

PSY100

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Lecture 1: Introduction to Psychology

Introduction

Psychology

- *Psyche* – life, spirit, soul, or mind
- *Logos* – explanation or study
- Within the ‘mind’ are *thoughts*, which in turn are linked to *behaviours*
 - o *Thoughts* – internal mental processes (harder to study)
 - o *Behaviours* – overt actions (easier to study)
- *Psychology* – the *scientific* study of thought and behaviour

Scientific Approach

- In the scientific approach, we must:
 - o Be open to any idea (be open ≠ accept)
 - o Criticize and test every idea
 - o Base our positions on the majority of evidence

Psychological Research

- We collect information (*data*) on a behaviour or behavioural disorder under different conditions
- With this data, we can better *understand*, *predict*, and *control* the behaviour or the disorder
- A common goal is to determine the *cause*

Breaking Down Behaviours

- At any one time, we are exposed to hundreds of objects and events
 - o Many different sights, sounds, smells, etc.
- We call these things *stimuli*
- Some stimuli are meaningful (they may cause/change our behaviour) but many are not
- The meaning of a stimulus is dynamic
 - o Different for different individuals
 - o Different in different environments (or contexts)

Case Study: Depression

- What is depression like? (symptoms)

- How common is depression? (rate)
- How do we treat depression?
- What *causes* depression? Out of all the stimuli we encounter, which plays the biggest role?
- Why do some people get depressed, but not others?

Big Questions

- Nature vs. Nurture
- Free Will vs. Determinism
- Accuracy vs. Inaccuracy
- Subconscious vs. Conscious

What We Can Do Using Psychology

- Facilitate behaviours
 - o i.e. *sports psychology* for boosting athletic performance
- Identify and treat maladaptive behaviours
 - o i.e. *cognitive-behavioural therapy* for treating anxiety
- Predict population events
 - o i.e. planning for consumer habits during economic downturn using *behavioural economics*

Understanding Psychology

Breaking Down Behaviours

- The behaviour *eating* can be deconstructed
- Biological
 - o Hunger is linked to physiological changes
 - o Blood sugar levels, leptin levels, insulin levels
 - o The levels of these signaling compounds change with eating or adipose (fat) storage
 - o The sight, smell, or thought of food can trigger a biological cascade which prepares us for eating (cephalic phase)
 - o Specific brain areas (e.g. hypothalamus) are involved in eating and energy metabolism
 - o Genes are also involved
 - Eating disorders (e.g. obesity) are heritable and run in families
- Environmental

- Eating is about more than replenishing energy
 - We'll eat even if we've eaten recently (i.e. have already balanced our glucose levels)
 - We'll eat even if we're 'stored a lot energy' (i.e. have more than enough fat)
- Other factors that influence eating:
 - Boredom
 - Curiosity/hedonism ("You're GOT to try this"; positive incentive value, food is rewarding)
 - Learned routines
 - Time may be a conditioned cue that increases hunger and drives us to eat
 - Marketing
 - Light foods (veggies, fruits) often marketed to women
 - Heartier foods (meats, potatoes) marketed to men
 - Does marketing create this behaviour or reinforce it?
 - Social environment
 - Men eat more (both pizza and salad) in front of women
 - Is this behaviour learned or is it innate? Can it be controlled?
 - Other attitudes
 - The belief that we control our own behaviour (*perceived behavioural control*) may affect eating
- Biological and environmental interaction

Understanding Behaviour

- Behaviour is *multifactorial* (many factors are influential, each generally has a small effect)
 - Predictive power is not equal (some stronger than others)
- All these factors interact
- Individual differences exist and can be remarkable
- Cultural differences exist too
- People interact with each other and influence each other (*reciprocal determinism*)

Biases/Errors in Thinking

- Confirmation bias
 - Overvaluing information that agrees with our beliefs and undervaluing information that does not
 - Common and very difficult to avoid

- Affects public attitudes and social policies on issues such as climate change, vaccination, and drug use
- To think scientifically, we must acknowledge all facts, even those not in our favour
- Some sources might support our claim, some might not
 - What matters is that the majority say
- Using an approach such as *meta-analysis*, we can weight the average effect of all studies
- Illusion of causality
 - Humans are hardwired to find relationships between phenomena linked in space and time
 - i.e. dark clouds suggest rain, many coughs suggest a cold, etc.
 - However, sometimes our threshold for identifying associations is too low, and we become wrong
 - Spurious/random relationships
 - Margarine might not cause divorce despite they are closely correlated
 - The clustering illusion
 - We may erroneously infer patterns from small, non-representative amounts of data that are actually random
 - Apophenia
 - We may see meaning in unconnected things (*apophenia*)
 - Seeing a “face” on random objects
 - Without an experiment, nothing is proven to work
 - Besides groups with treatment, we also need a group with no treatment (*control group*)
 - Without a control group to act as a frame of reference, we have no idea what has actually happened
- Other fallacies
 - Not me fallacy
 - “I don’t make mistakes, others do”
 - Argument from antiquity fallacy
 - “This idea has been around forever, so it must be true”
 - Appeal to authority fallacy
 - “Someone important said this, so it must be true”
 - Appeal to ignorance fallacy
 - “This idea has not been refuted yet, so it must be true”
 - Either/or fallacy
 - Dichotomous/binary thinking

- Beliefs
 - Not all beliefs are driven by evidence
 - *Terror management theory* – we experience terror as a result of our awareness that death is inevitable and unpredictable
 - And so we seek values and systems that provide meaning (religion being an example)
 - *Belief perseverance* – adherence to a belief in spite of evidence to the contrary
 - Sometimes we fear the consequences of admitting that we are wrong
 - It can be humbling and costly
 - Our reasons for denying an argument may be *emotional* rather than factual

History of Psychology

Structuralism

- Study the elements of psychological experiences such as colour, smell, reading
- Used the technique of *analytic introspection*
 - Verbal report on experience by many subjects
 - Identify elements by looking at consistencies in the reports
- Key contributors: **Wundt** and **Titchener**
- Gave credibility to psychology as a science
 - The scientific method applies
- Identified differences between *sensation* and *perception*
 - Seeing is different than feeling
- Suggested that *unconscious processes*, which cannot be revealed by introspection, accompany behaviour
 - i.e. we cannot explain how we do a math problem
- Due to the highly variable responses (inconsistent reports), the introspection technique failed to clearly identify any elements

Functionalism

- Explain how behaviours served adaptive functions that increased survival
 - i.e. focus on the purpose of mental processes, rather than their contents
- Example: anxiety helps keeping us safe
- Related to evolutionary theory proposed by Darwin
- Key contributors: many, including **William James**
- Highly theoretical (less experimental), but influential

- Framework for many seminal studies in psychology
- Basis for *evolutionary psychology*, which is a strong and relevant field today
- Theories difficult to test

Gestalt Psychology

- Emphasized that ‘the whole is greater than the sum of the parts’
 - o Contrasts with structuralism
- Primarily focused on *visual perception*
- Key contributors: **Wertheimer**
- Redefined how we study perception
 - o ‘The “whole” always matters’
- Limited in that it did not address mechanism
- We know there are ‘general principles of perception’, but we have no idea why these principles exist

Psychodynamics

- Study unconscious thoughts, feelings, and memories
- Emphasis on internal experiences/conflicts
- Utilized talk therapy and dream analysis, many subjects were psychiatric patients
- Key contributors: **Freud** and **Jung**
- Emphasized unconscious processing
- Illustrated significance of early development
 - o Contributed to *attachment theory*
- Influenced the development of therapy
- Increased the public awareness of psychology
- Limited in that many theories were not rigorously tested
 - o Most theories were based on studying patients

Behaviourism

- Focused on behaviour as it was believed that the mind could not be easily examined (i.e. it was a ‘black box’)
- Key contributors: **Watson** and **Skinner**
- Reinforcement and punishment

	Reinforcement (increase/maintain behaviour)	Punishment (decrease behaviour)
Positive (add stimulus)	<i>Add</i> pleasant stimulus to increase/maintain behaviour	<i>Add</i> aversive stimulus to decrease behaviour

Negative (remove stimulus)	<i>Remove aversive stimulus to increase/maintain behaviour</i>	<i>Remove pleasant stimulus to decrease behaviour</i>
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- Behaviour going up or down – reinforcement or punishment
- Adding or taking away something – positive or negative
- Changed our approach to studying learning and identified key principles of learning
- Illustrated the importance of *reinforcement* and *punishment* in shaping future behaviour
- Chief limitation is that it did not address the importance of mental processes or their contribution to behaviour
- Did not address how certain behaviours can be exhibited without a clear reinforcement history (i.e. language)

Cognitive Psychology

- Study mental processes (such as perception, thinking, memory, judgment)
- Innovative experimental designs and approaches (i.e. *neuroimaging*)
- Key contributors: **Ebbinghaus, Bartlett, Piaget**
- Identified factors contributing to memory/cognition
- Deconstructed thought processes for the first time
- Contributed to our understanding of neural circuitry
- Limitations include a lack of field cohesion (related to size) and empirical support (certain theories lack evidence, misleading correlations between brain activity and behaviour observed)

Social/Cultural Psychology

- Study how social situations and culture influence decision making
- Key contributors: **Heider, Schachter, Festinger**
- Individualism vs. collectivism
 - o The *index* reflects the degree to which people in a society are integrated into groups
 - High index of individualism – individualistic society
 - Low index of individualism – collectivist society
 - o Western societies tend towards individualism whereas Eastern societies tend towards collectivism
 - o Individualism and collectivism may influence many behaviours (family attitudes, facial expressions, prosocial behaviours, creativity, etc.)
 - o We must avoid stereotypes and focus on what is scientifically proven
- Illustrated influences of social context and conformity

- Identified the role of *societal norms* (e.g. for gender) and cultural factors (e.g. individualism vs. collectivism)
- Helped us 'break down boundaries' between groups
- Low effect sizes/modest predictive power; useful for society but not the individual
 - Culture is not good for predicting behaviour
- Depression rate is higher in countries that have higher GDP
 - Economic factors (employment, purchasing power, etc.)
 - Some jobs come with risks (i.e. social isolation)
 - Access to health care services
 - Affects diagnosis of depression
 - Social attitudes (valuation of happiness, stigma towards depression)
 - Diagnostic criteria
 - Other environmental features (diet, etc.)

Lecture 2: Research Methods in Psychology

Studying Variables in Psychology

Variables

- *Variable* – an attribute that assumes different values across people, places, and timepoints
- Behaviours vary between people (*individual differences*) and within each person
- In psychology, *behaviours* are the variables of interest

Distribution

- *Distribution* – graph of all the values that a variable can assume in a given population
- For each score (x-axis), there will be a number of people with that score (y-axis)
- Measures of *central tendency*:
 - *Mean*
 - The ‘average’ score of the variable within a population
 - Computed by dividing the sum of all scores by the number of cases
 - $\bar{x} = \frac{\sum x}{n}$
 - For IQ, mean = 100
 - Sensitive to extreme scores
 - Particularly if the population is small
 - *Outliers* – ‘extreme scores’
 - *Median*
 - The value separating the higher half of a population from the lower half
 - In (1, 3, 3, 6, 7, 8, 9), the median is 6
 - Not influenced by extreme scores/outliers
 - *Mode*
 - The most frequently occurring value in a population
 - In (2, 3, 3, 5, 5, 5, 7, 7, 6, 6, 5), the mode is 5
- *Standard deviation (SD)*
 - A measure of how much a score in the population typically deviates (\pm) from the mean
 - High SD means a lot of spread around the mean
 - Low SD means little spread around the mean
- Mean to SD ratio

- If $M = 100$, $SD = 15$ (100 ± 15), $ratio = 100/15 = 6.67$
- If $M = 100$, $SD = 25$ (100 ± 25), $ratio = 100/25 = 4$
- If $M = 100$, $SD = 50$ (100 ± 50), $ratio = 2$
- In cases where SD is high relative to M, we become concerned about high variability in the population
- Outliers
 - Definition: a score that is 2 absolute SD units away from the mean
 - For IQ ($M = 100$, $SD = 15$), outliers might have
 - $IQ < 70$ (2SD below 100)
 - $IQ > 130$ (2SD above 100)
 - Outliers can lead to misrepresenting means and limit the usefulness of statistics based on means
 - Means are also less useful when the data is not normally distributed

Defining Variables in Psychology

- Certain variables (e.g. height, weight) are easy to handle, because they are tangible and measurable, but others are not
- Consider *anger*, *happiness*, *sadness*
 - We believe these variables are real and reflect important attributes
 - However, we have no evidence these variables exist
 - There is no 'happy particles' or 'sad molecules'
- Happiness and sadness are referred to as *conceptual variables*
 - They are concepts, rather than tangible things
- Our main strategy is to look for behaviours associated with these conceptual variables that can be measured

Intelligence

- *Intelligence* – defined as 'the capacity to acquire and apply knowledge and skills'
- Conceptual variable
- We can approximate intelligence by measuring behaviours we think are associated with it

Defining Conceptual Variables

- There may be more than one way to define a variable
- Every time a scientist studies a variable, they must clarify how
- *Operational definition* – a strict definition of a variable within a study
 - What specific thing we are measuring to reflect the conceptual variable?

- Effective operational definitions rely on criteria validate by the academic community (such as standardized tests)

Construct Validity

- When we develop a definition of a variable, we want it to be a good definition
- *Construct validity* – the degree to which a construct measures what it claims to be measuring
 - o Does our definition actually reflect the conceptual variable?
- If our operational definition is a good way of measuring the variable, then we will have construct validity

Example

- We want to study *intuition* (a *conceptual variable*)
- We define intuition as the “ability to understand immediately without the need for further data or reasoning”
- We design a psychological test for intuition (INT-Z test) (an *operational definition* for intuition)
- We hope the INT-Z distinguishes intuitive people (higher scores) from un-intuitive people (lower scores)
- **Result:** There is *no relationship* between someone’s INT-Z score and their intelligence test scores, grades in school, mean income
- Our operational definition of intuition depends upon the INT-Z test results
- There is no construct validity here
 - o Our test claims to measure intuition, but the evidence suggests it does not

Reliability and Validity

- For a test to be useful, we need
 - o *Construct validity*
 - Our test measures what we say it measures
 - o *Test-retest reliability*
 - Every time we do the test, we get a similar result
 - o *Inner-rater reliability*
 - No matter who is scoring the test, we get a similar result
- If we don’t have these three things, the test is not useful
- A bathroom scale that is 20 pounds off every time
 - o High test-retest reliability
 - o Low construct validity
- A test of bias that never yields the same score

- Low test-retest reliability
- Low construct validity
- A test of IQ that is predictive of job performance
 - High test-retest reliability
 - High construct validity

Research Methods in Psychology

Variables

- We are interested in the cause of behaviours
- The cause of any one variable may be a change in another related variable
 - i.e. stress may affect depression, studying may affect grades
- In a *psychological study*, we collect data on multiple variables so that we may determine:
 - If the variables are related
 - The nature of their relationship
- Often times, we are testing an *evidence-based theory*
- Example
 - Use of social media has drastically increased recently
 - We are aware of previous research which suggests that another similar activity – playing video games – is associated with depression
 - We therefore *hypothesize* that social media (V1) is associated with depression (V2)

Hypothesis

- A proposed explanation of a phenomenon made on the basis of evidence that serves as a starting point for an investigation
- In the case above, we are postulating that social media increases depression-like behaviour
- A good hypothesis must be simple, clear, and *testable* with experimental studies
- Questions
 - How would we *test* the hypothesis that social media increases depression?
 - What data would support this hypothesis?
 - How would we get that data?
- Solutions (many possibilities)
 - Measure social media use (in hours) and depression in people randomly selected from a large population and see if there is a relationship

- Compare depression in 'heavy users' and 'non-users'
- Compare depression in areas where social media is available and where it is not
- Control social media use (e.g. 0, 1, 2, 3 hours) in a randomly selected population and measure depression

The Scientific Method

- Question → Background Research → Construct Hypothesis → Experiment → Analyze Results → Hypothesis is not supported → Revise Approach → (Back to Construct Hypothesis)
- Or, Hypothesis is supported (not likely)
- It is okay for hypotheses to be wrong

Research Approaches

- Descriptive research
 - General assessment of variables through systemic observation
 - It is not possible to infer causation in descriptive research, as the researcher is not doing a manipulation
 - Three main subtypes of descriptive research:
 - Case studies
 - An intensive examination of one individual
 - Can give valuable insight into rare phenomena
 - Provides *proof of existence* (that something can happen, even if improbable)
 - Common in medicine; basis of many of Freud's theories
 - Difficult to generalize to large populations
 - Surveys
 - Record data on a variable (or many variables) in a large population via questionnaires or interviews
 - Can be highly generalizable
 - Surveys are valuable in social psychology
 - Rely upon honesty
 - Accuracy varies; higher for some traits (extroversion) and lower for others (anxiety)
 - *Positive impression management* can occur
 - Exaggerating positive traits
 - *Malingering* can occur
 - Exaggerating/manufacturing problems
 - The *wording of questions* matters

- Depending on how we *frame* a question, the response varies
 - 1. Out of 600 people, 200 will live if you do this...
 - 2. Out of 600 people, 400 will die if you do this...
- Naturalistic observation
 - Observation of an animal in its natural setting without direct intervention
 - High external validity; highly generalizable; avoids concerns about the observer effect
 - Poorly controlled
 - Limited range of variables can be assessed
 - Difficult to study infrequent behaviours and thoughts
 - Ethical concerns
- Correlational analysis
 - *Correlation* – a mathematical measure of the strength of relationship between two variables
 - Technically an analytic technique, not a research design
 - The measure is termed the *correlation coefficient*
 - *Pearson r* – the coefficient for continuous variables
 - The *r* value ranges from 0 – 1
 - The higher the absolute *r* value (positive or negative), the stronger the relationship
 - We can do a correlation between any two variables in one population (e.g. alcohol and grades)
 - Interpreting correlations: does A cause B, or does B cause A?
 - Outside temperature (A) and human perspiration (B) are positively correlated
 - Hours of exercise (A) and body mass index (B) are negatively correlated
 - Social media use (A) and psychological well-being (B) are negatively correlated
 - In *none* of the above cases can we infer cause
 - We can never infer cause from a correlation alone
 - **Correlation does not equal causation**
 - Strong correlations suggest causal relationships, but are not definitive proof of them
 - Even strong correlations can be misleading, due to
 - *Third factor effects* (variable C causes A + B)
 - Attendance is positively correlated with marks ($r = 0.6$)

- Attendance alone might not cause high marks, many other variables might contribute
 - Motivation (the third factor) is strongly correlated with attendance and marks
 - Students who are motivated to attend lectures are also motivated to study, and studying causes high grades
- *Spurious associations*
 - Correlations can emerge by chance, and may not represent real relationships in nature
- *Non-linearity* (correlation equation won't work)
 - Curvilinear relationships cannot be accurately described by the correlation equation ($r = 0$)
 - The hypothesized relationship between arousal and performance is an example
 - Yerkes-Dodson Law
 - Always graph data, not just looking at the r value
- Experimental research
 - Allows for us to infer *causal* relationships between variables
 - *Experiment* – a controlled environment wherein we study the relationship between a defined set of variables by controlling all the rest
 - Simplest case: the researcher manipulates one variable (*independent variable/IV*) while measuring another (*dependent variable/DV*)
 - *All other variables* are kept constant if possible

Cause	Effect
Manipulated	Measured
Independent variable	Dependent variable

- Because all variables are kept constant but the IV, any change in the DV must be due to the IV
- Example
 - We want to determine the contribution of stress (IV) to exam performance (DV)
 - *Randomly assign* 500 people to two groups:
 - No stress (control), 250
 - High stress (treatment), 250
 - What affects exam performance
 - Hours spent studying, IQ, background in the subject, age, ..., and stress (the one we are interested in)

- We must control the influence of the above variables besides stress
 - If all of the other variables are successfully controlled, any group difference in the DV must be explained by the remaining variable: stress
- True experiments must have:
 - Random assignment to groups
 - Controlled manipulation of the IV in the laboratory
- *Quasi-experiment* – one of the IV's is not randomly assigned but another is
 - Group membership in one case (i.e. depression) is decided *before* the experiment begins
- Experimental designs
 - *Between-subject design*
 - 2+ groups, each given a different treatment
 - i.e. group 1 given Drug X, group 2 given Drug Y
 - *Within-subject design*
 - One group observed 2+ times (e.g. before and after treatment)
 - i.e. group 3 before Drug Z, group 3 after Drug Z
 - Experimenters lose touch with people over time
 - Takes long
 - Expensive
 - *Mixed design (between and within factors)*
 - 2+ groups, each observed 2+ times
 - Within-subject designs and mixed designs allow us to control for *confounding variables* (as subjects are compared to themselves)
- Experiments are favoured
- The study method we use depends upon needs and resources

Concerns with Experimental Designs

Concerns

- Sampling
 - To generalize results in the laboratory to a larger population (*external validity*), we need to make sure our lab sample is *representative* of that population
 - Example: sampling and SONA
 - Most psychology studies are done on psych students
 - Psych students are a special group with certain traits

- Frequently female (~75%) with higher IQ (>100), socioeconomic status and motivation than average
 - Results in psych students may not generalize to other groups composed of individuals with different traits
- If we cannot generalize our results, our study lacks *external validity*
- The *WEIRD* problem
 - Studies focus on **W**estern, **E**ducated individuals living in **I**ndustrialized, **R**ich, and **D**emocratic countries
 - ~12% of world's population, ~80% of study participants
 - Studies on this population might not generalize well to other communities
 - While *sampling bias* is a fault which should be acknowledged, studies with sampling bias are not necessarily 'wrong' or 'useless'
 - Addressing the WEIRD problem
 - More diverse/inclusive samples
 - More settings incorporated into research
 - Acknowledgement of additional interpretations
 - Replication of prior work in different contexts
- Confounding variables
 - When designing studies
 - An experiment is a carefully regulated environment where most variables are controlled
 - We can infer causal relationships (only IV changed, so the IV caused the difference in the DV)
 - Variables that a researcher fails to control can influence their study's results and limit its usefulness
 - *Confounding variable* – an uncontrolled variable that is related to the dependent and/or independent variables
 - Example:
 - Sarah is a lecturer who teaches a 1st year course
 - Mahim is a lecturer who teaches a 4th year course
 - We design an experiment to test whether Sarah is a better teacher than Mahim
 - Does teacher (IV) affect student performance (DV)?
 - A sample of 1st year students is split (via random assignment) between Sarah's and Mahim's courses

- The marks of the students in Sarah's first year course (mean = 90) are significantly higher than the marks of students in Mahim's fourth year course (mean = 82). Is Sarah a better teacher?
 - There is a *major confounding variable* in this study – course difficulty
 - All students are 1st year, and would find a 4th year course more difficult
 - The DV is confounded by the confounding variable of course difficulty
 - Can be fixed by having both instructors to teach courses with the same difficulty
- Demand characteristics
 - When subjects pick up cues during an experiment and modify their behaviour; thereby possibly affecting and altering the results of the study
 - Can be limited with some degree of opacity and/or *deception* by the researcher, which is a common practice
- The observer effect
 - People behave differently when they know that they are being observed
 - Exceptionally difficult to prevent in most cases
 - Only case where it is not an issue is in naturalistic observation studies (where there is no/less awareness of observation)
- The placebo effect
 - People generally have pre-existing beliefs about how treatments might affect them
 - i.e. belief that drugs will treat depression (positive expectation)
 - i.e. belief that culture/social setting does not affect decision-making (negative expectation)
 - A participant's pre-existing beliefs about a treatment may affect their response to that treatment
 - *Placebo effect* – an effect of a treatment that cannot be attributed to the active properties of that treatment
 - Very common in the life sciences (particularly for the treatment of pain and mood disorders)
 - Associated with neurophysiological changes (we can 'see' the placebo effect in our brain)
 - The placebo effect has increased in strength in America over the past two decades
 - Increased belief in physicians/medicine?
 - Role of marketing?
 - Elaborate settings?

