September 13:

- Sometimes, you may see a study say something one day and the next day, another study says the opposite. This is because each study uses different methodologies. Unless you're very careful to think about the study and understand it, it's very hard to interpret it. This is called **scientific literacy**.
- **Outliers** are data that are very far away from the others.
- The first step in the scientific process is to come up with a hypothesis. To get to the hypothesis, we start with **observational research**, which is when the researcher observes ongoing behaviour and notes them down. However, one of the challenges with doing observational research is the **Hawthorne effect**.
- The **Hawthorne effect** is when a person's behaviour changes as a result of being observed.
- The **placebo effect** is when you're led to believe that something will help you, it will often help you.
- While psychologists want to observe people without them knowing to eliminate the Hawthorne effect, there is an ethical code of conduct that states psychologists cannot watch people without their knowledge and consent.
- A **third variable/confound variable/mediator variable** is something that influences both dependent and independent variables.
- In order to know what's going on in some situations, we begin with observations and we get a suspicion of certain things that might be going on. Then, we follow that with correlational research. While correlational research helps us see that there is something going on, it doesn't really tell us how things are working. It doesn't give us **causal explanations**. That's where experiments are going to come in.
- A **positive correlation** occurs when one variable increases, the other variable also increases. Furthermore, the points lie close to a straight line which has a positive gradient.
- A **negative correlation** occurs when one variable increases, the other variable decreases. Furthermore, the points lie close to a straight line which has a negative gradient.
- A **no correlation** occurs when there is no pattern to the points.
- **Ordinate** is the y-axis.
- **Abscissa** is the x-axis.
- Correlations range from -1 to +1, inclusive. -1 is a perfect negative correlation. +1 is a perfect positive correlation. 0 means no correlation exists.
- Correlation does not imply causation. Correlation just says that there's something going on between the 2 variables. Experiments will prove that there is something going on between the 2 variables.

September 18:

- **Random assignment** 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.
- A **confound variable** is a variable outside of the researcher's control that might affect or provide an alternative explanation for the results. We want to ignore this.

- Your hypothesis must be specific.
- You have to operationally define things to do an experiment. However, there's usually a third variable, so we want to see **convergence** in experiments. **Convergence** is when a theory's predictions hold up to dozens of tests using a variety of operational definitions.
- We also like seeing **replication**, which is when another person or team does the experiment but with a slight difference, especially in random selection. If a bias snuck into one random selection, it shouldn't be able to sneak into other random selections.
- **Internal Validity** is concerned with if the experiment was performed well. It looks at issues that are related to potential confounds and/or poor measurement. This is where the role of peer-review comes in. When you write a scientific paper and submit it to a journal, the editor of that journal submits it to 3 other scientists that are doing similar research and they read your paper very carefully. One of the things they look for is internal validity.
- **External Validity** is concerned with if the experiment really maps onto the concepts it is intended to be studying. It looks at the validity of the operational definitions.
  I.e. External validity is concerned if the experiment supports the hypothesis and the theory.
  This is where replication and **manipulation checks** are important.
  We hope that people will replicate the experiment, but change the operational definitions and get similar results.
  A **manipulation check** is when the researcher debriefs the test subject at the end of the experiment and asks how the "manipulation part" made him/her feel. This is to check if your manipulation did what you think it did.
- **Cultural Validity** is concerned with if the findings are only applicable to some specific group of humans. The importance of representative samples and randomness is shown here.
- There are some very stringent rules on what we can do in ethical context.
- **APA Ethical Guidelines for Human Research:**
  - All research goes before an institution review board (IRB) for approval.
  - Research involving humans must meet the following standards:
    - **Coercion:** Participants cannot be forced in any way to participate in the study.
    - **Informed Consent:** Participants must know that they are involved in research and give their consent or permission.
    - **Anonymity/Confidentiality:** The identities and actions of the participants must not be revealed in any way by the researcher.
    - **Risk:** Participants cannot be placed at significant mental or physical harm.
    - **Debriefing:** Participants must be told of the purpose of the study and provided with ways to contact the researchers about the results after the research is complete.

        - **Deception:** If the participants are deceived in any way about the nature of the study, the participants must be debriefed after the study is over.
- **APA Ethical Guidelines for Animal Research:**
    - **Justification:** The proposed research must have a clear scientific purpose.
    - **Care:** Must care for and house animals in a humane way.
    - **Source:** Must acquire animals legally.
    - **Minimize Suffering:** Must design procedures that involve minimum suffering to the animals.
- **The 3 R's in Animal Testing:**
    - **Replacement:** Use alternative, non-animal methods to achieve the same scientific aim.
    - **Reduction:** Use statistical methods so that a smaller number of animals are required.
    - **Refinement:** Improve the experiments so that animals don't suffer.
- When you expose animals to a mirror, at first the animal will get excited, thinking that the reflection is another animal, but will lose interest later on. Researchers also discovered that some animals, like chimpanzees, will use the mirror to look at themselves.

