Chapter 1

1.0

- Psychology is *the scientific study of* mind *and* behavior
- Philosophers even suggested that the pineal gland in the brain might function as the magic tunnel between the physical world and the psychological world
- FMRI, allows scientists to "scan" a brain and see which parts are active
- Elliot became stoic after his removal of the tumor in his brain
- The mind often trades accuracy for speed and versatility
- "Autopilot" → behaving automatically

Psychology's Roots

- **Structuralists:** who tried to analyze the mind by breaking it down to its basic components
- **Functionalists:** who focused on how mental abilities allow people to adapt to their environments

Psychology's Ancestors: The Great philosophers

- Plato argued in favor of **nativism**, which maintains that certain kinds of knowledge are innate or inborn
- Aristotle believed that the child's mind was a tabula rasa (a blank slate) on which experiences were written, and he argued for **philosophical empiricism**, which holds that all knowledge is acquired through experience

From the Brain to the Mind: The French Connection

- Rene Descartes argued that body and mind are fundamentally different things—that the body is made of a material substance, whereas the mind (or soul) is made of an immaterial or spiritual substance
- **Dualism:** how mental activity can be reconciled and coordinated with physical behavior
- Suggested that the mind influences the body through pineal gland

- Thomas Hobbes argued that the mind and body aren't different things; rather, the mind is what the brain does

- Franz Joseph Gall also thought that brains and minds were linked, but by size rather than by glands
- Examined the brain of animals and of people who died of disease or as healthy people
- Observed that mental ability often increases with larger brain size and decreases with damage to the brain
- Developed **phrenology**: specific mental abilities and characteristics, ranging from memory to the capacity for happiness, localized in specific regions

- Pierre Flourens surgically removed specific parts of the brain from dogs, birds, and other animals and found that their actions and movements differed from those animals with intact brains (DUH! Let's see how you function after I remove parts of your brain..)

- Paul Broca worked with a patient who had suffered damage to a small part of the left side of the brain (they named it Broca's area very creative..)

Structuralism: Applying Methods from Physiology

- **Physiology:** study of biological processes, especially in the human body
- William James was drawn to Hermann von Helmholtz and Wilhelm Wundt (awwh boy crush)

Wundt and the Development of Stucturalism

- First to open a lab for psychology
- **Consciousness:** a person's subjective experience of the world and the mind
- **Structuralism:** the analysis of the basic elements that constitute the mind
- **Introspection:** involves the subjective observation of one's own experience
    - ⇒ **Example:** describing how you felt when you smelled that rainbow cake covered in Belgium chocolate.. mmm…

Titchener Brings Structuralism to the United States

- Studied with Wundt
- Emphasized the relationship between elements of consciousness
- Structuralist approach eventually faded → it lacked replicable observations (remember the Digital Labcoat we did with replicating experiments? Ya that. Not all results are reoccurring and consistent)

James and the functional Approach

- James decided to teach at Harvard (no big deal)
- Agreed on the importance of immediate experience and the usefulness of introspection as a technique (Wundt's idea)
- Disagreed on with Wundt's claim that consciousness could be broken down into separate elements
- Developed **functionalism:** the study of the purpose mental processes serve in enabling people to adapt to their environment
- Inspired by natural selection (the features of an organism that help it survive and reproduce are more likely than other features to be passed on to subsequent generations)
- Mental abilities must have evolved because they are adaptive
- Consciousness must serve an important biological function and the task for psychologists was to understand what those functions are
- Hall believed that as children develop, they pass through stages that repeat the evolutionary history of the human race
- Functionalism became more influential than structuralism

The Development of Clinical Psychology

- Clinics were beginning to study patients with psychological disorders

The Path to Freud and Psychoanalytic Theory

- Jean-Martin Charcot and Pierre Janet observed patients with **hysteria**: the temporary loss of cognitive or motor functions, usually as a result of emotionally upsetting experiences
- Hypnosis helped solve the problem
- Freud theorized that many of the patient's problems could be traced to the effects of painful childhood experiences that the person could not remember, and he suggested that the powerful influence of these seemingly lost memories revealed the presence of an unconscious mind
- **Unconsciousness:** the part of the mind that operates outside of conscious awareness but influences conscious thoughts, feelings, and behaviours
- **Psychoanalysis:** bringing unconscious material into conscious awareness
- Experimenting sexual experiences and unconscious sexual desires

Influence of Psychoanalysis and the Humanistic Response

- Freud's vision is dark and pessimistic
- Abraham Maslow and Carl Rogers started a new movement called **humanistic psychology**: an approach to understanding human nature that emphasizes the positive potential of human beings

