Reese, Wilhelm, Fama, Beck, & Wegner, 2010). In the context of a restrictive cell phone policy, the participant needs to enact a negative implementation intention or plan to not act (e.g., “If I get a text, I will not check my phone”) in order to follow the restriction (Adriaanse, van Oosten, de Ridder, de Wit, & Evers, 2011). However, research on these strategies shows that planning not to act on a habit can actually strengthen the habit by increasing thoughts of the target behavior, which is consistent with Wegner’s (1994) ironic process theory. By asking our high-restriction group to plan on not checking their phones (a negative implementation intention), we likely led them to think about their phones more than they would have.

These thoughts are likely distracting because the person receiving the text wonders about the message’s content (e.g., “Is it important?” “Is there something wrong at home?”). Ironically, the text’s actual content is probably much more benign. In fact, teens tend to text others for mundane reasons...
like wanting to say hi or to chat rather than for important personal matters (Lenhart, Ling, Campbell, & Purcell, 2010). Rather than restricting cell phone checking, which conjures anxiety (Skierkowski & Wood, 2012) and thoughts the student futilely tries to suppress, having course policies that permit students to check their phones is not only something students want (Tindell, 2012), but also may be something that allows them to spend more time focusing on class material.

**What Could Be Improved?**

A major benefit of the present study was that we looked at participants’ actual behavior rather than self-report, which is important since previous research shows that self-reported cell phone use and actual cell phone use are not significantly correlated (Underwood, Rosen, More, Ehrenreich, & Gentsch, 2012).

There are a few potential limitations to our study. First, our sample focused entirely on college students, ignoring older segments of the population and those who do not attend college, which could undermine generalizability. However, given the nature of our research question (how course policies affect college students), we must have a target population of college students. Some may also question whether participants in our study really cared about the texts since they came from us. Though this limits realism to some degree, many of our participants still received “real” texts during the study, it would not have been immediately obvious that the texts were from us, and responding to texts may be such an automatic response that the sender’s identity is not a key influence (and definitely was not for those in the group who were not allowed to check their phones). We cannot rule out the possibility that the lack of realism influenced the results, but the fact that we got an effect with this limitation suggests that in real-life settings, texts may be even more distracting.

In any simple experiment, there is always room for improvement, especially in terms of measuring additional factors that contribute to the dependent variable. In our case, though we found that placing restrictions on phone checking was problematic, since we did not allow either group to respond, we cannot be sure if students who could respond to texts (i.e., an even lower level of restriction) would do better or worse on the test. The truth is that there are numerous other variables that a researcher could test or additional factors that a researcher could control. In each case, it will become useful to add additional groups to the research design, a technique we will discuss more in Chapter 9.

**What’s Next?**

Importantly, our study is silent in terms of how checking one’s phone can potentially distract others (Fried, 2008). Thus, future research could use our same paradigm, but have a confederate be the person with the phone and see how others nearby react. It is also possible that the difficulty of the lesson or course content influences the cell phone’s ability to distract a student. Research on cognitive load, the extent to which a person has working memory available, suggests that in more demanding classes where load is higher, cell phone use could make it more difficult for students to pay attention and ignore their cell phone (Lavie, 2010).
The present findings can also apply to the workplace in terms of how interruptions influence job performance. Given the present findings regarding the negative effects of trying to ignore an interruption, it may be best to allow employees to check their cell phones. In fact, research shows that interruptions hurt task performance, but that there is a learning effect that takes place such that later interruptions are less damaging (Altmann & Trafton, 2007). Research on restrictive cell phone policies in workplace settings would help establish the true cost of cell phone use on worker productivity.

**What Do You Think?**

Given the research findings, what next study would you conduct to continue our understanding of cell phone use in classrooms?

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**YOUR TURN 8.3**

1. Fernando wants to determine if a person’s mood influences belief in God. He randomly assigns participants to either a positive or negative mood group, then administers a “Belief in God” measure, along with several demographic questions. To see if there is a difference between groups, which statistic should he use?
   a. t-test for dependent means
   b. Pearson r
   c. Effect size d
   d. t-test for independent means

2. Amie reads a magazine story that says people who undergo life coaching are more successful than those who do not. As a savvy statistics and research student, Amie wants to know the study’s _____, which will tell her whether the difference is significant, and the _____, which will tell her how large the difference was between the means.
   a. t score; degrees of freedom
   b. p level; t score
   c. p level; effect size
   d. effect size; p level

3. In the discussion, we noted that several variables that could serve as potential alternate explanations did not differ between the groups. Based on this, which of the following statements is true?
   a. Participants’ GPA and cloud knowledge did not have any influence on test performance.
   b. The groups were relatively similar on these variables, meaning that we kept them relatively controlled.
   c. Random assignment was not effective.
   d. All students who were participants in our study had a high degree of texting experience.
Final Thoughts

In this chapter we moved beyond basic correlation to begin establishing how one factor *causes* another. The simple two-group experiment allowed us to establish cause and effect by randomly assigning participants to groups and by implementing high degrees of experimental control. Our research question also demonstrated the potential benefits of studying counterintuitive research questions. That is, even though course instructors adopt well-intentioned course policies, it may be foolish to blindly trust in their effectiveness. Rather, put science to use doing what it does best: testing assumptions.

