Introduction to Psychological Science (Canadian) 2nd edition Krause Solutions Manual

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2/ READING AND EVALUATING SCIENTIFIC RESEARCH

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LECTURE GUIDE

I. MODULE 2.1: PRINCIPLS OF SCIENTIFIC RESEARCH (Text p. 30)

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Learning Objectives

- ✓ **Know** the key terminology of the scientific method module.
  - o See bold, italicized terms below.
- ✓ **Understand** the five characteristics of quality scientific research.
  - o These characteristics include:
    - (1) that measurements are objective, valid, and reliable;
    - (2) the research can be generalized;
    - (3) it uses techniques that reduce bias;
    - (4) the findings are made public; and
    - (5) the results can be replicated.
- ✓ **Understand** how biases might influence the outcome of a study.
  - o Demand characteristics affect how participants respond in research studies. They might try to guess what the study is about or paint themselves in a favourable light.
  - o Researchers can also unintentionally introduce bias.
- ✓ **Apply** the concepts of reliability and validity of examples.
  - o Students should be able to read scenarios involving research methods and determine whether there are issues with reliability or validity.
- ✓ **Analyze** whether anecdotes, authority figures, and common sense are reliably truthful sources of informaton.
  - o It is important to critically evaluate the source of information. Is one person telling his/her success story? Such anecdotal evidence is usually not generalizable. Is the claim endorsed by an authority figure or expert? It's important that it's not just opinion but also backed up by data. Common sense is also important, but good scientific research should come first.

1) The most important aspect of scientific research is that it strives for objectivity.
   i) *Objectivity* assumes that certain facts about the world can be observed and tested independently from the individual (e.g., scientist) who describes them.
   ii) However, the problem is that interpretations of events are subjective, meaning individuals' knowledge of the event is shaped by prior beliefs, expectations, experiences, as well as mood.

Five Characteristics of Quality Scientific Research

1) Quality scientific research meets the following criteria:
   i) It is based on measurements that are *objective*, *valid*, and *reliable*.
   ii) It can be *generalized*.
   iii) It uses techniques that reduce *bias*.
   iv) It is made *public*.
   v) It can be *replicated*.

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Scientific Measurement: Objectivity, Reliability, and Validity

1) The foundation of scientific methodology is the use of objective measurements.

Objective measurements (p. 31) *are the measure of an entity or behaviour that, within an allowed margin of error, is consistent across instruments and observors.*

i) For example, weight is something that can be measured objectively.
   a) Holding everything constant, a single object should weigh the same using multiple, functioning scales.

ii) The same goes for measuring behaviour in psychology.
   a) However, in psychology, the objectivity of the measure often comes from the person doing the measuring.

2) In psychology, we measure variables.

Variable (p. 31) *is the object, concept, or event being measured.*

i) All variables can be described and measured.

3) There are a number of instruments used to measure variables.
   i) Psychologists used to rely on observation and self-report to measure psychological variables.
   ii) In recent decades, contributions from neuroscience have allowed psychologists to increase the number of variables they can examine.
      a) For example, magnetic resonance imaging (MRI) allows researchers to view the brain.
      b) Researcher might also gather blood or saliva to be analyzed for enzymes, hormones, and other biological variables that relate to behaviour and mental functioning.

4) It's also important that all methods and variables used by researchers are carefully defined (Figure 2.1).
   i) This is important when conducting a study (for replications) as well as when sharing results.

Operational definitions (p. 32) *are statements that describe the procedures (or operations) and specific measure that are used to record observations.*

5) In 1998, the governor of Georgia in the U.S. spent $105,000 on classical music because they believed that providing children with classical music would make them smarter. Had they used operational definitions, they wouldn't have spent the money.
   i) For example, how did the researchers define the outcome of their study?
      a) Does classical music make you smarter, or does it improve memory?
      b) Is the effect permanent, or only while listening to classical music?
      c) Does the effect differ by type of classical music?
   ii) Across a number of studies over 700 individuals and multiple measures, the only improvement seems to be in one specific type of thinking called spatial reasoning—that is, the ability to look at objects and mentally manipulate them.
      a) However, the increase on an IQ test was only 1½ points, which is minimal given that a person's score can differ by 9 points from week to week.
      b) The effect also disappears after 10 minutes.
      c) Initially the research attributed the improvement to classical music (especially piano concerts), but later found the same effect after individuals listened to a recording of Stephen King horror novel.

6) The behavioural measures that psychologists use must also be reliable and valid.

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7) Multiple psychologists have to be able to observe individuals and record the same behaviour for it to be reliable.

Reliability (p. 32) *is when a measure provides consistent and stable answers across multiople observations and points in time.*

i) For example, a group of psychologists might observe children after they watch a violent TV program to see if they display aggressive behaviours.
   a) To have high inter-rater reliability, researchers must carefully train the judges as to the operational definitions of what counts as aggression (e.g., specific actions, how long they lasst, what isn't aggression, etc.).

ii) In this example, the instruments doing the measuring are people, but the same principles apply to mechanical instruments.
   a) Brain scanning machines, scales, etc., must also be reliable and consistent.

iii) Inter-rater reliability is also important.
   a) When more than one person measures a variable the same way, you have inter-rater reliability.
   b) Good operational definitions for variables improve inter-rater reliablity.

8) Closely related to reliability is the concept of validity, which evaluates whether a variable measures what it claims to measure.

Validity (p. 32) *is the degree to which an instrument or procedure actually measures what it claims to measure.*

i) For example, a psychologist could claim to measure intelligence based on shoe size.
   a) S/He could give a clear operational definition of how to measure shoe size
   b) His/her measure of shoe size could be reliable (a tape measure should give the same size every time).
   c) However, shoe size is not a valid measure of intelligence.
   d) A valid measure would assess things like problem solving and logical thinking.

9) Reliability and validity are essential components of scientific research.

Generalizability of Results

1) It is also important that the results of studies can be applied outside the laboratory to the real world in other contexts, with other people, etc.

Generalizability (p. 33) *refers to the degree to which one set of results can be applied to other situations, individuals, or events.*

2) Studying a large group of people is one way to increase the likelihood that the results will be generalizable.
   i) This way, psychologists can report on the average effect for the group and get a better sense of how individuals are *likely* to behave.
   ii) In the perfect world, psychologists would study an entire population of people; however, due to time, money, other costs, this is not practical or possible.
      a) Instead, researchers study a sample of a population and then generalize the findings from the sample to the entire population.

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Population (p. 33) *is the group that researchers want to generalize about.*

Sample (p. 33) *is a select group of population members.*

3) It is also important that the psychologist get a random sample of people from the population so that their sample best reflects the population.

Random sample (p. 33) *is a sampling technique in which every individual of a population has an equal chance of being included.*

i) For example, if you wanted to study the population of students at your school, it would most likely be impossible to track them all down, convince them to participate, and then actually have them participate. Therefore, you would take a random sample.
   a) If you approached students, this wouldn't be random because you're more likely to run into students who are in your major, live in your dorm, etc.
   b) Instead, you would have a computer randomly select names of students.
   c) However, obtaining a truly random sample is very difficult and so psychologists are more likely to settle for convenience samples (e.g., Intro Psych students).

Convenience samples (p. 33) *are samples of individuals who are the most readily available.*

4) Although laboratory research is convenient because researchers have complete control over the environment, it can limit generalizability because the laboratory does not always reflect the real world.
   i) For example, the effects of a cognivitve improvement CD were studied by bringing volunteers into the laboratory and measuring their ability to problem solve, might not generalize to a classroom where students are taking real tests for real grades.

Ecological validity (p. 34) *means that the results of a laboratory study can be applied to or repeated in the natural environment.*

ii) It is important not to *over-generalize*.
   a) Do not attempt to apply the results from a university convenience sample to the elderly population.
   b) Do not assume that an effect observed on adults will generalize to children.

<u>Sources of Bias in Psychological Research</u>

1) In order to have sound research, it is also important to keep bias out of the research.
   i) Various types of bias can be introduced by the researchers (*researcher bias*) doing the measuring, as well as by the people or animals being observed (*subject bias*).

Hawthorne effect (p. 34) *is a term used to describe situations in which behaviour changes as a result of being observed.*

2) In the 1920s, a study was done to examine the relationship between productivity and working conditions at Western Electric Company's Hawthorne Works.
   i) Researchers found that changing the lighting increased productivity.
   ii) They also found giving fewer but longer breaks increased productivity.
   iii) In fact, any change the researchers made results in productivity increases.

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iv) This is because after each change, the factory supervisors paid close attention to the workers.
   a) In this case, the research results were biased by the expectations of those observing, as well as by those being observed.

Working the Scientific Literacy Model: Demand Characteristics and Participant Behaviour

1) *What do we know about how bias affects research participants?*
   i) Participants often try to guess what the study is about instead of answering questions honestly and/or answer in a way that makes them look good.

   Demand characteristics (p. 35) *are inadvertent cues given off by the experimenter or the experimental context, that provide information about how participants are expected to behave.*

      a) For example, a researcher asks a volunteer to wear a heavy backpack and then asks him/her to guess how steep a ramp is.

   Social desirability/socially desirable responding (p. 35) *means that research participants respond in ways that increase the changes that they will be viewed favourably.*

      a) For example, many participants will not openly admit to being biased toward a certain social group (e.g., ethnicity, religion, sexual orientation) because that is not acceptable in our society.

2) *How can science test the effects of demand characteristics on behaviour?*
   i) Using the same backpack scenario, a study was done to examine how demand characteristics affect people's judgement.
   ii) Participants were placed into 1 of 3 groups:
      a) One group was simply asked to judge the steepness of the ramp.
      b) One group was asked to wear a 15 kg backpack and judge the steepness of the ramp.
      c) The third group was given a 15 kg backpack and told that it was full of electrical equipment to measure muscle activity in their ankles. To increase believability, they attached electrodes to the participants' ankles. Then they were asked to judge the steepness of the ramp.
   iii) All participants were taken to a room with the same ramp and aksed how steep they thought it was before and after stepping on it.
   iv) After this, participants sat at a computer and answered a survey, including questions in which they guessed the purpose of the study.
   v) Students who wore the backpack with no explanation judged the ramp to be steeper before and after stepping on it, compared to the other two groups.
      a) This same group also guessed that the study was about the effects of wearing a heavy backpack on perception of steepness. (The other two groups did not guess this.)

3) *How can we critically evaluate the issue of bias in research?*
   i) Researchers are another source of bias in research.
   ii) For example, Rosenthal and colleagues conducted a study in which they told teachers in 18 different classrooms that a certain group of children had "unusual" potential for learning (when, in reality, they were just a random selection of students).
      a) After 8 months, the children singled out as promising showed significant gains in grades and intelligence test scores (which were believed to be relatively stable).
   iii) Similar results have also been found with animal research.

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a) When research assistants were told they were handling "bright" rats, it appeared the animals learned faster than when handling "dull" rats.
b) Given that the rats were not influenced by these terms, it is likely that the assistants made subtle changes in how they observed and recorded behaviour.

4) *Why is this relevant?*
   i) Demand characteristics and other sources of bias can compromise research studies, so researchers must be vigilant to eliminate or control for such factors.

Psych @ The Hospital: The Placebo Effect

Placebo effect (p. 38) *is a measurable and experienced improvement in health or behaviour that cannot be attributable to a medication or treatment.*

1) To control for demand characteristics, researchers often have a placebo group.
   i) One group gets the real pill and another group gets a sugar pill (and no one is told who has which pill).
   ii) Those in the placebo group, who took the sugar pill, report feeling better.

2) The reason people feel better after taking a placebo is up for debate.
   i) Some argue the effect is "all in their head," whereas others believe there is an actual physiological response that leads to improvement, and still others say both are true.
   ii) Those given a placebo have shown physiological evidence of pain and nauseas relief.
   iii) For many (not all) there are changes in brain activity in regions involved in human pain when hospital patients take a pill, even if it is a placebo.
      a) This suggests that it's not just a matter of believing that a pill works, but the actual act of taking the pill that makes it contribute to improvement.

Techniques that Reduce Bias

1) The best technique to reduce subject bias is to provide anonymity and confidentiality to volunteers.
   i) *Anonymity* means that each individual's responses are recorded without any name or other personal information that could link a particular individual to specific results.
   ii) *Confidentiality* means that the results will be seen only by the researcher.

2) Also informing participants about how data will be used can help reduce their anxiety about participating.
   i) They are less likely to be concerned with their performance if they know their data is not going to be used to diagnose psychiatric problems, affect their grades, or harm them.

3) Participant bias can also be reduced by using blind procedures.

Single-blind study (p. 37) *is a study in which the participants do not know the true purpose of the study, or else do not know which type of treatment they are receiving (for example, a placebo or a drug).*

4) Researchers can also introduce bias, so an even more effective technique is a double-blind study.

Double-blind study (p. 37) *is a study in which neither the participant nor the experimenter knows the exact treatment for any individual.*

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   i) In this case, the researcher has an assistant conduct the observation or, at the very least, the researcher is not told which volunteer got which treatments.

5) Double-blind procedures are the best techniques for removing researcher and participant bias.
   i) Even the most ethical researcher might be influenced if s/he stands to make money from a test.
   ii) As we've seen, the Hawthorne Effect can also influence participants' performance.

Sharing the Results

1) One of the most important aspects of scientific research is making the results public.
   i) Sharing results is what allows researchers to test hypotheses and build theories.
   ii) It's also an important aspect of replication, which allows other researchers to confirm or reject the original researcher's observations and findings.

2) Academic journals are the primary method of sharing results in psychology.
   i) These are softbound books that contain a number of articles by different researchers on a single topic.
   ii) These books or journals are usually only found in libraries (including online libraries).

3) However, before research findings are published in academic journals, they go through a peer review process, which consists of two main tasks:
   i) First, an editor receives the manuscript from the researcher and determines whether it fits in with the topics covered by that journal.
      a) For example, an article on 17th century Italian sculpture wouldn't belong in the *Journal of Cognitive Neuroscience*.
   ii) Next, the editor sends copies of the manuscript to a select group of peer reviewers.
      a) Peers in this case means other professionals working in the same field of study.
      b) These reviewers critique the methods and results of the research and make recommendations to the editor regarding the merits of the research.
   iii) This process helps to ensure that only the best research is made public.

Peer review (p. 38) *is a process in which papers submitted for publication in scholarly journals are read and critiqued by experts in the specific field of study.*

Replication

Replication (p. 38) *is the process of repeating a study and finding a similar outcome each time.*

1) Once findings have been published, it is possible for researchers to check whether the results occurred by chance.
   i) Science is self-correcting.
   ii) However, not all results are replicated.

2) Earlier, the Mozart effect was discussed. This is the idea that listening to classical music makes you smarter. One of the first studies claiming this was conducted in 1993.
   i) Skeptical researchers tried to replicate the results without much luck.
   ii) Failure to replicate may indicate unintentional researcher bias, or sampling bias, or just fluke results.

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3) Psychology, like many other scientific fields, is experiencing what the media calls a "*replication crisis*."
   i) Results are not always replicated in subsequent investigations.
   ii) The 2015 *Science* journal published a paper aiming to replicate 100 studies in hopes that the majority of the findings would be replicated. However, only 36-47% were successfully replicated.
   iii) It is important to question, if a single replication is unsuccessful, which result do we believe: the original? Or the failed replication?
   iv) The solution involves performing the same study a number of times to see if it produces similar results.

Five Characteristics of Poor Research

1) There are a lot of scientific-sounding claims being made on TV, the Internet, etc. It is important to know how to differentiate between weak and strong evidence.

2) Poor evidence comes most often in one of five varieties: untestable hypotheses, anecdotes, a biased selection of available data, appeals to authority, and common sense.

3) The most important characteristic of science is that the hypothesis is testable and falsifiable.

   Falsifiable (p. 39) *means the process is precise enough that it could be proven false.*

   i) If a hypothesis is not falsifiable, then there is no way to prove the view is wrong, and there is always a way to change the hypothesis to fit the data.
      a) Modern psychology has few hypotheses that are not falsifiable.
      b) However, early personality work by Freud suffered from this problem; if the results did not appear as Freud's model had predicted, one could just say that other aspects of the personality were dominating at that time.
      c) More recent work on personality is falsifiable.

4) Anecdotal evidence is also not good science; for example, you might have seen a weight loss commercial with a person who lost 200 pounds. However, that is just anecdotal evidence.

   Anecdotal evidence (p. 39) *is an individual's story or testimony about an observation or event that is used to make a claim as evidence.*

   i) There is no way of knowing if this evidence is true.
      a) The result of the weight loss could have been due to a thyroid problem that was fixed, or changes in physical activity that were not part of the diet plan.

5) Biased data selection is also a problem.
   i) For example, a climate change denier could select only data that suggests that the climate is not changing (see Figure 2.2).

6) Another type of poor evidence is the appeal to authority.

   Appeal to authority (p. 40) *is the belief in an "expert's" claim, even when no supporting data or scientific evidence is present.*

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i) It is important to note that expertise in an area or topic does not mean it is evidence.
   a) The expert could be mistaken, dishonest, overpaid, or misquoted.
ii) One should also check to see if there is corresponding data to support the claim.
iii) It is also important to consider whether the expert has something to gain, or a hidden agenda.

7) Finally, poor evidence consists of an appeal to common sense.

Appeal to common sense (p. 40) *is a claim that appears to be sound, but lacks supporting scientific evidence.*

i) For example, many people once assumed that the world was the stationary centre of the universe.
   a) The idea of the Earth orbiting the sun at blinding speeds seemed like nonsense.
   b) That kind of force would fling us all into outer space!

8) There are commonly used methods to pass poor evidence:
   i) Appeals to tradition: We have always done it this way!
   ii) Appeals to novelty: It is the latest thing!