- In order to control for the placebo effect, we include *placebo comparison groups* that are given a placebo substance with no active ingredients
 - i.e. sugar pill (drug study) or water (alcohol study)
- If someone responds to a placebo, it is likely because of expectation/beliefs (because there are no active ingredients)
- *Single-blinding/participant blinding* – the participant does not know what treatment they are receiving (placebo or treatment)
- If a treatment truly works, it will affect behaviour more than either a placebo or no treatment
- It is possible to have both a *treatment effect* and a *placebo effect* in the same study
- The experimenter effect
 - *Experimenter effect* – if an experimenter wants a certain result, they might unconsciously behave in a way that gets the result
 - *Double-blinding* – the experimenters and participants are both blinded
 - Requisite for clinical studies

Lecture 3: The Brain

Ethics in Research

Intro

- Studies in Psychology follow strict ethical guidelines
- Before we do any experiment, we are required to get approval from our local ethics committees
- Human and animal research have separate committees

In Human Research

- *Informed consent*
 - o Subject is given all information relevant to participation, including the *possibility* of harm (e.g. reactions to drugs)
- *Freedom to leave* at any point
 - o People often do leave
 - o *Attrition* (subject loss) is high in human studies (~20-50%)
- *Debriefing*
 - o Research hypotheses and procedure are explained in full
 - o Any *deceptions* is revealed and explained when study is done
 - o Most studies involve deception

Why is Deception Necessary

- Participant expectations of treatment can affect the results (*placebo effect*)
 - o Generating expectations
- Awareness of the experimenter's hypothesis can affect the results (*demand characteristics*)
- Both the placebo effect and demand characteristics can confound a study
- For the above reason, certain details of the experiment are not revealed until the experiment is over (*deception*)
- Even though some deception is part of research, participants must still be informed of any potential harm in the experiment (*informed consent*)
 - o "You might get a real drug, but I'm not telling you if you are"

Tuskegee Syphilis Study (An STI)

- Purpose was to observe the 'natural history' of syphilis

- N = 600 people (399 with syphilis) of African-American descent observed over a 40-year period
- Participants not informed of the true nature of their condition
- Participants not given proper medical care (even after antibiotics become available)
- Tragedy which changed research ethics

Statistics

Testing Hypotheses

- Hypothesis: exercise reduces stress level
 - o Participants split into control group and exercise group by random assignment
 - o IV: exercise; DV: stress
 - o Between-subject design
- *Null hypothesis (H₀)* – there is no difference between groups
 - o Control group = exercise group
- *Alternative hypothesis (H_a)* – there is a difference between groups
 - o Control group ≠ exercise group
- If we reject the null hypothesis and accept the alternative hypothesis, we say that there is a *treatment effect* (or simply an *effect*)
- Alternative hypothesis supported: found the desired effect

Gathering the Data

- We get a chart for stress levels for each person in our two groups
- We can use this same data to generate distributions and charts
- If these two populations are different, we state that there is an *effect* of exercise (IV) on stress (DV)
 - o i.e. higher stress level in the control group
- How can we make sure that we are finding differences which are ‘real’ and not due to chance?

Differentiating Groups

- Ideally, we would have an *objective way* to tell if group differences are likely to be real and not due to chance
- In Psychology, we use *statistical tests*
- We have several tests (*t-test*, ANOVA, etc.) that we can use in different situations
- No test is perfect

The p Value

- Sometimes a result is due to an effect and sometimes it is due to chance
- Our tests tell us which of these two explanations is *most likely*
- Statistical tests give a p value (α), which can be thought of as 'the probability a result is due to chance'
- If $p = 0.05$, there is a 5% probability that a result was due to chance and a 95% probability that a result was due to an experimental effect

The Process

- Design experiment and complete experiment
- Get data
- Run a statistical test on data
- Test result has a p value
- The lower the p value of a group comparison, the more confident we can be that our group differences are not due to chance

What is a Good p Value?

- It depends
- We set the error margins in advance, prior to analysis
 - o If we don't, people may adjust it based on the result
- We decide what p values are acceptable (p threshold) (e.g. cut-off average to get into POST)
 - o $p = 0.05$ is common in Psychology
 - o $p < 0.01$ is common in drug studies
- We compare our test p value to the threshold value
- When the p value from our test is below threshold (i.e. $p < 0.05$), we say that the difference between the groups is *statistically significant*

T-Test to Compare Groups

- What looks visually convincing may be deceiving
 - o Always do the math
- A small difference may lead to very different p values

Study Considerations: Sample Size

- We must ensure that our *sample size* (n) is large enough to detect differences
- The larger the n , the more likely we are to find some kind of effect
 - o i.e. a poll of $n = 500$ people is more likely to find an effect than a poll of $n = 50$ people

- The ability to find significant difference (termed *statistical power*) is related to sample size

How Strong is the Effect?

- Not all effects are equally strong
- The magnitude of the treatment effect, is expressed in the form of *effect size*
 - o We get the statistical measure of effect size by doing statistical operations on our dataset (like we did for p)
- Some treatments are very strong (high effect size) whereas others are weak (low effect size)

Understanding Effect Size

- We are doing a study to determine how diet/exercise regimes (IV) affect weight (DV). We have 4 groups: (random assignment)
 - o Running 20 min daily (somewhat effective)
 - Small effect size
 - o Running 40 min daily (effective)
 - Moderate effect size
 - o Running 40 min daily + eat 500 less calories daily (most effective)
 - Large effect size
 - o Nothing (control)
- All are effective, but by different magnitudes
- Sometimes, an effect can be too small to be meaningful
- Strong effects could serve as first-line medical treatment and guide laws, regulations, and policies
- Weak effects might be concerning, but do not usually justify extreme action
- Weak effects are generally less suitable for treatments, unless they have other advantages (e.g. cheap, convenient, etc.)
 - o i.e. meditation vs. drugs

Effect Size and Replication

- The stronger the effect, the easier it is to replicate, and the more meaningful it may be
- Repeating the study is important

Effect Size and Sample Size

- Effect size is relatively unaltered by sample size
 - o i.e. when we increase our sample size by 10 times, the effect size would not change much

- While increasing our sample size increases the probability of finding statistical significance, it does not generally increase effect size
 - o i.e. when we use better magnifying glasses to observe the bug, it become more likely for us to find the bug, but the bug itself stays the same

The Scientific Process

- Do extensive research
- Come up with a hypothesis
- Plan a study to test the hypothesis
 - o Select design, operational definitions, sufficient sample size, set p threshold, ...
- Collect data
 - o Double-blinding usually preferred
- Do analysis (e.g. t-test); compare p value of test to p threshold
- Get effect size estimate
- Support/reject hypothesis; put findings in context
- Start over as necessary

Neurons and the Nervous System

The Nervous System

- Divided into *central (CNS)* and *peripheral (PNS)*
 - o CNS: brain and spinal cord, encased in bone (skull and vertebrae, respectively)
 - o PNS: everything else outside the CNS
 - Sensory connections to receptors in the skin
 - Motor connections to body muscles
 - Sensory and motor connections to internal body organs and gut

The Brain

- ~90 billion cells in the brain
- Two main cell types:
 - o *Neurons*
 - Neurons are excitable cells
 - They can generate and conduct electrochemical signals
 - *Dendrites* receive signal
 - Signal travels down the *axon*
 - “cable”
 - *Myelin* increases the efficiency of signal travelling down the axon

- *Axon terminal* releases neurotransmitter to send signal
- Neurons *intercommunicate*
 - Neurotransmitter released by Neuron A travels across the *synapse* to affect Neuron B
- Neurons receive a chemical signal (transmitter) from another cell, generate an electrochemical impulse (action potential) and then release a transmitter that signals to other cells
- The neuronal membrane
 - Thin *phospholipid bilayer* separating inside (intracellular) from outside (extracellular)
 - Because of the membrane, most substances cannot easily enter or leave (*selective permeability*)
- Resting membrane potential (RMP)
 - By restricting the flow of charged substances, the membrane creates a charge separation
 - There is a *potential difference* across the membrane (V_m)
 - The *resting membrane potential* of the neuron (RMP) is ~ -60 to -70 mV
 - More K^+ ions and A^- proteins inside the cell
 - Less Na^+ ions inside the cell
- Flow of ions across the membrane
 - *Channel* – ‘doors’ in the membrane
 - The structure of the door will only permit certain things to enter (e.g. Na^+ channels permit Na^+ entry)
 - Some doors are locked and require a ‘key’ to open (i.e. some channels only open in specific cases)
 - Channel opening can be triggered by different events
 - When they bind a certain substance (i.e. a neurotransmitter)
 - When channels open, charged substances will move across the membrane
- Consider the case for Na^+ ions
 - Strong inward driving force for Na^+ ions
 - Electrical forces (membrane is negatively charged)
 - Chemical forces (intracellular concentration of Na^+ is low)
 - If we open Na^+ channels, Na^+ ions will flow inward
 - Most Na^+ channels are closed at the RMP

- Some Na⁺ channels will open when they bind a neurotransmitter
- Channels
 - Ligand-gated channels open when they bind a transmitter
 - When certain *ligand-gated channels* bind a transmitter, they open and allow Na⁺ ions into the cell
 - Channel opening
 - Na⁺ ions enter
 - V_m depolarized
 - Membrane potential becomes less negative
 - EPSP
 - Excitatory post-synaptic potential
- Depolarization to threshold
 - Many EPSPs occur are cumulative
 - With many EPSPs, a *threshold* is reached
 - Threshold is -55 mV
- At threshold
 - *Voltage-gate channels* are opened, allowing even more Na⁺ ions into the cell
 - Opening will cause changes to V_m (start of *action potential*)
- The action potential
 - Stimulus → depolarization → action potential → repolarization → hyperpolarization → resting state
- AP propagation
 - Once initiated, propagates down the axon to the *axon terminal*
 - At the terminal, there is release of *transmitter* (chemical signal)
 - This transmitter allows the neuron to communicate with its target
- Myelin and saltatory conductance
 - Signal travels faster with myelination
 - Signal for pain is not as myelinated
 - Painful sensation may lag in time
- Myelination in multiple sclerosis
 - A defining feature of multiple sclerosis is damaged myelination (white matter lesions)
- After an action potential
 - Neuron cannot fire again
 - It must 'reset' to resting state
- IPSPs

- Whereas EPSPs push the neuron closer to firing threshold, *inhibitory post-synaptic potentials (IPSPs)* push it away
 - IPSPs make action potentials less likely
- Glutamate vs. GABA
 - Glutamate: neuron on
 - Excitatory, EPSP
 - GABA: neuron off
 - Inhibitory, IPSP
 - Disrupted E/I balance is a feature of many disorders, including Schizophrenia, Rett Syndrome, Epilepsy, etc.
- From neural activity to behaviour
 - Our brain has billions of neurons which work together
 - At any time, some neurons active and some are not
 - Different patterns of neuronal activity given rise to different behaviours and thoughts
 - Which neurons are firing matters
 - The firing rate of neurons also matters
- Glia
 - Including astroglia, microglia, oligodendroglia

Sequence of Events

- Transmitter from Cell A binds to receptors on Cell B
- Ligand-gated channels on Cell B open
- Na⁺ ions flow in, depolarizing Cell B (EPSP)
- Cell B may reach firing threshold (-55 mV)
- Voltage-gated Na⁺ channels on Cell B open
- Cell B generates an AP
- AP travels down the axon to the axon terminal
- Cell B releases a transmitter from axon terminal
- Transmitter from Cell B binds to receptors on cell C
- And the cycle repeats

Neurotransmitters and Receptors

- In many cases, each transmitter can bind to more than one receptor
 - e.g. seven subtypes of serotonin receptor
 - Receptor subtypes differ in their effects
- The reverse is also true: each receptor can bind more than one compound

- e.g. acetylcholine and nicotine activate nACh receptors; GABA and neurosteroids bind to GABA receptors
- This is why drugs work
- Most transmitters do more than just one thing
 - *Dopamine* – involved in pleasure, addition, reward, cognition, movement, etc.
 - *Serotonin* – involved in mood regulation (depression, anxiety, aggression), cognition, eating, etc.
 - *GABA* – an inhibitory transmitter with a ‘calming effect’, also regulates learning and other functions
 - *Glutamate* – the most abundant excitatory transmitter, the ‘on switch’ for most neurons in the brain

Structure and Functional Specialization of the Brain

Neurons in the Brain

- The brain contains ~90 billion cells, which are carefully organized together
- Gray matter
 - Cortex, cell bodies (nuclei)
- White matter
 - Subcortex, axons (tracts)

Hemispheres and Lateralization

- Left and right hemispheres control the *opposite* (contralateral) sides of the body
- In certain cases, the left and right may differ functionally
 - Language often lateralized left (~70-90% of people)
- Otherwise, the idea of ‘left-brain’ and ‘right-brain’ dominance is an exaggeration

Left-Right Brain Hypothesis

- Certain traits are lateralized to different hemispheres of the brain
 - Most inaccurate, except for language
- People are ‘heavily dominated’ by the activity of one hemisphere
 - Inaccurate

The Cortex of the Brain

- An ‘outer layer’ of cells (gray matter)
 - ~2-4 mm thick
- Functional specialization exists within the cortex

- Different regions of the cortex may do different things
- Cortex is the outer layer of lobe

The Four Lobes of the Brain

- Frontal lobe
 - The 'seat of *executive function*' in the brain
 - Involved in the *planning, organization, initiation, and inhibition of behaviour*
 - Central to initiating *voluntary muscle movement*
 - As it contains the primary motor cortex
 - Regulates *social behaviour, stress, memory, and decision-making*
 - Frontal cortex lesion – Gage
 - The injury was associated with pronounced behavioural changes, such as *increased impulsivity and inappropriate social behaviour* ("no longer Gage")
 - Orbitofrontal cortex and gambling
 - OFC activity in gamblers is different than in controls
 - This is correlational evidence
 - We did not randomly assign people to be gamblers
- Parietal lobe
 - Involved in language, spatial relationships and *tactile perception* (including touch, pain, and proprioception [where the body is in 3D space])
 - Contains the *somatosensory cortex*, where various regions of the body are represented
 - Area proportional to utility rather than size (e.g. hand occupies more area than leg)
 - Touch is different from pain
 - Pain involves many brain areas
 - Lesion might impair the ability to feel/recognize tactile stimuli (*tactile agnosia*), do math (*dyscalculia*), speak (*dysphasia*), and read (*dyslexia*)
- Temporal lobe
 - Associated with many key functions, including *hearing, language, multi-modal integration, and memory*
 - Primary auditory areas are found here
 - May be associated with much more complex functions such as *creativity and religiosity*
 - Abnormal temporal lobe activity (e.g. with epilepsy or injury) is associated with religiosity and intense spiritual/mystical experiences

- There have been attempts to experimentally elicit these experiences via stimulation of the temporal lobe
- May participate in *facial recognition*
 - Damage to the *right fusiform gyrus* can impair ability to recognize faces (*prosopagnosia* or face blindness)
- Occipital lobe
- Cerebellum (not a lobe)

Limbic System

- Hypothalamus
 - Small and complex structure with many subregions, each of which may serve a different (and vital) function
 - The Four Fs
 - Fighting
 - Fleeing
 - Feeding
 - Fucking
 - Important drive centre for *regulatory behaviour*
 - Governs the drive for aggressive, feeding, fearful, and sexual behaviours
 - Also a 'homeostatic regulator' that controls fluid balance, thermoregulation, and circadian rhythm
 - Participates in the regulation of stress responses via the *hypothalamic-pituitary-adrenal (HPA)* axis
 - Stressful event → HPA activation (hypothalamus → pituitary gland → adrenal gland → cortisol, adrenaline, noradrenaline released)
 - i.e. ability to run very fast when chased by a bear
 - Takes time for cortisol level to drop (i.e. to calm down)
 - Cortisol limits its own production
 - Negative feedback
 - Feeding
 - Damage to the hypothalamus (*lateral* and *ventromedial* subregions) disrupts appetite regulation and energy metabolism, resulting in weight changes
- Hippocampus
 - The name *hippocampus* was given to the structure due to its strong resemblance to a certain type of seahorse
 - Centrally involved in *memory consolidation*, spatially-guided behaviour and emotion (particularly anxiety)

- Termed '*the gateway to declarative memory*'
 - The memory that we can report to others
- Different roles of the hippocampus in memory have been proposed over time
- Case study of H.M. has been influential
 - *Hippocampus* surgically removed to treat epilepsy
 - Had *anterograde amnesia* from the point of injury
 - No new declarative memory after injury
- Amnesia
 - *Anterograde amnesia* – inability to form new memories
 - *Retrograde amnesia* – inability to access memories
 - Older memories may be accessible, whereas more recent memories are not
- Types of memory
 - Long-term memory
 - *Declarative* – things we know that we can tell others
 - *Episodic* – remembering our first day in school
 - Storage in cortex
 - *Semantic* – knowing the capital of France
 - Storage in cortex
 - *Nondeclarative (procedural)* – things we know that we can show by doing
 - *Skill learning* – knowing how to ride a bicycle
 - Basal ganglia, motor cortex, and cerebellum
 - *Priming* – Being more likely to use a word we heard recently
 - Cortex
 - *Conditioning* – Salivating when we see a favorite food
 - Cerebellum
- Standard Memory Consolidation Model (older theory)
 - Recent events: hippocampus involved
 - Remote events: hippocampus not involved
 - Hippocampus is analogous to a 'gate' – when it dysfunctions nothing ever gets in
- Older theories (e.g. the one above) argue that the hippocampus is:
 - Necessary for acquiring new declarative memories
 - Not vital for retrieving older, remote declarative memories
- Newer theories (e.g. *multiple trace theory*) argue that the hippocampus is:
 - Necessary for acquiring new declarative memories

- Important for retrieving older, remote declarative memories if those memories are rich in detail (episodic in particular)
- Hippocampus and stress reactivity
 - Contains receptors for *glucocorticoids* (such as *cortisol*), which are released by the HPA axis
 - May help inhibit HPA axis (negative feedback)
- Amygdala
 - Involved in *emotional processing* (fear, anxiety, anger, and positive emotions) and social behaviour
 - Lesions alter fear and anxiety
 - The exact effect varies depending upon the person and nature of the injury
 - Changes in amygdala structure in stress, depression, autism, anxiety, and post-traumatic stress disorder
 - One famous case of an amygdaloid lesion is S.M., 'the woman with no fear'
 - Felt a lot below normal level of fear in response to stimuli
 - Could not read fear on others' faces
 - Had a closer than normal talking distance
- Cingulate gyrus
 - *Gyrus* – a bump in the brain area
 - Plays a role in many behaviours, including social interaction, pain, emotion, and learning/memory
 - Cingulate lesions can have profound effect on social behaviour in humans and animals
- Thalamus (sometimes included)
- Basal ganglia (sometimes included)

From the Brain to the Body

The Spinal Cord

- Tracts for sending motor instructions out
- Tracts for delivering sensory information in

From the SC to the PNS

- Afferent sensory information goes in
- Efferent motor information goes out

Subdivisions of the PNS

- Peripheral nervous system (PNS)
 - Somatic nervous system
 - Cranial nerves
 - Responsible for voluntary movement and sensation in the face
 - Spinal nerves
 - Autonomic nervous system
 - Involved in involuntary functions
 - Divisions of the ANS
 - Sympathetic nervous system (SNS)
 - 'Fight or flight'
 - Running from a bear
 - Parasympathetic nervous system (PNS)
 - 'Rest and digest'
 - Food coma
 - Parasympathetic vs. sympathetic
 - Both systems provide input to similar structures
 - Contrasting effects on those structures' functions
 - *Theory: Imbalance/dominance* (e.g. parasympathetic > sympathetic) is what matters
 - Rest and digest – parasympathetic activity dominates
 - Fight or flight – sympathetic activity dominates
 - Enteric nervous system