Textbook:

- **Section 2.1:**
- **Five Characteristics of Quality Scientific Research:**
- Quality scientific research meets the following criteria:
    1. It is based on measurements that are objective, valid, and reliable.
    2. It can be generalized.
    3. It uses techniques that reduce bias.
    4. It is made public.
    5. It can be replicated.
- **Scientific Measurement Objectivity:**
- The foundation of scientific methodology is the use of **objective measurements**, the measure of an entity or behaviour that, within an allowed margin of error, is consistent across instruments and observers.
- A **variable** is the object, concept, or event being measured.
- Regardless of the specific experimental question being asked, any method used by a researcher to measure a variable needs to include carefully defined terms. **Operational definitions** are statements that describe the procedures and specific measures that are used to record observations.
- **Scientific Measurement: Reliability, and Validity:**
- The behavioural measurements that psychologists make must be valid and reliable. **Validity** refers to the degree to which an instrument or procedure actually measures what it claims to measure. A measure demonstrates **reliability** when it provides consistent and stable answers across multiple observations and points in time.

- There are actually a number of different types of reliability that affect psychological research:
    - **Test-retest reliability** examines whether scores on a given measure of behaviour are consistent across test sessions. If your scores on a test of depression vary widely each time you take the test, then it is unlikely that your test is reliable.
    - **Alternate-forms reliability** examines whether different forms of the same test produce the same results.
    - A third type of reliability takes place when observers have to score or rate a behaviour or response. Having more than one rater allows you to have **inter-rater reliability**, meaning that the raters agree on the measurements that were taken. If you design an experiment with clear operational definitions and criteria for the raters, then it is likely that you will have high inter-rater reliability.
- **Generalizability of Results:**
- **Generalizability** refers to the degree to which one set of results can be applied to other situations, individuals, or events.
- While it would be ideal to study an entire **population**, the group that researchers want to generalize about, the task of finding all population members, persuading them to participate, and measuring their behaviour is impossible in most cases. Instead, psychologists typically study a **sample**, a select group of population members. Once the sample has been studied, then the results may be generalized to the population as a whole.
- If researchers want to generalize the results to the entire population, they use a **random sample**, a sampling technique in which every individual of a population has an equal chance of being included. If researchers don't want to generalize the results to the entire population, they use a **convenience sample**, samples of individuals who are the most readily available.
- In addition, research should ideally have high **ecological validity**, meaning that the results of a laboratory study can be applied to or repeated in the natural environment.
- Although generalizability and ecological validity are important qualities of good research, we need to be careful not to over-generalize.
- **Sources of Bias in Psychological Research:**
- While creating objective, reliable, and valid measures is important in quality research, various types of bias can be unintentionally introduced by the researchers. This is known as a **researcher bias**.
- It is also possible for the participants, including animals, to introduce their own bias. This is known as **subject biases** or **participant biases**.
- The **Hawthorne effect** is when a person's behaviour changes as a result of being observed.
- In most psychological research, the participants are aware that they are being observed. This presents a different form of problem. Participants may respond in ways that increase the chances that they will be viewed favourably by the

experimenter and/or other participants, a tendency known as **social desirability/socially desirable responding**.