RESOURCES AVAILABLE FOR MODULE 2.1

Lecture Launchers and Discussion Topics

- The Tragedy of Dr. Semmelweis and Childbed Fever

Classroom Activities, Demonstrations, and Exercises

- Estimating the Frequencies of Our Own and Others' Behaviours

Web Resources

- Simeon's Cave of Magic and the Confirmation Bias: www.caveofmagic.com/
- Discovering Psychology Episode on Decision Making: www.learner.org/

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II. MODULE 2.2: SCIENTIFIC RESEARCH DESIGNS (Text p. 42)

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Learning Objectives

- ✓ **Know** key terminology related to research designs.
  - o See bold, italicized terms below.
- ✓ **Understand** what it means when variables are positively or negatively correlated.
  - o When two variables are positively correlated, they happen together (increase or decrease). For example, income and education are positively correlated. When two variables are negatively correlated, as one increases, the other decreases. For example, more sleep is associated with less irritability.
- ✓ **Understand** how experiments help demonstrate cause-and-effect relationships.
  - o Experiments rely on random assignment and the manipulation of an independent variable to show cause and effect. Two or more groups are randomly assigned to a group to ensure the groups are roughly equally. Then researchers manipulate an independent variable and measure the dependent variable. If one group turns out to be different, that difference is most likely due to the independent variable.
- ✓ **Apply** the terms and concepts of experimental methods to research examples.
  - o Students should be able to read research scenarios and identify which experimental methods are being used.
- ✓ **Analyze** the pros and cons of descriptive, correlational, and experimental research designs.
  - o Descriptive methods allow researchers to observe and give rich details about naturally occurring behaviours. Correlational designs build on this design by showing how those observed variables relate. However, correlation does not equal causation. Experiments are needed to determine cause-and-effect relationships. However, experiments done in laboratories may lack generalizabilty to real-world situations.

1) Psychologists always begin their research with a *research question*.
   i) For example, "How does attitude affect health?"
      a) They also make a hypothesis, or prediction, about the outcome.

2) To test the hypothesis, psychologists use a variety of methods, called research designs, to help guide investigators in:
   i) Organizing the study
   ii) Making observations
   iii) Evaluating the results

3) Because there are so many designs available, psychologists must choose the design that best fits the research question and is best suited to the subject of the research. However, all research designs have certain common characteristics:
   i) All designs include variables (from Module 2.1)
      a) Sense of humour is a variable. People have varying levels of it.
   ii) Operational definitions are needed to describe the variables and methods used.
      a) Humour might be measured using the Coping Humour Scale.
   iii) All designs result in collected data. These are the observations about the variables of interest.
      a) Data might consist of the scores on the Coping Humour Scale from each individual in the sample.

4) Table 2.1 lists the strengths and limitations of different research designs.

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Descriptive Research

1) The beginning of any new line of research must involve descriptive data.
   i) This type of data is only from observations.
   ii) There is no attempt to explain why a behaviour happened.
   iii) For example, researchers might observe a 2-year-old and count how many words are spoken or see how many hours per week a typical university student spends on homework.

2) These descriptions can be performed in different ways.
   i) ***Qualitative research (p. 43)*** *involves examining an issue without performing numerical measurements of the variables.*
   ii) ***Quantitative research (p. 43)*** *involves examining an issue or behaviour using numerical measurements and/or statistics*.
   iii) The majority of psychological studies are quantitative in nature.

3) To gather this type of data, psychologists use case studies, naturalistic observation, or surveys and questionnaires.

Case Studies

1) Case studies are useful when a researcher has very specific about an individual, such as symptoms of psychological disorders and detailed descriptions of successes or failures in treatment.

   Case study (p. 43) *is an in-depth report about the details of a specific case.*

2) This design allows researchers to gain an extensive amount of details regarding the effects of a treatment on an individual.
   i) For example, one study followed an individual for 16 weeks to examine a specific type of anxiety disorder.
   ii) Researchers documented how and when changes happened, and the effects of the treatment on the individual and the individual's life.

3) The main disadvantage of this design is that there is no guarantee that the findings can be generalized to other individuals and situations.

Working the Scientific Literacy Model: Case Studies as a Form of Scientific Research

1) *Case studies allow the clinician or researcher to present more details about an individual.*
   i) Detail comes at a price; sometimes it can become anecdotal evidence.

2) *What do we know about using case studies as a form of scientific research?*
   i) Case studies have been used for over 100 years and have described many unique neurological patients.
   ii) Case studies are also useful for describing psychological disorders and the outcomes of treatments.

3) *How can science test the usefulness of case studies?*
   i) Case studies can be used to test existing hypotheses.
      a) For example, emotions are thought to be centralized in the amygdala.
      b) A case study showing the emotional capability of someone with damage to the amygdala could support or refute this hypothesis.
   ii) Case studies can also be used to find similarities between different concepts.
      a) For example, case studies of post-traumatic stress disorder have revealed a great deal about the development of fears in all people; emotion and attention, when brought together can produce fear.

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4) *How can we critically evaluate the role of case studies in research?*
   i) Case studies can help guide understanding of existing theories.
   ii) Case studies can spawn new research.
      a) The case of Phineas Gage has led to extensive research in the role of the frontal lobes in shaping personality.

5) Why is this relevant?
   i) Case studies are not simply anecdotes; they can serve as inspiration for many future studies and test existing hypotheses.
   ii) Without case studies, our understanding of many rare issues in psychology would be limited.
   iii) It should be noted that case studies cannot be used for all research questions.
      a) For example, studies of groups of people in their nature settings cannot be studied with case studies.

Naturalistic Observation

1) Another approach is to observe people and animals in their natural settings.

   Naturalistic observation (p. 45) *is when psychologists unobtrusively observe and record behaviour as it occurs in the subject's natural environment.*

2) Naturalistic observation can happen anywhere that behaviour occurs.
   i) For example, researchers might observe chimpanzees in forests, or even human behaviours after drinking at a bar.
   ii) The key is that the researchers are making systematic observations of specific variables according to operational definitions.
      a) This is in contrast to those of us who like to people-watch.
   iii) Researchers must also be unobtrusive when they observe.
   iv) Naturalistic observation can be used for animals or humans.
      a) For example, one researcher used naturalistic observation to see how comments by sport spectators varied by gender, who they were speaking to, and by type of sports competition.

3) However, when researchers want more specific types of data, sometimes they need to develop specific questions for participants to answer.

Surveys and Questionnaires

1) Surveys and questionnaires are still a method of observation, except now the participant is making the observation regarding his/her beliefs, attitudes, opinions, etc.

   Self-reporting (p. 46) *is a method in which responses are provided directly by the people who are being studied, typically through face-to-face interviews, phone surveys, paper and pencil tests, and web-based questionnaires.*

2) The creation of object survey items is challenging.
   i) Must be unbiased.
   ii) Sometimes have to ask about questions that people don't want to discuss, such as depressive symptoms.
   iii) Researchers can sometimes determine if their survey questions are valid by comparing the results to clinical diagnoses.
   iv) Researchers also spend a great deal of time pretesting the items on a questionnaire to determine norms.

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Correlational Research

1) Psychologists almost always observe more than one behaviour or variable in descriptive research and they often want to know how these variables relate.

   Correlational research (p. 47) *involves measuring the degree of association between two or more variables.*

2) Correlational research may involve any of the descriptive methods discussed earlier, but now the data are evaluated in order to see if there are relationships between the variables.
   i) For example, do countries with higher graduation rates also tend to have higher income levels?
      a) How the variables relate or correlate can be visualized by using scatter plots (Figure 2.3).

3) Correlations have two main characteristics.
   i) They have direction (Figure 2.3).
      a) They can be positive, meaning that both variables occur together (e.g., as one increases, so too does the other) (Figure 2.3a).
      b) They can be negative, meaning that more of one variable results in less of the other (e.g., more sleep, less irritability) (Figure 2.3b).
   ii) Correlations also have *magnitude* or *strength*.
      a) This magnitude (like direction) is described in terms of a measure called the *correlation coefficient*.
      b) The correlation coefficient ranges from –1.0 to +1.0, but the closer to the absolute of 1.0, the stronger the relation.
      c) In a scatter plot, the dots are very close together when there is a strong correlation and all over the place when there is a weak correlation.

4) It is important to keep in mind that correlations only show how variables are related. A correlation does not equal causation!
   i) For example, a good sense of humour is related to positive health.
      a) Does humour cause one to have good health?
      b) Does good health lead to a good sense of humour?
      c) Or maybe a third variable causes both a good sense of humour and health.
   ii) For example, ice cream sales and homicide rates are positively correlated.
      a) Does ice cream consumption drive people to murder?
      b) Does murder lead to ice cream cravings?
      c) Most likely a third variable, such as hot summers, explains both.
   iii) We cannot establish cause with correlations because of the *third variable problem*, which refers to the possibility that a third, unmeasured variable is actually responsible for a well-established correlation between the two variables

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Myths in Mind: Beware of Illusory Correlations

1) Many common beliefs ingrained in our culture consist of perceived correlations that actually do not exist.
   i) For example, there are beliefs that crime increases when there is a full moon, opposites attract, and that gamblers can get on a "hot streak."
   ii) These are *illusory correlations*, which are relationships that really exist only in the mind, rather than in reality.
      a) Sound research studies have failed to show that full moons are related to bizarre or violent behaviour.
      b) People who are attracted to each other are usually very similar.
      c) And there is no such thing as a hot streak in competitive sports or gambling.
   iii) Stereotypes are often based on illusory correlations.

2) However, these perceptions of correlations exist because they easily come to mind.
   i) Normal events don't stand out as much, so we are less likely to take note of them, and in turn are slower to recall them vs. events or pairings that are not normal.

3) Correlations give the impression that one variable causes another.
   i) ***The Third Variable Problem (p. 48),*** *the possibility that a third, unmeasured variable is actually responsible for the well-established correlation between variables.*

Experimental Research

1) Experimental designs are the only designs that can provide strong evidence for cause-and-effect relationships.

2) Like correlational research, experiments have at least two variables. However, there are two main differences between the two designs:
   i) The random assignment of participants
   ii) The experimenter's control over the variables being studied

The Experimental Method

1) The first unique element of experiments is random assignment.

   Random assignment (p. 49) *is a technique for dividing samples into two or more groups, in which participants are equally likely to be placed in any condition of the experiment.*

   i) Similar to random samples, this gives each participant an equal chance of being place into any one of the experimental groups.
      a) This helps to ensure that the groups are roughly equal.
   ii) Allowing the participants to pick the group might lead to unequal groups.
      a) After all, there are individual reasons why we might choose to group ourselves with others.

2) When groups are not randomly assigned, all sorts of confounding variables could enter the picture.

   Confounding variables (p. 49) *are variables outside of the researcher's control that might affect or provide an alternative explanation for the results.*

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i) Confounding variables differ, depending on the variables and design of the study.
ii) However, researchers typically cannot control the moods that participants are in, or an individual's personality.

3) There are also specific types of variables used in experiments: independent and dependent variables.

Independent variable (p. 50) *is the variable that the experimenter manipulates to distinguish between the two groups.*

Dependent variable (p. 50) *is the observation or measurement that is recorded during the experiment and subsequently compared across all groups*

i) In regards to our experiment on how nature images affect stress, the visual material would be the IV and one's stress score would be the DV.
   a) The experimental group would view the nature images and the control group would view the neutral images.
   b) This is a between-subjects design, where the experimental group receives the treatment and the control group does not.
   c) If the experimental group showed a reduction is stress, we could conclude that exposure to nature images is responsible for the difference (as long as it was a well-designed experiment and confounds were accounted for).

Between-subjects design (p. 50) *is an experimental design in which we compare the performance of participants who are in different groups.*

Experimental group (p. 50) *is the group in the experiment that receives a treatment or the stimuli targeting a specific behaviour.*

Control group (p. 50) *is the group that does not receive the treatment or stimuli targeting a specific behaviour; this group, therefore, serves as a baseline to which the experimental group is compared.*

ii) Between-subjects designed can be problematic because it is hard to know if the two groups differed before the experiment, to solve this problem an experimenter can use a within-subjects design.
   a) In the example just discussed, a within-subjects design would involve showing participants all images from one condition (e.g., nature images) before being tested, and then showing the images from the other condition (e.g., neutral images) before being tested again. The order of the conditions would have to be random for each participant.

Within-subjects design (p. 50) *is an experimental design in which the same participants respond to all types of stimuli or experience all experimental conditions*

The Quasi-Experimental Method

1) Random assignment and manipulation of a variable are needed to determine cause-and-effect relationships. However, in some cases, random assignment is not possible.

Quasi-experimental research (p. 50) *is a research technique in which the two or more groups that are compared are selected based on predetermined characteristics, rather than random assignment.*

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2) For example, many studies compare men and women.
   i) We can't randomly assign people to one group or the other.
   ii) Men and women are also bound to differ in terms of genetics, gender roles, family history, and so on.
   iii) Because of this, quasi-experiments can point out relationships, but cannot determine what causes the differences between groups (like correlations can).

Converging Operations

1) Most interesting topics are studied using a variety of different designs, measures, and samples.
   i) *Converging operations* is a perspective taken when a hypothesis or theory holds up to dozens of different investigation designs methods.

RESOURCES AVAILABLE FOR MODULE 2.2

Lecture Launchers

- Case Studies of Vietnam War Experiences
- The Case of Joseph Goldberger and Pellagra
- Correlations and Causal Relationships
- Independent and Dependent Variables
- The Placebo Effect
- The Road from Hypothesis to Conclusion
- An Experimental Example
- Applied Experimental Psychology in the Real World

Classroom Activities, Demonstrations, and Exercises

- The Direction and Strength of Correlations
- Experimental Design
- Equating Groups on Multiple Variables Using Randomization
- Identifying the Parts of an Experiment
- Can Science Answer This Question?
- Observational Research in the Dining Hall
- Naturalistic Observation
- Understanding Correlations
- Correlational and Experimental Research
- Testing Random Assignment
- Small Samples
- Which Method Would You Use?
- Name That Research Method
- Using Memory to Demonstrate Methodology
- Softens Hands While You Do Dishes

Web Resources

- **Correlation Is Not Causation:** www.msnbc.msn.com/

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III. MODULE 2.3: ETHICS IN PSYCHOLOGICAL RESEARCH (Text p. 56)

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Learning Objectives

- ✓ **Know** key terminology related to research designs.
  - o See bold, italicized terms below.
- ✓ **Understand** the importance of reporting and storing data.
  - o Making data public allows other scientists, as well as the general public, to have access to the details of the research. This is important for replications, so that scientists know the characteristics of participants, methods used, and results obtained. Similarly, storage of the data is important in the event that other scientists wish to reanalyze the data or check for misconduct.
- ✓ **Understand** why animals are often used in scientific research.
  - o Scientists can administer treatments to animals that could never be applied to humans.
  - o Genetic research requires species with much shorter lifespans, so that successive generations can be observed. Scientists can also control genetic and environmental variables with animals that cannot be controlled with humans.
- ✓ **Apply** the ethical principles of scientific research to examples.
  - o Students should be able to read research scenarios and identify why they may fail to meet ethical standards.
- ✓ **Analyze** the role of using deception in psychological research.
  - o Sometimes deception must be used as a means of reducing participant bias. For example, if participants were told, "We are going to test how a recent stressor you experienced has affected your behaviour" they would probably answer how they thought they should answer. However, participants are still given a description of potential risks.

Promoting the Welfare of Research Participants

1) In order to protect the welfare of the participants, most research with human subjects involves short-term, low-risk methods, and there are ethical guidelines and procedures that must be followed.
   i) In Canada, all institutions that engage in human or animal research are required to have a Research Ethics Board (REB).

   Research Ethics Board (REB) (p. 54) *is a committee of researchers and officials at an institution that is charged with the protection of human research participants.*

   ii) The REB protects individuals in two main ways:
      a) The committee weighs the risks to the volunteers against the benefits of the research.
      b) It requires that volunteers agree to participate in the research.

Weighing the Risks and Benefits of Research

1) The majority of psychological research involves minimal exposure to physical or mental stress. Nevertheless, great care is taken to protect participants.
   i) Some studies cause stress by submerging a participant's hand in freezing water or having them exercise for short periods of time.
   ii) Some studies expose humans to the cold virus or make small cuts to the skin to study factors that affect healing.

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2) However, most measures that involve stress are those that cause cognitive and emotional stress, such as:
   i) *Mortality salience*: Humans are made aware of death.
      a) For example, by reading a passage of what happens to a decomposing body.
   ii) *Writing about upsetting or traumatic experiences*: People who have suffered a trauma (e.g., death of loved one, personal attack, etc) might be asked to write about the experience in great detail, sometimes repeatedly.

3) Another source of risk involves social situations.
   i) Some psychological research involves topics that could be damaging if made public (e.g., opinions of teachers, drug abuse, prejudices, etc).

4) The researcher, REB, and volunteer must weigh the potential risks of the study with the possible outcomes.
   i) For example, mortality salience tends to be a short-term stressor. From such studies, psychologists have learned how the loss of a loved one influences decisions about things such as donating or going to war.
   ii) Writing about upsetting experiences is also stressful, but psychologists have learned that those who write about stress tend to be healthier (emotionally and physically) in comparison to those who just write about everyday topics.

Obtaining Informed Consent

1) Nowadays, volunteers must be informed of what they a volunteering to do.

   ***Informed consent (p. 55)**: A potential volunteer must be informed (know the purpose, tasks, and risks involved in the study) and give consent (agree to participate on the information provided) without pressure.*

2) To be truly informed about the study, participants must be told at least the following details (see also Figure 2.5):
   i) The topic of the study
   ii) The nature of any stimuli (e.g., images, sounds, smells) to which they will be exposed
   iii) The nature of any tasks (e.g., tests, puzzles) they will complete
   iv) The approximate duration of the study
   v) Any potential physical, psychological, or social risks involved
   vi) The steps that the researchers have taken to minimize those risks

3) However, this comes into conflict with best designs (from Module 2.1) in which the participants are "blind" to avoid introducing participant bias.
   i) For example, if participants were told, "We are going to test how a recent stressor you experienced has affected your behaviour", they would probably answer how they thought they should answer.
   ii) In such cases, researchers use deception, or little "white lies."

   ***Deception (p. 55)** is misleading or only partially informing participants of the true topic or hypothesis under investigation.*

   iii) This is much more serious with medical research, in which participants are given a placebo instead of the actual treatment.
   iv) In both cases, participants are given enough information to weigh the risks of participating.

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4) In addition, participants must give full consent, which means they have the freedom to choose not to participate, and to not have to worry about any loss, harm, or damage.
    i) Participants must be given equal opportunities.
        a) For example, Introductory Psychology students participating for credit must be offered alternative credit opportunities if they choose not to participate in the study.
    ii) Volunteers have the right to withdraw from a study at any time without penalty.
    iii) Participants also have the right to withhold responses.
        a) For example, they do not have to answer survey questions that make them uncomfortable.