The Search for objective Measurement: Behaviourism takes Center Stage

- **Behaviourism:** the scientific study of objectively observable behavior

Watson and The Emergence of Behaviourism

- Watson believed that private experience was too idiosyncratic and vague to be an object of scientific inquiry
- He proposed that psychologists should focus entirely on the study of behavior
- Margaret Floy Washburn argued that nonhuman animals, much like human animals, have conscious mental experiences
- Watson was influenced by Pavlov
- Watson believed that human behavior is powerfully influenced by the environment

B.F. Skinner and the Development of Behaviourism

- Built the Skinner box
- The box has a lever and a food tray, and a hungry rat could get food delivered to the tray by pressing the lever
- **Reinforcement:** the consequences of a behavior determine whether it will be more or less likely to occur again
- Developed teaching machines for kids

Return of the Mind: Psychology Expands

- Behaviourism ignored the mental processes and evolutionary history of the organisms it studied

The Emergence of Cognitive Psychology

- Illusions: errors of perception, memory, or judgment in which subjective experience differs from objective reality
- Wertheimer's experiment, a person was shown two lights that flashed quickly on a screen, one after the other
- He started to reduce the time between flashes

- He reasoned that the perceived motion could not be explained in terms of the separate elements that cause the illusion
- **Gestalt psychology:** a psychological approach that emphasizes that we often perceive the whole rather than the sum of the parts
- Bartlett experimented with memory
- Jean Piaget studied the perceptual and cognitive errors of children in order to gain insight into the nature and development of the human mind
- Kurt Lewin argued that one could best predict a person's behavior in the world by understanding the person's subjective experience of the world
- **Cognitive psychology:** the scientific study of mental processes, including perception, thought, memory, and reasoning

Technology and the Development of Cognitive Psychology

- Donald Broadbent studied what happens when people try to pay attention to several things at once
- Invention of computers
- Writing computer programs

The Brain Meets the Mind: The Rise of Cognitive Neuroscience

- Damages to particular parts of the brain causes a person to lose a specific cognitive ability
- Karl Lashley conducted studies in which he trained rats to run mazes, surgically removed parts of their brains, and then measured how well they could run the maze again
- **Behavioural neuroscience:** links psychological processes to activities in the nervous system and other bodily processes
- They record electrical or chemical responses in the brain in the brain as the task is being performed or later removed specific parts of the brain to see how performance is affected
- Researchers used scanning technology to identify the parts of the brain in the left hemisphere that are involved in specific aspects of language, such as understanding or producing words
- **Cognitive neuroscience** is the field that attempts to understand the links between cognitive processes and brain activity

The Adaptive Mind: The Emergence of Evolutionary Psychology

- **Evolutionary psychology:** explains mind and behavior in terms of the adaptive value of abilities that are preserved over time by natural selection

- Evolutionary psychologists think of the mind as a collection of specialized "modules" that are designed to solve the human problems our ancestors faced as they attempted to eat, mate, and reproduce over millions of years
- Reproducing "jealous genes"
- Evolutionary adaptations should also increase reproductive success

1.23 The Development of Social Psychology

- **Social psychology:** the study of the causes and consequences of interpersonal behavior
- Normal Tripplett noticed that cyclists ride faster when they rode with others
- Trying to show that the mere presence of other people can influence performance on even the most mundane kinds of tasks
- Lewin adopted the language of midcentury physics to develop a "field theory" viewed social behavior as the product of "internal forces" and "external forces"
- Asch performed lab experiments to examine the "mental chemistry" that allows people to combine small bits of information about another person into a full impression of that person's personality
- Gordon Allport → study stereotyping, prejudice, and racism and to shock the world of psychology by suggesting that prejudice was the result of a perceptual error that was every bit as natural and unavoidable as an optical illusion

1.24 The Emergence of Cultural Psychology

- **Cultural psychology:** the study of how cultures reflect and shape the psychological processes of their members
- Studied by Wundt
- Margaret Mead and Gregory Bateson observed child-rearing patterns, rituals, religious ceremonies, etc
- **Absolutism** holds that culture makes little or no difference for most psychological phenomena
- **Relativism** holds that psychological phenomena are likely to vary considerably across cultures and should be viewed only in the context of a specific culture

1.27 Psychologists Band Together: The American Psychological Association

- American Psychological Society (APS) was formed in 1988 by 450 academic psychologists who wanted an organization that focused specifically on the needs of psychologists carrying out scientific research

- APA was all white males
- Today about half of all APA members are women, and the percentage of non-white members continues to grow

Chapter 2

2.1 Empiricism: How to Know Stuff

- **Dogmatism** to describe the tendency for people to cling to their assumptions and the word **empiricism** to describe the belief that accurate knowledge can be acquired through observation

2.2 The Scientific Method

- Empiricism is the essential element of the **scientific method**, which is a set of principles about the appropriate relationship between ideas and evidence
- We gather empirical evidence relevant to an idea and then modify the idea to fit the evidence
- **Theory**: hypothetical explanation of a natural phenomenon
- **The rule of parsimony**: plurality should only be posited when necessary or "keep it simple, stupid"
- **Hypothesis**: falsifiable prediction made by a theory
- Your observation should be consistent

2.3 The Art of Looking

- **Empirical method:** a set of rules and techniques for observation

What three things make people difficult to study?

