

Psych Modules 1 & 2-Research Methods

Research Methods 1

7 steps to the Scientific Method of research

- **Construct a theory:** a general set of ideas about the way the world works
- **Generate hypothesis:** form a testable statement guided by theories that make specific predictions about the relationship between variables involved in the theory
- **Choose research method:** determine the appropriate way in which the hypothesis will be tested
- **Collect data:** take measurements of the outcomes of the tests
- **Analyze data:** understand the data and discover trends or relationships between the variables (leads to decision of refuting/accepting original hypothesis)
- **Report the findings:** publish articles in scholarly journals, each submission to journal undergoes rigorous review processes by experts scientists
- **Revise existing theories:** incorporate new information into our understanding of the world. Theories are constantly revised to account for new information because of the dynamic nature of science.
 - **Paradigm shift:** particularly dramatic shift in way of thinking
 - Ex. 1543: Copernicus challenged existing dogma that the world existed at the centre of the universe
- Case study: Eric's evaluation of energy drink
 - Does mega study energy drink influence test performance?
 - **Theory:** test performance can be affected by external factors that occur while studying for the test
 - **Hypothesis:** students taking energy drinks should show improved test scores when compared with students not taking energy drinks
 - **Anecdotal evidence:** evidence gathered from others or self experience; ex asking a student who took a drink similar to mega study and see their test scores
 - Eric uses himself: drinks the energy drink and evaluates performance on test
- Anecdotal evidence is insufficient to draw scientific conclusions
 - Single experience might not be representative of the general result if you drank the energy drink several times
 - Personal experience might not represent others experiences under the same circumstances
 - Cannot be sure that result is due to energy drinks alone-perhaps test was unusually easy/difficult
- **Experiment:** scientific tool used to measure the effect of one variable on another.
 - Scientists manipulate independent variable and observe effect on dependent variable
 - Eric has not conducted a valid experiment: single experience does not allow him to properly measure the effects of the energy drink-has to properly manipulate independent variable: compare exams with and without mega study ingestion

- Control groups
 - Comparing manipulations with control groups
 - Eric manipulates independent variable by consuming mega study and comparing results to roommate who writes same test without MS
- Types of groups
 - Experimental group: receives manipulation of independent variable
 - Control group does not
 - Differences between groups should be minimal-so that they differ only in independent variable and differences in dependent variable are attributed to the manipulated independent variable
- Using a within-subjects design to ensure similarity between experimental groups
 - Manipulating the independent variable within each participant to minimize the effect of external variables on the dependent measure
 - Ex. Eric takes tests throughout the semester, sometimes taking energy drink and sometimes no then comparing results-Eric is acting as his own control group
 - Because same participant needs to be tested repeatedly it can be time consuming and costly to have subject complete entire study on their own
 - Measure being used may change during course of experiment ex. Difficulty of test may change throughout the semester
 - **Practice effect:** improved performance over the course of an experiment due to becoming more experienced
- **Between-subjects design:** one group acts as the control group
 - One group receives experimental manipulation and the other group doesn't (like Eric and roommate)
 - **Confounding variable:** a variable other than the independent variable that has an effect on the results-ex. one group being exclusively vegetarians while the other group isn't-may affect interpretation of results
- Sampling
 - More rigorous study design
 - Compares group of 20 students writing a test while taking mega study and a group of controls that haven't
 - Use strict criteria to ensure uniformity
 - High school average of 93%, blonde and Dutch descent
 - Issue here is so specific that it's difficult to recruit 40 participants with these criterion
 - Results not generalizable to the general population
- General group trying to learn about are the population (all undergrad students) and sample is 40 undergraduate students from population
 - Impossible to test effects on every single UG student in the world, so choose sample to well represent the general population
- **Random sample:** choosing a sample at random from the entire population

- **Random assignment:** assigning subjects to either the experimental or control group at random to avoid any biases that may cause differences between the group of subjects

Conducting an Experiment

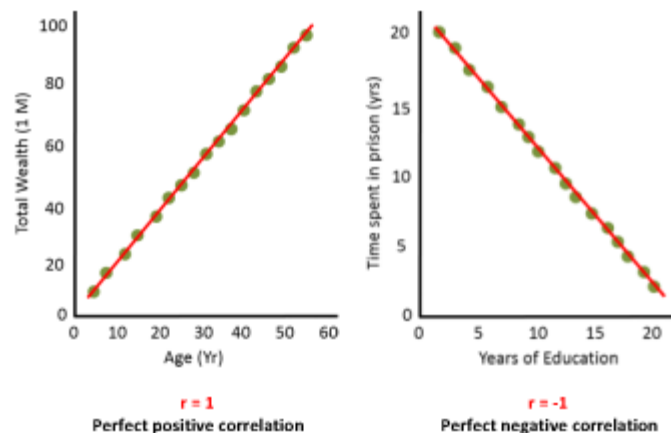
- **A tricky confound: the placebo effect**
 - Effect that occurs when an individual exhibits a response to a treatment that has no related therapeutic effect
 - Has to be taken into consideration in any study design experiment where the participants know in advance the expected/hypothesized outcome
 - For ex. Test improvement may be due to a participant's influence, not the experimental manipulation
 - **Participant bias:** when a participant's actions in an experiment influence the results outside of the manipulations of the experimenter
- Can counter the placebo effect in experimental group by giving the control group a mock treatment as well, ex giving the control group a drink as well but content is different-if neither groups know contents of the drink, then both are assumed to equally be affected by the placebo effect→removed as a confounding factor
 - **Blinding:** when participants do not know whether they belong to the experimental or control group, or which treatment they are receiving
- **Experimenter bias:** actions made by the experimenter, intentionally or not, to promote the result they hope to achieve
 - Reduced if experimenter does not know whether each individual belongs to the experimental or control group-double blind experiments
- **Double blind studies:** experiments in which neither the experimenter or the participants know which group the participants belong to