- This type of bias is particularly relevant when the study involves an interview in which the researcher has face-to-face contact with the volunteers. In these situations, the participants can look for feedback and then adapt their responses to be consistent with what they think is expected of them. The potential biasing effects of social desirability show us a challenge faced by many psychologists: the need to limit the effect that they have on the results of their own study so that the results are due to the variables being studied rather than to the participants responding to cues from the researcher. This challenge is not as simple as it appears. As a result, many researchers now collect data using computers; this allows the participants to respond with relative anonymity, thereby reducing the desire to appear likeable.
- The demand effect that we know the most about is the **placebo effect**, a measurable and experienced improvement in health or behaviour that cannot be attributable to a medication or treatment. It usually comes from drug studies.
- **Working the Scientific Literacy Model Demand Characteristics and Participant Behaviour:**
- Results of psychological studies should provide uncontaminated views of behaviour. In reality, however, people who participate in psychological studies typically enter the research environment with a curiosity about the subject of the study. Researchers need to withhold as much detail as possible,while still being ethical, to get the best, least biased results possible.
- When studying human behaviour, a major concern is **demand characteristics**, inadvertent cues given off by the experimenter or the experimental context that provide information about how participants are expected to behave.
- This issue of bias in research is very difficult to overcome. Very few researchers intentionally manipulate their participants, but many times these influences are subtle and accidental.
- In most cases, experimenters complete rigorous training and follow careful scripts when explaining experimental procedures to participants. These precautions help reduce experimenter effects.
- Additionally, many studies include interviews or questionnaires at the end of the study asking participants what they thought the experiment was about. This information can then be used by the experimenters to determine if the data from that participant are due to the experimental manipulation or to demand characteristics.
- One way to evaluate whether participants' expectations are influencing the results is to create an additional manipulation in which the researchers give different groups of participants different expectations of the results. If the groups then differ when performing the same task, then some form of demand characteristic, in this case from the participant, might be influencing performance. Of course, it is not always practical to include an additional group in a study, and, when doing clinical research, manipulating expectations might not be ethical.

But when researchers begin performing research on new topics or with new research methods, testing for demand characteristics would be a wise decision.

- Demand characteristics and other sources of bias all have the potential to compromise research studies. Given the time, energy, and monetary cost of conducting research, it is critical that results are as free from contamination as possible.
- Furthermore, the science of psychology involves the study of a number of very sensitive topics and the results are often used to help policymakers make better-informed decisions. Producing biased results will therefore have negative effects upon society as a whole.
- Demand effects are particularly problematic when studying clinical populations or when performing experiments with different types of clinical treatments. The results of these studies affect what we know about different patient populations and how we can help them recover from their different conditions. Biased results could therefore affect the health care of vulnerable members of our society.
- **Techniques That Reduce Bias:**
- One of the best techniques for reducing subject bias is to provide anonymity and confidentiality to the volunteers. Ensuring anonymity and confidentiality are important steps toward gathering honest responses from research participants. Participants are much more likely to provide information about sensitive issues like their sexual history, drug use, or emotional state if they can do so confidentially and anonymously.
- **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.
- **Confidentiality** means that the results will be seen only by the researcher.
- Another source of bias in psychological research involves participants' expectations of the effects of a treatment or manipulation. We saw this tendency in the discussion of the placebo effect earlier. The critical element of the placebo effect is that the participants believe the pill or liquid they are consuming is actually a drug. If they knew that they were receiving a sugar pill instead of a pain medication, they would not experience any pain relief. Therefore, it is important that experiments involving drugs utilize what are known as **blind procedures**.
- In a **single-blind study**, the participants do not know the true purpose of the study, or else do not know which type of treatment they are receiving. However, the researcher might unintentionally introduce bias. To solve this issue, researchers often use a technique known as a **double-blind study**, a study in which neither the participant nor the experimenter knows the exact treatment for any individual.
- **Sharing The Results:**
- Psychology's primary mode of communication is through academic journals. However, only a fraction of the journal articles that are written eventually get published. Rather, before research findings can be published, they must go through **peer review**, a process in which papers submitted for publication in scholarly journals are read and critiqued by experts in the specific field of study.

- In the field of psychology, peer review involves two main tasks. First, an editor receives the manuscript from the researcher and determines whether it is appropriate subject matter for the journal. Second, the editor sends copies of the manuscript to a select group of peer reviewers. These reviewers critique the methods and results of the research and make recommendations to the editor regarding the merits of the research.
- **Replication:**
- **Replication** is the process of repeating a study and finding a similar outcome each time. As long as an experiment uses sufficiently objective measurements and techniques, and if the original hypothesis was correct, then similar results should be achieved by later researchers who perform the same types of studies.
- **Five Characteristics of Poor Research:**
- Poor evidence comes most often in one of five varieties: untestable hypotheses, anecdotes, a biased selection of available data, appeals to authority, and appeals to common sense.
- Perhaps the most important characteristic of science is that its hypotheses are testable. For a hypothesis to be testable, it must be **falsifiable**, meaning that the hypothesis is precise enough that it could be proven false.
- A second characteristic of poor research is the use of **anecdotal evidence**, an individual's story or testimony about an observation or event that is used to make a claim as evidence.
- A third characteristic of poor research is the **biased selection of data**. We still need to be careful even if a scientific claim is backed up by published data. It is possible that some individuals, particularly politicians and corporations, might present only the data that support their views.
- The fourth kind of questionable evidence is the **appeal to authority**, the belief in an "expert's" claim even when no supporting data or scientific evidence is present. Expertise is not actually evidence; "expert" describes the person making the claim, not the claim itself. It is entirely possible that the expert is mistaken, dishonest, or misquoted.
- Finally, the evidence may consist of an **appeal to common sense**, a claim that appears to be sound, but lacks supporting scientific evidence.
- **Section 2.2:**
- Psychologists always begin their research with a research question. In most cases, they also make a prediction about the outcome they expect, the hypothesis. Psychologists then create a **research design**, a set of methods that allows a hypothesis to be tested.
- Research designs influence how investigators:
    1. Organize the stimuli used to test the hypothesis.
    2. Make observations.
    3. Evaluate the results.
- All research designs share the following characteristics:
    1. **Variables**. A variable is a property of an object, organism, event, or something else that can take on different values. How frequently you laugh is a variable that could be measured and analyzed.