5) Researchers who wish to study people who cannot give full consent (e.g., children, those with certain mental or neurological disorders) must obtain consent from a parent or next-of-kin.

6) After participation, volunteers are fully debriefed about the study.

Debriefing (p. 56) *means that the researchers should explain the true nature of the study, and especially the nature of and reason for the deception.*

The Right to Anonymity and Confidentiality

1) A final measure of protection involves anonymity and confidentiality.
    i) *Anonymity* means the data collected during a research study cannot be connected to individual participants.
        a) This helps reduce socially desirable responding, and social risks to participants.
        b) If pure anonymity isn't possible (e.g., the researcher has to watch the participant) then confidentiality is a reasonable substitute.
    ii) Confidentiality includes at least two parts:
        a) Researchers cannot share specific data or observations that can be connected back to the participant.
        b) All records must be kept secure (e.g., locked file or password protected database).

The Welfare of Animals in Research

1) Many think of psychology as the study of human behaviour, but many psychologists study the behaviour of animals for important reasons.
    i) Scientists can administer treatments to animals that could never be applied to humans.
    ii) Genetic research requires species with much shorter lifespans so that successive generations can be observed.
    iii) Scientists can manipulate the breeding of laboratory animals to meet the needs of their experimental procedures.
        a) Selective breeding helps scientists control for individual differences based on genetic factors.

2) Ethical standards for animal research were developed at the same time that standards were put in place for human research.
    i) There are committees that oversee the ethical treatment of animals, much like REBs oversee the treatment of human participants.
    ii) These committees focus on three main areas of ethical treatment:
        a) The animals must be provided appropriate housing, feeding, and sanitation for the species.
        b) They make sure that risk and discomfort are managed in a humane way.
        c) They also make sure any harm or discomfort experienced by the animal is justified by the potential scientific value of the research

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Working the Scientific Literacy Model: Animal Models of Disease

1) Researchers accidentally discovered a compound called MPTP that produced Parkinson's-like symptoms in people.
   i) Could inject in animals to test possible treatments for the disorder
   ii) Are animal models useful? Are they ethical?

2) *What do we know about animal models of disease?*
   i) There are animal models for all sorts of different disorders related to psychology.
   ii) There are at least four methods for creating an animal model:
      a) If a disease is related to a brain region, the region can be damaged with surgery or a substance like MPTP.
      b) Neurotransmitter function can be altered to mimic a disease.
      c) The animal's environment can be altered (e.g., stress can be introduced).
      d) The genetic makeup of the animal can be manipulated.

3) *How can science test animal models of disease?*
   i) Primary goal of animal models is to simulate the characteristics of disease so that researchers can test possible treatments without harming humans.
      a) Sounds a little unethical, until you understand the alternative
      b) For many disorders, there aren't enough people for a human model to be possible.
   ii) Animal models must have three characteristics
      a) Must have the same physiological characteristics as the disease in humans
   iii) Animal models must have three characteristics:
      a) Must have the same physiological characteristics as the disease in humans
      b) Animal model and human form of the disease must affect similar areas of the brain. (To measure the extent of depressive symptoms in rats, the researcher needs to find behaviours in animals that are consistent with depression in humans, such as not seeking rewards.)
      c) The subjects of the animal models must respond to treatments like humans do. (If studying depression, then the study should alleviate depressive symptoms such as lack of motivation.)

4) *How can we critically evaluate these models?*
   i) One common criticism is that "animal brains aren't human brains."
   ii) We don't always know what brain areas are involved with different disorders, so how can we be sure we are using the right animal model?
   iii) Researchers must infer the experiences of animals because animals can't speak.
   iv) If an animal has limited cognitive abilities, some disorders that involve complex cognitive impairments cannot be studied using an animal model.
   v) However, despite these reservations, animal models are the only option in many cases, and help to greatly reduce the suffering for millions of people around the world.
   vi) By having an effective REB to make sure that the animals are treated well, animal models can be an ethical way of helping improve life for many people.

Ethical Collection, Storage, and Reporting of Data

1) Researchers continue their commitments to maintain anonymity, confidentiality, and security of the data.

2) Once data are reported in a journal or at a conference, researchers typically keep the data for 3-5 years.
   i) Keeping the data relates to the public nature of research.

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a) Sometimes other researchers will ask for the data so that they can analyze it themselves to replicate findings.

3) Scientists are also obligated to be honest with their data.
   i) Sometimes researchers are under pressure to get funding or tenure based on research results.
   ii) Cases of *scientific misconduct* sometimes arise when individuals fabricate or manipulate their data to fit their desired results.
   iii) To reduce this pressure, researchers are required to acknowledge any potential conflicts of interests, which include personal financial gain.
      a) This is often seen as a footnote in a journal article.
   iv) If research results cannot be replicated, the data that has been kept can be examined to see if it was manipulated
      a) In some cases, researchers have a financial gain from certain results. Andrew Wakefield, who claimed vaccines caused autism, not only became "famous" for this finding, but stood to gain financially from "stomach tests" that he planned to market to test for autism related toxins
      b) Fortunately, the fact that Wakefield's study could not be replicated led science to self-correct and for the person committing the misconduct to be caught and the truth to be known.
   v) Authors are required to publish any conflicts of interest in their papers, which is thought to reduce the likelihood of misconduct.

RESORURCES AVAILABLE FOR MODULE 2.3

Lecture Launchers

- Animals in Psychological Research
- An Historical Perspective on Research Ethics
- Is There Privacy in a Public Restroom?

Web Resources

- CPA Code of Ethics: http://www.cpa.ca/

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IV. MODULE 2.4: STATISTICAL PRIMER (Text p. 62)

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Learning Objectives

- ✓ **Know** key terminology related to research designs.
  - o See bold, italicized terms below.
- ✓ **Understand** how and why psychologists use significance tests.
  - o Significance tests are statistics that tell us whether differences between groups are meaningful. For example, the mean scores of two groups could be very different; however, the variability of scores within each group will determine the likelihood the means of the two groups significantly differ.
- ✓ **Apply** your knowledge to interpret the most frequently used types of graphs.
  - o Students should be able to look at a histogram and be able to answer questions regarding its shape, measures of central tendency, and frequency of scores.
- ✓ **Analyze** the choice of central tendency statistics based on the shape of the distribution.
  - o It is important to consider they type of data and the shape of the distribution. For example, the mean and median usually give us more information about the central tendency. The mode is usually used for categorical data. For example, a mode can represent a candidate with the most votes.

1) Once data has been collected, the next step is data analysis.
   i) Initially, this involves organizing numbers into ways that can be summarized and visualized to get an overall picture of trends and possible outcomes of the research.
   ii) Data analysis is also important in confirming or rejecting a hypothesis.

Descriptive Studies

1) The first step in getting an overall picture of the data is describing the data.

   Descriptive statistics (p. 63) *are a set of techniques used to organize, summarize, and interpret data.*

   i) The most commonly used descriptive statistics are: frequency, central tendency, and variability.

Frequency

1) Graphing the data is a logical first step in getting an overall picture of how the data looks.
   i) This allows researchers to see the *distribution*, or the location of where the scores cluster on a number line and to what degree they are spread out.

2) Psychologist often graph data using a type of bar graph called a histogram.
   i) This allows researchers to see the same data, but with a line called a *curve*.
   ii) Like most bar graphs, the vertical axis shows the frequency.

   Frequency (p. 63) *is the number of observations that fall within a certain category of range of scores.*

   iii) These graphs are easily interpreted; the higher the bar, the more scores that fall into the specific range (Figure 2.6).
   iv) The horizontal axis basically describes the heights of the bars.

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3) Graphing gives a visual image from which psychologists can describe the data and make general estimates.
   i) For example, it shows where scores cluster together and how spread out they are.
      a) There are mathematical equations to determine this, but this is just a first step.

4) When scores are clustered in the middle and the right side of the curve mirrors the left side, we can describe this as symmetrical curve.
   i) Many variables fall into a normal distribution.
      a) For example, the scores on most standardized tests.

Normal distribution (p. 63) *(sometimes called the bell curve) is a symmetrical distribution with values clustered around a central, mean value.*

5) Sometimes the data clusters at one end and trails off at the other. In this case, we have a skewed distribution (Figure 2.7).

Negatively skewed distribution (p. 63) *is a distribution in which the curve has an extended tail to the left of the cluster.*

Positively skewed distribution (p. 63) *is a distribution in which the curve has an extended tail to the right of the cluster.*

   i) Most of the time, skews occur because there is an upper or lower limit to the data.
      a) For example, a person cannot take less than 0 minutes to complete a test.
      b) Instead, most students might finish a quiz in 6 minutes, but a few took much longer.
      c) Conversely, most scores would cluster around 90% on an easy quiz with a couple tailing off into the lower grades.

Central Tendency

1) When we identify the portion of the graph where the scores seem to cluster together, we are estimating central tendency.
   i) This is a single number that represents an entire data set.
   ii) The measure of central tendency we use depends on the distribution of data.

Central tendency (p. 63) *is a measure of the central point of a distribution.*

2) Psychologists use one of three measures to describe the central tendency of the data: mean, median, and mode (Figure 2.8).

Mean (p. 63) *is the arithmetic average of a set of numbers.*

Median (p. 64) *is the 50th percentile—the point on the horizontal axis at which 50% of the observations are lower and 50% of all observations are higher.*

Mode (p. 64) *is the category with the most frequent observations.*

   i) However, the mean and median usually give us more information about the central tendency (where scores cluster).
   ii) The mode is usually used for categorical data.
      a) For example, a mode can represent a candidate with the most votes.

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3) In a histogram of a normal distribution, the mean, median, and mode are the same value (Figure 2.8).

4) When distributions are skewed, the median is the best measure of central tendency (Figure 2.9).
   i) This is because the mean gets pulled toward the extreme scores, or tail.
   ii) The median is a relatively stable score.

Variability

1) Measures of central tendency tell us where scores cluster. However, sometimes scores are more spread out than clustered (Figure 2.12).

   Variability (p. 65) *is the degree to which scores are dispersed in a distribution.*

2) Because data can be clustered or spread out, researchers report both the mean and variability to help give a better picture of the data.

   Standard deviation (p. 65) *is a measure of variability around the mean.*

3) Standard deviation is one commonly used measure of variability.
   i) It can be thought of as the average distance from the mean.
   ii) For example, a standard intelligence test has a standard deviation of 15 points around the mean.
      a) About 67% of all data falls within one standard deviation of the mean.
      b) 68% of people would have an intelligence score between 85 and 115.
      c) 7% of all data falls between the first and second standard deviation, so 13.5% of people have an IQ between 70 and 85, and 13.5% have an IQ between 115 and 130.
      d) 5% of data falls beyond the standard deviation; thus, only a small percentage of people have IQs over 130.

Hypothesis Testing: Evaluating the Outcome of the Study

1) After researchers have described their data, the next step is to see whether the data support their hypothesis.

   Hypothesis test (p. 66) *is a statistical method of evaluating whether differences among groups are meaningful, or could have been arrived at by chance alone.*

   i) The results of a hypothesis test will tell us if the two groups are significantly different (due to the IV) with a certain degree of probability.

2) For example, let's say we wanted to know whether text messaging reduces feelings of loneliness in first-year university students (Figure 2.12).
   i) Students who regularly text are randomly selected and put into one of two groups:
      a) Those who can text (control group).
      b) Those who cannot text (experimental group).
   ii) In this example, the IV is the two groups (texting and no texting) and the DV is the score on the loneliness measure (higher score = more loneliness)
   iii) After 3 days, the students are asked to fill out a survey measuring loneliness.

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iv) We find that those who were able to text scored 3 points below the mean of the group who could not text.
   a) Can we conclude texting decreases loneliness?
   b) We need to also know the variability in the scores.

v) The means of the two groups can differ by three points and still be very similar, or differ by three points and be very different (Figure 2.13).
   a) The groups are likely to be similar if the scores are very spread out and different if there is little variability in each group.

3) Next, researchers need to determine if the difference in scores between the two groups is significant or has *statistical significance.*

Working the Scientific Literacy Model: Statistical Significance

1) Statistical significance occurs when two scores are farther apart then you would expect by chance alone.

   Statistical significance (p. 68) *implies that the mean of the groups are farther apart than you would expect them to be by random chance alone.*

2) *What do we know about statistical significance?*
   i) Statistical significance is based on the researcher making two hypotheses:

      The null hypothesis (p. 68) *assumes that any differences between conditions are due to chance.*

      The experimental hypothesis (p. 68) *assumes that the differences are controlled by the experimenter.*

      a) The goal of research is to create differences so large that they could not be due to chance
      b) The size of the difference is measured by the p value; lower p values indicate a lower likelihood that the difference is due to chance

   ii) Specific formulas are used to calculate the p-values.

3) *What can science tell us about statistical significance?*
   i) p values must be less than 0.05 in order to be considered significant; this means there is a less than 5% chance that the results are due to chance.
      a) This standard is used in many sciences, including psychology.
      b) However, in some cases, a false positive could have dire consequences (e.g., relying on a drug to cure a deadly disease).
      c) In these cases, a p value of less than 0.01 is often used.
   ii) When a sample is small it is difficult to get a significant p value
      a) This can be problematic when studying rare diseases where there are few people in the study; in these cases other methods can be used to assess the results.

4) *Can we critically evaluate the use of statistical significance testing in research?*
   i) There are two concerns related to significance testing
      a) The problem of multiple comparisons:
         i. If there is a 5% chance of a "fluke", the more tests you perform the greater the likelihood of a "fluke" outcome.
         ii. To combat this, there are tighter p value restrictions as the number of comparisons increases.

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b) An increased study size means an increased probability of getting a significant result
   i. Sometimes we may see big medical studies showing lifestyle choices as affecting health outcomes that may actually reflect the size of the sample, not the true effect of the lifestyle choice.

ii) Power analysis is an alternative to significance testing
   a) Instead of accepting and rejecting hypotheses, the researcher can adjust how much they believe a hypothesis to be true.

5) *Why is this relevant?*
   i) Statistical significance is a powerful standard for psychologists.
   ii) Statistical significance puts all researchers "on the same page."
   iii) There are alternatives for cases where significance is not the ideal approach.

RESOURCES AVAILABLE FOR MODULE 2.4

Lecture Launchers

- Pseudopsychology and the Mozart Effect
- Oscar the Deathcat: A Case of Illusory Correlation?

Web Resources

- **Rice Virtual Lab in Statistics:** www.onlinestatbook.com/
- **VassarStats:** http://vassarstats.net/
- **Oscar the "Deathcat":** http://www.youtube.com/

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WORK THE SCIENTIFIC LITERACY MODEL

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- MYPSYCHLAB: **Video Series**
  Episode 2: Research Methods offers six 5–7 minute segments covering the most recent research, science, and applications and utilizing the most up-to-date film and animation technology. Multiple-choice and short-answer questions are provided for student assignments.

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- ASSIGNMENT: **Work the Model**
  After students read the chapter and view the video, assign the discussion topic found in the "Why is this relevant?" section as a classroom discussion or as a short-answer writing assignment through MyPsychLab.

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▼ LECTURE LAUNCHERS AND DISCUSSIONS TOPICS

- The Tragedy of Dr. Semmelweis and Childbed Fever
- Case Studies of Vietnam War Experiences
- The Case of Joseph Goldberger and Pellagra
- Correlations and Causal Relationships
- Independent and Dependent Variables
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- An Experimental Example
- Applied Experimental Psychology in the Real World
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Lecture/Discussion: The Tragedy of Dr. Semmelweis and Childbed Fever

The case of Dr. Ignac Semmelweis and childbed fever complements the debacle surrounding the technique of facilitated communication and powerfully illustrates the tragedies that ensue when scientific information is ignored or rejected. It is an extraordinary story that is as much psychological as it is medical. In 1847, Semmelweis attempted to persuade his fellow physicians that they were contaminating women during childbirth with some substance acquired from the cadavers of women who had died from this illness. When his own students washed their hands in an antiseptic, the death toll plummeted, but his fellow physicians disbelieved this clear and objective evidence. Describe the case and ask students why the medical community was so reluctant to accept Semmelweiss's findings. A brief presentation on cognitive dissonance theory may be helpful. That is, after watching women perish from this gruesome infection, the physicians' knowledge that they had caused these deaths may have been too discrepant with their self-concepts as healers to resolve the dissonance. They disparaged Semmelweis and his evidence.

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Lecture Launcher: Case Studies of Vietnam War Experiences

An excellent example of how the case study works in psychological research is the work of Lambright (2003), who studied the responses of six Vietnamese volunteers (varying in age from 24 to 68) to the disruption in their daily lives, occupations, and the cultural adjustments brought about by the war in Vietnam. She conducted the interviews individually, in different locations throughout Vietnam during June and July of 2002. The six volunteers, from whom she obtained written consent, answered seven questions. While the standard seven questions might suggest that this face-to-face interview was a highly structured one, Lambright was in fact free to follow up any interesting answers with more questions as the need arose, making the interview an unstructured one. Here are two brief excerpts from those interviews, answers to the question "What about your culture explains its resilience during sustained disruption (such as war, famine, social and political crises)?"

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(Nguyen Ban, 24) "A happy stable family takes care of each other…we all overcome together. We have a solid base to stand on… The Vietnamese are very flexible, adaptable to the situation. They are resilient; in the hard time they are unified and come together in a community to fight against the enemy…"

(Le Minh Viet, 68): Resilience, without the ability to adapt under circumstances, we wouldn't have survived the Chinese domination, the French, and all the wars over the centuries. Circumstances shape the attitudes, the emotions, and the behaviours. All of us are used to war situation and became acclimated so it minimizes trauma."

Notice that while both interviewees stress the adaptability of the Vietnamese, the younger Nguyen seems focused on how Vietnamese people might react in some future conflict—Nguyen did not live through wartime. The older Minh did experience the war, and talks more about how the past affects his culture now. This kind of detailed information is only possible in a case study style of research. Mere observation would not provide the answers to Lambright's questions.