Research Methods 2

- Descriptive statistics present info at a glance to show overall idea of results of the experiment
- Includes Mean, Median and Mode
- Pie graphs, diagrams and bar graphs can communicate this info
- **Histogram:** type of graph used to report the number of times groups of values appear in a data set
 - Horizontal x-axis divided into bins-here each bin spans five digits
 - Vertical Y-axis measures number of times the value in the data set falls into a given bin called frequency
 - Used to create a **frequency distribution:** type of graph illustrating the distribution of how frequently values appear in data set
 - Smooth curve that connects the peak of each bar on the histogram
 - Height of each point plots the frequency-showing how likely each outcome is to occur

- **Normal distribution:** a distribution with a characteristic smooth, symmetrical, bell-shaped curve containing a single peak
- **Measures of central tendency**
 - **Mean:** the average value of a data set-very susceptible to influences by outliers
 - **Outliers:** extreme points, distant from others in a data set
 - **Mode:** the value that appears most frequently in the set
 - **Median:** the centre value in a data set when the set is arranged numerically
- Measures of central tendencies do not sufficiently summarize data, because they focus on centre/typical value alone-can't really tell us about how the values fall around that point
- **Measures of variability**
 - Tell us how spread out our data is and the distribution
 - **Standard deviation:** a measure of the avg. distance of each data point from the mean
 - Data sets with a larger stDev are more spread out than data sets with a smaller standard deviation
- Creates a histogram for both data sets (experimental control)→then calculates mean and standard deviation
 - Spread of scores is greater than spread for control group→has hypothesis been verified?
- Some variability in results is simply due to chance
 - Always random variability in individuals within each group so even if he gave identical drinks to everyone in both groups
 - So given that there will be random variability and he gave different drinks to both groups, what is the cut-off before we're convinced the treatment had a real effect?
- **Inferential Stats:** statistics that allow us to use results from samples to make inferences about overall, underlying populations
- Scores without any manipulation follow a symmetrical distribution
- Eric predicts that the experimental group will differ from the general population because experimental group will be shifted to the right due to increased performance (separate population), and control group belongs to the general population
 - Energy drink has no effect: both groups belong to the same population
 - Energy drink has positive effect: experimental is from diff population
- How significant is the difference?
 - Slight shift to the right
 - Is it due to random variation or due to enhanced performance resulting from drink?
 - Use t-test to find out
- **T-test:** a statistical test that considers each data point from both groups to calculate the probability that two samples were drawn from the same population
 - Results in a p-value: a value expressing the probability calculated by the t-test
 - prior to conducting experiment they decide they will need very strong evidence to convince them there is a true difference between two groups→typically less than 0.05

- indicates 5% probability they would've find the observed difference between two groups purely by chance → 95% confident the difference exists
- statistically significant if less than 0.05
- **statistical significance:** when the difference between 2 groups is due to some true difference between the properties of the 2 groups and not simply due to random variation
 - less than 5% probability of obtaining the data by chance
- p value=0.44 from Eric's experiment → means that even though he found a small change he would've found that same result 44% of the time even if the energy drinks had no effect whatsoever → too high to accept hypothesis; $0.44 > 0.05$
- Reviewing experimental design:
 - Analyze data: used descriptive (mean, stdev, histogram) and inferential statistics (t-test, form of hypothesis testing)
 - No conclusive evidence to support the hypothesis that energy drinks improved test performance
 - Report findings then go back and revise theory ex Diet is not a major factor contributing to the effect of enhanced performance
- Observational Research
 - Looking at existing data to observe the relationships between diff variables ex Smoking and cancer (without manipulating individuals-unethical to make ppl start smoking to observe effects)
 - In an observational study, can collect data on cancer rates in existing smokers and non smokers and observe any differences between the two
 - Follows the scientific method as well- hypothesis can be tested (ie what is the strength/direction of relationship between variable X and Y)
 - Can be examined by descriptive and inferential statistics
 - **Correlation:** a measure of the strength of the relationship between 2 variables
 - Ie. when a person smokes for a longer period of time, the rates of cancer incidents steadily increases
 - Measured by correlation coefficient "r" - tells us strength and direction of correlation



- As the correlation gets weaker, the correlation coefficient approaches 0, and a CC of 0 indicates no relationship whatsoever between the two variables
- Correlations are not always meaningful!
 - I.e. Common activities & allergy symptoms
 - Appears a strong relationship between allergy symptoms and ice cream consumed → although they seem strongly correlated, we can't say the relationship between the variables is CAUSING the activity → **correlation is not causation**
 - Likely true that allergy sufferers experience more symptoms during months when they eat more ice cream, we shouldn't be worried that ice cream is causing the allergies
 - People more likely to eat ice cream in the summer months when it's hot, and more likely to experience allergies in the summer due to presence of grass, pollen and other plants → **confounding variable**
- Good design is critical for meaningful results → for a scientist, failing to include a critical control group may prevent from producing meaningful results