Who knows—if a cell phone policy could unknowingly undermine learning, could other common course practices or policies be doing the same? Do pop quizzes help or hurt students’ scores on larger exams? If a professor requires class attendance, does that impose extrinsic motivations on students, when intrinsic motivation may serve them better? When professors give out their notes ahead of time, do students learn more or less? Does group work help students consider new perspectives, or does groupthink take over and ultimately narrow the range of ideas? You could do some research to find out. Before you set out to design a study, be sure to do a thorough literature review. You never know; it could be that others have already researched some of these questions, leaving it up to you to take the next step in broadening our understanding.
Review Questions

1. The local driving school owner, Lorraine, wants to see if her driving school students learn to drive better while listening to jazz music. To test this, she has half of her students listen to loud jazz music, while the other half listen to loud bluegrass music. Everyone learns the driving laws, parallel parking, and the meaning of road signs with music playing. Lorraine then measures the students’ performance on their driver’s license test. In this study the independent variable is ___, while the dependent variable is ___.
   a. music volume; driving test performance
   b. music volume; type of music
   c. type of music; driving test performance
   d. the driving skills in the lesson; music volume

2. As a TV producer, you are responsible for creating a reality TV show where 20 contestants from a variety of educational and experiential backgrounds and representing a variety of ages compete on physical and mental tasks like solving logic puzzles, building a pyramid, shooting a bow and arrow, completing a trivia quiz, and navigating an obstacle course. To create the two teams, you decide to put everyone’s name on a Ping-Pong ball and then draw teams like numbers in the lottery. Which of the following would present a problem to the fairness of your teams?
   a. Four of the contestants are math students from Ivy League schools.
   b. A majority of the contestants have been part of Habitat for Humanity and have building experience.
   c. Eight contestants consider themselves “trivia buffs.”
   d. None of the above.

3. Adele thinks the key to weight loss is eating expensive specialty dark chocolate bars that contain 65% cacao, pomegranate extract, and macadamia nuts. In particular, she thinks the pomegranate extract is the key ingredient. She wants to test her idea by comparing a group that eats 4 ounces of this specialty chocolate each day for a week to another group. What would be the best control group to test Adele’s belief?
   a. A group that eats 4 ounces of a white chocolate bar.
   b. A group that eats 4 ounces of dark chocolate containing 65% cacao, grape extract, and macadamia nuts.
   c. A group that eats 4 ounces of dark chocolate containing 85% cacao, raspberry extract, and peanuts.
   d. A group that eats macadamia nuts and drinks 4 ounces of pomegranate extract.

4. Eerikki works in human resources and believes that employees at his telemarketing company would be more productive if they took a 30-minute nap each day at 2:30 p.m. at their desks. To test this, he has half of the employees
take a nap, while the other half sit quietly for 30 minutes at 2:30 p.m. at their
desks. To determine productivity, Eerikki examines log sheets to measure
the number of sales each group made. In this study the experimental group
is the ___, while the control group is the ___.
a. nap group; quiet rest group
b. quiet rest group; nap group
c. time of day; number of sales
d. log sheets; number of sales

5. Chip is doing a study on gift-giving around the holidays. He finds that people
who received lots of gifts for their birthdays during childhood expect more
gifts as adults. In order for Chip to conclude a causal relation, he still needs
to establish which of the following?
a. Covariation  c. Temporal precedence
b. Correlation   d. Elimination of extraneous variables

6. Royale is a tattoo artist at The Ink Spot. He believes that getting a tattoo
makes people become more outgoing, brave, and confident. To test this,
he finds 60 people who want to get a tattoo and randomly gives half of
them a tattoo on their shoulder blade, while the other half get a temporary
tattoo in the same spot. Royale asks everyone to keep a daily diary that he
will use to determine how outgoing, brave, and confident participants have
been over the next 3 months. Once the study is underway, Royale becomes
worried that some of his participants were already outgoing and finds out
that about a dozen already had tattoos. Should Royale be concerned? Why
or why not?
a. Yes, if people were already outgoing, then a tattoo cannot have any effect
   on them.
b. Yes, having people who already have tattoos ruins the whole premise of
   the study.
c. No, random assignment should balance these types of differences out
   between groups.
d. No, a dozen people isn’t enough to worry about.