Interview Questions:

1. What about your culture explains its resilience during sustained disruption (such as war, famine, social and political crises)?
2. What lessons have been learned as a result?
3. How have these lessons been integrated into the current society?
4. Can you share some examples of adjustment to the turmoil, examples known within your area of expertise or with which you are personally familiar?
5. Can you give examples of maladjustment known within your area of expertise or with which you are personally familiar?
6. In thinking about your answers, what do you see as being particular to the Vietnamese culture that explains your response to the above questions?
7. Is there anything else you would like to add to this interview?

Reference:

Lambright, L.L. (2003) Paper presented at International Conference, Midwest Institute for International/Intercultural Education, Cleveland, Ohio, April.

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Lecture/Discussion: The Case of Joseph Goldberger and Pellagra

The case of Joseph Goldberger and pellagra is another powerful, true-life story from the history of medicine that shows how the correlation between this disease and poverty obscured the true causal mechanism: Poor diet. Early in the twentieth century, diets deficient in niacin killed many poor Southerners. Dr. Joseph Goldberger discovered the cause of the disease, and generated controversy by demonstrating that it was not caused by germs. Because cases of pellagra were often higher among those with poor sanitation (e.g., no indoor plumbing), contamination by means of germs was the favored theory, a clear case of mistaking correlation for causation. In his attempt to discover the true cause, Goldberger experimented on himself, his colleagues, his wife, and prisoners. The case also raises important ethical questions; that is, to what extent did prisoners feel coerced into participating? It is worth mentioning that Goldberger exchanged pardons for participation in his medical research. Goldberger's ideas were not universally well received and some were reluctant to accept his findings. For example, Goldberger accurately predicted that the drop in cotton prices in 1920 would lead to increased poverty and cases of pellagra. In anticipation of this outcome, he argued for social programs to improve nutrition in the U.S. South. In response, he was accused of impeding tourism and discouraging economic investment in the region by some Southerners, memorably led by then-

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congressman Jimmy Byrnes.

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Lecture/Discussion: Correlations and Causal Relationships

There seems to be a general human tendency to attribute causality to correlated events. The layperson, like the psychologist, often imposes patterns of (apparently) lawful regularity on observed events. Given what is perceived as an "effect," we search for causes. Events are more likely to be singled out for attention and analysis when they are unusual, anomalous, and discontinuous with our prior experience. When such events are natural phenomena, they are typically relegated to the status of "cause" and then the search is directed toward their aftereffects.

One of the most persistent instances in which pseudo-correlations of behaviour consequences are reported to flow from salient natural and human events is the "baby boom" syndrome. For example, the allegation of increased births nine months after a major power blackout in New York is well known. So too, is the baby boom in Israel nine months after their war with Egypt.

Invariably, when base rate data are used to compare the assumed "increase in births," the effect vanishes. That is, when seasonal fluctuations in births are taken into account, there is no unusual effect left to relate to the nine-months-earlier unusual event. But that does not deter the correlation seekers. Three University of North Carolina sociologists attributed a 1955 drop in Southern birth rates to the Supreme Court's 1954 school desegregation decision (Rindfuss, Reed, & St. John, 1978). They theorized that uncertain prospects for the future "demoralize" prospective parents (both whites and, to a lesser extent, blacks), causing them to postpone any children they might otherwise have conceived in the three- or four-month period immediately following the decision. The subsequent recovery in the birth rate is attributed to the realization that desegregation would, in fact, proceed slowly.

And on it goes. Less than a week after Chicago's "Blizzard of '79," at least one newspaper columnist was speculating on the possibility of a baby boom in the coming autumn (Kup's column, *Chicago Sun-Times*, January 17, 1979, p. 52).

Another example of the temptation to confuse correlation with a causal connection is in the area of extramarital sexual affairs. Biracree (1984) found that for men there was an almost perfect positive correlation between annual income and the percentage of men who had been unfaithful to their wives. This relationship was not true for married women. If this finding is valid, what are the possible explanations for these relationships? Is there any strong evidence to support any of these explanations, or are they, at the moment, speculations?

References:

Biracree, T. (1984). *How you rate: Men* and *How you rate: Women*. New York: Dell.
Rindfuss, R. R., Reed, J. S., & St. John, C. A. (1978). A fertility reaction to a historical event: Southern white birthrates and the 1954 desegregation ruling. *Science, 201*, 178–180.

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Lecture/Discussion: Independent and Dependent Variables

In the cereal and fruit example, the cereal and the fruit are independent variables and the rash is the dependent variable. One useful way of thinking about and identifying independent and dependent variables is to remember that the basic hypothesis underlying any experiment is "X causes Y" (coloring a movie [X] changes the way people respond to it [Y]; a cereal [X] caused a rash [Y]; a fruit [X] caused a rash [Y]). To test such hypotheses, X is manipulated in order to determine its effect on Y. Thus, X is the independent variable and Y is the dependent variable. Advise students that, when trying to identify independent and dependent variables (as might happen in the context of an exam question), they should put the variables in the scenario into an "X causes Y" statement.

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Lecture/Discussion: The Placebo Effect

The power of suggestion is powerful indeed. Consider the example of the placebo effect. During the 1950s, surgeons routinely performed a simple operation to relieve chest pain suffered by patients with angina pectoris. An amazing number of the patients—nearly 90%—reported relief from pain. An experimental study divided angina patients into two groups and informed them that they were going to have an operation that had a very high success rate in relieving angina pain. The actual surgery was performed on only half the patients. What was done with the other half would no longer be allowed according to ethical medical standards. The surgeons took the remaining half of the patients, put them under anesthesia, made the surgical incision in their chests, and then simply sewed them up again. When the patients awakened in the recovery room, they were told that the operation had been performed (Cherry, 1981). The patients who had the sham surgery did even better than the patients who had undergone the actual operation! Their pain had been relieved simply by the power of suggestion. Remind students of the aspirin study and ask why the researcher included a placebo.

Reference:
Cherry, L. (1981, September). Power of the empty pill. *Science Digest*, 116, 60–67.

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Lecture/Discussion: The Road from Hypothesis to Conclusion

How do we know that cigarette smoking is dangerous to your health?
Cigarette smoking became common in Europe after French and British soldiers picked up the habit from Turkish soldiers in the Crimean War of 1854 to 1856. The habit was adopted by a few Americans in the next 30 or 40 years. The tobacco was strong and they rolled their own. More American males began to smoke after the automatic cigarette-making machine was perfected in North Carolina in the 1880s. Very few women smoked, at least in public, until after World War I when U.S. tobacco companies began to target women with their advertising.

People must have suspected that cigarettes are dangerous to health long before any research was done. The slang term for cigarettes, "coffin nails," was used during the first half of the century.

The conjecture became a hypothesis when doctors noticed that many people who died of lung cancer had been heavy smokers, and it was also suspected that nicotine affects the circulatory system. Early studies

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produced high negative correlations between cigarette smoking and age at death: the more people smoked, the younger they were when they died.

This correlational data resulted in the first warning labels on cigarettes in the 1960s: "Caution: The Surgeon General has determined that cigarette smoking may be hazardous to your health." Notice that the warning reads "may be hazardous," rather than "is hazardous." The conservative warning is all that is justified by correlational data. A relationship between variables does not imply that the variables are causally related. The earlier death of smokers could be for reasons other than cigarette smoking. Perhaps smokers live more stressful lives, and both the smoking and their illness are the result of stress. Also, it is possible that smokers are not as careful of their health in other ways as nonsmokers; maybe they don't exercise or have nutritious diets. Or perhaps both the smoking and the mortality have a genetic basis.

To do a definitive experiment on the effects of smoking, one would need to get a sample of 100 or so young people who have never smoked and assign them randomly to a smoking group and nonsmoking group. The smokers would smoke at least one package of cigarettes a day for life, beginning at age 16 or 18, and the nonsmokers would not smoke at all. The dependent variable is age at death, and the successors of the original researchers could not analyze the data until all the subjects died. If the nonsmokers lived significantly longer, the researchers would be justified in concluding that cigarette smoking *is* hazardous to health.

An experiment like this has not been done, and probably never will be done. In the 1970s the label on cigarette packages was changed to read, "Cigarette smoking is dangerous to your health." The evidence that prompted this change came from several sources. One source was studies that tried to match smokers and nonsmokers on various alternative causes, such as stress, and thus to control for its effects on health. Another source of evidence came from animal studies. The conclusions that cigarettes are truly "coffin nails" is based on large amounts of data and a multitude of studies.

Many studies were required to get from a hypothesis to a firm conclusion in the establishment of a causal link between smoking and disease and death. The reason is that there are humane and ethical constraints that rule out certain types of research. Because humans are the primary focus in psychology, it is often difficult for us to get answers to important questions. As just one example of this, we would like to know if child abuse has permanent effects on personality, and if so, what these effects are. But we cannot assign infants at birth to be abused or not abused, so to study this question we must try to tease out these effects from the mass of environmental variables that affect the development of human personality.

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Lecture/Discussion: An Experimental Example

Can vitamins increase IQ?

Suppose you hear about an intellectually challenged boy who did better schoolwork after being given a dose of a vitamin-mineral supplement, and you decide to conduct an experiment to see if intellectual functioning of intellectually challenged children can really be improved by such a diet supplement. You start with the hypothesis, "A vitamin- mineral supplement (independent variable) added to the diet of intellectually challenged children will improve their intellectual functioning (dependent variable)."

Your first task is to define your variables more precisely. What vitamins and minerals will you use, and at what strength? How many times a day and for how many months? You may decide to use an IQ test score

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as a numerical measure of your dependent variable; you may also decide that you will require a minimum increase in the number of points as acceptable evidence of improvement, because many chance factors can influence test scores.

You draw your subjects from a group of children who have all been tested and diagnosed as intellectually challenged, and you randomly assign them to either the experimental group, who will get the supplement, or the control group, who will be given a placebo (some inert substance) instead of the supplement.

There are several precautions you will need to take to avoid bias in your results. Besides controlling for similarity of your two groups at the start, you will want to be sure that the subjects in both groups are exposed to all the same conditions during the experiment except for the exposure to the independent variable, the nutritional supplement. Temperature, timing, instructions, conditions of testing, and other events during the time of the experiment should be as similar as possible for the two groups.

Your own desires to prove or disprove the idea that vitamins may increase school performance may be a possible source of bias. To reduce this bias, would you conduct a single-blind or double-blind experiment?

For a fixed period of time, say four months, the children in the experimental group receive the supplements in tablets at each meal. The control-group children also receive tablets, but they contain nothing of biological value (a placebo). Neither the children nor those working with them or testing them know which child is getting which kind of tablet. At the end of the four months, intelligence tests are given again to see if the groups now differ.

You may find that both groups have higher scores than originally, perhaps from all the extra attention they have been receiving or from some natural development over this period. So you use the control group's scores as a baseline and compare the experimental group's scores with that baseline.

If you find no difference, the study may end there, or you may try variations, perhaps a stronger supplement or a longer time period or subjects who are less intellectually challenged.

If you do find a difference in your original study, you will evaluate the probability that your obtained difference could have occurred by chance alone, even without the independent variable. If it is unlikely that it is a chance finding, your confidence in the hypothesis is increased.

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Lecture/Discussion: Applied Experimental Psychology in the Real World

Students often have difficulty understanding how general research results can be applied to the real world. In other words, "How does this relate to me?" The following example provides connections between basic research in sensation and perception and possible military or medical errors.

A number of devices use sound (beeps, clicks, etc.) to provide feedback regarding bodies, structures or machines. These sounds are designed to provide people with information about changes in the current situation. For example, in medicine, drops in heart rate or blood pressure are signalled with beeps. Jet pilots receive information regarding positioning in the form of sounds as well. The purpose of these devices is to provide immediate auditory feedback that signals potential problems. The auditory nature allows the surgeon or pilot to be visually focused on something else at the time.

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Unfortunately, results of recent research (Neuhoff, Kramer, and Wayand, 2002) suggest that people often misperceive how sounds change when both their pitch and loudness change. Rather than noticing the changes immediately and accurately noting the meaning of the changes, individuals may miss the changes entirely or misinterpret them. Because of this misperception, people can't accurately judge the intended meanings of the sounds. Real-world complications that could arise from this problem range from medical mistakes to serious pilot errors. For example, if a pilot does not accurately identify the sounds of the flight system that are designed to alert him/her of possible mechanical issues, the chances of mechanical failure or crashes may be increased. This result is contrary to the purposes of those feedback systems that are designed to enhance safety. It appears that the initial assumptions of inventors/creators of these systems regarding the accuracy of human interpretations of the sounds may have been incorrect.

References:
www.apa.org/news/press/releases/2002/03/auditory.aspx
Neuhoff, J. G., Kramer, G., & Wayand, J. (2002). Pitch and Loudness Interact in Auditory Displays: Can the Data Get Lost in the Map? *Journal of Experimental Psychology—Applied*, Vol. 8. No.1

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Lecture/Discussion: Animals in Psychological Research

Should animals be used in psychological research?
A controversial issue in psychology, and in many other fields of study, involves the use of animals in research. Is it ethical to subject animals to unnatural and/or painful situations in the pursuit of knowledge about the human condition? You might present students with some additional information about the use of animals in psychological research and the nature of the debate.

Psychologists who study animals are sometimes interested in comparing different species or hope to learn more about a particular species. Their work generally falls into the area of basic science, but often it produces practical benefits. For example, using behavioural principles, farmers have been able to reduce crop destruction by birds and deer without resorting to their traditional method—shooting the animals. Other psychologists are primarily interested in principles that apply to both animals and people. Because many animals have biological systems or behavioural patterns similar to those of human beings, using animals often allows more control over variables than would otherwise be possible. In some cases, practical or ethical considerations prevent the use of human beings as subjects. By studying animals, we can also clarify important theoretical issues. For example, we might not attribute the greater life expectancy of women solely to "lifestyle" factors and health practices if we find that a male-female difference exists in other mammals as well.

As the text points out, those who support the use of animals in research argue that animal studies have led to many improvements in human health and well-being. In recent years, however, animal research has provoked angry disputes over the welfare of animals and even over whether to do any animal research at all. Much of the criticism has centered on the medical and commercial use of animals, but psychologists have also come under fire. Critics of animal research have pointed to studies that produce no benefits for human beings but involve substantial harm to the animals being studied. A few years ago, for instance, a Maryland psychologist studying the nervous system was convicted of cruelty to animals after he cut the nerve fibers controlling limb sensation in 17 monkeys. The purpose of his research was to find ways to

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restore the use of crippled limbs in stroke victims. The charges alleged abusive treatment of the animals. The psychologist's conviction was eventually reversed on appeal, but by then the government had withdrawn its funding of the project.

People have staked out extreme positions on both sides of this debate. The controversy has often degenerated into vicious name-calling by extremists on both sides. Some animal rights activists have vandalized laboratories, and threatened and harassed researchers and their families; some scientists have unfairly branded all animal welfare activists as terrorists (Blum, 1994). A more positive result of the debate has been the close examination of the American Psychological Association ethical code for the humane treatment of animals and the passage of stricter federal animal welfare regulations governing thehousing and care of research animals. Most psychological organizations, however, oppose proposals to ban or greatly reduce animal research. The APA and other organizations feel that protective legislation for animals is desirable but must not jeopardize productive research that increases scientific understanding and improves human welfare.

Reference:
www.the-aps.org/publications/tphys/legacy/1983/issue5/271.pdf

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Lecture/Discussion: An Historical Perspective on Research Ethics

When discussing the ethical treatment of human research participants, several "classic" studies, which would be ethically questionable by today's standards, serve as examples. For instance, many instructors discuss Stanley Milgram's studies of obedience, Philip Zimbardo's prison simulation, or Stanley Schachter's studies of autonomic arousal and attribution. Students often have mixed reactions to these examples. Some find them relatively innocuous, whereas others have strong reactions to the treatments participants were asked to endure. The fact that such studies took place within relatively recent times compounds the issue. Some students see these 1960s experiments as "long ago and of a different time," whereas others see them as examples of the "unethical treatment psychologists still foist on people to this day."

To provide a context for these types of issues, your students might be interested in hearing about older examples of ethically questionable research. For example, Carney Landis, a noted psychologist of the 1920s and 1930s, conducted a series of studies dealing with the experience and expression of emotion. In one set of studies he was particularly interested in capturing facial expressions of emotion, and used strong elicitors of emotion to produce them. For example, one situation involved dropping a lit firecracker underneath an unsuspecting subject's chair, whereas another involved showing participants pornographic (for their day) photographs and photos of horribly disfiguring skin diseases.

Although these manipulations may seem harsh, Landis used stronger ones as well. For example, participants were instructed in one situation to plunge their hand into a pail of shallow water that, unbeknownst to them, contained 3 live frogs. (This manipulation was presumably used to evoke disgust.) To quote Landis, however..."After the subject had reacted to the frogs the experimenter said, 'Yes, but you have not felt everything yet, feel around again.' While the subject was doing so he received a strong...shock from an induction coil, attached to the pail by concealed wiring."

And for the *coup de grâce*:

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> "The table in front of the subject was covered with a cloth. A flat tray and a butcher's knife were placed on the cloth. A live white rat was given to the subject. He (sic) was instructed, 'Hold this rat with your left hand and then cut off its head with the knife.'...In five cases where the subjects could not be persuaded to follow directions the experimenter cut off the head while the subject looked on."

Mention is also made of a final experiment involving shock which "...varied from a just noticeable intensity to a strength which caused the subject to jump from the chair," as well as other studies. Landis' participants, in passing, included graduate students, a stenographer, a schoolteacher, and a 13-year-old boy with high blood pressure

Although Landis has been singled out for examination here, there certainly is no lack of experiments from the 1920s through the 1960s work mentioned above that can provide examples of ethically dubious research. Discussing such studies, especially in light of current APA standards, should produce spirited discussion among your students.

Reference:
Landis, C. (1924). Studies of emotional reactions II: General behaviour and facial expression. *Comparative Psychology*, *4*, 447-509.

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Lecture/Discussion: Is There Privacy in a Public Restroom?