2. **Operational definitions**. Operational definitions are the details that define the variables for the purposes of a specific study.
3. **Data**. When scientists collect observations about the variables of interest, the information they record is called data.

- **Descriptive Research:**
- **Descriptive research** describes the characteristics of the phenomenon that is being studied.
- These descriptions can be performed in different ways:
    1. **Qualitative research** involves examining an issue or behaviour without performing numerical measurements of the variables. In psychology, qualitative research often takes the form of interviews in which participants describe their thoughts and feelings about particular events or experiences.
    2. **Quantitative research**, involves the examination of an issue or behaviour by using numerical measurements and/or statistics. The majority of psychological studies are quantitative in nature. These designs can involve complex manipulations, but it is also possible to perform more descriptive studies using numbers.
- To answer the research questions, researchers usually gather data using one or more of the following designs:
    1. Case studies
    2. Naturalistic observation
    3. Surveys and questionnaires
- **Case Studies:**
- A **case study** is an in-depth report about the details of a specific case.
- Rather than developing a hypothesis and then objectively testing it on a number of different individuals, scientists performing a case study describing an individual's history and behaviour in great detail.
- Generally reserved for individuals who have a very uncommon characteristic or have lived through a very unusual experience.
- **Naturalistic observation:**
- **Naturalistic observations** are observations that unobtrusively observe and record behaviour as it occurs in the subject's natural environment.
- **Surveys and questionnaires:**
- Another common method of descriptive research used by psychologists is **self-reporting**, 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.
- The creation of objective survey and questionnaire items is extremely challenging. Care must be taken not to create biased questions that could affect the results one way or another.
- Researchers can determine if their questions are valid in multiple ways:
    1. For clinical questionnaires, the researchers can compare the results to a participant's clinical diagnosis.

2. For questionnaires examining other phenomena, researchers perform a large amount of pretesting in order to calculate norms or average patterns of data.

- **Correlational Research:**
- **Correlational research** involves measuring the degree of association between two or more variables.
- Correlations can be visualized when presented in a graph called a scatterplot.
- Two main characteristics that describe correlations are:
    1. **Direction**: The pattern of the data points on the scatterplot will vary based on the relationship between the variables. If correlations are **positive**, it means that the two variables change values in the same direction. If correlations are **negative**, it means that the two variables change values in the opposite direction.
    2. **Magnitude/strength**: This refers to how closely the changes in one variable are linked to changes in another variable. This magnitude is described in terms of a mathematical measure called the **correlation coefficient**. A correlation coefficient of zero means that there is no relationship between the two variables. Furthermore, 1.0 is the most positive correlation coefficient possible and -1.0 is the most negative correlation coefficient possible. 1.0 and -1.0 coefficients have an equal magnitude or strength, but they have a different direction.
- The correlation coefficient is a measure of association only. It is not a measure of causality. I.e. Correlation does not equal causation.
- The **third variable problem** is the possibility that a third, unmeasured variable is actually responsible for a well-established correlation between two variables.
- **Illusory correlations** are relationships that really exist only in the mind, rather than in reality.
- **Experimental Research:**
- Experimental designs improve on descriptive and correlational studies because they are the only designs that can provide strong evidence for cause-and-effect relationships.
- There are two key differences between correlational research and experiments:
    1. The random assignment of the participants.
    2. The experimenter's control over the variables being studied.
- **The Experimental Method:**
- A critical element of experiments is **random assignment**, 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.
- Random assignment allows us to assume the two groups will be roughly equal.
- A **confound variable** is a variable outside of the researcher's control that might affect or provide an alternative explanation for the results.
- Randomly assigning participants to the different experimental conditions also allows the researcher to assume that other sources of variability such as mood and personality are evenly spread across the different conditions. This allows you

to infer that any differences between the two groups are because of the variable you are testing.