Lecture 4: Sensation, Perception, and Consciousness

Sensation vs. Perception

Intro

- *Sensation* – process of receiving information from the environment through our sensory organs (initial phase)
- *Perception* – interpreting/organizing this information so that we may understand and react to it (later phase)
- Perception is akin to a ‘painting’ of the environment produced using information collected via sensation
- There are many cases where our perceptions do not ‘match’ our sensory information (i.e. are not accurate)
- The same sensory information can result in multiple perceptions (depending on context and experience)
- Example: we autocomplete misspelled words, and pass all not-robot tests
- People have trouble distinguishing words in non-fluent languages
 - o *They have poor speech segmentation*

Stimulus Detection

- In an environment, we may report many sensory stimuli
 - o i.e. *visual, auditory, tactile, olfactory, gustatory*
- We are not always accurate in our reports
- We may report experiencing stimuli when no stimuli are present
 - o e.g. report a noise not there
- We may fail to perceive stimuli that are actually present
 - o e.g. fail to report a smell that is there
- Terminology

		Perceiver's response	
		'Yes'	'No'
Stimulus	Present	Hit	Miss
	Absent	False alarm	Correct rejection

Response Bias

- Example: we *think* we hear a sound late at night. We're worried that someone is in our home.
 - o We would investigate the perceived noise
 - o Consequences of being wrong are low
 - o Benefits of being right are high
- However it is not always beneficial to be "yesyesyesyesyesyesyesyes" or "nononononono"

Threshold

- The 'stronger' the signal, the easier to detect
- *Absolute threshold* – the weakest stimulus intensity (in units) at which we correctly detect the stimulus >50% of the time (i.e. above chance)
- Stimuli below this threshold are termed *subliminal*
- We don't have to be 'aware' of a stimulus for it to influence our behaviour
 - o Subjects with *blindsight* are not aware of visual stimuli, but still react to them
 - They respond to a stimulus they are not aware of
 - o In certain cases, the pathway for responses and the pathway for awareness may be separate

Detecting Changes in Stimuli

- Stimulus sensitivity affects our ability to identify changes in stimulus intensity
- Some people are able to recognize small changes in stimuli (e.g. light and temperature)

The Just Noticeable Difference (JND)

- *Just Noticeable Difference (JND)* – the point (in stimulus units) at which one can just barely discriminate a change in a stimulus intensity
- Also termed the *difference threshold*
- If the JND = 4 kg, the two weights must be different by *at least* 4 kg for one to tell them apart
 - o e.g. 1 and 5
- JND is generally proportional to stimulus intensity

Weber-Fechner Law

- Attempts to describe our ability to detect changes in the intensity of a stimulus
- $\frac{\Delta I}{I} = K$
- The slope, K , is a constant
- As K is constant, we can expect that the JND (ΔI) will increase any time stimulus intensity (I) increases

The Senses

Sensory Organs

- Contain *specialized receptors* attached to neurons, these neurons send signals into the brain
- The brain has dedicated networks for each sense

General Pathway

- In the sensory organ are sensory receptors
- These receptors are connected too neurons
- These neurons contribute to *nerves* (peripheral nervous system/PNS) that go into the brain
- Within the brain, most sensory pathways' synapse in the *thalamus*
 - o Thalamus analogous to Union Station
- From the thalamus, we go to *specific cortical areas*

Vision

Vision

- Processing the stimulus of *light*
 - o *Light* – EM wave
 - Different wavelength are associated with different colours

From the Eye to the Brain

- Photoreceptors → Optic Nerve → Thalamus (Lateral Geniculate Part) → Visual/Occipital Cortex

Rods and Cones

Rods	Cones
Dense in <i>periphery</i>	Dense in <i>fovea</i>
Useful for seeing in dim light/darkness	Operate in bright light
Less involved in colour	Role in colour perception; mutations cause <i>colour blindness</i>

- Different types of cones may contribute to colour perception
 - o Certain cones react very strongly to certain wavelengths of light

Trichromatic Colour Theory

- Also called *Young-Helmholtz Theory*
- Every colour is a combination of three *independent* colour signals (and perhaps the activity of three cones)
- Analogy: RGB Colour Slider

Opponent Process Colour Theory

- Processing of signals in *pairs*, contrasting colour signals interact
 - o Blue vs. Yellow
 - o Red vs. Green
 - o Black vs. White
- Reddish green DNE
- Explains *after images*

Visual Perception – Gestalt Psych

- The whole is greater than the sum of its parts
 - o Proximity
 - o Similarity
 - o Continuity
 - o Closure
 - o Area
 - o Symmetry
 - o Figure vs. ground

Depth Perception

- Partly innate
 - o Babies won't cross the perceived cliff, even when called
- Modifiable by learning
 - o Grasping behaviour improves with time

Beta Effect

- Sequential series of static images produce the illusion of motion

Hearing and Auditory Function

Begins with Sound Waves

- Pressure Vibrations in the air
- The magnitude of air pressure (in molecule density) is *amplitude*

- Related to *loudness*
- Changes in air pressure (from high to low) are cyclic (they repeat over time)
- The amount of cycles per second is *frequency (in Hz)*
 - Related to *perceived pitch*
- Sounds are perceived differently because the waves involved have different physical characteristics

dB/Hz Hearing Threshold

- The absolute threshold for hearing depends on the frequency
- We are most likely to detect frequency range from 2000-10000 Hz

Auditory Processing

- 1. Waves are funneled into the auditory canal
- 2. Captured waves strike *tympanic membrane (eardrum)*
- 3. Vibrations relayed through *ossicles* (malleus, incus, stapes) to *oval window of the cochlea*
 - *Cochlea* – snail-like
- 4. Vibrations in *oval window* disturb the fluid in cochlea
- 5. From the cochlea to the brain
 - Fluid motion bends *hair cells*
 - Like wind bending wheat
 - Hair cell bending triggers nerve impulses in the attached neurons
 - These neurons form the *auditory nerve*
 - From the *auditory nerve*, signals are relayed to nuclei in the brain stem
 - Signals are then processed by the *thalamus*
 - From there, they are transmitted to the *auditory cortex* in the *temporal lobe*

Vestibular System

- Related to the auditory system is the vestibular system, which is involved in our perception of *balance*

Taste (Gustation)

The 5 Tastes

- Related to the chemical structure of food
 - Sweet
 - Salty
 - Sour

- Umami
- Bitter (tend to be poisoned)

Tongue

- *Papillae* – some are concerned with tactile sensation, some secrete enzymes, some are concerned with *taste*

Taste Hypothesis

- *Taste map theory*
 - Certain parts of the tongue sensitive to different tastes
 - Disproven
- *Supertaster bud theory*
 - Taste bud density → better taste discrimination
 - Currently debated

The Taste Pathway

- Taste cells → Bipolar neurons → Cranial nerves → Brainstem structures → VPM
Thalamus → *Primary Gustatory Cortex (Insula)*

Multisensory Integration

- Smell (of food), sight (of food), etc. contribute to taste perception

Smell (Olfaction)

Olfaction

- Important for survival
 - Threat warning (e.g. detect fire + spoiled food)
 - Social behaviour (recognition of friends, attraction to mates)
- Notably different than other pathways in terms of processing (i.e. involvement of the thalamus)
- Compared to other senses, poorly studied and poorly understood

Olfactory Pathway

- Begins with *olfactory receptors* in the *olfactory bulb* responding to odorant molecules in the air
- Bipolar Receptor → Glomerulus → Olfactory nerve → Primary Olfactory Cortex (Pyriform) → Secondary Olfactory Cortex (*Orbital Frontal Cortex*)

Olfactory Receptors

- Detect *volatile odorants*
- Receptors allow us to recognize many odours (estimates ~1 trillion)
- It is unclear how odorants interact with receptors
- Many have argued that it is the chemical structure of odorants which is important (*shape theory*)
- Some have argued for vibrational energy instead (*vibrational theory*; controversial)

Shape Theory

- Odorants activate receptors that are responsive to their shape
 - o Related to their chemical structure
- An odour compound may contain many chemicals, and thus may activate a complement of receptors

Are Humans Poor Sniffers?

- Humans stand upright and often miss the volatile odours close to the ground
- It is 'socially inappropriate' for humans to get close to the source of most odorants
- We are not using our sense of smell to its full extent

Nose

- Emotional tears do not have a discernable odour but influence behaviour
- Men smelling women's emotional tears show less sexual attraction to women, less arousals during arousing films
- Awareness is *not required* for a change in behaviour

Smell and Reproduction in Humans

- Humans can predict sex accurately from odour
- Synchronization of menstrual cycles of women in groups
- In women, olfactory sensitivity increase during ovulation and pregnancy
- Men can judge stage of reproductive cycle from odour
- Importance for reproduction poorly understood

Losing Senses

- Loss of smell (*anosmia*) can predict pathology

Touch, Pain, and Proprioception

The Sense of Touch

- Important for social development
- Communicates warmth, caring, and support
- Affected in *autism*
- Different receptors adapt at different rates to stimulation
 - o Fine touch is fast, whereas pain is slow
 - e.g. when we put our shoes on, we don't feel it anymore

Touch

- Sensory receptors/Sensory organs → Spinal cord → Brain (i.e. thalamus) → Cortex (i.e. somatosensory cortex)

Pain

A feeling resulting from injury	<i>A feeling that injury has occurred</i>
Linked to the healing process	Can extend beyond the healing process, e.g. chronic pain
Can be studied relatively easily	Private experience; difficult to study objectively

- *Adaptive response*, allowing us to identify danger and withdraw
- Pain network involves Prefrontal cortex (PFC), Anterior Cingulate Cortex (ACC), Insula, and Somatosensory Cortex (S1, S2)

Insensitivity to Pain

- Serious condition
- High frequency of injury and early death rate
- Injuries progress significantly and become severe before being noticed
- Individual differences in pain correlated with differences in the activity of the prefrontal cortex, anterior cingulate, and somatosensory cortex

Factors Affecting Pain

- Pain is a complex experience shaped by many factors
- Treatments for pain can target these factors
- Factors
 - o Environmental
 - o Psychological
 - o Cognitive/behavioural
 - o Physiological

Proprioception

- Sense of the relative position of one's body and the strength of effort employed in movement

- Achieved through input from specialized neurons in the skin, joints, bones, ears, and tendons
 - o Neurons communicate compression and contraction of muscles
- We make very fast adjustments (e.g. when we are about to lose balance)

Sensory Intersections

Taste

- Integrates all senses at once

Intersection Between the Senses

- Our perception of sound is influenced by visual information
 - o i.e. intersection of hearing and vision
- This is not just an illusion but an important part of how we communicate on a daily basis
- Many people feel they can listen better when they are watching someone
- A similar effect may be involved in *speech-reading/lip-reading*
 - o Visual inputs may be used to activate the auditory cortex, facilitating speech parsing

Speech-Reading

- Involves many areas of the brain
- The *superior temporal sulcus* (STS) is a key site for multi-sensory integration

Interactions Between Senses

- Disconnects can occur, causing adverse experiences
 - o Nausea when information from eyes/body does not match that from the vestibular system (spinning chair)
- Blending of different sensory modalities (*synesthesia*) can occur in rare cases

Illusions

Colour Constancy

- The subjective perception of a colour remains constant under varying illumination conditions
- Our visual system 'adjusts' our perception of colour in a scene based on the perceived illumination of that scene ('subtracts the illumination of that scene')

Consciousness

Consciousness

- *Consciousness* – our subjective awareness of ourselves and our environment
- We have *automatic* (unconscious) and *controlled* (conscious) behaviours as well as both *implicit* (unconscious) and *explicit* (conscious) memory
- Consciousness is fundamental to our sense of identity, free will, and morality
- Most processing is thought to be unconscious processing

States of Consciousness

Daydreaming	Drowsiness	Dreaming
Hallucinations	Orgasm	Food or oxygen starvation
Sensory deprivation	Hypnosis	Meditation

- States differ in physiological characteristics
 - o e.g. breathing, heart rate, neurotransmitter levels, brain activity, etc.
- States may also differ in their effects on behaviour

Sleep

- Why do we need sleep?
 - o Maintenance of the brain (clearance of waste) and restoration of injured tissue
 - o Ontogenetic development of the brain
 - o Maintenance of learning and memory processes
 - o Energetically favourable
 - o Dreaming
- Sleepers in the population
 - o Mean for adults is ~7-8 h
- Sleeping and the student
 - o ~50-60% of students report poor sleep
 - 10% meet criteria for a sleep problem
 - o Poor sleep is linked to less study time, lower GPA
 - o Sleep quality moderated by intrapersonal adjustment, friendship quality, and academic stresses
- Studying sleep with EEG
 - o *Electroencephalogram (EEG)* – a device which measures electrical activity in specific brain regions
 - o Sleep stages
 - Stage *NREM1* (Light Sleep)
 - Slightly lower frequency activity (Alpha and Theta waves)

- Stage *NREM2*
 - Lower frequency activity (Theta) with sleep spindles and K-complexes
- Stage *NREM3/4* (Deep Sleep or Slow Wave Sleep)
 - Mostly very low frequency activity (Delta) and some spindles
 - Efficient sleepers (<6 hours) spend more time in NREM3
- *REM* (Dream Stage)
 - High frequency activity, similar to eyes-open wakefulness, *atonia* (no movement)
- Frequency ranges
 - Beta: >13 Hz
 - Alpha: 7-13 Hz
 - Theta: 4-7 Hz
 - Delta: 1-4 Hz
- Sleep in the elderly
 - Greater sleep latency, more arousal periods (likely awakenings), less REM, less NREM3, less overall sleep

Dreams

- Commonly associated with REM sleep (80% of dreams occur at this time)
- Generally have a narrative as well as an 'experiential resemblance to waking life'
- Centered around aversive themes (>64%), few dreams typically classify as happy (<18%)

Why Do We Dream?

- *Theory of wish fulfillment*
 - Act out the desires that we must repress during the day
- *Evolutionary theory*
 - Dreams include events that are a threat to reproductive success
 - We devise new ways to manage these threats
- *Activation-synthesis theory*
 - Dream states an attempt by the brain to interpret random activity
 - "Dreams are meaningless"

Sleep/Wake Cycles

- Light → Suprachiasmatic nucleus → Pineal gland → Melatonin production decreases → More alert
- Variations in sleep-wake cycles
 - Early birds and night owls *naturally* exist within the population

- Sleep-wake cycle is affected by many factors, including genetics, age, gender, etc.
- *Chronotype* – the type of person in terms of when one wakes up
- Early birds vs. night owls
 - Depending on our cycle, our cognitive performance might be best at a different time of day
 - Night owls who are men perform more poorly when taking classes during the day

Hypnosis

- Trance-like state of consciousness, usually induced by a procedure known as hypnotic induction
- 20% of the participants are entirely unsusceptible whereas ~15% are highly responsive
- May be effective in managing anxiety and pain
- Best candidates are *open to new experiences*, willing/eager to be hypnotized, able to focus their attention and capable of fantasy
- Success of hypnotic induction is also predicted by: conformity, relaxation, obedience, suggestibility, etc.

Meditation

- An activity in which an individual either *trans the mind* and/or induces an *altered state of consciousness*
- Meditation is widely practiced and has shaped culture, religion, and medicine
 - ~8% of adults have meditated (and ~1.6% of children)
- Certain meditation styles, such as mindfulness meditation, may help treat *anxiety*, *depression*, and *chronic pain* disorders

Genes and Behaviour

Gene

- Unit of heredity transferred from parent to offspring
- In humans, 50% of the genetic material is from the father (sperm) and 50% is from the mother (egg)
- Genes encode for *proteins*, which are essential structural component of every organism
- Because genes determine the structure of the *nervous system*, they also determine its functional output
- Genetic variation

- We have ~20000-25000 different genes
- Each of these genes may have multiple alternative versions (*alleles*) with different functions
- Analogy for alleles
 - Most computers have the same basic parts (video card, motherboard, CPU, etc.)
 - However, the *type of part* each computer has is different
 - Depending upon the part the computer has, it functions differently
- The *genes* we inherit from our parents play a powerful role in determining our physical traits, including eye colour, hair colour, height, weight, body shape, etc.
- Genetic and behavioural similarity
 - The more similar we are genetically, the more similar we tend to be behaviourally
 - Monozygotic twins are 100% identical genetically
 - Dizygotic twins are 50% identical genetically
 - Monozygotic twins should be more similar than dizygotic twins

Heritability

- Within a population, traits may vary significantly (*phenotypic variation*, V_P)
 - This variability in traits may be due to changes in genetic factors (V_G) or changes in environmental factors (V_E)
 - $V_P = V_G + V_E$
- *Heritability* (H^2) – the proportion of phenotypic variation explained by genetic factors, such that
 - $H^2 = \frac{V_G}{V_P}$
- Psychological traits are heritable
 - Many psychological traits, including personality, intelligence, ideology, religiosity, etc., are heritable
 - In some cases, the heritability increases with age (e.g. for intelligence)
 - Environment usually plays a big role, as does randomness
 - This includes disorders
- Nature (Genetics) vs. Nurture (Environment)
 - Both forces are significant and interact with each other
- G x E Interaction: Conduct Disorder
 - In humans, the gene variant for *monoamine oxidase A* (MAOA; the warrior gene) may affect vulnerability to childhood maltreatment
- Fitness
 - Anxiety/depression

- They help us to run away from threats
- Dementia
 - Does not inhibit reproduction, and those genes will not become less common
- High intelligence
 - People with high intelligence tend to have less children
- Why do traits become common?
 - With severe *environmental pressures*, certain traits become advantageous (i.e. are *selected for*)
 - In epidemics, disease resistance traits (humans)
 - With antibiotics, antibiotic resistance traits (bacteria)
 - People with these traits *have more offspring* (or greater *reproductive fitness*)
 - Alleles for traits that increase reproductive fitness become more common in a population
 - Alleles for traits that reduce fitness become less common
 - Without environmental pressures, allele frequencies likely won't change much in a population
- Sexual selection
 - Selection for a trait that doesn't directly increase survival, but does increase reproductive fitness (via increasing appeal to the opposite sex)
 - e.g. blue eyes (they just look cool, and that's it), peacock's tails

Key Principles

- All traits are heritable (often ~50%)
- No trait is 100% heritable
 - The environment always explains some behavioural variability (often ~50%)
- A typical trait is associated with many genetic variants, with each accounting for a very small percentage of behavioural variability (<1%)
 - One trait, many genes
- Genes can serve many functions
 - One gene, many traits
 - Termed *pleiotropy*
- Genes affect the likelihood of encountering environments and the response to environments
 - Genes for creativity may attract us to artistic disciplines
 - Genes for IQ permit entry into high-level universities
 - Genes for stress resilience may lower depression risk in response to stressful life events

- Avoid value judgments as much as possible
 - Whether a trait is 'bad' or 'good' can depend upon the context
 - Genes for low alcohol resistance reduce risk for addiction
- There are no necessary policy implications
 - i.e. we should not change the laws based on anything on this document

Lecture 5: Learning and Memory

Learning

Intro

- *Learning* – A relatively permanent change in behaviour resulting from experience

Classical Conditioning

Learning

- We are excellent at forming relationships between *stimuli* (S-S) close together in space/time
- *S-S associations* let us predict events and adjust our behavioural responses (R)
- Ex. Dark clouds (S1) suggest rain (S2) is coming, and we know to stay inside (R)
 - o Dark clouds is not meaningful until we are conditioned
 - o Rain is meaningful

Classical Conditioning

- Two stimuli are *repeatedly paired together*
 - o S1: clouds, S2: rain
 - o S1 and S2 appear together many times
- After pairing, S1 becomes a signal that S2 is coming
- S1 can elicit responses related to S2
 - o With clouds (S1), we expect rain (S2) and bring an umbrella (R)
- S1 acquires a meaning through training (*conditioned stimulus/CS*) whereas S2 has a meaning without training (*unconditioned stimulus/UCS*)
- CC in dogs
 - o Before Conditioning
 - Food (Unconditioned Stimulus) → Salivation (Unconditioned Response)
 - Bell (Neutral Stimulus) → No salivation (No Conditioned Response)
 - o During Conditioning
 - Bell + Food → Salivation (Unconditioned Response)
 - o After Conditioning
 - Bell (Conditioned Stimulus) → Salivation (Conditioned Response)
 - o S1 (NS/CS) = bell
 - o S2 (UCS) = food

- UCR = salivation
- CR = salivation

Terminology

- *NS (neutral stimulus)* – originally no meaning becomes
CS (conditioned stimulus) – meaning acquired through training
 - i.e. bell
- *UCS (unconditioned stimulus)* – meaningful without training
 - i.e. food
- *UCR (unconditioned response)* – the ‘natural response’ to the UCS without training
 - i.e. saliva
- *CR (conditioned response)* – the response to the CS that is acquired through training
 - i.e. saliva

CC In Advertising

- Alcohol (CS) + Socializing (UCS)
- Coke (CS) + Christmas environment (UCS)

CC Can Be Aversive

- *Phobias* may begin with the pairing of a neutral stimulus (NS) with an aversive event (UCS)
- As a result, the NS becomes a CS which elicits the same unpleasant feelings as the UCS
- Aversive learning is generally strong and resilient
 - Phobias of snakes, insects, and needles are common

Fear Conditioning

- A shock (UCS) is paired with a certain environment (CS1, blue box) and a tone (CS2, bell)
- As a result, CS1 + CS2 come to signal the UCS
- When re-exposed to CS1 or CS2, the animal expects the UCS
 - The anticipation of the UCS is reflected in *freezing behaviour* (CR, similar to fear)

CS-UCS Pairings

- Some CS-UCS pairings are easier to make than others
- Animals easily learn taste (CS) → illness (UCS) associations (*conditioned taste aversion*)
- Other stimuli may be difficult to pair with illness (lights, music, temperature) and therefore make poor CS

- We may be genetically hardwired for certain CS-UCS associations (prepared to learn them; referred to as *preparedness*)
- In addition to our genetic programming, our ability to learn CS-UCS associations is also dependent upon on *previous experiences*

Blocking of CC

- After a UCS has been paired with one CS, it may be hard to pair that UCS with other CS in the future
- Learning a sound-food pairing (CSA-UCS; 1st) blocks the acquisition of a light-food pairing (CSX-UCS; 2nd)
 - o Sound → Food; Sound → salivation
 - o Sound + Light → Food; Light → no salivation
 - Sound and light delivered at the same time
 - No meaning is transferred to light
- One theory suggests that *prediction error* is important
 - o *Prediction error* = *actual outcome* – *predicted outcome*
 - o The greater the prediction error, the greater the learning we would expect
 - o The argument is that we learn best when we make mistakes or are surprised (i.e. when prediction error is high)
 - o 1st paradigm: sound paired with food
 - Sound has no meaning (predicted outcome is nothing)
 - Sound is paired with food (actual outcome is food)
 - Actual outcome is different than predict outcome
 - Prediction error is high, learning occurs
 - o 2nd paradigm: light + sound are presented together
 - Sound already signals food (as shown above)
 - Predicted outcome of the light + sound pairing is food
 - Actual outcome of the light + sound pairing is food
 - Prediction error low, no meaning occurs

Variation in Stimuli

- Stimuli vary greatly in their properties
- Consider the bell (CS) that elicits salivation (CR) in Pavlov's experiment
- There are many types of bells, and each might make a slightly different sound (frequency, pitch, loudness, etc.)
- Will all these different bells elicit the same CR?
 - o It is possible, but it depends on *similarity*

- New stimuli similar in characteristics to the original CS may elicit responses conditioned to that CS
- This phenomenon is termed *stimulus generalization*
- Pavlov's experiment: a new bell (previously unpaired) that sounds similar to the old bell (the old CS) will elicit a response (CR; salivation)
- Ex. for similarity
 - o A pigeon was trained to peck for food (R) when shown a light of wavelength 600 nm (original S)
 - o Next, the pigeon was exposed to different wavelengths of light
 - o When exposed to lights with wavelength near 600 nm (similar S), responses were frequent
 - o Otherwise, responses were rare

Stimulus Generalization

- May be increased by anxiety
 - o If we are anxious on an MC test, all options look the same
- Common for fear-inducing stimuli
 - o We readily become afraid of similar stimuli
- Not always a 'bad thing', can be very useful/adaptive (e.g. forming social networks)

Is CC Permanent?