In an infamous study of the correlates and consequences of invasion of personal space, Middlemist and colleagues measured latency to urinate and urination duration among men in public restrooms. In a pilot study, men designated as "subjects" were covertly observed urinating in a public restroom. Results indicated that onset of urination correlated negatively (r =.315) with the distance between the subject and another male using a nearby urinal. When only 1 urinal separated the men, mean latency of the subjects to urinate was 7.9 seconds; when 3 or more urinals separated the men, the latency was 5.7 seconds. Subsequently, an experimental study was carried out. Using a bucket and mop as props, urinals in a college restroom were blocked. Subjects were forced either to urinate at a urinal adjacent to a confederate or at a urinal separated by an "out-of-order" urinal between the two men. In a third control condition, no confederate was present. The subjects were observed and timed covertly by means of a "periscope" hidden within and monitored from a stall. Results revealed mean latencies to onset of urination of 4.9, 6.2, and 8.4 seconds within the control, moderate, and close distance groups. No subjects were ever informed that they had participated in a study. Clearly then, there was no attempt to obtain informed consent and no debriefing provided. Students may want to consider what possible harm could have resulted from such a study. Did subjects have a reasonable expectation of privacy in such a public setting? Could such a study have been done without the deception of the "secret recording"? Could such a study be carried out today? A complete version of the article may be located from the *Journal of Personality and Social Psychology*, 1976) at www.psychologytoday.com/.

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Lecture/Discussion: Pseudopsychology and the Mozart Effect

Before discussing pseudoscience, ask students about their impression of the so-called Mozart effect. Most students have heard of the general phenomenon and have seen advertisements and CDs of music "designed to increase your children's IQ." Bring in a magazine advertisement and read from it, touting the merits of the product. Ask students if they believe it, and if they would buy the product. Probe them by asking what "proof" they would need that the product actually works. Usually, students will begin to question the merits of the product, at which point you can discuss the actual psychological findings of this moneymaking gimmick by summarizing the work of Steele, Bass, and Crook (1999).

Pseudoscience quite literally means "false science." Its "claims [are] presented so that they appear scientific even though they lack the supporting evidence and plausibility" (Shermer, 1997, p. 33). Furthermore, pseudoscience appears to use scientific methods and tries to give that "science-y" impression. Some characteristics of Pseudoscience include the following:

1. Associates itself with true science
2. Relies on and accepts anecdotal evidence
3. Sidesteps disproof
   - any possible outcome is explained away
   - a theory is not a good theory if it can explain everything because it can never make specific predictions
4. Dangerously reduces complexity to simplicity (to a consumer society)

Ask students why the Mozart effect would be considered pseudoscience based on the 4 aforementioned characteristics. Have students give other examples of possible pseudoscience such as graphology, palmistry, aromatherapy, and quite arguably Eye-Movement Desensitization and Reprocessing (EMDR).

References:
Steele, K.M., & Bass, K. E., & Crook, M. D. (1999). The mystery of the Mozart effect: Failure to replicate. *Psychological Science, 10*, 366–369.
Shermer, M. (1997). *Why people believe weird things: Pseudoscience, superstition, and other confusions of our time.* New York: W. H. Freeman & Co.

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Historically, a number of superstitions have been associated with cats. (For a brief summary, see the Committee for the Scientific Investigation of Claims of the Paranormal.)

During the summer of 2007, the story of "Oscar the Deathcat" hit the Internet. The story originated in an article written for the *New England Journal of Medicine* (and also in *Slate Magazine*). It is possible that Oscar can predict the deaths of the elderly and infirm, but extraordinary claims such as this require extraordinary evidence. Students should consider one additional causal mechanism: That Oscar the Deathcat is another superstitious belief due to an illusory correlation. The issue of Oscar may be addressed with reference to the "Great Fourfold Table of Life" presented in the text. Note that although the article on Oscar was published in the *NEJM*, it was NOT a peer-reviewed article! Students may want to consider the degree to which the *Journal*'s prestige and the author's professional status conferred credibility to the story of Oscar. The original *NEJM* and *Slate* articles links are listed here; a link to a video presentation on Oscar is listed in the Media Resources section.

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References:
New England Journal of Medicine:
http://content.nejm.org/cgi/content/full/357/4/328?ijkey=PVKerq1VfkJKc&keytype=ref&siteid=nejm

Slate Magazine: www.slate.com/id/2171469/

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▼ CLASSROOM ACTIVITIES, DEMONSTRATIONS, AND EXERCISES

- Estimating the Frequencies of Our Own and Others' Behaviours
- Experimental Design
- Equating Groups on Multiple Variables Using Randomization
- Identifying the Parts of an Experiment
- Can Science Answer This Question?
- Observational Research in the Dining Hall
- Naturalistic Observation
- Understanding Correlations
- Correlational and Experimental Research
- Testing Random Assignment
- Small Samples
- Which Method Would You Use?
- Name That Research Method
- Using Memory to Demonstrate Methodology
- Give the Doctor Some Advice
- What Do Journals Look Like?
- Wonder Horse Dials 911 to Save Boy's Life
- Softens Hands While You Do Dishes

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Activity: Experimental Design

The overarching goals of the following exercise are to demonstrate how psychology and the scientific method can be used to address issues that interest your students, to teach them how the concepts they are learning influence experimental design, and to impress on them an appreciation for the challenges faced by experimental psychologists. Lead your class through the process of designing an experiment. Start with a hypothesis generated through brainstorming by the class. Allowing your students to provide the hypothesis ensures that it will interest them and that they will stay engaged. Students may start with topics such as alien abduction, crop circles, and the Loch Ness monster. Welcome this, as it gives you a terrific opportunity to talk about alternative explanations, existence proofs, and the fact that some topics, such as the proof of the existence of God, remain firmly outside the boundaries of science. The scientific method is not a panacea; it is a highly structured method for testing measurable factors and relationships. After your class has agreed on an issue to test, lead them toward a consensus and a testable hypothesis about the issue. Once your class has clearly defined a hypothesis, lead them through a discussion of possible alternative explanations. Challenge their hypothesis and their beliefs. Are there other possible explanations that are simpler and more likely? What assumptions and possible biases underlie their hypothesis? How would the hypothesis (and their assumptions and biases) generated by your class be different than explanations put forward by people from different cultures and different times? You might want to mention that spirit possession was a widely held explanation for mental illness until relatively recently. After listing a number of possible alternative explanations, allow your class to suggest a very basic methodology for testing the hypothesis and eliminating the alternative explanations. You might want to give them a head start by suggesting the kind of data that they would need to collect to measure the variables of interest. Depending on the hypothesis chosen and the sophistication of your class, outlining a reasonable experiment may be a difficult process. If the class begins to show signs of overload, you can quickly switch gears and use the exercise to demonstrate the difficulty in designing and executing well-controlled experiments.

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Demonstration: Equating Groups on Multiple Variables Using Randomization

An interesting demonstration of randomization is described in an article by Enders, Laurenceau, and Stuetzle, titled "Teaching Random Assignment: A Classroom Demonstration Using a Deck of Playing Cards." The authors describe a simple strategy in which students "randomly assign" cards to two groups. The two groups of card/subjects are then compared with respect to the frequency of specific characteristics such as the number of face cards, red cards, etc. This will help students see how random assignment helps equate groups on characteristics beyond those the experimenter has in mind. Two packs of cards may also be used.

Reference:
Enders, Laurenceau, and Stuetzle. (2006). Teaching Random Assignment: A Classroom Demonstration Using a Deck of Playing Cards. *Teaching of Psychology*, *33*(4), 239–242.

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Activity: Identifying the Parts of an Experiment

To help students learn to identify the components of an experiment, **Handout Master 2.1** presents the abstract from a recent article from the *Journal of the American Medical Association* on an issue of some interest to many: Smoking cessation. The abstract is dense, but the independent and dependent variables are clear, along with the treatment and placebo. It is interesting to note that side effects are also reported within the placebo group. Students may suggest possible explanations for this "nocebo" effect.

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Activity: Can Science Answer This Question?

Students are asked to identify whether specific questions can be addressed using the methods of science. The student handout is included as **Handout Master 2.2.** Suggested answers and explanations are listed below.

1. No. The question as stated is vague and the terms are not defined. What does "bad" mean? (Good and bad are value judgments.) Who or what is "society"? Bad for whom? However, specific correlates and consequences of abortion can be studied.
2. Yes. The independent variable would be "before or after eating" and the dependent variable would be talkativeness, which could be operationally defined (e.g., as the length of replies to questions).
3. Yes, so long as the variables are operationally defined. The independent variable would be jogging versus not jogging (or perhaps the frequency or duration of jogging); the dependent variable would be some measure of mental attitude, such as scores on a psychological test.
4. Yes. This question requires only the computation of a correlation between doctors' GPAs in medical school and their subsequent incomes. Such variables as "years in practice" would have to be
controlled and a representative sample would have to be selected.
5. No, probably not; it would be a little like comparing apples and oranges. Physiological measures

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of emotional strength would not be useful because there is not always a relationship between physiological arousal and subjective experience, and because love tends to be a more enduring emotion than anger.

6. Yes. The independent variable would be "bottle-fed versus breast-fed." The dependent variable would be alertness, which would have to be operationally defined in behavioural terms. If babies were randomly assigned to the two groups, the study would be an experiment. If the researcher used babies whose mothers had already made the decision about feeding method, the study would be correlational, and inferences about cause and effect could not be made.
7. No. "Moral" is a broad, vague term that means different things to different people. Moreover, many unanticipated economic, political, and social developments could affect the outcome. Even if "moral" could be defined adequately, and projections from current trends and conditions could be made, the results might turn out to be meaningless, because definitions of morality change over time. What is "moral" in the 1990s might not be moral in 2020, and vice versa.
8. No. The subjects would be very uncooperative!

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Assignment: Observational Research in the Dining Hall

Koschmann and Wesp (2001) provide several research activities for observational research, correlational research, and experimental research. One way to introduce students to research methods is to allow them to become more cognizant of their everyday surroundings and fellow classmates' behaviours. Koschmann and Wesp suggest that the college or university dining hall is an excellent "laboratory" to observe human behaviour. Merely ask students to observe others during meals in the cafeteria, such as seat selection or food choices. You might encourage student research teams to decide which behaviours they wish to observe. Ask students to record their observations, maintain confidentiality, and "debrief" anyone who asked them what they were doing. During the next scheduled class, ask students to share their findings and to generate discussion about potential hypotheses that may provide a better understanding of the behaviours they observed.

Reference:

Koschmann, N. & Wesp, R. (2001). Using a dining facility as an introductory psychology research laboratory. *Teaching of Psychology, 28*, 105–108.

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Assignment: Naturalistic Observation

Objective: To collect data on spatial relationships
Materials: None
Procedure: Assign students to small groups of four or five individuals. Ask each to collect data on personal space in two distinct social situations, perhaps the student union building or other public areas on campus and a situation such as a party, a bar, or another area where individuals are talking. Ask the students to estimate the distance that individuals stand apart when they talk in this public area, noting any differences between same sex and opposite sex individuals. Encourage students to be creative in their data collection; for example, they could approach the participants with a yardstick, or they could count the number of tiles on the floor. Students will come up with their own ideas on the best methods of data collection. When students bring their data to class, summarize each group's findings in terms of the mean

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distances individuals stand apart while talking and put the results on the overhead or chalkboard. Break out the data by sex and situation. Discuss any problems the students encountered with this type of data collection.

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Activity: Understanding Correlations

This exercise on correlations can be used as a classroom demonstration or as a take-home assignment following a lecture on the nature and uses of correlations. The student handout for this exercise is included as **Handout Master 2.3.** Suggested answers are provided below; however, there are other reasonable explanations.

1. *Positive*. Mutual influence. Similar life experiences.
2. *Negative*. Orphanage environment has an adverse effect on cognitive development. Intelligent children are more likely to be adopted.
3. *Positive*. Violent pornography stimulates violent behaviour. Both the violent crime and the number of stores are related to the size of cities. Violent criminals are attracted to violent pornography.
4. *Negative*. Absent students miss pearls of wisdom from the mouth of the instructor. Students with jobs or other responsibilities find it difficult both to get to class and to find time to study.
5. *Positive*. The money appropriated to control crime was poorly spent. The city grew during the eight years, resulting in more crime and more tax revenues.
6. *Positive*. Both variables are related to socioeconomic factors; children from affluent homes have both intellectual and physical advantages over children from substandard home environments. Age is the third variable that accounts for scores on both variables; older children have bigger vocabularies and are also stronger and better coordinated.

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Activity: Correlational and Experimental Research

Many students have difficulty understanding the difference between correlational research and experimental research. It might be useful to walk the class through an example where both kinds of research are illustrated with the same variables. Two examples that could be used this way are the relationship between violent television viewing and aggression, and the relationship between similarity and liking. In both examples either variable could plausibly be caused by the other (or by some third factor); so the step up from correlational to experimental research, where causality can be determined, can be seen as useful. Spend some time discussing how psychologists must be ingenious to turn concepts such as "liking" into measurable variables (this will help students appreciate the scientific process). As examples, you can present actual studies that have been done in these two areas. Byrne (1971) discusses extensive research on the influence of similarity on attraction, and Liebert and Sprafkin (1988) discuss the effects of television on children.

References:

Byrne, D. (1971). *The Attraction Paradigm.* New York: Academic Press.
Liebert, R., & Sprafkin, J. (1988). *The Early Window: Effects of Television on Children and Youth.* New York: Pergamon Press.

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Activity: Testing Random Assignment (Group activity)

Students are often distrustful of random assignment, thinking that the people with the best memory or the worst sense of smell will all end up in the same group and make the results of research undependable. This demonstration is designed to show that random assignment does produce equivalent groups.

Provide students with small cards and have them record their height in inches on the card. If the class is small, ask them to record the height of their best friend on a second card. Collect the cards and then randomly assign them to several groups of 20. Have students calculate means for the groups.

The means should be quite close, illustrating that random assignment has produced equivalent groups. You might also explain that random assignment is not infallible and can be a source of experimental error.

This activity can be extended by using groups of different sizes, such as 2, 5, 10, 20, and 50, to show that the probability of getting groups that are not equivalent decreases as group size increases.

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Activity: Small Samples
Objective: To discover if small samples can really be representative
Materials: A coin, copies of the chart in **Handout Master 2.4**
Procedure: Sometimes students have a hard time believing that 1,000 people or so can represent the entire population of Canada. This activity will help them see that small samples can be representative. Divide students into small groups and instruct them as follows:

Point out to students that, as *n* gets bigger, the more balanced the percentage of heads and tails becomes. However, they should notice too that *n*=20 isn't much better than *n*=15. And it took a lot longer to collect 5 samples of 20 coin tosses each. In other words, there wasn't much gain in representativeness for the extra cost in time and energy. So, small samples can be representative, and increasing the size of a sample doesn't always pay off when costs are balanced against benefits.

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Activity: Which Method Would You Use?

The following examples can be used to generate a class discussion on the research methods used by psychologists. Write the methods on the board: case histories, naturalistic observation, laboratory observation, surveys, tests, correlational studies, and experiments. Then, for each situation, ask students to decide which method is appropriate and briefly describe why.

1. Determining the favourite food of adolescents.
   Method: Survey
   Explanation: Adolescents constitute a large population and the information sought should be accessible through questionnaires or interviews. Care will be needed to construct a sample that is representative of the population under consideration.

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2. Determining whether a person is introverted or extroverted.
   Method: Psychological test
   Explanation: The goal is to measure psychological qualities within an individual. Other methods (e.g., case history, naturalistic observation) might be employed, but they are more time-consuming and do not offer the degree of standardization, reliability, and validity found in a well-constructed test.

3. Determining if frustration causes aggression.
   Method: Experiment
   Explanation: Cause-and-effect information is being sought. In science this information is obtained through experimentation in which the proposed causal variable is manipulated under controlled conditions.

4. Determining if level of education is associated with crime.
   Method: Correlation
   Explanation: This technique is used to determine if and how strongly two variables are related. Establishing that a correlation exists, however, does not address the problem of why two things are related.

5. Determining how teenagers behave on their first date.
   Method: Naturalistic observation
   Explanation: A description of behaviour as it occurs in a real-life situation is being sought. Making the observations without arousing suspicion in subjects could be problematic, and the investigator will need to be careful to prevent "guinea-pig" reaction.

6. Determining the behaviour of subjects who are anxious about participating in research.
   Method: Laboratory observation
   Explanation: The goal here can be readily achieved within an environment artificially set up by the experimenter. The advantage of this approach is that the investigator has greater control over the situation being studied.

7. Determining why a housewife gave up a flourishing career.
   Method: Case history
   Explanation: Making this determination requires in-depth information about the way a variety of psychological factors, expectations, values, motives, past experiences, and so forth, blend together within the person. This kind of information is unique to the person and could not be assessed through standardized tests.

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Activity: Name That Research Method

In this exercise, students are asked to match brief descriptions of research with the name of the method being used. Copy **Handout Master 2.5** and distribute to students as a basis for this exercise.
Answers: 1-c, 2-a, 3-e, 4-f, 5-d, 6-b.

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Activity: Using Memory to Demonstrate Methodology

This demonstration introduces the concept of the experimental method; however, it is equally applicable to the material in the memory chapter. Students are given the question "Can we improve memory by using a mnemonic technique?" and are asked to design an experiment to test the hypothesis. The experiment is then conducted using procedures summarized below. Through this procedure, students are guided through a typical psychological experiment and are introduced to the concepts of independent variable, dependent variable, experimental and control groups, and control procedures.

Prepare a mnemonic technique and write it on small slips of paper to hand to some of the students (half of the class). Construct a list of common words to use in conjunction with the mnemonic. Here is one of many mnemonic techniques:

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Word List: Pet, Road, Eagle, Screen, Ink, Dog, Envelope, Number, Target, Income, Alley, Library

Begin a discussion of the experimental method by asking for definitions of a hypothesis. After discussing the students' definitions tell them that they are going to conduct an experiment in class and provide themwith the question above as the hypothesis. After defining mnemonic techniques, inform the class that you have a mnemonic technique but need to know how to proceed from this point. Students are asked for input as to how to test the hypothesis. Usually someone proposes that the class be divided into two groups: one that receives the mnemonic and one that does not. Ask how the students should be assigned to each group. This leads us to a discussion of random assignment.

The experiment begins by passing out the slips of paper with the mnemonic to the "experimental" group. All students are then given the following instructions: "I am going to read a list of words; when I'm finished I want you to recall as many words as you can IN THE SAME ORDER AS THEY WERE READ." Tell the experimental group how to use the mnemonic: "The letters of the word correspond to the first letter of each word in the list, so you can use the word to help you remember the order of the words in the list."