- The **independent variable** is the variable that the experimenter manipulates to distinguish between two or more groups. The participants cannot alter these variables, as they are controlled by the researcher.
- The **dependent variable** is the observation or measurement that is recorded during the experiment and subsequently compared across all groups. The levels of this variable are dependent upon the participants' responses or performance.
- A **between-subjects design** is an experimental design in which we compare the performance of participants who are in different groups. One of these groups is the **experimental group** which is the group in the experiment that receives a treatment or the stimuli targeting a specific behaviour. The experimental group always receives the treatment. The other group is the **control group** which is the group that does not receive the treatment or stimuli targeting a specific behaviour. This group serves as a baseline to which the experimental group is compared.
- A between-subjects design allows the researcher to examine differences between groups, but what if the two groups were different from each other simply by chance? In order to reduce this possibility, researchers often use **within-subjects designs**, an experimental design in which the same participants respond to all types of stimuli or experience all experimental conditions.
- **The Quasi-Experimental Method:**
- Random assignment and manipulation of a variable are required for experiments. They allow researchers to make the case that differences between the groups originate from the independent variable. In some cases, though, random assignment is not possible.
- **Quasi-experimental research** is a research technique in which the two or more groups that are compared are selected based on predetermined characteristics, rather than random assignment.
- Quasi-experiments can point out relationships among pre-existing groups, but they cannot determine what it is about those groups that lead to the differences.
- **Converging Operations:**
- When a theory's predictions hold up to dozens of tests using a variety of designs, a perspective known as **converging operations**, we can be much more confident of its accuracy, and are one step closer to understanding the many mysteries of human and animal behaviour.

Method	**Strengths**	**Limitations**
Case studies	Yields detailed information, often of rare conditions or observations	Focus on a single subject limits generalizability
Naturalistic observation	Allows for detailed descriptions of subjects in environments where behaviour normally occurs	Poor control over possibly influential variables

Surveys and questionnaires	Quick and often convenient way of gathering large quantities of self-report data	Poor control; participants may not answer honestly, written responses may not be truly representative of actual behaviour
Correlational study	Shows strength of relationships between variables	Does not allow researchers to determine cause-and-effect relationships
Experiment	Tests for cause-and-effect relationships; offers good control over influential variables	Risk of being artificial with limited generalization to real-world situations

- **Section 2.3:**
- **Promoting the Welfare of Research Participants:**
- In Canada, all institutions that engage in research with humans, including colleges and universities, are required to have a **research ethics board (REB)**, a committee of researchers and officials at an institution charged with the protection of human research participants.
- REBs help ensure that researchers abide by the ethical rules set out in the **Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (2nd edition)**, a set of requirements created by the Government of Canada's Panel of Research Ethics.
- The REBs are intended to protect individuals in two main ways:
    1. The committee weighs potential risks to the volunteers against the possible benefits of the research.
    2. It requires that volunteers agree to participate in the research.
- **Weighing the Risks and Benefits of Research:**
- Some examples of measures that involve possible cognitive and emotional stress are:
    1. **Mortality salience.** In this situation, participants are made more aware of death, which can be done in a number of ways. For example, participants may be asked to read or write about what happens to a human body after death.
    2. **Writing about upsetting or traumatic experiences.**
- Another source of risk is related to the fact that some studies ask participants to provide the experimenter with sensitive and/or personal information. Disclosing this information is a potential threat to a person's reputation, friends, and family. Psychologists must find ways to minimize these risks so that participants do not suffer any unintended consequences of participating in psychological research.
- Indeed, everyone involved in the research process, the researcher, the REB, and the potential volunteer, must determine whether the study's inherent risks are worth what can potentially be learned if the research goes forward.
- Today, it is mandatory that research participants be informed of any risks to which they may be exposed and willfully volunteer to take part in a study.