- Our environments are constantly changing
- With time, some S-S relationships we have learned are no longer relevant
- To keep up to date, we should have a way to modify (or eliminate) associations that aren't useful anymore
- One way associations can be adjusted is *extinction*

Extinction

- Earlier, we paired a CS (bell) + UCS (food)
- *Acquisition* – CS presentation caused a CR (salivation)
- *Extinction* – if we stop pairing the CS with the UCS
 - o i.e. delivering the bell on its own multiple times
- *Extinction* – the unreinforced presentation of the CS that results in a decline (or elimination) of the CS
- Extinction "looks" like forgetting, but it is very different
- Evidence suggests extinction results in the *inhibition, not loss*, of learned associations
 - o The memories are still there, just dormant/suppressed

- This argument is supported by the phenomenon of *reinstatement*, *renewal*, and *spontaneous recovery* that are observable following extinction

Reinstatement

- *Reinstatement* – after extinction, the CS can return to full strength following a *single UCS-CS repairing*
- Ex.
 - o Animal associates Box B (CS) with a shock (UCS), and so they stay in box B for shorter
 - o When the CS is presented alone (no shock), the animal gradually exploring Box B again (CR decline; extinction)
 - o *One CS-UCS repairing* and the animal avoids Box B again (reinstatement)
- Extinction takes a while (and often doesn't fully eliminate the CR)
- Reinstatement is fast (and often returns the CR to full strength)

Spontaneous Recovery

- A 'rebound' increase in the CR a prolonged time after extinction
 - o *Time-dependent effect*, no CS-UCS repairing involved
- After extinction, we wait (no CS, no UCS), then when we test the animal again, the CS is back
- Extinction takes maintenance

Renewal

- Extinction is highly specific to context
- Suppose the animal is trained in a blue box. Even if we extinguish a CS-UCS pairing (bell-shock) in one context (e.g. green box), the CS can still elicit a CR in other novel contexts (e.g. purple box)
- Ex. a fire alarm broke in one room so that it randomly rings. People will not run upon hearing the fire alarm in that specific room, but not in other rooms

Extinction Varies in the Population

- Individuals differ in their ability to extinguish behaviour
- Even in people who are very effective at extinguishing behaviour, certain conditions (stress, alcohol, anxiety, etc.) can prevent extinction

Extinction in Therapy

- In phobias and other disorders, we sometimes have clear triggers for episodes of anxiety/fear

- These reactions may have been acquired through experience and may be suppressed by experience too
- Repeated exposure to these triggers over time in a safe environment may diminish the expressed fear (*exposure therapy*)
- Useful in treatment of mood disorders (e.g. anxiety, depression) and post-traumatic stress disorder
- Variants have been done using virtual reality (*virtual reality exposure therapy* or VRET)
- There is an interest in using VR programs to augment rehabilitation programs (following stroke) and modify social behaviours in autism

Operant Conditioning

Intro

- Stimuli (S) are associated with behavioural responses (R) (*S-R associations*)
 - o R associated with positive stimuli (S+) are performed frequently
 - o R associated with negative stimuli (S-) are performed rarely
- *Operant conditioning* – the frequency of a behaviour is controlled by its consequences

Encouraging Adaptive Behaviours

- A cat is trapped in a puzzle box
- With time, the cat will learn to more frequently engage in behaviours that permit escape (e.g. press lever)

Thorndike's Law of Effect

- Responses that create a typically pleasant outcome in a particular situation are more likely to occur again in a similar situation, whereas responses that produce a typically unpleasant outcome are less likely to occur again in the situation.

Reinforcement vs. Punishment

	<i>Reinforcement</i> (Increase/maintain behaviour)	<i>Punishment</i> (Decrease behaviour)
<i>Positive</i> (add stimulus)	<i>Add</i> pleasant stimulus to <i>increase/maintain</i> behaviour	<i>Add</i> aversive stimulus to <i>decrease</i> behaviour
<i>Negative</i> (remove stimulus)	<i>Remove</i> aversive stimulus to <i>increase/maintain</i> behaviour	<i>Remove</i> pleasant stimulus to <i>decrease</i> behaviour

Reinforcement Schedules

- In a *continuous reinforcement schedule*, a reinforcing stimulus is always delivered after every single of episode of a behaviour
 - Rarely seen
- *Partial reinforcement* occurs on schedules that are based upon time (*interval schedules*) or amount of responses (*ratio schedules*)
 - More difficult to extinguish than continuous reinforcement schedule
 - Such schedules may be *fixed* or *variable*
- Four schedules:
 - *Fixed Interval*
 - *Variable Interval*
 - *Fixed Ratio*
 - *Variable Ratio*

Fixed Interval (FI)

- Reinforcement within a *specific amount of time*
- Ex. if we complete an assignment (R) by a specific date (interval), we will get a high mark (reinforcement)
 - We often won't start the assignment (show little responses) until near the end of the deadline
- High responding near the end of the interval

Variable Interval (VI)

- Reinforcement after an *average amount of time*
- Ex. if we check our Quercus account (R) within the next 12 hours (interval average), we will eventually get to know our test mark (reinforcement)
- Response rates are steady

Fixed Ratio (FR)

- Reinforcement after a *specific amount of responses*
- Deals offered by businesses often use the FR schedule
- Ex. for every three tires we buy (R), we get a fourth one free (reinforcement)
- *Post-reinforcement pause*
 - Since we got what we want, and it takes a while for a new one to appear

Variable Ratio (VR)

- Reinforcement after an *average amount of responses*
- Common in games of chance such as poker
- If we keep betting on 'good' hands (R), we will eventually win (reinforcement)

- Highest response rate out of all four and the response rate is steady

Other Reinforcement Consequences

- Reinforcement does not just change the frequency of behaviours
- Using controlled reinforcement, we can gradually train an animal to exhibit behaviours not normally possible
- *Shaping* involves gradually producing a complex behaviour through the reinforcement of successive approximations of that behaviour
 - o i.e. for music, we learn a series of skills at one time before putting them all together

Other Forms of Learning

Observational Learning

- *Observational learning* – an animal learns through witnessing the behaviours of another animal
 - o We don't have to experience things directly (e.g. going through a hard time)
 - o Different from conditioning, which requires the animal experience thing directly

Latent Learning

- Learning that is not being expressed
 - o Usually because of a lack of incentive
- Ex. consider a 'messy roommate'
 - o The roommate clearly knows how to clean, but they don't do it because:
 - No reward for cleanliness
 - No punishment for messiness

Definition of Learning

- We originally called learning a 'relatively permanent change in behaviour resulting from experience'
- The change in behaviour might not be visible (as in latent learning), perhaps due to incentives
- The experience need not be personal experience (as in observational learning)

Memory

Intro

- *Memory* – process whereby information is stored, consolidated, and retrieved
- Several types (or stores):
 - Sensory
 - Directly from our perception
 - *Short-term/STM*
 - Lasts a relatively short time span
 - i.e. seconds to minutes
 - ‘Mental sketchpad’ where information is kept
 - Information stored in STM decays and is soon forgotten, unless it is *emotionally salient* and/or *mentally rehearsed*
 - Capacity
 - Most humans can recall a sequence of 7 ± 2 (i.e. 5-9) items with little difficulty
 - Most data is designed with this limit in mind (phone numbers, SIN, student numbers, etc.)
 - However, we are often able to remember more items
 - *Chunking* – dividing a body of information into several meaningful groups
 - Increases STM capacity
 - STM capacity becomes 5-9 chunks
 - *Long-term/LTM*
 - *Declarative* – things we know that we can tell others (hippocampus dependent)
 - Episodic (e.g. remembering our first day of school)
 - A person’s unique memory of an event from their perspective
 - “Remembering”
 - Semantic (e.g. knowing the capital of France)
 - General knowledge that anyone could know
 - “Knowing”
 - Associated with the cortex
 - *Nondeclarative* – things we know that we can show by doing (hippocampus independent)
 - Experience influences future behaviour (e.g. typing, drawing, music, etc. that are learned with experience)
 - Involuntary
 - No awareness of memory being utilized
 - Contents of implicit memories cannot be reported

- Skill learning (e.g. knowing how to ride a bicycle)
- Priming (e.g. being more likely to use a word we heard recently)
- Conditioning (e.g. salivating when we see a favorite food)
- Associated with the cortex and other brain regions
- *Serial processing* – order matters
 - Sensory → short-term → long-term

Primacy/Recency Effect

- When given a short list of items, we would generally remember the first and last part well (but forget the middle part)
 - Also termed the *serial position effect*

STM vs. Working Memory/WM

- The concept of *working memory (WM)* is related to STM
- The two terms are *not* the same
- WM specifically refers to the framework of processes that *temporarily store* and *manipulate information*
 - i.e. WM allows us to perform mental operations upon information (such as taking the derivative)
- *Several processes* that work together to manage information (visuospatial sketchpad, phonological loop, and central executive)
- WM involves manipulating information
- Digit Symbol Test
 - 1: \Leftrightarrow , 2: \in , 3: \exists , ...
 - We need to translate each number into the symbol
 - As we practice, we would not need to look at the correspondences to translate
- OSPAN test
 - Count the number of unrelated words that can be remembered (*temporary storage*) while simultaneously carrying out a math task (*active processing*)
 - Is $\frac{d}{dx}x^2 = 2x$?
 - Snow
 - Is $5^3 = 125$?
 - Dog
 - Is $\int_0^1 x dx = \frac{1}{2}$?
 - Net
 - Is $\sin \frac{\pi}{2} = 1$?
 - WHAT ARE THE WORDS?

Comparing Memory Properties

- Duration
 - Length of time information lasts in store
 - STM lasts seconds, LTM lasts a lifetime (virtually limitless)
- Capacity
 - Volume of information in store
 - STM is limited, LTM is limitless
 - As long as we rehearse
- Accuracy
 - Amount details consistent with original experience
 - Complicated

On Memory

- Most people think of memory as a process wherein we retrieve something from the past (video, book, audio track...) and re-experience it in the present
 - This idea presumes that a memory is stored in a 'permanent form' and does not change
 - False
- Memory is *(re)constructed*
 - Memory is not passively retrieved but actively assembled
 - We do not 'see the past' but build a mental representation of it
 - Construction of this representation is influenced by our current goals, expectations, knowledge, and schemas
 - Memories may change every time we recall them
 - e.g. a good restaurant in our memory may not taste **that** good
 - Memory over time
 - Memories for everyday and emotionally arousing events become inaccurate over time, though confidence in arousing memories remains high
 - Consistent detail decreases over time
 - Inconsistent detail increases over time
 - Our confidence in our memory is misleading
 - Whenever we recall a memory, we are likely making it vulnerable to interference
 - A good example of this phenomenon is the gradual change in personal anecdotes

- Details change, emotional tone changes based on context (e.g. audience feedback)
- One mechanism by which memories may be 'updated' is *memory reconsolidation*

Memory Reconsolidation

- Long-term memory \Leftrightarrow Active memory (in use)
 - The \Leftrightarrow is the process of reconsolidation
 - Memories being 'updated' after being recalled

Inaccurate Memories

- The term *eyewitness* applies to someone with a firsthand account of an event (i.e. memory of it)
- Eyewitness testimony plays a pivotal role in the legal system, but it is not perfectly reliable
 - $\frac{3}{4}$ of wrongful convictions are due to erroneous testimony
- Though eyewitnesses are often confident in their testimony, their accounts can be inaccurate
 - Eyewitnesses are just as confident in incorrect accounts as they are with correct ones
 - Confidence is not perfectly related to memory accuracy
- After a crime, an eyewitness' memory can be modified by interviews, media coverage, and other events
 - This is an example of the *misinformation effect*, and it can happen in other cases

Misleading Memories

- Encoding (one event)
 - A car beside a '**yield**' sign
- Post-event information (questions)
 - First group: consistent with slide show: "Did another car pass the red Datsun while it was at the **yield** sign?"
 - Second group: neutral with slide show: "Did another car pass the red Datsun while it was at the **street** sign?"
 - Third group: inconsistent with slide show: "Did another car pass the red Datsun while it was stopped at the **stop** sign?"
- Retrieval (two-alternative forced choice recognition)
 - The responses between groups are different

- Despite the fact that no one should have the memory of a car at a stop sign

Misinformation Effect

- We are all vulnerable, but some groups are more vulnerable than others
- Young children and older adults generally more vulnerable
- Individual traits may matter
 - *High empathy* and *low intelligence* are linked to increased vulnerability
- Even individuals with exceptional memory (extreme outliers) are vulnerable to misinformation

Imagination Inflation

- Other interventions do not just modify memory, but can create memories of events that never happened (*false memories*)
- In this study, people are asked to imagine events and then later judge whether or not a certain event occurred
- If someone is asked to imagine an event, they may later recall that it happened to them
- Not a strong effect, but it is there

False Memories During Therapy

- Improper interventions can modify the patient's memories or create false memories
- For this reason, it's important for therapists to be careful and follow guidelines

Retrieving Memories

- In *recognition*, we are identifying information as familiar or not familiar (e.g. MC test)
 - Subtle cues given
- In *recall*, we must recall with subtle cues (e.g. essay test)
 - Requires one to know the context very well
- Performance in multiple choice and essay is correlated; most students do better on multiple choice

Retrieval Failures

- Sometimes we have a memory but cannot retrieve it fully
 - The *tip-of-the-tongue* phenomenon
- Often times, all we need is a subtle cue (hint) to retrieve the full memory
 - Called *priming*
 - Works because memories are interconnected

- e.g. if the answer is “school bus”, then a hint of “student” may lead to the answerer recalling the answer

Note-Taking

- The way in which we document our experiences can affect our subsequent memories
- Student taking longhand notes perform better on conceptual questions than those taking laptop notes
- If someone else is using a laptop nearby, we are likely to perform worse
 - In which case we are dividing attention to the laptop

Study Methods

- There are many ways in which we can represent information (e.g. mental images, drawing, text, etc.)
- These forms may be processed separately (e.g. image and word processing)
 - *Dual Coding theory*
- Recall is better if *mental imagery* is encouraged, if words are presented with matching images and if animations paired with narrations
 - Abstract words, which cannot easily be paired with images, are harder to remember than concrete words
- One of the best ways to recall information is to practice retrieving it (testing ourselves)
 - After studying a concept, try doing a free recall of everything we learned
 - Afterwards, compare our recollection to the original information and make corrections
 - This is termed *retrieval learning*, and has been shown to be very effective
 - Best results are obtained when testing/studying or testing alone
- Study schedules
 - Some choose to study for a long time in a few sessions (termed *massed practice*)
 - Others study for a moderate time in many more sessions (*spaced practice*)
 - Spaced practice is superior for long-term recall
 - People *believe* they have learned more with massed practice (false)
 - Confidence is misleading
 - Most people don't use great methods, even if they are aware of them

Learning Styles (such as VARK)

- Visual, auditory, reading, kinesthetic
- However, there is no strong evidence for styles
 - Most people do not study according to their specified learning style

- 'Matching' of learning styles (e.g. auditory learning for auditory learners) does not improve performance
- Those with 'visual styles' tend to perform better no matter what study methods are used

Lecture 6: Intelligence and Language

Neural Mechanisms of Learning/Memory

How Does Learning Occur?

- During experience, there is brain activity that results in long-term result
- The areas that are 'engaged' by an experience may change over time (i.e. *experience-dependent neuroplasticity*)
 - o These structural changes may lead to functional changes in behaviour (i.e. *learning*)

Memory In the Brain

- Brain has ~86 billion neurons
- Any one memory may be represented in a few of these many cells
 - o i.e. a few hundred or a few thousand
- A subset of cells representing a memory is termed a *memory trace/engram*
- Neurons in an engram are inter-connected with one another via synapses
 - o "Neurons that fire together, wire together"
- Changes in *synaptic strength* might be especially important for learning
- Stronger synaptic connections between neurons might lead to stronger memories
- *Long-term potentiation (LTP)* – the cellular process by which synaptic connections increase in strength
 - o Achieved through re-learning, re-studying
- If we stimulate Neuron A very quickly, the EPSP induced from Neuron A to Neuron B in the future is much more stronger than before

LTP and Memory

- LTP is seen throughout the nervous system, including the hippocampus, cortex, striatum, and spinal cord
- LTP is often correlated with learning and memory
 - o Learning is linked with the development of LTP
 - o Deficits in learning/memory are linked to deficits in LTP
- Rather than just altering synaptic strength, we are increasing dendritic complexity and adding synapses
 - o This means a neuron can process more input

- Activity-dependent variations in synaptic strength such as LTP may be a fundamental mechanism by which we acquire and modify all behaviours
 - o Includes pain, motor learning, and addiction
- Learning usually involves changing the structure of neurons and their environment
 - o If we change many many many neurons, the change may be visible to us
 - o Changes in vasculature (blood vessels) also occur with experience

LTP in Chronic Pain

- In the PNS, *C fibers* transmit signals regarding pain-related information to the spinal cord
- LTP in C fibers may contribute to *chronic pain*
- LTP in the *anterior cingulate cortex* (which is involved in pain processing) may also contribute to chronic pain

Intelligence

Intelligence

- *Intelligence* – the capacity to acquire and apply knowledge and skills
 - o Have information and deploy them to solve problems
- *A conceptual variable*
- Easy to define but challenging to study

General Intelligence (*g*) Theory

- Intelligence may include many cognitive abilities
 - o We can measure these abilities using standardized cognitive tests
- For any individual, the results of different cognitive tests are highly *correlated*
 - o i.e. if we do well on one cognitive test, we generally do well on other tests
- Performance on different subjects in school are positively correlated (0.40 – 0.83)
 - o Performances are also correlated with a constructed factor, *g*
- Scores on cognitive tests are also positively correlated with each other
 - o They are also correlated with a constructed factor, *g*
- A common element contributes to all cognitive abilities (an ‘engine’ driving all cognitive processes)
- Constructing *g* with factor analysis
 - o *Factor analysis* – A statistical technique
 - o Feed the scores of cognitive tests to an equation outputs intelligence

Quantifying Intelligence

- The most popular technique for estimating g is the *intelligence quotient (IQ)* score
 - o IQ is an operational definition of intelligence
- In an IQ test, we give an individual many cognitive tasks and observe their performance
- Performance data is used to compute an IQ score
- *Weschler Adult Intelligence Scale (WAIS)* tests are popular
 - o High construct validity
 - o IQ is divided into categories, which are in turn further divided into sub-categories, etc.