Read the list of words, pausing about 4 seconds between words. Then tell the students to write down as many words as they can remember in the same sequence as they were read. Allow about three minutes of recall time, then ask the students to correct their own paper and tabulate the results on the board. This demonstration typically yields a large difference between the two groups. If desired, you can initiate a discussion of statistical inference and perhaps conduct some preliminary analyses. Discuss how the results pertain to the original hypothesis.

Reference:
Davis, S. F., & Palladino, J. J. (1994) *Interactions: A newsletter to accompany Psychology*, *1(Win)*, 1.

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Activity: Give the Doctor Some Advice

This exercise describes research on the effects of drinking and driving. However, this study is flawed and students are asked to suggest ways to correct the errors. Copy **Handout Master 2.6** and distribute to students as a basis for this exercise.

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Suggested answers:

1. e
2. Possible confounding variables:
   The vodka and the placebo should be mixed in equal amounts of orange juice.
   Subjects should be chosen randomly and also assigned randomly to the different groups. (The same amount of alcohol affects males and females differently.)
   The researcher should not select friends, colleagues, or his own students as the subjects for this research, or any research, because of possible experimenter expectancy and demand characteristics.
   The subjects should participate at the same time of day since their last meal can determine how potent the effects of alcohol can be.

Informed consent should be obtained before the research, not after.

Given these many possible confounding variables, Dr. Moesteller should be more cautious in his conclusions.

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Activity: What Do Journals Look Like?

Scientific journals and peer review are essential to the field, but even after they are fully described, may seem remote and abstract to students (especially when they have just entered college). Bring relatively recent journal issues to the class, pass them around and ask students to examine the tables of contents for articles that address issues that seem personally interesting to them; ask them to read the titles out loud to the class. Journals from the Association for Psychological Science are excellent for this exercise because they address diverse issues in psychology. The exercise is useful for demonstrating that psychological journals present findings that are of wide relevance and interest.

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Activity: Wonder Horse Dials 911 to Save Boy's Life

Jane Halonen suggests a fun class exercise that tests students' understanding of experimental methodology principles. Once you have covered the basics of correlation, experimentation, and causal inference, challenge your students to apply these principles by examining the outrageous claims made in tabloid headlines, many of which imply a causal relationship (e.g., dreaming in black-and-white improves your sex life; garlic diet improves memory...but not breath; large gopher presence precedes volcano eruptions). For this exercise, bring in a variety of headlines from the *Star*, *National Enquirer*, *Weekly World News*, *Globe*, etc. that are psychology-related and causal-sounding (or ask students to bring in examples). Challenge students to design simple studies that will accurately test whether or not the relationship claimed in the headline is a valid one. Halonen reports that students enjoy the opportunity to "think like scientists" in response to humorous and outrageous claims and that this exercise helps stimulate them to scrutinize causal claims from all sources and to design experiments more carefully and creatively (and, if that isn't enough, they can practice their newfound skills in line at the grocery store)!

Reference:

Halonen, J. S. (1986). *Teaching critical thinking in psychology*. Milwaukee: Alverno Productions.

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Activity: Softens Hands While You Do Dishes

A variation of the tabloid exercise suggested above encourages students to apply experimental principles to claims they are bombarded with on a daily basis—television and magazine advertising. For this exercise, bring in (or have your students bring in) samples of advertising and have students critique the product claims of success according to principles of experimental methodology. Ads can be critiqued on several grounds, including the problem of personal testimony as unreliable, the absence of a control or comparison group, the presence of extraneous variables, the presence of plausible alternative explanations, unclear or undefined variables, and a lack of supporting statistics. Jane Halonen reports that students become enthusiastic about the usually dreaded topic of experimental methodology when they realize it has the potential to make them smarter consumers.

Reference:
Halonen, J. S. (1986). *Teaching critical thinking in psychology*. Milwaukee: Alverno Productions.

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- Handout Master 2.2 Can Science Answer This Question?
- Handout Master 2.3 Critical Thinking Exercise: Understanding Correlations
- Handout Master 2.4 Small Samples
- Handout Master 2.5 Name That Research Method
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Handout Master 2.1

Identifying the Parts of an Experiment

Please read the following abstract (i.e., summary) of a recent article by Jorenby and colleagues that appeared in the *Journal of the American Medical Association* (July 2006). Identify the following:

1. Independent variable; describe the treatment in some detail.
2. Dependent variable; describe this outcome variable in detail.
3. Method of selecting participants.
4. Method of assigning participants to groups.
5. Hypothesis/Research question.
6. Outcome (i.e., results) of the study.

You may also want to consider the following question: Why would members of the control group also experience "side effects"?

Efficacy of varenicline, an alpha4beta2 nicotinic acetylcholine receptor partial agonist vs. placebo or sustained-release bupropion for smoking cessation: a randomized controlled trial.

CONTEXT: Varenicline, a partial agonist at the alpha4beta2 nicotinic acetylcholine receptor, has the potential to aid smoking cessation by relieving nicotine withdrawal symptoms and reducing the rewarding properties of nicotine.

OBJECTIVE: To determine the efficacy and safety of varenicline for smoking cessation compared with placebo or sustained-release bupropion (bupropion SR).

DESIGN, SETTING, AND PARTICIPANTS: A randomized, double-blind, placebo-controlled trial conducted between June 2003 and March 2005 at 14 research centers with a 12-week treatment period and follow-up of smoking status to week 52. Of 1413 adult smokers who volunteered for the study, 1027 were enrolled; 65% of randomized participants completed the study.

INTERVENTION: Varenicline titrated to 1 mg twice daily (n = 344) or bupropion SR titrated to 150 mg twice daily (n = 342) or placebo (n = 341) for 12 weeks, plus weekly brief smoking cessation counseling.

MAIN OUTCOME MEASURES: Continuous abstinence from smoking during the last 4 weeks of treatment (weeks 9–12; primary end point) and through the follow-up period (weeks 9–24 and 9–52).

RESULTS: During the last 4 weeks of treatment (weeks 9–12), 43.9% of participants in the varenicline group were continuously abstinent from smoking compared with 17.6% in the placebo group (odds ratio [OR], 3.85; 95% confidence interval [CI], 2.69–5.50; P<.001) and 29.8% in the bupropion SR group (OR, 1.90; 95% CI, 1.38–2.62; P<.001). For weeks 9 through 24, 29.7% of participants in the varenicline group were continuously abstinent compared with 13.2% in the placebo group (OR, 2.83; 95% CI, 1.91-4.19; P<.001) and 20.2% in the bupropion group (OR, 1.69; 95% CI, 1.19–2.42; P = .003). For weeks 9 through 52, 23% of participants in the varenicline group were continuously abstinent compared with 10.3% in the placebo group (OR, 2.66; 95% CI, 1.72–4.11; P<.001) and 14.6% in the bupropion SR group (OR, 1.77; 95% CI, 1.19–2.63; P = .004).

Treatment was discontinued due to adverse events by 10.5% of participants in the varenicline group, 12.6% in the bupropion SR group, and 7.3% in the placebo group. The most common adverse event with

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varenicline was nausea, which occurred in 101 participants (29.4%)

CONCLUSIONS: Varenicline is an efficacious, safe, and well-tolerated smoking cessation pharmacotherapy. Varenicline's short-term and long-term efficacy exceeded that of both placebo and bupropion.

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Handout Master 2.2

Can Science Answer This Question?

Psychology is an empirical science; that is, its knowledge is obtained through observation, experimentation, and measurement. Some questions cannot be answered empirically and are, therefore, outside the realm of science.

Decide whether scientific research can answer the questions below and respond "yes" or "no" to each question. Do not try to answer the question itself. Just say whether or not scientific research can, in principle, address the question. Briefly explain why each question is, or is not, a good candidate for scientific inquiry.

For the questions that can be studied scientifically, identify what the independent and dependent variables would be in the experiment.

1. Is abortion on demand bad for society?
2. Do people talk more after they have eaten than they do when they are hungry?
3. Does jogging lead to a positive mental attitude?
4. Are the incomes of doctors related to the grades they make in medical school?
5. Which emotion is stronger, love or anger?
6. Are breast-fed babies more alert than bottle-fed babies?
7. Will people be more moral in the year 2020 than they are now?
8. Are people who commit suicide sorry after they have done it?

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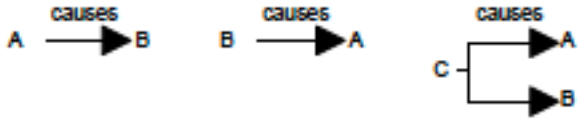
Handout Master 2.3

Critical Thinking Exercise: Understanding Correlations

Correlational studies show relationships between variables. If high scores on one variable predict high scores on the other variable, the correlation is *positive*. If high scores on one variable predict low scores on the other variable, the correlation is *negative*.



Showing that two variables are related does not justify claiming that a causal relationship exists. There may be a causal relationship, but other explanations usually exist. For example, the variables may be related because both have a causal relationship with a third variable.



For each of the correlational studies described below, decide whether the correlation is positive or negative and give two alternative explanations for each finding.

1. A study of married couples showed that the longer they had been married, the more similar their opinions on social and political issues were.
   Positive or negative?

   Explanation 1:

   Explanation 2:

2. An intelligence test was given to all the children in an orphanage. The results showed that the longer children had lived in the orphanage, the lower their IQ scores.
   Positive or negative?

   Explanation 1:

   Explanation 2:

3. In a study of American cities, a relationship was found between the number of violent crimes and the number of stores selling violence-depicting pornography.
   Positive or negative?

   Explanation 1:

   Explanation 2:

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4. A college professor found that the more class absences students have, the lower their grade in the course tends to be.
   Positive or negative?

   Explanation 1:

   Explanation 2:

5. A politician running against a candidate who had been in office for eight years pointed out that violent crime had increased steadily during those eight years even though the administration appropriated more and more money to fight crime.
   Positive or negative?

   Explanation 1:

   Explanation 2:

6. It was found that elementary-school children who made high scores on a vocabulary test also tended to make high scores on a test of physical strength and muscular coordination.
   Positive or negative?

   Explanation 1:

   Explanation 2:

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Handout Master 2.4

Small Samples

You probably know that when you flip a coin, the chance of getting a head or a tail is 50%. But this probability is based on an infinite number of coin tosses. But how well does tossing the coin twice represent the whole population of tosses, or the infinite number of tosses? If a sample of 2 tosses, or n=2 as a statistician would express it, doesn't represent the population, what about a sample of 5 or 10 or 15 or 20? To answer these questions, you have to take repeated samples of the same size. Toss a coin twice (n=2), and then write the number of heads and tails in the column labeled #1. Repeat the process four more times, recording your results the second time under #2, the third time under #3 and so on until you have a total of five samples, each of which consists of two coin tosses. When the n=2 row is completely filled in, calculate the overall percentage of heads and tails. Now use the same process to collect data on samples of n=5, n=10, n=15, and n=20.

Sample size	Toss #1		Toss #2		Toss #3		Toss #4		Toss #5		Overall %	
	H	T	H	T	H	T	H	T	H	T	H	T
n=2												
n=5												
n=10												
n=15												
n=20												

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Handout Master 2.5

Name That Research Method

Here are the major research methods used by psychologists. Match each with one of the following examples of research.

a. case history
b. naturalistic observation
c. laboratory observation
d. survey
e. psychological tests
f. experiment

1. Frank is a full professor who is interested in the factors that affect the performance of rats who are learning to find their way through a complex maze. Every afternoon he gives each of his 50 rats ten trials in the maze, counting the number of wrong turns each rat makes on its way through the maze.

2. Ben is counselling with Fennimore Jones in a small room in the neuropsychiatric hospital. Ben is a graduate student in clinical psychology and Fennimore is his client. Fennimore was admitted to the neuropsychiatric hospital when he came to the student health clinic complaining that he hears voices shouting obscenities at him, and confiding that he thinks he is going through a spontaneous sex change. After each session with Fennimore, Ben writes a report describing Fennimore's verbal and nonverbal behaviour and his interpretations of the behaviour.

3. Carl is a graduate student who plans to become a psychometrician. He, like Ben, is working at the neuropsychiatric hospital. His job is to administer a battery of tests to new patients. He will send the test results, along with his summary and interpretation of them, to the patient's clinical psychologist or psychiatrist.

4. Ada is testing the hypothesis that color preference can be influenced by associating a colour with a pleasant experience, such as eating. This afternoon she is delivering a supply of red, yellow, blue, green, and white nursing bottles to the mothers of newborns who have consented to let their infants be subjects in her research.

5. Dee is an assistant professor who will teach introductory psychology for the first time next term. She has chosen some films to show to her class of more than 200 students, and is now preparing a questionnaire to administer to her students after each film. She thinks getting student reactions to the films will be helpful next time she teaches the class.

6. Ed is an undergraduate psychology major. For his senior thesis he is investigating the nature of the audience for pornography. This afternoon he is sitting in his car across the street from one of the pornographic bookstores in the area. He is taking notes on the sex, approximate age, and ethnicity of the patrons as they enter and leave the store.

]

◄Return to Activity: Name That Research Method
▼ Return to List of Handout Masters
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Handout Master 2.6

Give the Doctor Some Advice

Dr. Moesteller has long been interested in the effects of alcohol on human behaviour. His latest experiment involved giving college students one of three kinds of drinks:

- 3 oz. of 100-proof vodka mixed with a standard size glass of orange juice,
- 2 oz. of 100-proof vodka mixed with a small glass of orange juice, or
- 3 oz. of a nonalcoholic but vodka-flavoured substance mixed with a standard size glass of orange juice.

Dr. Moesteller recruited some of his subjects from the school's track team, which was easy because he is the assistant coach. He recruited the rest of his subjects from his introductory psychology class. Dr. Moesteller assigned the women on the track team to the 2 oz. vodka group, the men from his class to the 3 oz. vodka group, and the women from his class to the nonalcoholic group.

The women on the track team participated right after they finished practicing, and students from his class participated at various times during the day. After each group had a chance to drink the beverage, he had them sit in an automobile simulator where their task was to step on the brake every time they saw a red light.

Much to his surprise, the 2 oz. group showed slower reaction times to the red light than the 3 oz. group. The nonalcoholic group was the quickest to react. As soon as the experiment was over, he explained to the subjects the true purpose of the experiment and had them sign an informed consent form. From his analysis of the results, Dr. Moesteller concluded that drinking alcoholic beverages can slow reaction time for braking in college students who drive after drinking.

1. Based on his experiment, was Dr. Moesteller's conclusion correct?
   a. No, because he did not randomly select his subjects.
   b. No, because he knew some of his subjects better than others.
   c. Yes, because subjects in both experimental groups had slower reaction times than the control group.
   d. Yes, because his results agree with what we all know from our experience with those who drink and drive.
   e. No, because there were too many confounding variables in his experiment, including both a and b.

2. On the other side of this page, give Dr. Moesteller some advice on how he might improve his research on drinking.

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▼ WEB RESOURCES
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Simeon's Cave of Magic and the Confirmation Bias: www.caveofmagic.com/
Discovering Psychology Episode on Decision Making: www.learner.org/
Correlation Is Not Causation: www.msnbc.msn.com/
APA Code of Ethics: www.apa.org/
Ethics and Animal Experimentation: www.apa.org/
Rice Virtual Lab in Statistics: www.onlinestatbook.com/
VassarStats: http://faculty.vassar.edu/
Illusion and Statistical Analysis: www.npr.org/
Oscar the "Deathcat": www.youtube.com/

Research Design

Simeon's Cave of Magic and the Confirmation Bias: www.caveofmagic.com/
This site presents an amusing and effective example of the confirmation bias, briefly mentioned again in this chapter. In this magic trick, participants pick a card from six, are asked to memorize it and then are shown a second array with their card magically "deleted." The trick works because of confirmation bias; in fact, all of the cards are different, but participants notice only that the card they selected has been deleted. Ask students to figure out how the trick is done.

Discovering Psychology Episode on Decision Making: www.learner.org/
The first 10 minutes of this video features an interview Nobel Prize winner Daniel Kahneman and the late Amos Tversky as they discuss the availability and representativeness heuristics.

Correlation Is Not Causation: www.msnbc.msn.com/
Recently, researchers reported that drinking pop, even diet pop, is related to heart disease and diabetes; some possibilities are suggested in the news story from MSNBC. Students may write a brief paper generating additional possible causal mechanisms underlying this surprising correlation and describing how this association could be investigated experimentally, including the independent and dependent variables, and what difficulties they might encounter creating a double-blind study and ensuring that the experiment is consistent with ethical guidelines.

Ethics

APA Code of Ethics: www.apa.org/
American Psychological Association's Ethical Principles of Psychologists and Code of Conduct. Your students may be required to participate in experiments as part of their introductory course. Introduce them to this website either at the start of the semester (to allay their fears about participating in studies) or at the end (as a "wrap-up" paper comparing their research experiences with the ethical guidelines stated by APA).

Ethics and Animal Experimentation: www.apa.org/
Read arguments for the importance of animal research for promoting the understanding and welfare of human beings. The Committee on Animal Research and Ethics (CARE) has produced two videos on the importance of animal research. The first describes research in sensation and perception; the second describes research on pharmacology. Descriptions of the videos may be found at www.apa.org/research/responsible/care-video.aspx. They may be ordered through the APA order department: order@apa.org.

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Research/Statistics

Rice Virtual Lab in Statistics: www.onlinestatbook.com/
Includes links to an online statistics textbook, simulations and demonstrations, case studies, and basic statistical analysis tools.

VassarStats: http://vassarstats.net/
Richard Lowry from Vassar College maintains this excellent site for statistical calculations.

Illusion and Statistical Analysis: www.npr.org/
Psychological scientist Thomas Gilovich is interviewed during the first 10 minutes of this NPR show. The topic is the illusory "hot hand" in basketball, that is, the much-held belief in "streak shooting." This illusion illustrates well the importance of statistical analyses.

Oscar the "Deathcat"
http://www.youtube.com/
The story was also covered in the news; a brief video clip is available.

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▼ MULTIMEDIA RESOURCES

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On-line Resources: MyPsychLab www.mypsychlab.com

See/Hear/Learn/Explore More Icons integrated in the text lead to web-based expansions on topics, allowing instructors and students access to extra information, videos, podcasts, and simulations. The in-text icons are not exhaustive—there are many more resources available to instructors and students on-line at www.MyPsychLab.com.