- **Obtaining Informed Consent:**
- Before any experimental procedures begin, all participants must provide **informed consent**: A potential volunteer must be informed and give consent without pressure.
- To be truly informed about the study, volunteers should be told, at minimum, the following details:
    1. The topic of the study.
    2. The nature of any stimuli to which they will be exposed.
    3. The nature of any tasks they will complete.
    4. The approximate duration of the study.
    5. Any potential physical, psychological, or social risks involved
    6. The steps that the researchers have taken to minimize those risks.
- Sometimes, researchers use **deception**, misleading or only partially informing participants of the true topic or hypothesis under investigation. In psychological research, this typically amounts to a white lie of sorts. The participants are given enough information to evaluate their own risks.
- In medical research situations, deception can be much more serious.
- Importantly, in both cases, the deception is only short-term. Once the experiment is over, the participants are informed of the true nature of the study and why deception was necessary. Additionally, if a treatment was found to be effective for the experimental group, it will often be made available to participants in the control group at the end of the experiment.
- Once participants are informed, they must also be able to give consent.
- Modern psychological research includes the following elements in determining whether full consent is given:
    1. **Freedom to choose.** Individuals should not be at risk for financial loss, physical harm, or damage to their reputation if they choose not to participate.
    2. **Equal opportunities.** Volunteers should have choices.
    3. **The right to withdraw.** Volunteers should have the right to withdraw from the study, at any time, without penalty. The right to give informed consent stays with the participants throughout the entire study.
    4. **The right to withhold responses.** Volunteers responding to surveys or interviews should not have to answer any question that they feel uncomfortable answering.
- Usually, these criteria are sufficient for ensuring full consent. Sometimes, psychologists are interested in participants who cannot give their consent that easily. In this case, a parent or next-of-kin must give consent on behalf of the participant. All the rules of informed consent still apply.
- After participating in the research study, participants must undergo a full **debriefing**, which means that the researchers should explain the true nature of the study, and especially the nature of and reason for any deception.
- **The Right to Anonymity and Confidentiality:**
- **Anonymity** means that the data collected during a research study cannot be connected to individual participants.

- **Confidentiality** includes at least two parts:
    1. Researchers cannot share specific data or observations that can be connected with an individual.
    2. All records must be kept secure so that identities cannot be revealed unintentionally.
- **REBS for Animal-Based Research:**
- Three main areas of ethical treatment are emphasized by researchers and animal welfare committees:
    1. Basic care of laboratory animals. This means providing appropriate housing, feeding, and sanitation for the species.
    2. Minimization of any pain or discomfort experienced by the animals.
    3. Although it is rare for a study to require discomfort, when it is necessary, the researchers must ensure that the pain can be justified by the potential benefits of the research.
- The same standards apply if animals are to be sacrificed for the research.
- **Ethical Collection, Storage, and Reporting of Data:**
- Once data are reported in a journal or at a conference, they should be kept for a reasonable amount of time, generally, three to five years is acceptable. The purpose of keeping data for a lengthy period relates to the public nature of good research. Other researchers may request access to the data to reinterpret it, or perhaps examine the data before attempting to replicate the findings.
- While it might seem as though the confidentiality requirement conflicts with the need to make data public, but this is not necessarily true. For example, if the data are anonymous, then none of the participants will be affected if and when the data are shared.
- In addition to keeping data safe, scientists must be honest with their data. Unfortunately, cases of **scientific misconduct** sometimes arise when individuals fabricate or manipulate their data to fit their desired results. The chances of fraudulent data being published can also be decreased by requiring researchers to acknowledge any potential conflicts of interest.
- **Section 2.4:**
- **Descriptive Statistics:**
- **Descriptive statistics** are a set of techniques used to organize, summarize, and interpret data.
- In most research, the statistics used to describe and understand the data are of three types: frequency, central tendency, and variability.
- **Frequency:**
- The **frequency** is the number of observations that fall within a certain category or range of scores
- A **histogram** is a type of bar graph. The vertical axis of histograms shows the frequency.
- A **normal distribution/bell curve** is a symmetrical distribution with values clustered around a central, mean value.
- A **negatively skewed distribution** is a distribution in which the curve has an extended tail to the left of the cluster.