Cognitive Tests

- May be interfered by culture/background
- *Picture completion* tests the ability to recognize missing details
- *Block design* requires one to complete a shape quickly with random blocks
 - o Observes speed
- *Raven's progressive matrices* requires one to complete complex patterns
 - o Measures *non-verbal spatial ability*
 - o Also observes speed
 - o Not interfered by literacy/culture/etc. because one only needs to know shapes

Measuring Intelligence – Barriers

- *Language ability* and *culture* may complicate intelligence testing
- IQ tests developed for one group (e.g. for Europeans) may not apply well to another (e.g. Chinese)
- To reduce the influences of language and culture on the measurement of intelligence, it is important to use *culture-specific tests* and *non-verbal assays* (such as Raven's matrices)

Intelligence Quotient (IQ)

- Normal distribution
- $M = 100, SD = 15$, ~68% scores between $\pm 1 SD$
- We may not see the same distribution if e.g. we test university students

Intelligence and Info Processing

- People who are intelligent 'think quickly'
- *Reaction time (RT)* is negatively correlated with IQ
 - o i.e. the smarter you are, the faster you react
 - o Low RT, high IQ

- RT is a predictor of dementia in the elderly
- People with high IQ show more efficient brain activity (i.e. less brain activity, same performance) during working memory tasks of moderate difficulty
 - o Smart people filter distractions better and show less overall brain activity during difficult tasks

Intelligent Brain

- Intelligence is correlated with white matter integrity (i.e. myelination), brain size, neuron number (in cortex), and *cortical thickness*
 - o Myelination means signal is faster
- Cortical thickness decline with age, and this may contribute to *age-related cognitive decline*
- Not all forms of cognition are equally affected by aging

Crystallized vs. Fluid Intelligence

- Fluid intelligence decreases with age
 - o E.g. reasoning ability, memory, processing speed
- Crystallized intelligence increases with age
 - o E.g. vocabulary

IQ as a Predictor of Success

- In Terman's famous study, children with a high IQ (mean IQ ~150) were tracked for 50+ years
- The children ('Termites') went on to be quite successful
- IQ is correlated with job performance
 - o Correlation is stronger with more complex jobs
- To an extent, higher IQ is good for leadership positions, however, past a certain point (IQ > 120), IQ may be detrimental to perceived leadership ability
- Very high IQ scores are associated with lower perceived leadership ability (*curvilinear relationship*)

Correlates of IQ

- Positively correlated with longevity (how long your life is) and height/weight
- Negatively correlated with criminal behaviour and divorce rate
- IQ is positively correlated with income (however only 9 percent of variations of income can be explained by IQ, i.e. $r^2 = 0.09$), and it is not an excellent predictor of wealth
 - o There are many other non-cognitive variables (creativity, personality, etc.) being predictors of success

Non-Cognitive Predictors Useful

- One study examined whether you could predict Special Forces selection in the military from physical, psychological, or physiological measures
- Physical measures (e.g. pull-ups, run times, etc.) turned out to be good predictors of selection
- Psychological measures (e.g. IQ) were also predictors
- Physiological measures (e.g. cortisol) were not predictors
- Other studies have shown similar results

Other Tests Also Have Predictive Power

- E.g. SAT, GRE, MCAT, etc.

Nature or Nurture?

- Mental abilities (e.g. creativity, musical talent, mathematics proficiency, etc.) tend to run in families and are thus considered *heritable*
- The ability of genetics to predict IQ *increases* with age ($h^2 = 0.4$ to 0.8)
- Intelligence is one of traits with the highest heritability score, not including disorders

Increase of Heritability for IQ

- A high IQ allows us to enter into specialized environments that will further reinforce IQ
 - o The enriched learning environment may be conducive to further increasing IQ
- Genes may affect our attraction to environments and our ability to benefit from them
 - o *Genetic mediation of environmental effect*
 - o Genes for IQ might attract us to activities that maximize IQ (e.g. school, reading, problem-solving, etc.)
 - o Genes for IQ might maximize the benefits we get from these environments (e.g. genes for plasticity mean our brain changes more with the same experiences)
- Genes for IQ may take effect later in life (*innovation*) and become increasingly important over time (*amplification*)
 - o E.g. genes for losing less brain cells over time

IQ and the Environment

- The *Flynn effect* suggests that environment matters
 - o *Flynn effect* – the effect in which overall IQ scores increased over time (i.e. from last century to this century)
- Genetics is not favoured as an explanation, as the effect has emerged too rapidly (~50 years)

- Genetic changes are very slow
- Various environmental factors possible: nutrition, widespread information access, familiarity with testing, etc.
- Many have argued that the Flynn effect has already stopped and may even be reversing
 - The reasons for this reversal are currently unclear, but may involve other environmental factors such as scarcity
- Benefits might hit a ceiling (*asymptote*)
 - Past this point, increases in environmental quality might not matter
 - Increasing environmental quality has:
 - More benefits to low quality
 - Less benefits to already-high quality

Scarcity Mentality

- *Scarcity* – lack of resources
- Scarcity and being worried about scarcity may impair cognition
- Poor cognition in turn can lead to further financial difficulties and stress (feedback)
 - *poverty* \Rightarrow *impaired cognition* \Rightarrow *poverty* \Rightarrow ...

Other Environmental Factors

- In certain areas, *pollution* might contribute to the disparity in IQ scores
- Lead poisoning can cause impairments in IQ and cognitive functioning
 - A major issue in lower income neighbourhoods and certain communities

On the Power of Environment

- Environmental quality benefits intelligence to a point
 - Past this point, increasing environmental quality likely has limited benefit
- Most treatments (e.g. cognitive training) have failed to produce a lasting increase in cognitive ability
- Commercial 'brain games' don't work albeit popular
- Parenting strategies generally have weak influences

On the Genetics of IQ

- There are no necessary policy implications that come with understanding the heritability of IQ (or any trait)
- Historically, cultural movements based upon genetics have had tragic consequences
- The philosophy of *eugenics* proposed that trait improvement in the human race could occur through controlled breeding
- Policies based on eugenics during the *eugenics movement* had terrible effects

The Eugenic Movement

- ~30 countries had eugenic policies (such as sterilization) in the early to mid 1900s
 - o Including the US and Canada
- Eugenics was later appropriated by Nazi Germany in the 1940s and associated with mass genocide

Sternberg's Theory of Intelligence

- *Analytical intelligence*
 - o Academic problem solving and computation
 - o Measured by IQ tests
- *Creative intelligence*
 - o Imaginative and innovative problem solving
- *Practical intelligence*
 - o Street smarts and common sense
- This model is important because it emphasizes the role of *creativity*

Creativity

- Creativity is *weakly correlated* with intelligence and moderately correlated with personality features
 - o Particularly *extraversion* and *openness to experience*
- What makes a person an especially high achiever may be a combination of traits (high IQ and high creativity)
- Measuring creativity is challenging
 - o Not unlike measuring intelligence
 - o *Alternative use task*
 - “List as many possible uses for a newspaper as you can within 10 minutes”
 - Involves *divergent thinking*
 - Scored on 4 scales
 - Originality – rare uses worth more points
 - Fluency – total number of all responses
 - Flexibility – number of different categories used
 - Elaboration – amount of detail in each response
 - o *Remote association task*
 - “What single word associates the 3 words together: plate, lining, fox in 30 seconds”
 - Answer: silver (reason: silver plate, silver lining, silver fox)

- Involves *convergent thinking*

Gardner's Eight Intelligences

- Spatial
- Bodily-kinesthetic
- Intrapersonal
- Naturalist
- Musical
- Interpersonal
- Logical-mathematical
- Linguistic

Emotional Intelligence

- *Interpersonal* and *intrapersonal intelligence* are intelligences relating with how people feel
- One measure is the *Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT)*
 - 4 branches
 - *Perceiving* emotion
 - Q: How much of each emotion is being shown in this picture (from 1-5, highest to lowest)
 - Happiness, fear, sadness, surprise
 - *Understanding* emotion
 - Q: Tom felt anxious, and became a bit stressed when he thought about all the work he needed to do. When his supervisor brought him another project, he felt _____.
 - Overwhelmed, depressed, ashamed
 - *Facilitating thought* with emotion
 - Q: what moods might be helpful when meeting in-laws for the first time (from 1-5)
 - Tension, surprise, joy
 - *Managing* emotion
 - Q: Debbie just came back from vacation. She was feeling peaceful and content. How well would each action preserve her mood (1-5)
 - She started to make a list of things that she needed to do
 - She began thinking about her potential next vacation
 - She decided to ignore the feeling since it wouldn't last
- Most emotional IQ tests have *low reliability* and *construct validity*
- Relationship to work performance and leadership is inconsistent between studies

- 'Emotional IQ', rather than being an independent attribute, may reflect a 'combined effect' of IQ and other personality traits working together

Summary – Intelligence

- One of the best predictors in Psychology, but not the only predictor we should consider
- Highly heritable (linked to genes)
- Environment has an important effect on intelligence (to a point), so keeping environmental quality high is vital
- General intelligence *g* theory is favoured over other theories (i.e. Sternberg and Gardner)
- Emotional intelligence not widely recognized

Language

Language

- “The crown jewel of cognition”, “the one thing we do that animals do not”
- Used to record and transmit information
- Gives us with the capacity to define and solve complex problems
- Affects our fitness for survival and reproduction
- Acquired through observational learning (i.e. watching others), experimentation (i.e. trying grammar), reinforcement, and shaping
- Learning a language is very different than learning any other skill
- In a sense, humans may be “programmed” to learn and use language
- Even when a language is absent in a population, that population may go on to develop one

Nicaraguan Sign Language

- In the 1970s, a group of deaf children (~400) were isolated in the Nicaragua education system
- Their teachers did not know sign language
- Efforts to teach the children lipreading/fingerspelling met with only limited success
- Remarkable, the deaf children spontaneously developed their own form of sign language (a *pidgin*)
- Originally, this language was quite simple
- However, within several iterations over time, its complexity increased significantly

Aspects of Language

- *Phonemes* – elementary sounds in a language
- *Morphemes* – the smallest units of meaning
- *Syntax* – the set of grammatical rules that control how words are put together
- *Contextual information* is important to understanding language
- Small amounts of phonemes (~44 in English) combine to create many more words (~170000) which can be arranged in an infinite number of ways to express an infinite number of ideas

Phonemes Vary by Language

- Language have different sound libraries and make different sound distinctions
- English speakers can differentiate the /r/ and /l/ phonemes
 - o In Japanese, /r/ and /l/ are the same phoneme
 - o Japanese speakers may have trouble distinguishing “rake” and “lake”, which are heard differently by English speakers
- English speakers have difficulty acknowledging phoneme distinctions present in other languages
 - o In Arabic, /c/ and /k/ may represent different phonemes

Emotions in Language

- Phonemes may have an inherent emotional meaning
- The phoneme /l/ (appearing twice in lullaby) tends to occur in pleasant, soft, tender scripts as well as in passive words
- The phoneme /r/ (appearing twice in roar) tends to occur in unpleasant and active words
- There have been attempts to use the affective qualities of words to produce a ‘dictionary of affect’
- Two dimensions contribute to affect
 - o *Valence* (negative to positive)
 - o *Activation* (high to low)

Syntax

- *Syntax* – the set of rules by which we construct sentences
- Varies by language
 - o E.g. German and English organize sentences very differently
- Correct syntax does not always result in comprehensible language
- Examples of correct syntax but uninterpretable
 - o San Jose cops kill man with knife
 - They stabbed him?

- The man killed has a knife?

Language Lateralization

- Language is lateralized to the left hemisphere in most people
 - One of the few cases where there is lateralization of function
- True for both spoken and signed languages
 - Even though sign languages involve hand movements
- In a given person, we find out how language is lateralized (left or right) by doing specific tests
- If the language hemisphere is damaged (e.g. with stroke or during surgery), language deficits will result

Language Difficulties

- Language involves many brain areas (frontal, temporal, and parietal)
 - Damage to any of these areas might cause deficits
- *Broca's aphasia* involves a difficulty in speech production, but comprehension can be intact
- *Wernicke's aphasia* involves a difficulty in both comprehension and speech production
- *Alexia/Dyslexia* involves difficulty in reading
 - Comprehension and speech production may be preserved

Language Development in Children

- ~7 months: *babbling* that lacks meaning
- ~10-12 months: *common words* emerge
- Spoken words may be altered/simplified
 - "Keekee" for kitty
 - "Nana" for banana
- Abnormal in *autism spectrum disorders (ASD)*
- Sensitivity for language is very high in low age and declines over time
 - Harder to learn a language later in life

Sensitive Periods for Language

- Acquisition easiest at 3-7 years of age, challenging after ~18 years
- Idea that language acquisition becomes much more difficult with age is generally believed, but is quite difficult to test
 - Motivation for second language learning is different
 - Context in which second language is learned varies
- Language acquisition may involve different mechanisms in different ages

Bilingualism

- ~50% of the world is bilingual
- In North America, rates are lower (~20%)
 - o Concerns about multilingualism's effect on cognition
- Early research showed that bilingual children processed language more slowly and had lower verbal scores. However, this research was problematic as:
 - o Studies were done primarily in children of low SES (socio-economic status)
 - o Tests were done in English even for ESL students
- Current research suggests a different view
 - o In some studies, bilinguals have better cognitive abilities

Can Language Affect How We Think?

- Generally, we think of language as an expression of our thoughts
- However, we may want to consider the possibility that language itself can change our thoughts
- The *Sapir-Whorf hypothesis* postulates that the structure of a language determines a native speaker's perception and categorization of experience
 - o People in the Dani culture of New Guinea (who have only two terms for colour) can still categorize colours like English speakers (who have many words for colour)
 - Number of words thus did not affect categorization
 - However, there was evidence that the words used affected perceptions (mixed support)
 - o People in the Amazonian Piraha tribe who have no linguistic method for expressing exact quantities are still able to match observations to large numbers (mixed support)
- Mixed support for the theory, big problem is lack of studies
- Part of the reason why the SW hypothesis has not received strong support is that it is very difficult to test
- We cannot teach a language in the laboratory easily, and so we must rely on the languages that exist
 - o Language is also often contaminated by culture
- It is clear, however, that our learned social attitudes influence our thoughts (i.e. *social psychology*)

Animal Vocalizations

- Male mice singing to find mates

- Rats 'laugh' when tickled
- Black-capped chickadees make calls associated with social behaviour
- Monkeys have calls to warn each other of predators
- Many animals have 'food-associated vocalizations'

Language vs. Vocalizations

- A given animal species has a limited range of vocalizations, which are generally made in specific situations and have a specific meaning
- Human language is much more flexible and can be used to communicate to an infinity of ideas, the interpretation of which is based on context
- Animals can learn some human language, but they never achieve high proficiency
 - o They also do not use human language to communicate with each other, only to humans
 - o Kanzi the bonobo learned human language
- There is an interest in using touchscreen methods for people with language/communication disorders

Evolution of Language

- May have emerged ~hundred thousand of years ago
 - o Linked to the development of the brain, vocal track, and certain genetic mutations (e.g. FOXP2)
- We have biological, psychological, and social theories of language development
- May have roots in gestural communication
 - o Mirror system for grasping in primates has similarities to language systems in humans
 - o When we became bipedal, hands freed for gesturing
 - o With tools, speaking became more important (hands busy again)

Lecture 7: Emotion and Personality

Emotion

Emotion

- *Emotion* – a brief conscious experience associated with
 - o Intense mental activity
 - o A high degree of pleasure/displeasure
 - o Physiological states which occur via activation of the *autonomic nervous system* (ANS)
 - o Physical responses (such as *facial expressions*)
- *Adaptive* and tied to specific behaviours
 - o Love and social interaction
 - o Guilt and penance
 - o Fear and survival responses
 - o Disgust
 - o Etc.
- The ability to control emotions (*emotional regulation*) is related to mental health, job performance
- Emotions may be preferred for decision-making if:
 - o There is a lack of time
 - o There is a lack of information
 - o There are too many options
 - o The options are ambiguous

Physiology of Emotion

- The *autonomic nervous system*
 - o Involuntary effects
 - o Many structures receive input from both systems
 - o The effects of SNS and ANS are different
- PNS vs. SNS: function

PNS Dominance	SNS Dominance
- respiration	+ respiration
- heart rate	+ heart rate
+ heart rate variability	- heart rate variability

- blood pressure	+ blood pressure
- galvanic skin resistance	+ galvanic skin resistance
- catecholamines	+ catecholamines

- All these properties can change in emotion

Facial Expressions and Emotion

- *Ekman's theory* proposes six basic emotions
 - Disgusted
 - Angry
 - Afraid
 - Sad
 - Happy
 - Surprised
 - Here, each emotion is tied to a different *facial expression*
- Expressions are innate
 - Even tribes isolated from human contact make the same facial expressions to express similar feelings
 - Individuals who are blind (who have never seen any facial expressions) make similar facial expressions
 - Meaning is generally consistent across cultures (with some variation)
- Expressions by culture
 - Certain facial expressions (such as a smile) may have a different meaning in different cultures
 - Rewards/bonding (Western) or dominance (Eastern)
 - *Emotional suppression* may be evident in some cultures (collectivist/Eastern in particular)
- Voluntary/involuntary expressions
 - Damage to the *frontal cortex* (contains the motor strip) impairs voluntary smiling but not involuntary (reflexive) smiling
 - Damage to the *basal ganglia* (e.g. in *Parkinson's Disease*) has the reverse effect: people can smile voluntarily but not involuntarily (stone-faced; *masking*)
 - Many people claim that they can tell a 'fake smile' (voluntary) from a 'real smile' (involuntary)
 - The facial movements in each smile may be different
 - Of the two muscles involved in a real smile (*orbicularis oculi* for the eyes and *zygomaticus major* for the mouth) one is difficult to contract voluntarily (*orbicularis oculi*)
- Facial feedback hypothesis

- In an early study, people forced to smile – by holding a pen in their mouth – rated cartoons as funnier
- However, replication efforts failed, suggesting the effect of expressions on mood was weaker than expected
- Most facial expressions are *hybrids* (and perhaps most emotions are, too)
- Plutchik outlines 8 core emotions
 - They exist in opposed pairs, with intersections
- Facial action coding system (FACS)
 - Taxonomize facial movements (with codes)
 - E.g. 1C – inner brow raise, 26B – jaw drop, etc.
 - Combinations of movements associated with emotions
 - Understand facial movements, understand emotions ('reading faces')
- The RMET test
 - 'Reading Minds through the Eyes Test' where we infer emotion from the eyes
 - Females generally slightly outperform males
 - People with *autism* or other disorders may perform poorly
 - Interestingly, typical male vs. female differences may be absent in people with autism

Nonverbal Cues to Emotion

- Facial expressions
- Proximity
- Body appearance
- *Body language*
- Gestures
- Paralanguage

Body Language and Emotion

- Cuddy's initial research suggested that certain postures (*power poses*) changed risk-taking behaviour, emotion, and physiology
 - High power body language vs. low power body language
- In men, high power poses were linked to reduced cortisol and increased testosterone
- Though this study is intriguing, it has been difficult to replicate and has become controversial
- Subsequent reports have suggested reliable effects on self-perception and emotion
 - On the other hand, the original effects on physiology and risk-taking behaviour do not appear as strong

- This situation (and that of the facial feedback hypothesis) reminds us why replication is vital

Summary

- Emotion is linked to physical responses (facial expressions, posture) and physiological responses
- Expressions are innate and their meaning is generally pancultural, with few exceptions
- “Pure” facial expressions and emotions are rare
- We can infer emotion and other traits from physical responses (faces and posture)
- Some evidence for postural feedback

Where Do Emotions Come From

- Common view: origin of emotions
 - o Not a scientific theory, but rather a common-sense view
 - o Perception of bear (brain role, involves perception) → feeling of fear → physiological reactions (ANS role, effect on many of the body’s organs)
- James-Lange Theory
 - o Event → arousal → interpretation → emotion
 - Interpretation – “my heart is beating fast, I’m afraid”
 - o An event increases physiological arousal which in turn creates emotion (we interpret the arousal)
 - o Different states exist because of different interpretations
 - o If this were true, different emotions should have different non-overlapping physiological states
 - However, the physiology of different emotions is similar
- Cannon-Bard Theory
 - o Event → arousal + emotion
 - Arousal and emotion are separate
 - o An event elicits physiological arousal and emotion separately via distinct pathways (e.g. ANS for arousal, brain for emotion)
 - o If this were true, we would expect emotion to persist even if the ability to create physiological states was impaired/lost (e.g. via spinal cord injury)
 - While emotions persist after spinal cord injury, they are blunted in intensity (particularly positive emotions)
 - The two pathways are not entirely separate
- Schachter Singer’s Two-Factor Theory
 - o Event → arousal → cognitive labels → emotion
 - Cognitive label – “I see a bear, I’m afraid”

- An event elicits cognitive appraisal and physiological arousal, which together produce emotion (we interpret the initial event and the arousal)
- The modern view
 - Emotion is a product of complex, reciprocal influences of the brain, nervous system, and perception on each other

Cognition in Emotion

- Cognitive appraisal of emotions can be incorrect
 - Our cognitive perceptions are not always accurate
- Sometimes, during intense periods of arousal, a person may be unable to properly identify the source of their emotion (*misattribution*)
 - A study has participants crossing a safe bridge (control) and an arousing (scary) bridge. The subjects who crossed the scary bridge called the interviewer a lot more times
 - Not an experiment since people were given the choice of which bridge to cross
 - No random assignment
 - The perceived source of arousal transferred from the scary bridge to the experimenter
- A cause of misattribution may be *excitation transfer*
 - The intensity of one emotion may be transferred to another emotion that comes afterward
 - Ex. rioting after a sports victory
 - Arousal is carried through

Cognitive-Behavioural Therapies

- We can harness the potential of cognitive appraisal to influence emotion for therapeutic purposes
- *Cognitive-behavioural therapies* for anxiety and depression, for example, involve teaching people new cognitive approaches to emotions
 - E.g. if someone looks at you in a strange way, rather than perceiving that you did something wrong, think of it as the person is looking at the guy behind you

Emotional Regulation

- Neural mechanisms of mood
 - Frontal lobe
 - Cingulate cortex
 - Hypothalamus

- Amygdala
- Hippocampus
- Many of the areas are considered part of the larger network called the *limbic system*
- PFC in emotion
 - Prefrontal cortex (tempers anxiety)
 - Centre for rational, logical thought. It is involved in laying down new memories and tempering learned fear responses
 - Prefrontal and anterior cingulate cortex (enhances anxiety)
 - Amplifies negative information in our surroundings and makes us pay attention to it
 - Amygdala
 - Emotional memories and our learned reactions to them are stored here. When active, it triggers the release of hormones responsible for the fight-or-flight response

Stress

Stress

- *Stress* – a feeling of tension that generally occurs due to demanding circumstances
- Associated with multiple physiological changes (e.g. changes in neurotransmitter levels, immune function, heart rate)
- When we use the word ‘stress’, we are thus referring to a psychological and physiological state
- Many events (stimuli) may be considered *stressors*