What Is MyPsychLab? MyPsychLab is a learning and assessment tool that enables instructors to assess student performance and adapt course content. Students benefit from the ability to test themselves on key content, track their progress, and utilize individually tailored study plan. In addition to the activities students can access in their customized study plans, instructors are provided with extra lecture notes, video clips, and activities that reflect the content areas their class is still struggling with. Instructors can bring these resources to class, or easily post on-line for students to access.

Instructors and students have been using MyPsychLab for over 10 years. To date, over 600,000 students have used MyPsychLab. During that time, three white papers on the efficacy of MyPsychLab were published. Both the white papers and user feedback show compelling results: MyPsychLab helps students succeed and improve their test scores. One of the key ways MyPsychLab improves student outcomes is by providing continuous assessment as part of the learning process. Over the years, both instructor and student feedback have guided numerous improvements, making MyPsychLab even more flexible and effective.

Pearson is committed to helping instructors and students succeed with MyPsychLab. To that end, we offer a Psychology Faculty Advisor Program designed to provide peer to-peer support for new users of MyPsychLab. Experienced Faculty Advisors help instructors understand how MyPsychLab can improve student performance. To learn more about the Faculty Advisor Program, please contact your local Pearson representative. In addition to the eText and complete audio files, the MyPsychLab video series, MyPsychLab offers these valuable and unique tools:

MyPsychLab assessment questions: Over 3000 questions, distinct from the test bank, but designed to help instructors easily assign additional quizzes and tests, all that can be graded automatically and loaded into an instructor's grade book.

MyPsychLab study plan: Students have access to a **personalized study plan**, based on Bloom's Taxonomy, arranges content from less complex thinking–like remembering and understanding–to more complex critical thinking–like applying and analyzing. This layered approach promotes better critical-thinking skills, and helps students succeed in the course and beyond.

Experiments Tool: On-line experiments help students understand scientific principles and practice through active learning – 50 experiments, inventories, and surveys are available through MyPsychLab.

APA assessments: A unique bank of assessment items allows instructors to assess student progress against the American Psychological Association's Learning Goals and Outcomes. These assessments have been keyed to the APA's latest progressive Learning Outcomes (basic, developing, advanced).

ClassPrep available in MyPsychLab: Finding, sorting, organizing, and presenting your instructor

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resources is faster and easier than ever before with ClassPrep. This fully searchable database contains hundreds and hundreds of our best teacher resources, such as lecture launchers and discussion topics, in-class and out-of-class activities and assignments, handouts, as well as video clips, photos, illustrations, charts, graphs, and animations. Instructors can search or browse by topic, and it is easy to sort your results by type, such as photo, document, or animation. You can create personalized folders to organize and store what you like, or you can download resources. You can also upload your own content and present directly from ClassPrep, or make it available on-line directly to your students.

MyPsychLab Highlights for Chapter 2: Reading and Evaluating Scientific Research

NEW Experiments Tool to promote active learning

Research Methods

Survey: Participating in a Research Survey Experiment: Implicit Association Test: Cats and Dogs

Audio File of the Chapter

A helpful study tool for students—they can listen to a complete audio file of the chapter. Suggest they listen while they read, or use the audio file as a review of key material.

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VIDEO RESOURCES

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MyPsychLab Video Series

Episode 2: Research Methods

1. The Big Picture: How to Answer Psychological Questions?
2. The Basics: The Scientific Method
3. Special Topics: Ethics
4. Thinking Like a Psychologist: Critical Thinking
5. In the Real World Application: Working Together to Resolve Conflict
6. What's In It For Me? How am I being Influenced?

This video series offers instructors and students the most current and cutting edge introductory psychology video content available anywhere. These exclusive videos take the viewer into today's research laboratories, inside the body and brain through breathtaking animations, and out into the street for real-world applications. Guided by the Design, Development and Review team, a diverse group of introductory psychology professors, this comprehensive new series features 17 half-hour episodes organized around the major topics of the introductory psychology course syllabus. For maximum flexibility, each 30-minute episode features several brief clips that bring psychology to life.

FEATURES

Format

The MyPsychLab video series was designed with flexibility in mind. Each half-hour episode in the MyPsychLab video series is made up of several five-minute clips which can be viewed separately or together:

- *The Big Picture* introduces the topic of the episode and draws in the viewer.
- *The Basics* uses the power of video to present foundational topics, especially those that students find difficult to understand.

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- *Special Topics* dives deeper into high-interest and often cutting-edge topics, showing research in action.
- *Thinking Like a Psychologist* models critical thinking and explores research methods.
- *In the Real World* focuses on applications of psychological research.
- *What's In It for Me?* These clips show students the relevance of psychological research to their lives.

Flexible Delivery
Students can access the videos anytime within MyPsychLab, and each clip is accompanied by enriching self-assessment quizzes.

Other Pearson Psychology Video Collections:
Introductory Psychology Teaching Films Boxed Set ISBN (0131754327)
Offering you an easy to use multi-DVD set of videos, more than 100 short video clips of 5–15 minutes in length from many of the most popular video sources for Psychology content, such as ABC News; the Films for the Humanities series; PBS; and more!

Pearson Education Teaching Films Introductory Psychology: Instructor's Library 2-Disk DVD Annual Edition (ISBN 0205652808)
Annual updates of the most popular video sources for Psychology content, such as ABC News; the Films for the Humanities series; PBS; and more in 5-15 minute clips on an easy to use DVD!

Lecture Launcher Video for Introductory Psychology (ISBN 013048640X)
This 60-minute videotape includes twenty-five segments covering all of the major topics in introductory psychology. All of the segments have been selected from videotapes in the Films for Humanities & Sciences collection. The segments are intended to provide brief illustrations of concepts, and to serve as a starting point for classroom discussions.

FILMS FOR HUMANITIES AND SCIENCES VIDEO LIBRARY (www.films.com)
Qualified adopters can select videos on various topics in psychology from the extensive library of *Films for the Humanities and Sciences*. Contact your local sales representative for a list of videos and ISBNs.

Other video series are available, ask your Pearson sales representative for more details.

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Answer Key

CHAPTER 2

Module 2.1a Quiz :: p. 39

1. A 2. B 3. C 4. A

Module 2.1b Quiz :: p. 40

1. B 2. C 3. A

Module 2.1 Summary Apply Activity :: p. 41

The problem with the instrumentation is one of **reliability**. One key measure of reliability in research is the degree to which a measurement provides consistent, stable responses. In this case, the recording device does not meet this criterion.

The problem with Dr. Nielson's happiness measure probably concerns its **validity**. The different observers were always in agreement on how they recorded the children's behaviour, so their measure is reliable. However, given what the second group of researchers found, it is possible that Dr. Nielson's group is actually measuring how energetic children are, rather than how happy they are. (This could also go the other way around: The researcher who was recording whether children were energetic may have been unknowingly measuring whether they were happy.)

Module 2.2a Quiz :: p. 46

1. B 2. C 3. D

Module 2.2b Quiz :: p. 49

1. B (This is a strong negative correlation. The strength of the relationship is strongest because it is closer to −1.0 than either 1.54 or 1.10 are to 11.0. Correlation coefficients cannot go above 11.0 or below 21.0.)

2. A 3. C

Module 2.2c Quiz :: p. 51

1. C 2. B 3. A 4. A

Module 2.2 Summary Apply Activity :: p. 52

independent; dependent

positive; negative

Module 2.3a Quiz :: p. 59

1. B 2. C 3. B

Module 2.3b Quiz :: p. 60

1. D 2. B

Module 2.3 Summary Apply Activity :: p. 61

It is not really informed consent if the volunteers are exposed to risks before signing the consent form. The "informed" part of informed consent means that individuals are fully informed about risks they may experience as a result of participating in the study.

This research design is unethical because it requires volunteers to answer all of the questions in a survey. Participants generally have the right to quit at any time, or to decline to answer any specific questions they choose. This issue is particularly important with sensitive topics such as sexuality.

Module 2.4a Quiz :: p. 66

1. B 2. D 3. A 4. C

Module 2.4b Quiz :: p. 69

1. C 2. A

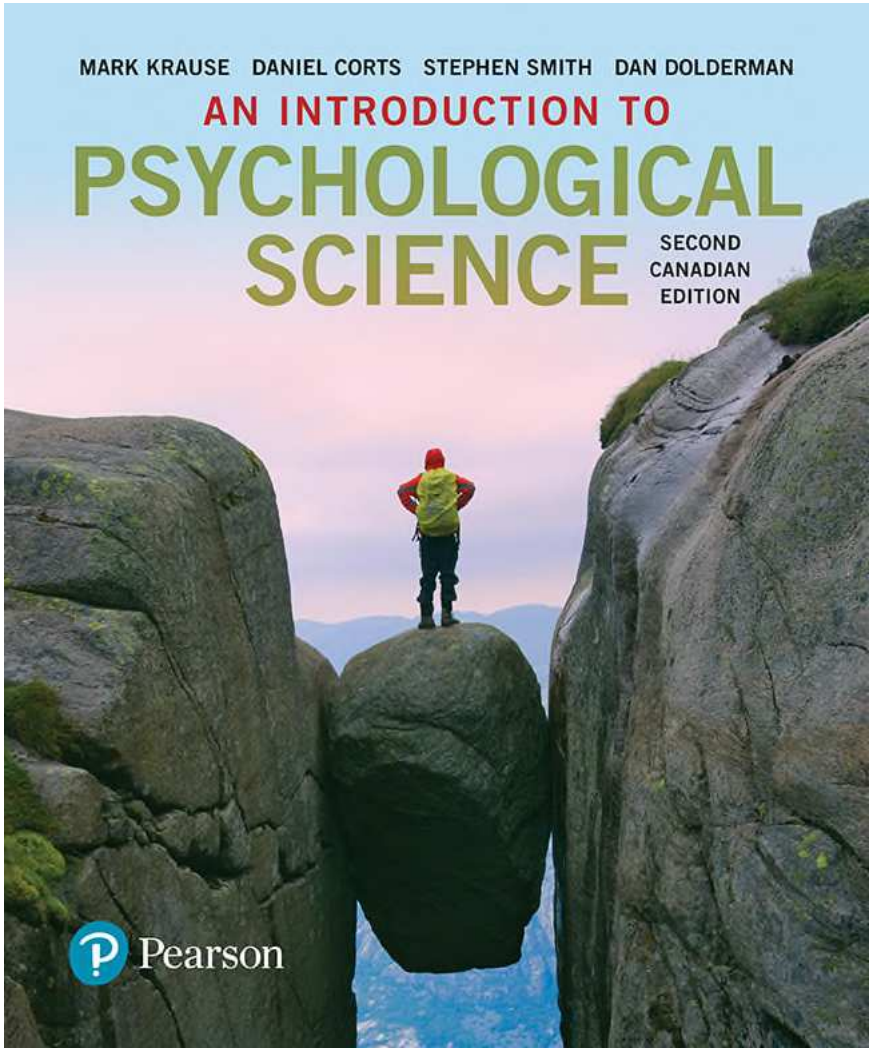
Module 2.4 Summary Apply Activity :: p. 70

Negatively skewed 2. 90–94

3. 9 (4 between 80–84 and 5 between 85–89)

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Chapter 2

Reading and Evaluating Scientific Research

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Modules (1 of 2)

2.1: Principles of Scientific Research

2.2: Scientific Research Designs

2.3: Ethics in Psychological Research

2.4: A Statistical Primer



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Modules (2 of 2)



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2.1 Learning Objectives

- Know the key terminology related to principles of scientific research.
- Understand the five characteristics of quality scientific research.
- Understand how biases might influence the outcome of a study.
- Apply the concepts of reliability and validity to examples.
- Analyze whether anecdotes, authority figures, and common sense are reliably truthful sources of information.

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Five Characteristics of Quality Scientific Research

- Based on measurements that are objective, valid, and reliable
- Generalizable
- Use of techniques that reduce bias
- Made public
- Can be replicated

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Scientific Measurement: Objectivity, Reliability, and Validity (1 of 3)

Objective measurements (p. 31)

- Weight

Variable (p. 31)

Measuring variables

- Functional magnetic resonance imaging (fMRI)
- Blood or saliva
- Self-reporting

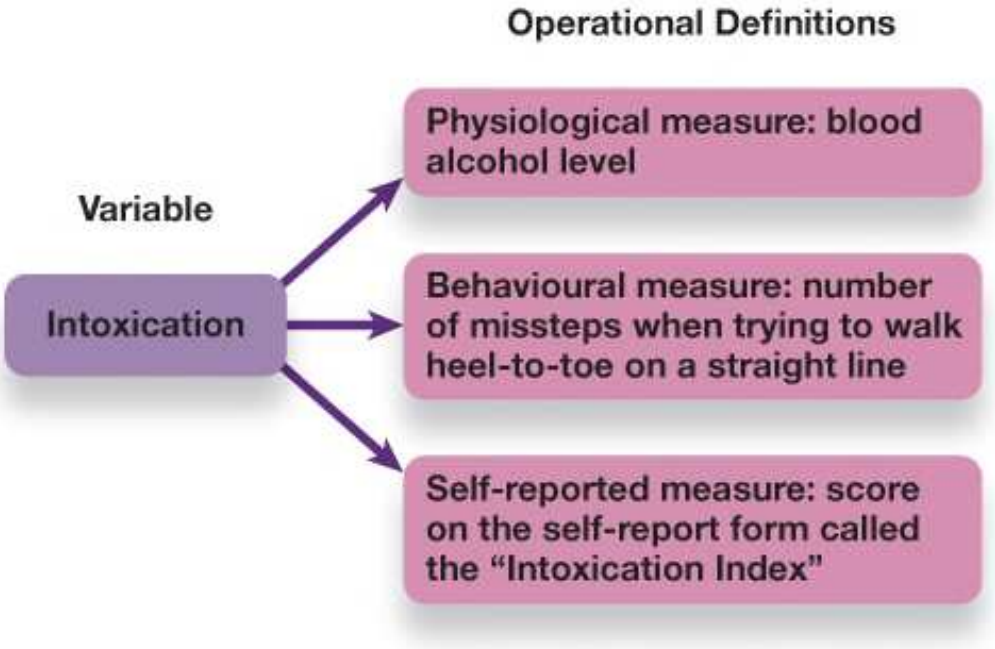
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Scientific Measurement: Objectivity, Reliability, and Validity (2 of 3)

Figure 2.1 Operational Definitions

A variable, such as the level of intoxication, can be operationally defined in multiple ways. This figure shows operational definitions based on physiology, behaviour, and self-report measures.



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Scientific Measurement: Objectivity, Reliability, and Validity (3 of 3)

Reliability (p. 32)

- Consistent and stable

Validity (p. 32)

- True measurements

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Generalizability of Results (1 of 2)

Generalizability (p. 33)

- Outside the laboratory

Study large groups

- Population (p. 33)
  - Sample (p. 33)

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Generalizability of Results (2 of 2)

Best reflection of population

- Random sample (p. 33)

Settle for easier sample

- Convenience sample (p. 33)

Location of study

- Laboratory research
- Naturalistic research
- Ecological validity (p. 34)

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Sources of Bias in Psychological Research

Researcher Bias

Subject/Participant Bias

Hawthorne effect (p. 34)

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Working the Scientific Literacy Model: Demand Characteristics and Participant Behaviour
(1 of 2)

What do we know about how bias affects research participants?

- Demand characteristics (p. 35)
- Social desirability (p. 34)

How can science test the effects of demand characteristics on behaviour?

- Backpack scenario

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Working the Scientific Literacy Model: Demand Characteristics and Participant Behaviour
(2 of 2)

How can we critically evaluate the issue of bias in research?

- Researcher bias
  - Bright rats vs. dull rats

Why is this relevant?

- Bias compromises studies
- Placebo effect (p. 37)

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Psych @ The Hospital: The Placebo Effect

Debate about placebo effect

- "All in their head"
- Actual physiological response

Brain activity in regions involved in pain

- Multiple ways for placebos to affect our responses to pain

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Techniques That Reduce Bias

- Anonymity
- Confidentiality
- Inform participants
- Single-blind study (p. 37)
- Double-blind study (p. 37)

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Sharing the Results

Academic journals

- Peer review (p. 38)
- Replication (p. 38)

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Risky Paths to Truth: Anecdotes, Authority, and Common Sense

Anecdotal evidence (p. 39)

- Weight loss commercials

Appeal to authority (p. 40)

- Corresponding data?
- Biased expert?

Appeal to common sense (p. 40)

- Earth is centre of universe

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2.2 Learning Objectives

- Know the key terminology related to research designs.
- Understand what it means when variables are positively or negatively correlated.
- Understand how experiments help demonstrate cause-and-effect relationships.
- Apply the terms and concepts of experimental methods to research examples.
- Analyze the pros and cons of descriptive, correlational, and experimental research designs.

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Descriptive Research (1 of 2)

Descriptive data

- From observations
- No attempt to explain why

Case study (p. 43)

- Extensive details
- Lacks generalizability

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Descriptive Research (2 of 2)

Naturalistic observation (p. 45)

Self-reporting (p. 46)

- Participant makes the observations

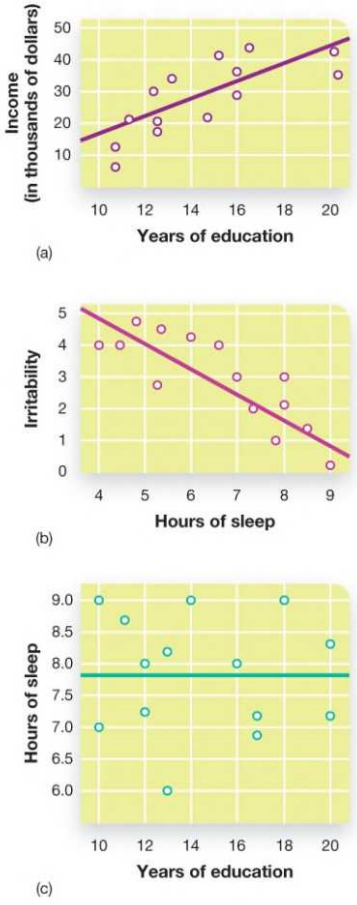
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Correlational Research

Figure 2.4 Correlations Are Depicted in Scatterplots

Here we see two variables that are positively correlated (a) and negatively correlated (b). In the example of a zero correlation (c), there is no relationship between the two variables.