- A **positively skewed distribution** is a distribution in which the long tail is on the right of the cluster.
- **Central Tendency:**
- The **central tendency** is a measure of the central point of a distribution.
- There are three different measures of central tendency used in psychology:
    1. The **mean** is the arithmetic average of a set of numbers.
    2. The **median** is the 50th percentile. The point on the horizontal axis at which 50% of all observations are lower, and 50% of all observations are higher.
    3. The **mode** is the category with the highest frequency.
- If the data are normally distributed, researchers generally use the mean, but, if the data is skewed in some way, then researchers need to think about which measure is best.
- The measure used the least is the mode, because it provides less information than the mean or the median. The mode is typically only used when dealing with categories of data.
- When the data is not a perfectly symmetrical curve, the mean, median, and mode will produce different values. If the histogram spreads out in one direction, we are usually better off calculating central tendency by using the median, because extreme values will have a large effect on the mean, but not the median.
- **Variability:**
- **Variability** is the degree to which scores are dispersed in a distribution.
- High variability means that there are a larger number of cases that are closer to the extreme ends of the continuum for that set of data.
- Low variability means that most of the scores are similar.
- Variability can be caused by measurement errors, imperfect measurement tools, differences between participants in the study, or characteristics of participants on that given day.
- All data sets have some variability, but, if information about variability is not provided by the researcher, it is impossible to understand how well the measure of central tendency reflects the entire data set. Therefore, whenever psychologists report data from their research, their measures of central tendency are almost always accompanied by measures of variability.
- The **standard deviation** is a measure of variability around the mean.
  I.e. The standard deviation is the average distance from the mean.
- A large standard deviation would indicate that there is a lot of variability in the data and that the values are quite spread out from the mean. A small standard deviation would indicate the opposite.
- Step 1 of statistics is creating a graph and reporting two numbers, the measure of central tendency and standard deviation, so that you can provide a summary of your data that almost anyone can understand.
  Step 2 uses these measures to test whether or not your hypothesis is supported by your data.

- **Hypothesis Testing Evaluating the Outcome of a Study:**
- A **hypothesis test** is a statistical method of evaluating whether differences among groups are meaningful, or could have been arrived at by chance alone.
- If the means differ between groups and there is little overlap in the distribution of scores, the groups are much more likely to be significantly different. If the means differ between groups, but there is much overlap between the distributions of scores, it is unlikely that these two groups would be significantly different.
- **Working the Scientific Literacy Model Statistical Significance:**
- **Statistical significance** is a concept that implies that the means of the groups are farther apart than you would expect them to be by random chance alone. It was first proposed in 1925 by Ronald Fisher.
- Statistical significance testing is based on the researcher making two hypotheses, the **null hypothesis** and the **experimental hypothesis**.
- The **null hypothesis** assumes that any differences between groups or conditions are due to chance.
- The **experimental hypothesis** assumes that any differences are due to a variable controlled by the experimenter.
- The goal of researchers is to find differences between groups that are so large that it is virtually impossible for the null hypothesis to be true.
- The probability of the results being due to chance is known as a **p-value**. Lower p-values indicate a decreased likelihood that your results were a fluke, and therefore an increased likelihood that you had a great idea and designed a good experiment.
- When Fisher first presented the idea of significance testing, he noted that scientists needed to establish a fairly conservative threshold for rejecting the null hypothesis. He correctly thought that if it were quite easy for researchers to find a significant result, it would increase the likelihood that results labelled as being significant were actually due to chance. If enough of these false positives occurred, then the entire idea of significance would soon become meaningless. Fisher therefore recommended that researchers use $p < 0.05$ as the cut-off point. If a p-value were less than 0.05, then there was less than a 5% chance that the results were due to chance. This p-value quickly became the standard in a number of fields, including psychology.
- There are at least two concerns related to significance testing:
    1. The first is the problem of multiple comparisons. If a fluke result can occur approximately 5% of the time, the more tests you perform for your experiment, the greater the likelihood that one of them is due to chance. In order to cope with this problem, researchers generally use a stricter acceptable p-value; as the number of comparisons increases, researchers decrease the p-value. This makes it more difficult to produce significant results, but does help ensure that the results are not due to chance.
    2. A second problem is the fact that as you increase the number of participants in your study, it becomes easier to find significant effects. If you sample thousands of people extremely small differences will still be statistically significant.

- As an alternative to significance testing, Jacob Cohen developed a technique known as **power analysis**, whose goal is to calculate **effect sizes**. Rather than saying that a difference is significant, which is essentially a yes or no decision, effect sizes tell the researcher whether the difference is statistically small or large. So, instead of an experiment supporting or disproving a theory, effect sizes allow the researcher to adjust how much they believe that their hypothesis is true.