Causes of Stress

- However, not all stressors are equally stressful
- According to some data, the major stressors are work, money, and the economy
- Reasons can differ by year and by *demographic*
 - Several studies suggest higher stress levels in Gen Z

Stressor

- *NUTS* model

Novelty	Something new we have not experienced before
---------	----------------------------------------------

Unpredictability	Something we had no way of predicting
Threat to the ego	Our competence as a person is called into question
Sense of control	We feel we have little or no control over the situation

- Many stressors are too subtle to have an effect by themselves
- However, the effects of multiple stressors are cumulative
 - o “Straw that breaks the camel’s back”
- Multiple stressors may add together to increase overall stress and risk for illness
- The *Holmes-Rahe scale* is an attempt to quantify the risk for illness on the basis of stressful life events
 - o E.g. Death of family member – 63, fired at work – 47, etc.
 - o Score <150 – low risk
 - o Score 150-299 – moderate risk
 - o Score >300 – high risk
 - o The correlation of scores with illness is significant, but weak (~0.12)

Stress – From Acute to Chronic

- It is important to consider how long a stressor is applied
- Stress which is brief/temporary (*acute stress*) can be beneficial for some functions (such as for athletics)
- Stress which is prolonged and/or repeated (*chronic stress*) is generally detrimental
- Chronic stress and the brain
 - o Stress can lead to long-term alterations in the brain
 - o As the brain generates our behaviour, stress-induced brain changes may have behavioural consequences
 - o Some of the brain areas changed by stress (hippocampus, amygdala, and prefrontal cortex) are involved in regulating emotional regulation
 - o Chronic stress changes the way that our brain responds to future stressors
 - “Event after which we feel we are never the a person again”
- Chronic stress and neurons
 - o The neurons of stressed animals show less branching (though the effects are complex and can vary)
 - We lose the ability to control inputs
- Chronic stress and the hippocampus
 - o Smaller in depression

- Size is negatively correlated with number of depressive episodes and cortisol levels
- Chronic stress and cortical thinning
 - In veterans with *post-traumatic stress disorder (PTSD)*, there is a cortical thinning proportional to symptom severity
 - Effects greatest in the frontal cortex and temporal lobe

How Can We Manage Stress

- Stress management and gender
 - *Social networks* and *reading* are particularly more common strategies in women
- Quality social relationships are an effective buffer against stress
- Social isolation is a reliable predictor of stress and mental health episodes
- Predicting future stress
 - People overestimate their emotional reactions to stress (*impact bias*)
 - Negative events seem insurmountable, but we adapt
 - “I will never get over this” after a breakup – but we do
 - Positive events make us feel good briefly, but the effect wears off fast
 - “All I need is _____ and I will be happy forever” – doesn’t work
 - Overestimation of emotional impact of losses is particularly great, leading to *loss aversion*
 - People overestimate how good/bad they will feel
 - Overestimation of negative emotion is stronger
- Money = happiness?
 - Many early studies suggested that happiness increases with income, but only to a point
 - No further increase with income > \$75000
 - Increases in income and purchasing power over the 90s, with no increase in happiness
 - Depression is often higher in countries with high GDP
 - Lottery winners do not show lasting changes in happiness
 - Later studies have shown different results
 - You can keep earning and get happier and happier and happier
 - Widespread agreement that income is positively correlated with life evaluation/satisfaction

Personality and Personality Traits

- *Personality* – an enduring and characteristic pattern of thinking, feeling, and behaving
- *Personality traits* – stable units of personality
- Personality traits are *conceptual variables* that we measure by *personality tests*
- Though much of personality may be unconscious, most personality tests only examine our conscious experiences
- Personality Test Questions (on the scale of 1-5):
 - Q1: I spend time with friends often – 2
 - Q2: Most people would describe me as cheerful – 3
 - Q3: I have a reputation as a thrill seeker and adrenaline junkie who enjoys dangerous activities – 3
 - Q4: I would describe myself as a high-energy person – 4
 - For any one person, the score on these questions is highly positively correlated
 - The higher we score on any one of these questions, the higher we'll tend to score on others
 - These questions may look like they are measuring different traits, but they could all be measuring parts of the same trait
 - We're not asking four different questions, but the same question four ways
 - The trait is extraversion
- *Factor analysis* used to construct personality trait or personality factor
 - First, we ask many questions on personality
 - Next, we use the pattern of answers to generate a small, meaningful amount of personality factors

Five Factor Model of Personality

- **O**penness to experience (novelty-seeking)
 - Imagination, artistic interests, emotionally, adventurousness, intellect, liberalism
- **C**onscientiousness
 - Self-efficacy, orderliness, dutifulness, achievement-striving, self-discipline, cautiousness
- **E**xtraversion
 - Friendliness, gregariousness, assertiveness, activity level, excitement-seeking, cheerfulness
- **A**greeableness
 - Trust, morality, altruism, cooperation, modesty, sympathy
- **N**euroticism (overlaps with stability)
 - Anxiety, anger, depression, self-consciousness, immoderation, vulnerability
- FFM traits lie on a continuum

- One lies on one point between introverted and extroverted, not on one or the other
- The traits are not good or bad, but rather advantageous/disadvantageous depending on the situation

Personality Traits as Predictors

- High C, low N, and high A predicts strong job performance
- O is positively correlated and A is negatively correlated with perceived leadership ability
- O is negatively correlated with family size (reduced reproductive fitness?)
- We tend to overestimate the stability of traits in others and underestimate the stability of our own traits
 - “Other people are predictable, I’m not”
 - Self and observer reports inaccurate, though observer less so
 - Third-party test most accurate

Personality Traits and Disorders

- C is negatively correlated with most disorders (except anorexia)
- O positively correlated with most disorders (schizophrenia, bipolar and major depression)
- N is positively associated with major depression
- E is positively associated with attention deficit disorder
- Caused by shared source (i.e. the genes for X is also for Y)

Personality and Genetics

- For most personality traits, the heritability $h^2 = 0.4 \sim 0.55$
- Certain social attitudes appear highly heritable (conservatism, right-wing authoritarianism)
 - h^2 for conservatism increases with age
- In contrast, religiosity has a much lower (but still noticeable) h^2 that also increases with age
- h^2 for a specific religious style is negligible

Assortative Mating by Personality

- Mating is not random and is based on personalities of both parties
- For *neuroticism*, *openness*, and *agreeableness*
 - The more x the wife, the more x the husband for all x in the above three

Personality with Aging

- With aging (16 to 60 years) there are increases in A and C, decreases in E and O

Changing Personality

- Younger individuals show a strong interest in changing personality traits, often wanting to increase their strength (e.g. more extroverted, open to experience, etc.)
- “Volitional, goal-directed personality change’ does seem possible, but is seldom significant
- With age, the desire to change personality traits *decreases*, as does the magnitude of change desired
 - o “I really want to be like ...” to “I’d like to be a bit more ..., but I’m fine as it is right now”
- Certain experiences, such as psilocybin (drug) therapy, are associated with small personality trait changes

Other Tests

- MBTI
 - o *Myers-Briggs Type Indicator (MBTI)*
 - o Several dimensions to the MBTI:
 - Introversion vs. Extraversion (I v E)
 - Sensation vs. Intuition (S v I)
 - Thinking vs. Feeling (T v F)
 - Judging vs. Perceiving (J v P)
 - o Though popular, particularly in business circles, the MBTI has been criticized for having *poor reliability* and *construct validity*
- MMPI
 - o *Minnesota Multiphasic Personality Inventory*
 - o Used to assess *psychopathology* in adults
 - o 500 items across multiple scales
 - o Understandably, people who are taking a personality test such as the MPI may sometimes exaggerate – whether unconsciously or not
 - People may deliberately falsify information
 - People may simply fill out the test at random
 - o The MMPI has built-in mechanisms to detect abnormal responding, termed *validity scales*
 - “I can’t go on” in one question and “I love ice cream” is kind of a contradiction, which suggests something abnormal
- Projective tests
 - o Much of personality may be unconscious

- *Projective personality tests* are designed to reveal unconscious processes by having people 'project' them on to the tests
 - *Rorschach Inkblot test*
 - *Thematic Apperception test*
 - *Draw-A-Person test*
- These tests have *low construct validity*

The Barnum Effect

- Tendency to believe that descriptions are specific to them even though they could describe almost anyone
- Explains our attraction to horoscopes, fortune-telling, tarot card reading, and non-standardized personality tests
- Sensitivity to the effect is related to favourability of the judgment and other variables

Lecture 8: Developmental Psychology

Developmental Stages

- *Childhood* – 1-10 years
 - The period between infancy and puberty
- *Adolescence* – 11-17 years
 - Onset of puberty, prior to beginning of adulthood
- *Adulthood* – 18+ years
 - Consists of several distinct substages
 - Early: 18-40
 - Middle: 40-65
 - Late: 65+

Intro

- Over time, many of our traits change (i.e. they *develop*)
- Traits follow a *developmental trajectory* in organisms of the same species, including humans
 - The trajectory can be shifted by certain events

Development in Children

Early Developmental Events

- Prenatal → perinatal → postnatal
- Events are not always planned and may be random/accidental (e.g. illness, stress, injury)
- In general, earlier and longer events are associated with stronger and more lasting effects

Prenatal Events

- During pregnancy, the developing fetus is highly sensitive to its prenatal environment
- Any changes during this time may have consequences
 - *Maternal cortisol levels* during pregnancy are associated with altered cognition, emotion, and structure of the hippocampus and amygdala
 - *Maternal immune activation* (i.e. with illness) is associated with higher risk for schizophrenia and autism
 - *Valproic acid use* is associated with autism
 - Teratogens

Postnatal Events

- Extremely complex and come in many forms
 - o Maternal care
 - o Environmental enrichment (play, social interaction, schooling)
 - o Nutrition

Self-Concept

- *Self-concept* – collective knowledge an individual has of their own characteristics, including personality traits, physical features, abilities, values, goals, and role
- By 2, awareness of *sex* and *gender* begins
- By 4, awareness of physical features (height, weight, looks)
- By 6, identification with attributes (“I am a nice person”) (start of *social comparison*)

Development of Memory

- Rare to have memories before 3-5 years of age (*childhood amnesia*), evidence of interaction with culture
 - o Memory recall only reach chance level for events after 5

Childhood Annesia – Theories

- Development of the brain
 - o Prefrontal cortex (~25 years)
 - o *Hippocampus* (might generate new cells; cell turnover (loss) may be too high for memory storage when young)
 - o i.e. you only store things after you finish building a box
- Development of language
 - o Language may reinforce memory encoding
 - o Language proficiency at ~3 years (later in some disorders)
 - o Cultural differences in verbal interactions with children may explain cultural differences in memory (environmental effect)

Theories of Child Development

- Piaget’s Stages of *Cognitive Development*
- Erikson’s Stages of *Psychosocial Development*
- Kohlberg’s Theory of *Morality Development*

Piaget’s Stages of Development

- *Discrete stages*; unidirectional progress is made through independent exploration of the environment

Stage	Approximate Age	Highlights
Sensorimotor stage	0-2	<ul style="list-style-type: none"> - Here and now rather than past and future - Exploration through moving and sensing - Object permanence
Preoperational stage	2-6	<ul style="list-style-type: none"> - Language acquisition - Egocentrism - Illogical reasoning
Concrete operational stage	6-12	<ul style="list-style-type: none"> - Logical reasoning - Mastery of conservation problems - Learning by doing
Formal operational stage	12+	<ul style="list-style-type: none"> - Abstract reasoning - Idealism - Improved problem solving

- Sensorimotor stage – object permanence
 - Objects exist even they are out of your field of view
- Preoperational stage – Theory of Mind (ToM)
 - *Theory of Mind* – the ability to take on other people’s perspectives
 - Plays a role in our social interactions and moral judgments
 - Evident in the pre-operational stage but continues to develop throughout life
 - One way of testing for a ToM in children is the *Sally-Anne Test*
 - There is a basket and a box. Sally puts a ball in the basket and exits the room. Anne transports the ball into the box. When Sally comes back, check whether Sally checks the box
 - Solving this problem involves understanding the situation from Sally’s perspective (she holds a *false belief*)
 - Children with disabilities – such as *autism*, tend to perform poorly
 - However, it has also been suggested that the verbal component of the test may pose problems
 - ToM in adults
 - Involves recursive analysis
 - “I know that he knows” (2nd order)
 - “I know that he knows that I know” (3rd order)

- Peaks in young adulthood and tends to decline in late adulthood (linked to problems in cognitive function)
- Concrete operational stage – conservation mastered
 - We pour water from the tall container into the fat container and it fills both container to full
 - Children before the CO stage often incorrectly assume that water in a tall container > water in a fat container
 - Children after the CO stage correctly understand that water in a tall container = water in a fat container
- Critiques of Piaget's Theory
 - Development does not occur in discrete stages, but is *continuous* and *bidirectional*
 - Children can revert to 'earlier stages' of development depending on the situation and stress
 - Did not address *culture*
 - Studies focused on European children
 - West European and East Asian children may differ
 - Did not address *social interaction* (which is very important for humans and primates) and focused on independent exploration of the environment

Sociocultural Learning

- *Vygotsky* advocated a framework that emphasized social interactions, culture, and language in development
- He argued that people could learn through interacting with more knowledgeable and supportive experts

Erikson's Theory of Development

- *Eight stages* at different ages extending from infancy into late adulthood (birth to 65+ years)
- Each stage is characterized by different *challenges* and *intrapersonal relationships*
- The completion of each stage would result in specific life changes (*resolution*)

Virtue (Stage)	Age	Challenge	Relationship	Resolution
Hope (oral-sensory)	0-1.5	Trust vs. Mistrust	Primary caregiver (often mother)	Trust in caregivers
Will (muscular-anal)	1.5-3	Autonomy vs. Shame/Doubt	Parents	Sense of what can be controlled; sense of free will

Purpose (locomotor)	3-6	Initiative vs. Guilt	Family	Independency through exploration and action
Competence (latency)	6-12	Industry vs. Inferiority	Neighbours, school	Meeting the standards set by others
Fidelity (adolescence)	12-18	Identity vs. Role confusion	Peers, role models	Develop positive sense of self
Love (young adulthood)	19-40	Intimacy vs. Isolation	Friends, partners	Give and receive love; make commitments
Care (middle adulthood)	40-65	Generativity vs. Stagnation	Household, coworkers	Interest in guiding next generation, parenthood
Wisdom (late adulthood)	65+	Ego vs. Despair	Mankind	Acceptance

- Competence and social comparison
 - Starting at ~6 years, children compare themselves to others in different ways
 - Comparison continue through life, but decline with age
 - Social comparison is not always a bad thing, it depends upon the number and type of comparisons
 - Upward social comparison is linked with social media use (e.g. facebook) and low self-esteem

Theories of Morality

- Dilemma: should a poor person steal a drug to save his wife?
- Kohlberg's Stages of Morality

Age	Stage	Description	Example
Young children	Preconventional morality	<ul style="list-style-type: none"> - Focus on self-interest - Punishment is avoided - Rewards are sought 	"The man should not steal, he will go to jail"
Adolescents	Conventional morality	<ul style="list-style-type: none"> - Care about how actions affect others - Desire to please and be accepted 	"He should not steal the drug. His wife would not want to go to jail because of the crime"

Adults	Postconventional morality	<ul style="list-style-type: none"> - Abstract reasoning to justify behaviour - Moral behaviour is based on chosen principles such as justice, dignity, and equality 	"The man should steal the drug and give it to his wife. He should then turn himself in"
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- Critique of Kohlberg's Theory
 - o Does not address cultural differences or sex differences
 - o Young boys tend to value principles of justice and rights, whereas young girls tend to value caring and helping
 - o This test may be better for assessing the development of boys, who do not acquire caring behaviour early

Attachment Theory

- Emotional and physical attachment to the primary caregiver is critical
- Psychologists have studied attachment theory using several clever approaches, including *The Strange Situation* (devised by Ainsworth)
 - o 1. Parent and infant play
 - o 2. Parent sits on sofa while infant plays (secure base)
 - o 3. Stranger enters and talks to parent
 - o 4. Parent leaves. Infant and strangers alone in the room
 - o 5. Parent returns and offer comfort if needed. Stranger leaves
 - o 6. Repeat
- Three main types of attachment suggested:
 - o Secure
 - o Insecure – avoidant
 - o Insecure – resistant (insecure – anxious/ambivalent)

Attachment type	Exploring/ orientation towards mother	Behaviour when mother leaves	Stranger anxiety	Behaviour when mother returns	Behaviour of mother
Secure	Explore unfamiliar room with an orientation	Some discomfort	Comfortable with stranger when mother is present	Greeted her positively	Sensitive and supportive

	towards mother				
Avoidant-insecure	No orientation to mother while exploring room	Unconcerned with her absence	Comfortable with stranger	Uninterested	Rejected/ignored infant
Resistant-insecure	Unconcerned with exploring	Intense distress	Uncomfortable with stranger	Rejected her	Inconsistent

- Attachments
 - Secure (70%)
 - Children given a positive working model
 - Carer who is emotionally available, sensitive, and supportive
 - Avoidant (20%)
 - Children have a working model of themselves as unacceptable and unworthy
 - Carer who is rejecting
 - Resistant (10%)
 - Children have a negative self-image and exaggerate their emotional responses to gain attraction
 - Carer who is inconsistent

Physical Comfort is Important

- Harlow's Monkeys were deprived of their mothers and given one of two surrogates: wire or cloth
- Monkeys strongly preferred the cloth mother – even when the cloth mother provided no food

Parenting Styles and Culture

		Demandingness	
		High	Low
Responsiveness	High	Authoritative parenting	Permissive parenting (<i>indulgent</i>)
	Low	Authoritarian parenting	Rejecting-neglecting parenting (<i>uninvolved</i>)

- Authoritative is slightly favoured

- Higher achievement and esteem, fewer behaviour problems
- Uninvolved is universally recognized as the worst
- Culture matters
 - Depending upon the culture, certain styles may be more common and/or effective
 - Model is a simplification, some cultures have complex parenting styles that do not fit into it at all

Parenting Style and Behaviour

- Rank (from the most antisocial to the least)
 - Uninvolved > indulgent > authoritarian > authoritative

The 'Tiger Mom' Stereotype

- 'Battle Hymn of a Tiger Mother' and 'Triple Package' advocate a very intensive parenting style
- Research is ambiguous, unclear whether such a parenting style is optimal or detrimental
 - We don't know

Problem with All Studies into Parenting

- They are all correlational
- You can't randomly assign a kid into a specific style of parenting

The Environment

- Parents often plan activities (e.g. exercise, games, Montessori classes, toys, playdates, etc.) which they believe will facilitate development
- These activities could be considered forms of *environmental enrichment*
- Do they work?
- Environmental enrichment = education?
 - Education associated with lower risk of dementia and less cognitive decline
 - Utility of programs for gifted students unclear (difficult to tell, few studies)
 - Arguments have been made that programs might work better for disadvantaged individuals
 - Disabilities, low socioeconomic status, rehabilitation
 - As experimental studies in humans are not possible, it is worth looking at animal studies
- Animal research
 - Lab rats and pet rats grow up in different environments
 - Pet rats are usually smarter than lab rats

- Lab rats are raised in impoverished environment
 - Pet rats have more things to play around with (enriched environment)
- EE tends to increase synapses, dendritic arborisation, and neurons in the hippocampus (*neurogenesis*)
- EE changes the brain
 - Increase in dendrite length, astrocyte processes, vascular volume, and number of synapses/neurons
- The *Flynn Effect* suggests that environment matters
 - Benefits might hit a ceiling (*asymptote*). Past this point, increases in environmental quality might not matter
- While we do not understand EE:
 - We do understand the danger of impoverished environments
 - In humans and animals, poor environments early in development have severe effects
 - Harlow's monkeys (deprived of their mothers), for example, showed cognitive impairments
 - Children in low quality orphanages without reliable caretakers showed developmental delays
- Are these effects reversible?
 - Limited catch-up is possible if adoption occurs <6 months, but becomes progressively difficult
 - Children adopted after 6 months may show *autistic-like traits* (such as language impairment)
 - Early effects include lower activity in the orbitofrontal cortex, amygdala, hippocampus, and temporal cortex
 - Other effects may persist into adulthood (reduced total brain volume, impaired cognition, high risk for mental health disorders)
- The 'feral' child: Genie
 - Severely isolated and physically abused
 - At the time she was discovered (age 13), she could not use language
 - Even after intense training, Genie never fully acquired a first language
 - She could acquire vocabulary, but had difficulty learning grammar/syntax
 - Genie's tragic situation highlights the importance of *developmental windows*

Potential Long-Term Effects of Stress

- One study examined the brains of people who endured abuse during childhood
- Some of these individuals had completed suicide
- These individuals had *altered glucocorticoid systems* in their hippocampus (HPA axis)

- Significant early life trauma may reduce the ability of the hippocampus to regulate stress in adulthood
- The negative feedback loop is less sensitive, thus cortisol level goes very high
- Stress and glucocorticoid receptors
 - The gene for glucocorticoid receptor is modified (repackaged) and glucocorticoid receptors are less expressed as a result (epigenetic process)
 - Implication: stress rewires one's stress networks
 - More likely to have mental health issues

Development in Adolescents

Adolescent Development

- Emergence of *egocentricity*
- Teenagers are often self-conscious and under the impression that everyone is watching them
 - Fear of embarrassment is common
 - Ex. rather freeze than being embarrassed with two non-matching mittens
- During adolescence, teenagers seek out role models and peers on which to model their behaviour
 - Our typical adolescent will try out many identities before settling on who they are
 - This is all part of developing a *positive sense of self*

Adolescence and the Brain

- Adolescence is regarded as a critical period for brain development – perhaps the last critical period
- The *prefrontal cortex* matures substantially during adolescence
 - *Synaptic pruning* (removal of synapses) is observed
 - We lose a little bit, but not all
 - Synapse decline at 20
- The PFC is important for planning, organization, and inhibition of behaviour – skills an adolescent is still developing
- Maturation of the brain may continue until age 25