7. Pastora is a club promoter who was hired to increase profitability at The
Groove Lounge. Pastora decides to make the lights even dimmer and have
oil drums with dry ice to make the entire club foggy. She thinks these changes
will lead patrons to experience deindividuation, which will lead them to buy
more food and drinks. As people leave the club at night, Pastora asks every-
one demographic information, has them complete a deindividuation measure
and a self-esteem measure, and asks the club owner how much money was
made each night. Which element of her study was included as a manipulation
check?
a. The deindividuation measure
b. The self-esteem measure
c. The amount of money the club made
d. The number of dry ice blocks the club uses each night
8. Dr. Winston is doing a class demonstration where she has half of the class complete a series of 10 math problems, while the rest of the class completes a series of 10 analogies to determine which type of problem promotes greater alertness in her students. She randomly assigns students to groups to complete their problems quietly. Once everyone is finished, she asks everyone in Group 1 to report their current alertness level out loud. She then does the same for Group 2. Which of the following is a problem with Dr. Winston’s design?
   a. There was a problem with independence such that the groups started out being different.
   b. There was a problem with independence such that individuals knew their groups.
   c. Participants were not matched up based on math and verbal ability.
   d. Some participants may be math or vocabulary geniuses.

9. As a speech pathologist, Flavia always wants to make sure her clients get the best treatment. One day a salesperson for a neurological diagnostic company comes to Flavia’s office to share information about the effectiveness of a new diagnostic tool for stuttering to be compared with the current leading technique. The bar chart comparing the two groups looks impressive, but Flavia wants to see the statistical results. The appropriate statistic for comparing two groups is a ______. In those numbers, if Flavia wants to know how big the difference is between the two diagnostic tools, she would focus on the ______.
   a. t score; effect size
   b. Pearson r; p level
   c. p level; Pearson r
   d. t score; p level

10. Arielle hypothesizes that the more often a mother interacts with her child, the less distressed the child will be when left with a stranger. This is an example of what type of hypothesis?
   a. A nondirectional hypothesis
   b. A directional hypothesis
   c. A null hypothesis
   d. A causal hypothesis

11. Describe the benefits of using confederates in an experiment.

12. Why is using random assignment in experiments important when trying to establish causality?

13. What role does a manipulation check play when interpreting the results of an experiment?
Applying What You’ve Learned

1. Find a published empirical article that describes an experiment. Evaluate the groups in terms of experimental control. A) What did they control well? B) What could they have controlled better?

2. Go to the list of studies on http://psych.hanover.edu/research/exponent.html. Find a correlational study you find interesting and design a two-group experiment to test a similar research question.

3. This chapter’s study focused on how overly restrictive cell phone policies can undermine test performance. Design a study to test this basic idea on driving behavior. Be sure your study carefully considers potential harm to participants.

4. Find a product on http://www.asseenontv.com and create a two-group experiment to test the “As Seen on TV” product’s effectiveness.

5. Texting and technology influence our lives in many ways. Generate five new ideas for studies that have the same focus, but that do not focus on classroom settings or on restrictive cell phone policies. Pick your favorite idea and describe how you would test it with a two-group design.

6. Read the following study: Kay, A. C., Wheeler, S., Bargh, J. A., & Ross, L. (2004). Material priming: The influence of mundane physical objects on situational construal and competitive behavioral choice. *Organizational Behavior and Human Decision Processes*, 95, 83–96. doi: 10.1016/j.obhdp.2004.06.003. As you will see, in Study 1, researchers placed participants into either a business materials group or a neutral control condition, then had them complete a word completion task. A) For this study, please identify the independent variable, levels, dependent variable, and hypothesis. B) What did they control well? C) What could they have controlled better?

7. The Novice Researcher: It is important to have experimental control. Playing the role of a novice researcher, design a two-group study that has at least four problems with experimental control. At the end, identify each problem and discuss how a more experienced researcher would have handled it.
**Key Concepts**

- control group, p. 244
- covariation, p. 241
- effect size, p. 260
- experimental control, p. 244
- experimental group, p. 244
- experimental hypothesis, p. 250
- experimental realism, p. 256
- extraneous variable, p. 242
- independence, p. 252
- independent samples t-test, p. 260
- internal validity, p. 242
- manipulation check, p. 257
- matched-pair design, p. 254
- mundane realism, p. 243
- null hypothesis, p. 261
- random assignment, p. 254
- researcher notes, p. 257
- simple experiment, p. 243
- temporal precedence, p. 242
- t-test for independent means, p. 260
- two-group design, p. 243

**Answers to YOUR TURN**

**Your Turn**

8.1: 1. c; 2. d; 3. a
8.2: 1. b; 2. d; 3. c
8.3: 1. d; 2. c; 3. b

**Answers to Multiple-Choice Review Questions**

1. c; 2. d; 3. b; 4. a; 5. d; 6. c; 7. a; 8. b; 9. a; 10. b