Definitions:

- **Anecdotal evidence:** An individual's story or testimony about an observation or event that is used to make a claim as evidence.
- **Appeal to authority:** The belief in an "expert's" claim even when no supporting data or scientific evidence is present.
- **Appeal to common sense:** A claim that appears to be sound, but lacks supporting scientific evidence.
- **Between-subjects design:** An experimental design in which we compare the performance of participants who are in different groups.
- **Case study:** An in-depth report about the details of a specific case.
- **Central tendency:** A measure of the central point of a distribution.
- **Confounding variable:** A variable outside of the researcher's control that might affect or provide an alternative explanation for the results.
- **Control group:** 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.
- **Convenience samples:** Samples of individuals who are the most readily available.
- **Correlational research:** Involves measuring the degree of association between two or more variables.
- **Debriefing:** When researchers explain the true nature of the study, and especially the nature of and reason for any deception.
- **Deception:** Misleading or only partially informing participants of the true topic or hypothesis under investigation.
- **Demand characteristics:** Inadvertent cues given off by the experimenter or the experimental context that provide information about how participants are expected to behave.
- **Dependent variable:** The observation or measurement that is recorded during the experiment and subsequently compared across all groups.
- **Descriptive statistics:** A set of techniques used to organize, summarize, and interpret data.
- **Double-blind study:** A study in which neither the participant nor the experimenter knows the exact treatment for any individual.
- **Ecological validity:** The results of a laboratory study can be applied to or repeated in the natural environment.
- **Experimental group:** The group in the experiment that receives a treatment or the stimuli targeting a specific behaviour.

- **Experimental hypothesis:** Assumes that any differences are due to a variable controlled by the experimenter.
- **Falsifiable:** The hypothesis is precise enough that it could be proven false.
- **Frequency:** The number of observations that fall within a certain category or range of scores.
- **Generalizability:** The degree to which one set of results can be applied to other situations, individuals, or events.
- **Hawthorne effect:** Behaviour change that occurs as a result of being observed.
- **Hypothesis test:** A statistical method of evaluating whether differences among groups are meaningful, or could have been arrived at by chance alone.
- **Illusory correlations:** Relationships that really exist only in the mind, rather than in reality.
- **Independent variable:** The variable that the experimenter manipulates to distinguish between two or more groups.
- **Informed consent:** A potential volunteer must be informed (know the purpose, tasks, and risks involved in the study) and give consent (agree to participate based on the information provided) without pressure.
- **Mean:** The arithmetic average of a set of numbers.
- **Median:** The 50th percentile—the point on the horizontal axis at which 50% of all observations are lower, and 50% of all observations are higher.
- **Mode:** The category with the highest frequency (that is, the category with the most observations).
- **Naturalistic observations:** Observations that unobtrusively observe and record behaviour as it occurs in the subject's natural environment.
- **Negatively skewed distribution:** A distribution in which the curve has an extended tail to the left of the cluster.
- **Normal distribution:** A symmetrical distribution with values clustered around a central, mean value.
- **Null hypothesis:** Assumes that any differences between groups (or conditions) are due to chance.
- **Objective measurements:** The measure of an entity or behaviour that, within an allowed margin of error, is consistent across instruments and observers.
- **Operational definitions:** Statements that describe the procedures or operations and specific measures that are used to record observations.
- **Peer review:** A process in which papers submitted for publication in scholarly journals are read and critiqued by experts in the specific field of study.
- **Placebo effect:** A measurable and experienced improvement in health or behaviour that cannot be attributable to a medication or treatment.
- **Population:** The group that researchers want to generalize about.
- **Positively skewed distribution:** A distribution in which the long tail is on the right of the cluster.
- **Qualitative research:** Examining an issue or behaviour without performing numerical measurements of the variables.
- **Quantitative research:** Examining an issue or behaviour by using numerical measurements and/or statistics.

- **Quasi-experimental research:** A research technique in which the two or more groups that are compared are selected based on predetermined characteristics, rather than random assignment.
- **Random assignment:** 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.
- **Random sample:** A sampling technique in which every individual of a population has an equal chance of being included.
- **Reliability:** Consistent and stable answers across multiple observations and points in time.
- **Replication:** The process of repeating a study and finding a similar outcome each time.
- **Research design:** A set of methods that allows a hypothesis to be tested.
- **Research ethics board (REB):** A committee of researchers and officials at an institution charged with the protection of research participants.
- **Sample:** A select group of population members.
- **Self-reporting:** 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.
- **Single-blind study:** A study in which 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).
- **Social desirability/Socially desirable responding:** Research participants respond in ways that increase the chances that they will be viewed favourably.
- **Standard deviation:** A measure of variability around the mean.
- **Statistical significance:** The means of the groups are farther apart than you would expect them to be by random chance alone.
- **Third variable problem:** The possibility that a third, unmeasured variable is actually responsible for a well-established correlation between two variables.
- **Within-subjects designs:** An experimental design in which the same participants respond to all types of stimuli or experience all experimental conditions.
- **Validity:** The degree to which an instrument or procedure actually measures what it claims to measure.
- **Variable:** The object, concept, or event being measured.
- **Variability:** The degree to which scores are dispersed in a distribution.