Crystallized vs. Fluid Intelligence

- Crystallized intelligence (goes up with age)
 - Vocabulary

- Fluid intelligence (goes down with age)
 - o Speeded performance
 - o Reasoning ability
 - o Memory

Change in Risk Evaluation

- Adolescents engage in risk-taking behaviours more frequently than adults
 - o Not because adolescents are uninformed (don't know the risks)
- Adolescents often make risky decisions knowing the risks involved
 - o This could be due to *incomplete frontal lobe development*, altered pleasure responses, emotional development, and age-specific environmental settings
- Risk-taking behaviour is not always a bad trait
 - o In certain cases, it may be an excellent one
 - E.g. people who do creative projects are taking risks

Adulthood

Changes in Aging

- Bone density
- Sensory loss: vision, hearing
- Motor and other physical difficulties
- Hormonal and other physiological changes
- Cognitive and emotional changes

Cognitive Decline in Aging

- Though some cognitive decline in aging is normal, significant decline is unusual and may suggest pathology
- *Crystallized intelligence*, the general knowledge of the world, often increases with age (e.g. vocabulary)
- *Fluid intelligence*, the ability to think and acquire information quickly and abstractly, declines with age

Change in Memories with Aging

- Older adults who are able to maintain an active lifestyle tend to be as happy as they were when younger
 - o Larger/stronger social networks (relationships, friends, family) associated with greater happiness

- As we age, we are more likely to view our own past positively (“back in my day”) and imagine more positive futures (*positivity bias*)

Socioemotional Selectivity Theory

- Older adults have fewer relationships which are based on different motives
- Relationships in older adults are based more on emotion rather than information
- With aging (16 to 60 years), there are increases in agreeableness and conscientiousness, decreases in extraversion and openness

Pathological Aging

- *Dementia* – a progressive neurological disease that includes loss of cognitive abilities significant enough to interfere with everyday behaviours
 - o *Alzheimer’s disease* is the most common form
 - Progressive, incurable disorder
 - No real treatments
 - Most common form of dementia, affects ~40 million people
 - Number expected to x2 by 2040
 - ~10-15% of people over age 65
 - Care is very costly due to high level of impairment
 - ~\$214 billion in 2014
 - Features of AD
 - Progressive neuronal loss
 - β -amyloid plaques
 - Neurofibrillary tangles (involving Tau)
 - Reduced acetylcholine transmission
 - Risk of Alzheimer’s Disease increases with age

Studying the Brain in the Laboratory

Studying the Brain in the Lab

- Several tools for measuring brain activity during behaviour, including:
 - o Electroencephalogram (EEG) and Event-related potential (ERP)
 - o Functional Magnetic Resonance Imaging (fMRI)
 - o Positron Emission Tomography (PET)
- Two key properties:
 - o *Spatial resolution* (measure brain structure)
 - Increases → easier to tell what brain areas we are observing

- *Temporal resolution* (measure activity over time)
 - Increases → easier to tell how activity changes over time

Electroencephalography

- Measures electrical activity in specific brain regions
- Useful in studies of arousal, consciousness, and epilepsy
- We decide where to place the electrodes based on which region we want to observe
- The electrodes only measure a few neurons (superficial neurons around the electrode)
- EEG does *not* measure fire rate
- EEG measures the electrical signal before the action potential
 - Not the action potential itself
- Poor spacial resolution (we don't know which neurons we are measuring)
- EEG favoured for studying arousal
- Measures potential *difference* (in volts) over *time* (in seconds)
 - The voltage varies in a 'wave-like' manner over time, with *peaks* and *valleys*
 - The variation in the voltage over time gives us *frequency*
- Frequency ranges
 - Beta = 13-30 Hz
 - Alpha = 7-13 Hz
 - Theta = 4-7 Hz
 - Delta = 1-4 Hz
- Studying consciousness with EEG
 - In meditation, more beta and theta frequencies

The Event-Related Potential (ERP)

- Neural activity related to a brief mental process
- ERP is measured using EEG equipment
- EEG applied when asked the patient to do a task (i.e. do a math problem), take a break, do another task, repeat
- Potential because we are measuring voltage, and event-related because we are measuring the potential during an event
- ERP with language processing
 - Incorrect meaning → higher potential (vs. correct meaning)
 - i.e. The cats won't bake
 - N400 signal peaks (within 400ms after hearing the sentence)
 - The worse the error, the higher N400 peaks
 - Incorrect syntax → lower potential (vs. correct syntax)
 - i.e. The cats won't eating

- P600 signal drops (within 600ms after hearing the sentence)

EEG and ERP – Summary

- Great temporal resolution (biggest advantage)
 - Millisecond scale
 - Great for measuring rapid changes in arousal/consciousness (regular EEG) and rapid cognitive processes (ERP)
- Poor spatial resolution (biggest disadvantage)
 - Difficult to determine which specific areas are active
 - Deeper brain areas cannot be measured

Positron Emission Tomography

- A *synthetic radiotracer* is injected into the subject
- This radiotracer reacts with tissue in the brain; this reaction produces a signal that can be measured with specialized equipment
- Wherever the radiotracer goes in the brain, there will be a signal generated
- Many radiotracers available for different purposes
- Measuring Activity with PET
 - If we use a radiotracer similar to glucose (such as *Fluorodeoxyglucose*, ^{18}F), that tracer will 'go where glucose goes' (i.e. to active neurons)
 - Signal differences between brain regions reflect differences in glucose demands (and neuronal activity)
 - Weak signal in cognitive impairment/Alzheimer's disease
 - If we use a radiotracer similar to opiate transmitters, that tracer will go where opiate transmitters go (it will bind to opiate receptors)
 - Signal differences between brain regions reflect differences in opiate receptor occupancy
- Diagnosing disorders with PET
 - Certain proteins are upregulated (increased) in pathology (e.g. B-amyloid in Alzheimer's Disease)
 - If we can develop a radiotracer which interacts with these proteins, we can track them in the living brain
 - While intriguing, these techniques are not reliable enough to be used in formal diagnosis

PET – Summary

- Decent spatial resolution
 - Better than EEG but worse than MRI

- Poor temporal resolution
 - o Difficult to resolve rapid changes in neural activity
- Due to its resolution issues, PET is no longer preferred as a structural/functional measure
- Main current use is in characterizing substances (e.g. receptors, proteins)

MRI and Functional MRI

- Magnetic Resonance Imaging
- MRI Method
 - o Brain tissues are first magnetized in a strong magnetic field; strength of the field matters
 - o When hit with a radiofrequency pulse, the magnetized tissues emit a signal which depends upon their structure
 - o If we capture these signals, we can use them to artificially reconstruct the tissues of the brain
- Basis of the fMRI signal
 - o Oxygenated and deoxygenated blood have different magnetic properties which can be measured
 - o If we measure blood oxy/deoxy ratio in a given area, we'll have a correlation of neuronal activity in that area
 - i.e. active neurons use oxygen
 - o Measures what happened a few seconds ago
- fMRI for behaviour and disorders
 - o Brain activity differs in different tasks
 - o Brain activity may differ with personality characteristics and mental health disorders (such as addiction)

fMRI – Summary

- Great spatial resolution (great for studying brain structure)
 - o Best out of techniques we have covered
 - o Can be “paired” with other techniques (e.g. PET)
- Decent temporal resolution
 - o Better than PET, not as good as EEG
 - o Lag of several seconds between neuronal activity and signal
- Popular technique for *cognitive neuroscience*, but should be interpreted with care

Additional Info

- All three techniques are measuring *correlates* of brain activity

- Not the action potentials themselves
- Analogy: looking at gas bills to determine how fast a car is

Lecture 9: Mental Health Disorders

Intro – Mental Health

- Refers to psychological/emotional well-being
- In 'mental health disorders', well-being is reduced (depression, anxiety, addiction, etc.)
- There is substantial co-morbidity (multiple mental health disorders at the same time)
- ~50% of those with anxiety have depression
- ~33% of those with substance abuse disorder have depression
- Whenever we evaluate any mental health disorder, we should consider other related disorders too

Depression

Depression

- Loss of interest or pleasure in activities normally enjoyed (e.g. anhedonia)
- Decreased energy (e.g. fatigue)
- Feelings of guilt or low self-worth
- Disturbed sleep, appetite, and activity (may sleep/eat more/less than usual)
- Inability to concentrate
- Thoughts of suicide

Depression is Not

- An attitude, weakness, or a character flaw
 - o Historically, a large proportion of people (~30-50%) have held this view
 - o Depression can happen to almost anyone in difficult circumstances, though risk varies
- A brief 'phase'
 - o Persistent (>2 weeks to years or more) and recurrent
 - o Does not lift for social occasions or work commitments
- Always associated with a single clear cause
 - o Many factors may act together to cause depression
 - o Accumulation of events

Global Burden of Depression

- Affects ~350 million people worldwide annually
 - o ~5% of the population, 1/20

- Rates increasing in young cohorts (e.g. millennials, iGen)
- Can lead to suicide and is associated with poor outcome of other health disorders
- Serious economic cost as it can lead to absenteeism and poor work quality (~30-50 billion in the US)
- Leading cause of disability worldwide

Types of Depression

- Unipolar depressive disorder
 - Major Depressive Disorder (MDD; chronic)
 - Short, then resolve
 - Major Depressive Episodes (MDE; acute but often recurrent)
 - May or may not re-emerge
- Bipolar disorder
 - Include MDEs as well as Manic episodes
- Post-partum depression
- Dysthymia
- Seasonal affective disorder

What is Depression

- Not just a psychological disorder
- Like other disorders, depression has characteristic *physiological and anatomical features*
 - Understanding these characteristics might be useful in diagnosing and treating depression

Diagnosing Depression

- Requires assessment from a trained professional (e.g. doctor, psychologist, psychiatrist, etc.)
 - Patient answers questions about their health
 - Diagnostic criteria from the DSM are used
 - Tests may be done to exclude other health problems with similar symptoms (e.g. thyroid issues)
- This method is effective but time-consuming and expensive (and to some, also inaccessible)
- Diagnosing with biomarkers
 - Quicker and cheaper, provided they work
 - Many possibilities, *none reliable or widely accepted*
 - Blood tests for certain compounds which differ in depression (e.g. acetyl-L-carnitine)

- EEG could be used; gamma band activity may differ in depression disorders

The 'Depressed Brain'

- Commonly, two brain areas differ in depression: the *hippocampus* and the *orbitofrontal cortex (OFC)*
 - The hippocampus is involved in learning/memory spatial behaviour, anxiety, and more
 - The OFC is involved in decision-making, particularly the evaluation of stimuli (rewards)
- Both brain areas are smaller in depression
- Importance of the hippocampus
 - The hippocampus regulates mood
 - Changes in the hippocampus may be driving the changes in mood evident in depression
- Abnormally *high* activity in *amygdala* and OFC
- High brain activity is *not* always good

Summary – Features of Depression

Brain Region	Volume	Activity
Hippocampus	-	
Orbitofrontal cortex	-	+
Anterior cingulate cortex	-	
Amygdala		+

Compound	Concentration
5-hydroxytryptamine (5-HT/Serotonin)	-
Norepinephrine (Noradrenaline)	-
Gamma-aminobutyric acid (GABA)	-
Cytokines	+
Cortisol, Corticotrophin-releasing factor (CRF)	+

Why Does the Brain Matter?

- Measurements of the brain are not currently useful in diagnosis, but they might be one day
- Outside of diagnosis, measurements of the brain may *predict* which treatment is best for someone

- This is important as many people do not respond to their first treatment and must switch
- Brain scans of the anterior cingulate cortex predict the response to several treatments for depression, including cognitive-behavioural therapy and drugs

What Causes Depression?

- We don't know
- We only know what is linked to depression

Epidemiology of Depression

- Gender
 - *More common in women* (10-25%) than in men (10-15%) though the severity does not differ by gender
 - Suicide attempts more common in women, though these attempts less frequently result in fatalities
 - Differences may be explained by gender roles and/or physiological differences (e.g. hormonal function)
 - Some mood disorders in women are related to hormonal fluctuations (e.g. post-partum depression, premenstrual dystrophic disorder)
- Country/culture
 - Worldwide burden has been expressed using a measure called DALY (**D**isability **A**adjusted **L**ife **Y**ears)
 - DALY takes into account the *years affected by disability* and the *years lost to disability*
 - Lifetime prevalence is generally greater in *high income countries*, as is DALY
 - Why developed countries?
 - Economic and environmental factors (diet, stress, etc.)
 - More awareness and less stigma
 - Better diagnostic criteria and health care system access
 - Beliefs about the efficacy of emotional regulation
 - Valuation of happiness in Western cultures
 - Higher valuation is associated with higher risk (*cultural effect*); may be relevant to downward social comparison
 - People who highly value happiness have a higher risk in mental health
- Socioeconomic status
 - Low SES (i.e. low income) increases risk
 - E.g. getting fired and cannot get a new job

- This relationship holds in Eastern and Western communities, even after controlling for other variables
- Most scientists argue that low income leads to depression rather than the contrary
 - Correlation between income and well-being
- Low income may be associated with increased risk for many reasons (e.g. lack of insurance, health care, etc.)
- Burden is *higher* in developed countries with stronger economies, but risk is *lower* in people of higher socioeconomic status
 - i.e. within a high income country, people who earn the least have the highest risk
- Occupation
 - If one doesn't have a job, the risk is higher (nearly x2, according to one poll)
 - Why does the risk vary by job?
 - Social interaction plays a role but it's complex
 - Frequent and/or difficult interactions (service) increases risk
 - Lack of social interactions (trucking/transport) increases risk
 - Stress level (high increases risk)
 - Physical activity (low increases risk)
 - Jobs offer varying degrees of validation (skills), feelings of meaning/status/acceptance, income, and access to vital services (e.g. healthcare)
- Education
 - Rates higher in university students, particularly medical students

Theories of Depression

- Monoamine hypothesis
 - Low monoamine neurotransmitters (norepinephrine and serotonin) → Low mood (depression)
 - Drugs that increase monoamine levels – such as *selective serotonin reuptake inhibitors (SSRIs)* and *monoamine oxidase inhibitors (MAOIs)* – have antidepressant effects
 - SSRIs and MAOIs are our first-line drugs in the treatment of depression and anxiety disorders
 - *SNRIs (selective norepinephrine reuptake inhibitors)* are also available
 - Some drugs inhibit serotonin and norepinephrine uptake
 - Major SSRIs
 - Citalopram (Celexa)

- Escitalopram (Lexapro)
 - Fluoxetine (Prozac)
 - Paroxetine (Paxil)
 - Sertraline (Zoloft)
 - How these drugs work is still being debated; currently, we have only theories
- Effects of SSRIs
 - *Serotonin transporters* reuptake serotonin, eliminating it from the synapse
 - SSRIs inhibit these transporters, leading to increased serotonin levels in the synapse (rapid effect)
- Problems with monoamine hypothesis
 - Antidepressants sometimes increase anxiety (so-called '*jitterness syndrome*')
 - >30% of patients do not respond to SSRIs
 - SSRIs are not always effective
 - >30% of patients do not respond to SSRIs
 - Though SSRIs increase serotonin levels immediately, mood is not improved for weeks
- Neurogenesis hypothesis
 - It might not be monoamine levels per se, but a *secondary effect* of monoamines on brain structure
 - Effects of monoamines on neurogenesis suggested
 - Antidepressants increase hippocampal neurogenesis, at least in animals
 - Newly-generated neurons may improve *stress resiliency*
 - If neurogenesis is blocked, antidepressants are less effective
 - Generalization to humans may be premature, as the extent and significance of neurogenesis is disputed
- Neuroendocrine hypothesis
 - Stress and high glucocorticoids (such as cortisol)
 - Glucocorticoids can have negative effects on the brain
- Neuroinflammation hypothesis
 - Higher levels of pro-inflammatory cytokines
 - Glucocorticoids and cytokines interact
- GABA/Glutamate hypothesis
 - GABA levels may go down in depressed patients
 - GABA receptors are downregulated in mood disorders

Genes for Depression

- Heritable (~40%), which indicates a genetic basis
- Several genes are risk factors, but each explains only a small proportion of depression risk (<< 1%)
- There is not one depression gene, but *tens to hundreds* of depression genes
- Genetic factors may interact with environmental factors to increase the risk for depression

Treatment of Depression

- Highly treatable and manageable in ~70-80% cases
- Main barrier is access to care (e.g. lack of insurance and/or trained professionals)
 - o Problem for less wealthy countries and low income individuals
- Another barrier is intent to seek help (self and societal stigma)
- Primary methods
 - o Psychoeducation
 - Generally first step
 - o Psychotherapy
 - o Cognitive behavioural therapy (CBT)
 - o Pharmacotherapy (for moderate/severe cases)
- Antidepressant Controversy
 - o Ongoing debate about *over-prescription* (for off-label use and mild depression) and *withdrawal*
- Secondary methods
 - o *Transcranial magnetic stimulation (TMS)*
 - Research linked to UofT
 - Rapidly growing in popularity
 - Quick, cost-effective
 - o *Ketamine*
 - *Rapid* effect, might be useful for severe depression
 - New; still being refined
 - Concern of side effects
 - Approved for use in some cases
 - o Meditation is also a popular form of complementary alternative medicine used to manage depression
 - Accessible, low-cost, generally safe, and well-tolerated
 - Meditation has modest but noticeable effects in treating depression and anxiety
- For treatment-resistant cases (1)
 - o *Electroconvulsive therapy*

- Electrical stimulation applied to the brain, usually over frontal lobe
- Side effects include confusion, memory loss (largely transient)
- *Cingulotomy*
 - Psychosurgery
 - Removal of the anterior cingulate
 - Also used in the treatment of OCD and pain disorders
- *Deep brain stimulation*
 - Use an implanted electrode to artificially reset activity in the brain ('pacemaker')
 - Electrode targeted to brain areas associated with the *cingulate*
 - Still developing, not commonly used

Anxiety

Anxiety

- 'The anticipation of negative experience'
 - Associated with tension and worry
- Can be adaptive and facilitate survival (the 'good')
- If excessive or poorly controlled, can negatively affect memory, cognition, quality of life, and cause other problems (e.g. sleep disorders) (the 'bad')

Anxiety and Performance

- Hypothesized relationship between anxiety and performance (inverted U) that is predicted by an adaptation of the *Yerkes-Dodson Law*
 - x-axis – arousal
 - y-axis – performance
 - e^{-x^2}
- For certain individuals (e.g. those with high motivation), anxiety may improve performance on certain tasks
- In individuals with a high working memory capacity, anxiety is associated with increased test performance
 - In those with a low capacity, the *reverse* is true

Types of Anxiety Disorders

- *Generalized Anxiety disorder* – exaggerated worry/tension in day-to-day situations
- *Social Anxiety disorder* (or *Social Phobia*) – similar but everyday social situations
- *Panic Disorder* – unexpected episodes of intense fear

- *Post-Traumatic Stress Disorder (PTSD)*
- *Obsessive-Compulsive Anxiety Disorder* – unwanted (obsessions) and/or repetitive behaviours (compulsions)

The 'Anxious Brain'

- Damage to the amygdala profoundly affects anxiety, inhibiting the amygdala (i.e. w/GABA) reduces anxiety
- Increasing GABA activity may help treat anxiety
- Many anti-anxiety drugs increase GABA receptor activity (e.g. benzodiazepines/valium), as does alcohol
- SSRIs are also used to treat the disorder
- The spiral (downward)
 - o Feelings: sad and hopeless
 - o → Thoughts: my life is horrible; I can't stand feeling like this
 - o → Behaviour: lie in bed all day; avoid other people
 - o → Thoughts: I'm such a loser, I can't even get out of bed; I have no friends
 - o → Physical: fatigue, lack of energy
 - o → Behaviour: not motivated to do anything
 - o → Feelings: despair
 - o → Memories: I've been miserable forever
 - o → Thoughts: what's the point in living?
- Regulation strategies
 - o Suppression-based (inhibit the thought)
 - Do not think negative thoughts (in anxiety/depression)
 - Do not think about the pain (in chronic pain)
 - Do not think about food (in dieting)
 - Do not think about the 'substance' (in addiction)
 - This approach does not work
 - Suppression takes mental effort and leads to feeling of exhaustion, cannot be maintained indefinitely
 - After suppression, rebound where thoughts/behaviours become more frequent and intense
 - Possibility of *ironic processing* – the more someone tries not to think about something, the more someone does
 - Suppression does not work well; correlation between suppression and mental health problems
 - o Reappraisal-based (reframe thought and/or its antecedent event)

- Re-evaluate the circumstances that lead to emotional and/or the emotion itself
- We still think about the event, we just think about it differently
- Reappraisal-based strategies are generally more effective in emotional regulation than suppression strategies
- Cognitive-behavioural therapy
 - May be used to treat depression and anxiety
 - How we frame the event matters
 - Getting ignored by someone – ‘they did not see me’ rather than ‘they hate me’
- Acceptance-based (accept the thought as it is)
 - Focuses on embracing thoughts and feelings, without feeling ashamed about them
 - Promise in treating anxiety, depression, and addiction
 - Growing in popularity, many randomized trials (high-quality evidence) in the last 15 years alone
 - Acceptance and commitment therapy is now well-known
 - Described as the ‘third wave’ of therapy
 - Related are mindfulness-based approaches, which also advocate for acceptance and thoughts
- Exposure-based (repetition of antecedent event)
 - Repeated exposure to the stimuli which trigger anxiety
 - Gradually, the anxiety response to the stimulus declines over time (because there is no reinforcement)
 - i.e. if cars make someone anxious, make them drive for many times and they will not become anxious on cars over time