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Myths in Mind: Beware of Illusory Correlations

Illusory correlations (p. 48)

- Crime increases when the moon is full
- Opposites attract
- Gamblers on a “hot streak”
- Stereotypes

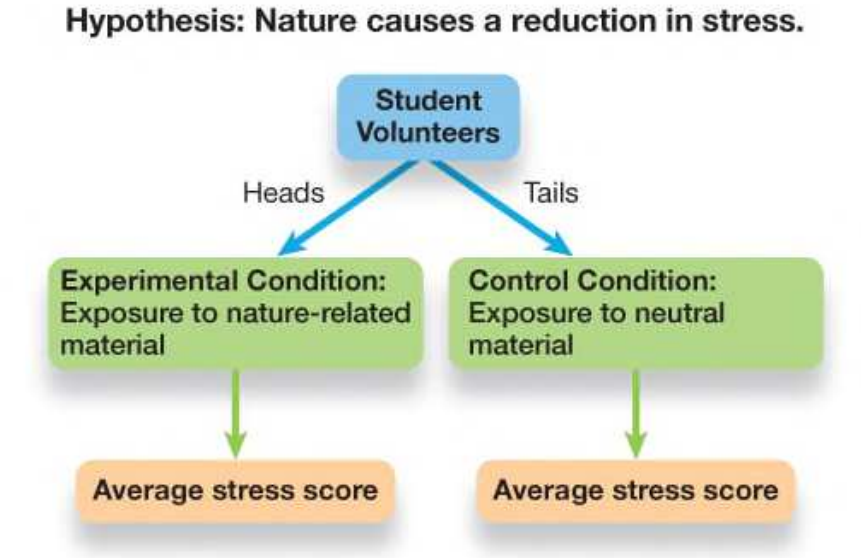
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Experimental Research: The Experimental Method

Figure 2.5 Elements of an Experiment

If we wanted to test whether exposure to nature-related images causes a reduction in stress (as is assumed by people who have nature scenes as their computer's wallpaper), we would first need to randomly assign people in our sample to either the experimental or control condition. The dependent variable, the stress levels, would be measured following exposure to either nature-related or neutral material. To test whether the hypothesis is true, the average stress scores in both groups would be compared.



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Experimental Research: The Quasi-Experimental Method

Quasi-experimental research (p. 50)

- Random assignment not always possible
  - Comparing men and women
- Cannot determine cause-and-effect

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2.3 Learning Objectives

- Know the key terminology of research ethics.
- Understand the importance of reporting and storing data.
- Understand why animals are often used in scientific research.
- Apply the ethical principles of scientific research to examples.
- Analyze the role of using deception in psychological research.

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Promoting the Welfare of Research Participants

Ethical issues must be addressed before a study begins

- Tuskegee Syphilis Study from 1932

Institutional Review Board (IRB) (p. 54)

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Weighing the Risks and Benefits of Research

Minimal stress to participants

- Physical stress
  - Hand in freezing water
  - Cold virus
  - Small cuts
- Cognitive and emotional stress
  - Mortality salience
  - Writing about upsetting or traumatic experiences

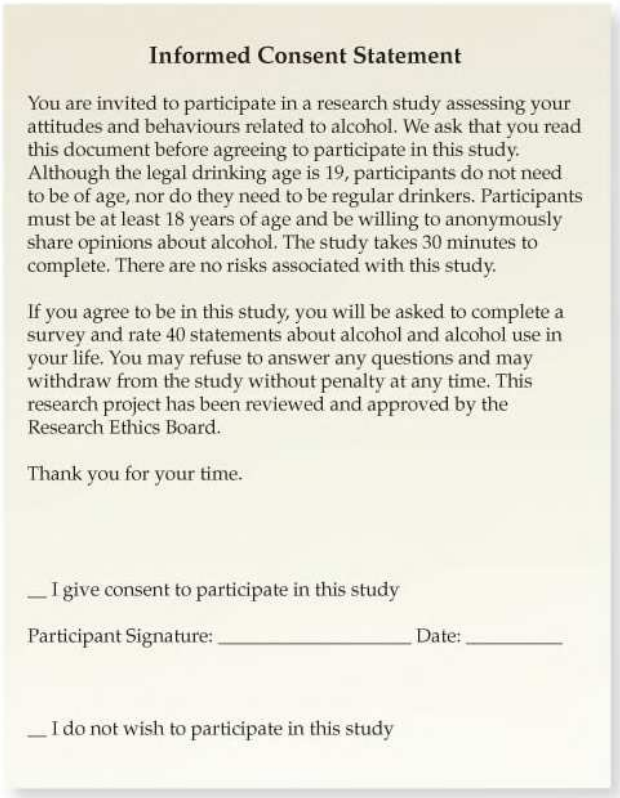
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Obtaining Informed Consent (1 of 2)

Figure 2.6 Informed Consent

Research participants must provide informed consent before taking part in any study. As shown here, the participant must be made aware of the basic topic of the study as well as any possible risks.



Informed Consent Statement

You are invited to participate in a research study assessing your attitudes and behaviours related to alcohol. We ask that you read this document before agreeing to participate in this study. Although the legal drinking age is 19, participants do not need to be of age, nor do they need to be regular drinkers. Participants must be at least 18 years of age and be willing to anonymously share opinions about alcohol. The study takes 30 minutes to complete. There are no risks associated with this study.

If you agree to be in this study, you will be asked to complete a survey and rate 40 statements about alcohol and alcohol use in your life. You may refuse to answer any questions and may withdraw from the study without penalty at any time. This research project has been reviewed and approved by the Research Ethics Board.

Thank you for your time.

__ I give consent to participate in this study

Participant Signature: _____ Date: _____

__ I do not wish to participate in this study

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Obtaining Informed Consent (2 of 2)

Deception (p. 55)

- Given enough information to consent

Full consent

- Not participate without penalty
- Given equal opportunities
- Opt out anytime
- Withhold responses

Debriefing (p. 56)

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The Right to Anonymity and Confidentiality

Anonymity

- Reduces social desirability and social risks

Confidentiality

- Cannot share specific data
- Records secured

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The Welfare of Animals in Research

Committees oversee ethical treatment

- Given appropriate housing, feeding, and sanitation

Risk and discomfort managed humanely

- Harm and discomfort is justified

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Ethical Collection, Storage, and Reporting of Data

Data kept for 3 to 5 years

- Replication

Honest with data

- Acknowledge conflicts of interest
- Scientific misconduct

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2.4 Learning Objectives

- Know the key terminology of statistics.
- Understand how and why psychologists use significance tests.
- Apply your knowledge to read and create the most frequently used types of graphs.
- Analyze the choice of central tendency statistics based on the shape of the distribution.

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Descriptive Statistics

Descriptive statistics (p. 63)

- Frequency
- Central tendency
- Variability

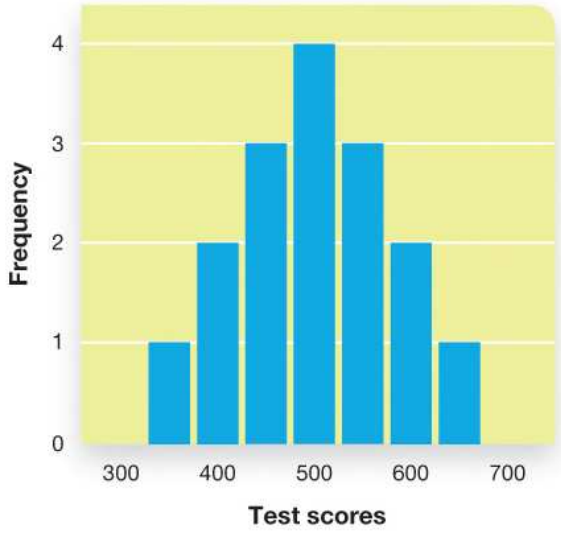
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Frequency

Figure 2.7 Graphing Psychological Data

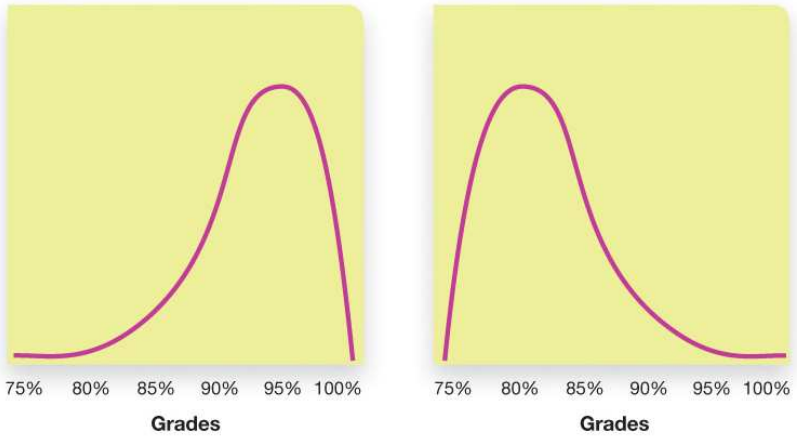
The frequency of standardized test scores forming a normal curve.



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Figure 2.8 Skewed Distributions

Negatively skewed distributions have an extended tail to the left (as in the left graph below). Positively skewed distributions have an extended tail to the right (as in the right graph below).

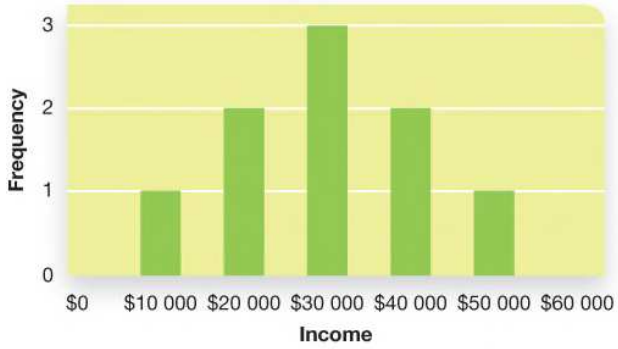


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Central Tendency

Figure 2.9 Central Tendency in Symmetrical Distributions

This symmetrical histogram shows the annual income of nine randomly sampled households. Notice that the mean, median, and mode are all in the same spot—this is a characteristic of normal distributions.



The graph shows that these nine households have the following incomes:

$10 000
$20 000
$20 000
$30 000
$30 000
$30 000
$40 000
$40 000
$50 000

Total = $270 000

Mean income per household:
$270 000 ÷ 9 = $30 000

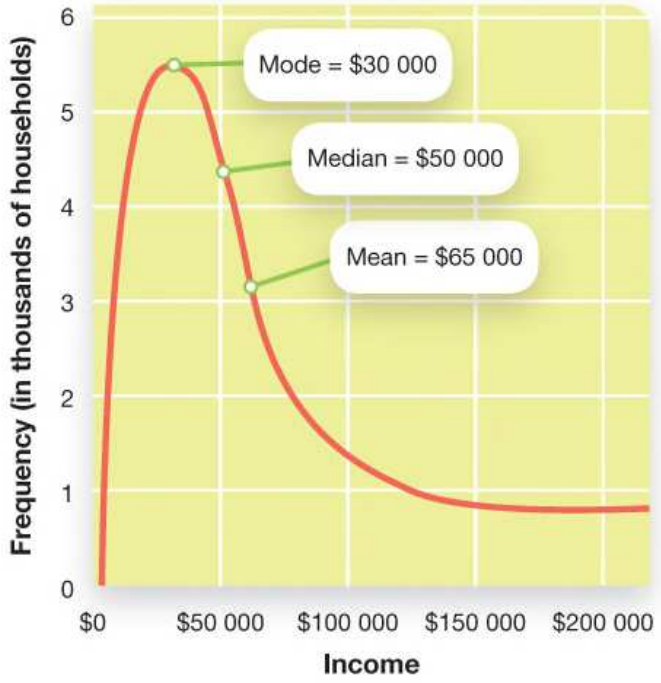
Median (halfway between the lowest and highest numbers):
$30 000 (10, 20, 20, 30—30—30, 40, 40, 50)

Mode (most frequent number): $30 000

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Figure 2.10 Central Tendency in a Skewed Distribution

The mean is not always the ideal measure of central tendency. In this example, the mode and the median are actually more indicative of how much money most people make.

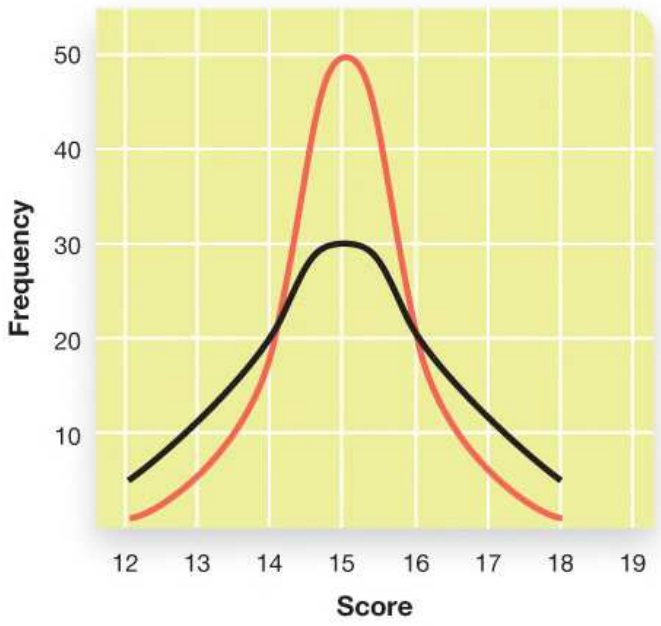


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Variability

Figure 2.11 Visualizing Variability

Imagine that these curves show how two classes fared on a 20-point quiz. Both classes averaged scores of 15 points. However, the students in one class (depicted in red) scored much more similarly to one another compared to students in another class (depicted in black), whose scores showed greater variability. The class represented by the black line would have a higher standard deviation.

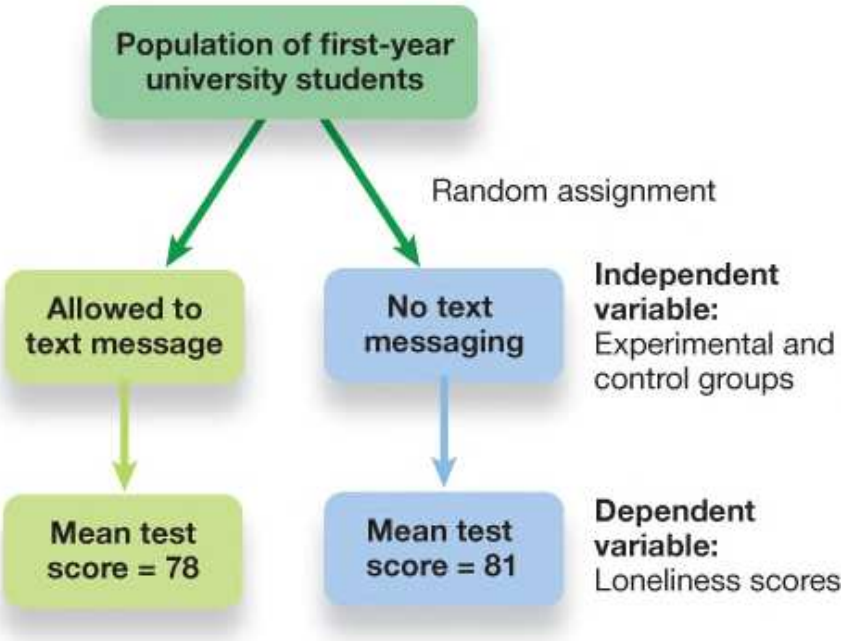


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Hypothesis Testing: Evaluating the Outcome of the Study (1 of 2)

Figure 2.13 Testing a Simple Hypothesis

To conduct an experiment on whether texting reduces loneliness, students would be randomly assigned to either text-messaging or no-text-messaging groups. Their average scores on a loneliness scale would then be compared.

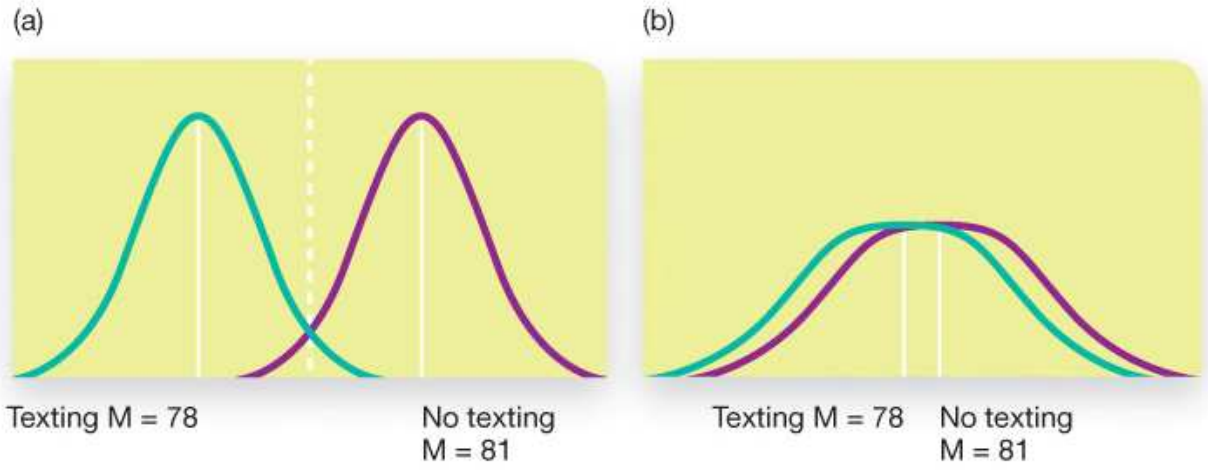


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Hypothesis Testing: Evaluating the Outcome of the Study (2 of 2)

Figure 2.14 How Variability Affects Hypothesis Testing

(a) The means (represented by M) differ between the two groups, and there is little overlap in the distribution of scores. When this occurs, the groups are much more likely to be significantly different. (b) Even though the means differ, there is much overlap between the distributions of scores. It is unlikely that these two means would be significantly different.



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