Addiction

Definition

- Difficult to define
- One popular definition: ‘*complex brain disease* in which there is *compulsive engagement* in a behaviour despite knowledge of *harmful consequences*’
- The term ‘brain disease’ suggests a perspective where impaired brain function is involved
 - Matters for treatment
- ‘Behaviour’ can refer to many things (drug use, gambling, sex, or video games)

- 'Harmful' is itself a poorly defined term

Behavioural Addictions

- Dispute over whether other behaviours (e.g. eating and internet gaming) are addictive
- DSM-V mentions 'Internet Gaming Disorder' as needing study, but does not formally recognize it
- The World Health Organization (WHO) does recognize the condition, but this decision has been criticized

DSM-V and Substance Use Disorder

- Impaired control
- Social problems
- Risky use
- Physical dependence
- Suggests a role of 'cognitive control' systems in the *frontal cortex*
- The cycle
 - Drug administration and drug-seeking behaviour
 - Failed impulse suppression
 - Takes addictive agent
 - → Drug euphoria (positive reinforcement)
 - Activated reward pathways
 - → Neuroadaptations withdrawal and tolerance
 - Protracted hedonic dysregulation
 - → Drug-craving (negative reinforcement)
 - Drug-related cues and stress
 - Limbic activation
 - → Loss of control, denial/poor decision-making
 - Hypofrontality/low D2
 - Reduced gray matter density
 - → Back to first step
- Addiction is a complex problem
 - It involves changes in our self-control and changes in the meaning of stimuli (i.e. rewards)

Impulse Control

- One of the most common effects of frontal cortex lesion is impairment in impulse control (e.g. Phineas Gage)

- Changes in frontal cortex activity are associated with a reduced ability to assess value and control behaviour
- Evaluating stimuli
 - Abnormal activity in the OFC (involved in evaluating stimuli) in gambling and other related problems
- Often we have to wait for a reward
 - Does the value of rewards change over time?
- *Temporal discounting*
 - Rewards may reduce in value as we wait
 - We can wait for rewards – but there is a limit to how long we will do this
 - Patients with OFC lesions have great difficulty waiting
 - Go for early small rewards (\$10 now) rather than big late rewards (\$20 in 5 weeks)
- Marshmallow test
 - If one avoids eating one marshmallow now, one gets two marshmallows later
 - Test performance is linked to test scores, social success, and stress reactivity
 - Also related to family background, cognitive ability, and home environment
 - Replications have been successful
- Rewards
 - Food
 - Drink
 - Relationships
 - Money
 - Drugs
- *Reward system*
 - A group of interconnected neural structures implicated in the attribution of reward
 - Signalling centrally involves the transmitter *dopamine (DA)*
 - A critical part is the *mesolimbic pathway*
 - Ventral tegmental area (VTA) → nucleus accumbens (NAc) synapse in particular
- Conventional views on DA
 - Rewards causes DA release (False)
 - DA is associated with the *expectation* of reward
 - DA is why one likes the reward (False)
 - Oversimplifies things
 - One can and should go on a DA fast (False)
 - Impossible to avoid the DA system

- DA and reward
 - DA is not essential for *learning* response-reward associations
 - Can learn with reduced DA; high DA does not improve learning
 - DA is not essential for *liking* rewards
 - Animals without DA still 'like' cocaine, but use it less
 - DA neuron activity also linked to aversive stimuli
 - DA is more linked to *wanting*
 - Liking and wanting change in substance abuse; liking is thought to decrease while wanting increases
 - In drug addiction, 'wanting' increases over time and 'liking' decreases
 - 'Wanting' causes addiction

Risk Factors for Addiction

- Stability of home environment
- Gender (higher rates in males)
- Mental health status
- Early use and peer groups
 - If one takes drugs when young, one's brain begins to develop differently
- Genetics
 - Heritability for addiction 0.4 or above

Theories of Addiction Over Time

- *Physical dependence theories* – take the drug to avoid withdrawal
 - Problem – some drugs don't have strong withdrawal effects
- *Positive incentive theories* – take the drug for pleasurable effects
 - Problem – positivity of drug is not always high
- *Instrumental drug use/self-medication theories* – take the drug for a particular benefit
 - E.g. for health benefits
 - Problem – does not explain all the cases
- *Personality-based theories* – traits are correlated with drug use (e.g. openness to experience)
 - Neuroticism and openness associated with high level of drug use
 - Agreeableness and conscientiousness associated with low level of drug use

Problems with Animal Models

- Social networks (e.g. peers, family) are risk factors for mental health disorders
 - Most animals live alone
 - Most rodents are *singly-housed* (no community interaction)

- Animals are typically housed in low quality environments, with few competing activities
 - o Taking the drug is probably the best thing to do
- Laboratory setting may not accurately represent the context under which addictions occur

Rat Park Study (Controversial)

- Rats given access to an enriched environment with opportunity for social interaction used less morphine
- Lead to a re-examination of animal models of addiction
- Environment almost certainly matter, but it is not the only factor

Treating Addiction

- Many barriers exist (stigma, legal implications, etc.)
 - o Most do not seek treatment
- Prognosis good with treatment
 - o Majority recover
- Treatment takes many forms, but is rarely pharmacological (drug-based) in nature
- Idea of 'addiction as a disease' has implications for treatment efficacy and quality of life
 - o Beliefs vary by country
 - o If one considers it a disease, one would feel helplessness
- Choice vs. disease perspective
 - o *Choice* emphasizes personal accountability
 - Context, reinforcement and punishment would all matter
 - Belief in accountability may lead to more effort in abstaining
 - o *Disease* perspective acknowledges deficits in biological systems (e.g. specific neural pathways)
 - o Perspectives may affect treatment efficacy, and certainly affects legal regulation of drugs
 - If 200 people are looking at one person, that person most likely will not take drugs
 - o *Hybrid perspectives* (disease affecting the circuitry in the brain) also exist
- Predictors of treatment success
 - o Psychological and physiological health problems
 - Depression or chronic pain → less likely to succeed
 - o Marital status
 - Married → more likely to succeed
 - o Education and economic pressures
 - o Fear of legal sanctions

- More likely to succeed
- Concern about respect from friends, family, and society
 - More likely to succeed
- Self-efficacy
 - More likely to succeeded

Bipolar Disorder

Bipolar Disorder

- Episodes of *depression* and *elevated mood*
 - Previously called manic depression
- During periods of *elevated mood (mania/hypomania)* the individual feels extremely energetic, happy, and/or irritable
- They may experience reduced need for sleep and make poor decisions with little regard for consequences
- Mania puts one at risk and is usually followed by depression
- ~1% of the global population
- One of the most costly disorders worldwide (top 10)
 - Economic costs estimated to be \$45 billions in the US
 - Frequently results in absenteeism
- Risk of suicide and self-harm is high
- Related to a number of other traits (particularly creativity), and over-represented in certain parts of the population

Bipolar Disorder and Creativity

- In the creative population (which includes artists and scientists), there is an over-representation of individuals with bipolar disorder
- Students with an arts education are at higher risk for later diagnosis of bipolar disorder
- The genes involved in creativity may also be linked to genes regulating mental health
 - Only small amount of genes give only one of creativity or bipolar disorder

Bipolar Disorder – Treatments

- Many possible treatments for bipolar disorder, including *lithium*, valproate, anticonvulsants, and antipsychotics
- *Lithium* is the most commonly employed treatment with the best results for long-term use
 - Mechanisms not well understood

Lecture 10: Social Psychology and Decision Making

Schizophrenia

Symptoms of SZ

- Positive symptoms
 - Hallucinations (seeing/hearing things not there)
 - Delusions (beliefs not based in fact)
 - Disorganized speech
- Negative symptoms
 - Lack of emotion (pleasure, motivation)
 - Flattened effect (not expressing emotions)
 - Impaired social interaction
 - Alogia (poor speech)
- Cognitive deficits
 - Impaired attention, memory, and executive function
 - Avolition (lack of motivation)
- Each symptom cluster may have its own mechanism

Classification of SZ

- Analogy
 - All dogs: similar in traits, similar in genes
 - All brown fur: similar in trait, very dissimilar in genes (contains bears, dogs, etc.)
 - One group reflects a real category in nature, the other group reflects a surface similarity in a single trait

Schizophrenia

- Disorder is *heterogeneous*
 - Many subtypes, with different features
- The disorder is thus not a 'single thing' but a 'collection of things' grouped together
- The classification in the clinic may not reflect how the disorder functions in the natural world

Features of SZ

- ~0.5-1% of the population (similar worldwide)
- Onset and severity differs by sex
 - o Males: ~18 years (earlier, worse outcomes)
 - o Females: ~30 years (later, better outcomes)
- Associated with disrupted neurotransmission (*dopaminergic (DA)*, glutamatergic and GABAergic)
 - o Positive symptoms are similar to the effects of drugs that increase DA signalling (e.g. amphetamine, L-DOPA)
 - o Positive symptoms reduced by drugs that block DA signalling (DA antagonists; antipsychotic drugs such as haloperidol)
- Dopamine hypothesis of SZ
 - o Positive symptoms - overactivity of the mesolimbic pathway
 - o Negative and cognitive symptoms – mesocortical pathway dysfunction

Major Risk Factors for SZ

- *Prenatal and postnatal* risk factors
 - o Some are 'choices' (e.g. drugs) whereas others are 'random accidents' (e.g. illness)
- Genetic bases of SZ
 - o Heritability h^2 is estimated to be 0.7-0.8
 - o Major genetic influence and only moderate effect of environment
- Convergent model
 - o Many *hits* (genetic and environmental) create risk for neurodevelopmental disorders
 - o Sometimes parents provide the best environment but still cannot help their children having SZ

Autism

Symptoms of Autism

- Poor social interaction
 - o Fails to respond to name, poor eye contact, resists cuddling, prefers playing/being alone
 - o May not recognize/respond to social cues
- Repetitive behaviours/difficulty switching behaviours
 - o Arranging objects, making sounds, hand flapping, head rolling, and baby rocking

- Special interests
- Slow language development
 - Starts later than age 2 (may remain non-verbal), repetition of words/phrases (*echolalia*), abnormal tone/rhythm
- *Theory of mind* is affected
 - Assessed by the Sally-Anne Test
- Reading emotional expressions is affected
 - Assessed by the *Reading Minds through the Eyes Test/RMET*
- Language acquisition of affected
 - Slower than normal, may not occur in certain cases (non-verbal autism)

The Spectrum

- Heterogeneous group of disorders, defined by a set of symptoms
- Some forms of ASD come with extreme cognitive abilities (~10%), but most do not
- Certain ends of the spectrum are underrepresented
 - One end with extreme ability (geniuses)
 - The other end with severe learning disability

Autism in the Population

- ~1% population, more common in boys (~3:1)
- Rates increasing
 - Increased awareness
 - More sensitive diagnosis
 - Increased parental age
 - People used to be parents when they are 18
 - Certain drugs (valproate), nutritional deficiencies, plastic exposure, etc.
 - Vaccines do NOT contribute to rates increasing

Convergent Model

- Interaction with genetic factors ($h^2 = 0.7-0.8$)
- Can't do anything to prevent illness when pregnant

Why Are the Boys Affected More?

- Disorder harder to diagnose in women (*masking*)
 - 'Socially appropriate' interests are common in women, making the disorder less apparent
- Higher 'genetic load' may be required in women (*female protective brain theory*; controversial)

- Similar theory proposed for SZ
- Autism-related genes interact with sexuality dimorphic biological pathways
 - Effects of hormones on gene expressions

Making in Autism

- Presenting self as if the disorder is not present
- Planning and controlling expressions (do not happen reflexively/authentically)
- The 'real person' is never recognized
- One notable study compared perceptions of people with ASD to typically-developing (TD) individuals
 - In this study, a third party TD observer briefly viewed the behaviour of either *individuals with ASD* or *TD individuals (thin slicing)*
 - The observer was *not aware* of the clinical status of the person that they were observing (i.e. blinded)
 - After viewing the individual's behaviour, the observer rated the person in several ways
 - They watch the person for like 30s and forms a judgment of them, and the judgment stays forever
 - Observer's perceptions of individuals with ASD is consistently negative for most traits
 - Observer declared less intention to pursue social interaction with individuals in the ASD group
 - Perceptions resilient even after many exposures

Social Interaction

Social Interaction

- Critical to the survival of our species
- We cooperate in large groups (e.g. hunting, sharing food, construction, etc.) to handle big challenges
- Vital to courtship, mating, and child-rearing
- Social contact is a basic human need
 - Insufficient human interaction can severely affect mood

First Impression

- Impressions of competence and trustworthiness rapidly (milliseconds) based on *facial features alone*

- We can reliably predict election winners just from pictures, though our accuracy is affected by culture
 - o Without knowing anything about who they are
 - o Culture matters – Americans can predict who wins an American election, Japanese can predict who wins a Japanese election
- Sometimes, these rapid judgments are effective
- In the context of picking future partners, first impressions, are surprisingly accurate
- Other times, these rapid judgments are incorrect, biased, harmful, and/or unfair (as in *stereotypy*)
 - o E.g. negative judgments of individuals with autism
- Our judgments rarely change with time or experience
- Why we like someone is *not* just based on their actions

For Most Couples:

- Similarity in intelligence and education ($r = \sim 0.35$)
- Similarity in the personality traits of openness, neuroticism, and agreeableness ($r = 0.2-0.3$)
- Similarity in attractiveness (*matching hypothesis*)
- Attractiveness is associated with positive qualities (*halo effect*); possible evolutionary benefit (fertility signal)
- Importance of attractiveness may vary
- Odd of divorce rates from lowest to highest: (lower is better)
 - o eharmony (online dating website for people who want a serious relationship) < school < family < church < friends < match.com < social event < work < other < bar
- Why relationships might end (likelihood)
 - o Men: sexual infidelity > emotional infidelity
 - o Women: emotional infidelity > sexual infidelity

Relationship with Teacher

- Why we love/hate a teacher
 - o Ratings (i.e. ratemyprof)
 - *Attractiveness* is positively correlated with rating
 - *Difficulty* negatively correlated with rating
 - This relationship holds across different courses, departments, and institutions
 - This relationship holds not only for teachers, but also for other authority figures as well (e.g. political figures, parents, etc.)

- Attractiveness bias
 - Perceived attractiveness is:
 - Positively correlated with perceptions of intelligence, competence, and academic performance
 - Negatively correlated with perceptions of 'criminal' traits
 - Influential for men and women
 - In 'mock jurors', attractiveness is not strongly associated with conviction rate but is linked to sentencing outcome for most crimes
 - More attractive, less harsh sentence (and vice versa)
 - Similar correlations for real legal cases
 - Effects are not overpowering and vary by the trait
 - Effects may be blunted/removed by:
 - Additional information about the individual
 - Talking about their life in detail
 - 'Enforced deep thinking' about the individual
 - Think about what they are accused of doing
 - Never, ever judge someone for their appearance
 - Both biases (for attractiveness, against attractiveness) are *ugly* and should be avoided

Attributions

- People judge others without taking their actions into account
- Even if we see their actions, we may still misjudge
- We might explain their behaviour as the result of their qualities (*dispositional attribution*)
 - One underperformed on the test because they are a bad student
- Alternatively, we could explain their behaviour as the result of their situation (*situational attribution*)
 - One underperformed because they were distracted by a tragedy

Defensive Attributions

- In *self-serving bias*, individuals overemphasize dispositional factors when they succeed and situational factors when they fail
 - Common in individualistic cultures (Western) where there is emphasis on personal achievements
- This bias may prevent performance from improving
 - It is vital to address personal deficiencies (dispositions) as the environment (situation) is often uncontrollable

- When it comes to judging others, we often focus on their dispositions rather than their situations (*actor-observer bias*)

Heuristics, Decision-Making and Implicit Biases

Decision-Making and Heuristics

- During our lifetime, we are faced with many problems and must make many important decisions quickly
- In this regard, *heuristics* are useful
- A heuristic is an approach to decision-making, problem-solving or discovery
- Heuristics can be executed quickly and don't require a lot of information
 - o But they aren't always accurate
- *Heuristics*
 - o 'Rules of thumb'
 - o 'Best practices'
 - o 'Intuitive judgments'
 - o 'Common sense'

Availability Heuristic

- Tendency to make decisions based on the information which comes to mind first (i.e. is most available)
- The information we use to make a decision include: recent, frequent, extreme, vivid, negative
- According to this notion, the memories that are salient and easiest to recall most profoundly affect judgment
- Example: plane crash → 'I'll never fly again'; hear some crime report → 'the world is getting worse and worse'

Representativeness Heuristic

- Our tendency to organize information based on the similarity of that information to already established categories
- We all use this heuristic, to an extent
- To an extent, this heuristic can be both efficient and useful
- Examples:
 - o Does the light blue flower belong to the dark blue flower group or red flower group?

- Most people would answer dark blue, as light blue and dark blue both belong to the category of blue
 - Given a person in a dress and a person in a suit, and that one of them goes to Harvard
 - Most people would say that the person in a suit goes to Harvard
- The representativeness heuristic may be useful for making rapid judgments in certain situations
- However, application of this heuristic to people can be impractical, inaccurate, and harmful
- Representativeness heuristics are linked to *stereotypy*
- Relevant to this discussion is the idea of unconscious (or *implicit*) *discrimination*

Implicit Discrimination

- *Implicit discrimination* is a construct
- Some scientists believe that it is a hidden barrier against certain groups
- Suggested to occur everywhere – including in *hiring* and *admission practices*
 - E.g. people look at the last name, and then make a different decision
- Implicit associations
 - Discrimination may be driven by associations of which the individual is unaware (*implicit associations*)
 - These learned associations may influence unconscious processing and drive decision-making
 - One technique for addressing implicit associations is the *implicit association test (IAT)*
 - Several variations of the test; critical to all is the measurement of *reaction time* (in seconds)
- IAT
 - Subjects categorize two concepts that reflect group membership (X1, X2) with an attribute (Y)
 - The concepts of 'black' (X1) or 'white' (X2) might be categorized with the attribute 'athletic'
 - In the IAT, the *reaction time* to respond to an association is recorded
 - Subjects shown X1-Y and X2-Y
 - Is X1-Y verified faster than X2-Y? Or is it the other way around? Or is there no difference at all
 - Faster responses are argued to reflect strong learned associations and might suggest bias
- Criticism of the IAT

- There are no perfect tests
- Low test-retest reliability (one's performance can change if one does the test more than once)
- Low correlation with/weak relationship to discriminatory behaviour (the test is not a great predictor of bias)
 - Construct validity issue (what is the point of the test then?)
- However, it has been argued that weak effects in the individual become important on the societal level

Stereotype Threat

- Stereotypes might not just affect our judgment of others, but our own behaviour
- *Stereotype threat* is when a fear fulfilling a stereotype in a task negatively affects performance of that task
- Meta-analysis suggest effect is small to moderate

Why Do We Make Bad Decisions?

- Tired
- Anxious
- Distracted
- Hungry
- Resisting these forces takes resources (willpower). The more energy we spent on resisting these forces, the less resources we have for decision-making (*ego depletion*)
- Ego depletion at work
 - One influential study argued that judges are more likely to make favourable decisions after a meal break than they are before
 - The proportion of favourable decisions decreases with movement away from the meal break
- However...
 - Correlational not experimental study (interpret with care)
 - Cases are not ordered randomly; cases without legal representation (i.e. no lawyer) come last
 - Cases without representation are likely to result in unfavourable outcomes
 - The effect shown in the original study may be overestimated or even non-existent
 - Effects of experimentally-induced hunger are different

Obedience, Conformity, and the 'Darker Side' of Human Behaviour

On Human Behaviour

- To an extent, obedience and conformity are very important for group cohesion
- The potential for obedience and conformity may increase with the size of the group (to a point)
- The larger the group, the more powerful the effect
 - o When everyone says a wrong answer, we would give an incorrect response as well
- Unfortunately, obedience and conformity can sometimes lead people to act in unusual and even immoral ways
 - o The research of Milgram (Shock experiment) and Zimbardo (Stanford Prison Study) explored this possibility

Milgrim Experiment

- Learner (L) is asked questions by the teacher (T)
- (T) is told by the experimenter (E) to give (L) an electric shock for wrong answers
- (T) believes they are shocking (L)
- (L) is an actor who pretends to be shocked and protests to the shocks
- In spite of protests by (L), (T) will give shocks
- Proximity and contact is a factor – but obedience is always surprising high
- Participants engaged in a behaviour (shocking an individual who protested) that they would otherwise perceive as unacceptable
- Though subjects expressed doubts, many would continue applying shocks with prodding by the experimenter
- Partial replications and modern-day extensions have produced similar results

Stanford Prison Study

- Participants were assigned to roles of 'prisoner' and 'guard' whereas the head of the study was assigned the role of 'superintendent'
- People reportedly became consumed in their roles
 - o i.e. prisoners becomes more like prisoners and guards becomes more cruel
- This study is one of the most popular studies in Psychology, but is also one of the most controversial and criticized
- Since the study was done several decades ago, the results and methods have continually been debated
- Though initially most participants believed that they were incapable of cruelty, cruel behaviours did emerge

- Some guards (~33%) became increasingly aggressive, and were said to exhibit 'sadistic-like' tendencies
- The study – which was supposed to last two weeks – was prematurely terminated after 6 days
- Criticisms
 - Small sample size (n) and selection bias (whoever responded to the ad)
 - Demand characteristics and observer effect
 - Emphasis on qualitative, anecdotal reports that are difficult to verify and analyze quantitatively
 - Some news reports exaggerate/make up stuff to catch attention
 - Experimenter (Zimbardo) was a participant (warden)
 - Normally not allowed
 - Numerous ethical issues (has NOT been replicated, though extensions have been attempted)

Course in Review

- Nature vs. Nurture
 - Heritability, environmental
- Free will vs. Determinism
 - Biological drives on certain behaviours but not others
- Accuracy vs. Inaccuracy
 - Accuracy in memory, evaluating personality of self, judgment of other people
- Conscious vs. Unconscious
 - Unconscious personality, implicit memory, unconscious processing