1. **Complexity**: the human brain is way too complicated
2. **Variability**: no one ever do, say or think exactly the same
3. **Reactivity**: people often think, feel, and act one way when they are being observed and a different way when they are not

- **Methods of observation**: allow them to determine what people do
- **Methods of explanation**: allow them to determine why people do it

2.5 Observation: Discovering What People Do

- To observe means to use one's senses to learn about the properties of an event or an object

2.6 Measurement

Defining and Detecting

- **Operational definition**, which is a description of a property in concrete, measurable terms
- **Measure**: a device that can detect the condition to which an operational definition refers
- **EMG**: a device that measures muscle contractions under the surface of a person's skin

Validity, Reliability, and Power

- **Validity** refers to the extent to which a measurement and a property are conceptually related
  - ⇒ i.e. Frequency of smiling is a valid way to define happiness because people all over the world tend to smile more often when they feel happy
- **Reliability:** which is the tendency for a measure to produce the same measurement whenever it is used to measure the same thing
- **Power:** which is the ability of a measure to detect the concrete conditions specified in the operational definition
- Valid, reliable, and powerful measures consistently detect concrete conditions that are conceptually related to the property of interest when and only when those conditions actually exist

Demand Characteristics

- **Demand characteristics** are those aspects of an observational setting that cause people to behave as they think they should
- **Naturalistic observation** is a technique for gathering information by unobtrusively observing people
- People are less likely to be influenced by demand characteristics when they cannot be identified as the originators of their actions, and psychologists often take advantage of this fact by allowing people to respond privately
  - ⇒ i.e. completing questionnaires when they are alone
- Some may not reveal the reason behind the experiment until the end → "blinding" the participant
- They may use misleading stories or explanations

Observer Bias

- Experimenters should be "blind"
- Expectations can influence observations
- Expectations can influence reality
- **Double-blind observation**: an observation whose true purpose is hidden from both the observer and the person being observed

2.7 Descriptions

Graphic Representations

- **Frequency distribution**: a graphic representation of measurements arranged by the number of times each measurement was made
- It can have a shape, such as a bell curve (Gaussian distribution)

- **Normal distribution**: mathematically defined frequency distribution in which most measurements are concentrated around the middle

Descriptive Statistics

- Brief summary statements that capture the essential information from a frequency distribution
- 2 kinds of descriptive stats: those that describe the **central tendency** of a frequency distribution and those that describe the **variability** in a frequency distribution
- Descriptions of central tendency are statements about the value of the measurements that tend to lie near the center or midpoint of the frequency distribution
- Mean, median and mode
- Descriptions of central tendency are statement about the location of the measurements in a frequency distribution, descriptions of variability are statements about the extent to which the measurements differ from each other
- Range
- **Standard deviation** is a statistic that describes the average difference between the measurements in a frequency distribution and the mean of that distribution
    - ⇒ On average, how far are the measurements from the center of the distribution?

2.9 Explanation: Discovering Why People Do What They Do

- Discover casual relationships between properties

2.10 Correlation

Patterns of Variation

1. You measure a pair of **variables**, which are properties whose value can vary across individuals or over time
2. Make a series of measurements rather than just one
3. You tried to discern a pattern in your series of measurements

- By looking at patterns of variation, we can use measurement t discover the relationships between variables
- Correlations can describe the past and predict the future
- A **positive correlation** describes a relationship between two variables in "more-more" or "less-less" terms
- A **negative correlation** describes a relationship between two variables in "more-less" or "less-more" terms

Measuring Correlation

- **Correlation coefficient** is a measure of the direction and strength of a correlation, and it is symbolized by the letter r
- R can range from -1 to 1

- If every time the value of one variable increases by a fixed amount the value of the second variable also increases by a fixed amount, then the relationship between the variables is called a **perfect positive correlation** and ***r* = 1**
- If every time the value of one variable increases by a fixed amount the value of the second variable *decreases* by a fixed amount, then the relationship between the variables is called a **perfect negative correlation** and ***r* = −1**
- If every time the value of one variable increases by a fixed amount the value of the second variable does not increase or decrease systematically, then the two variables are said to be **uncorrelated** and ***r* = 0**

The Third-Variable Problem

- **Natural correlations** are the correlations we observe in the world around us, and although such observations can tell us whether two variables have a relationship, they cannot tell us what kind of relationship these variables have
  - ⇒ Violent games equal violent children
- **Third-variable correlation**, which means that two variables are correlated only because each is causally related to a third variable
- **Matched samples technique**, which is a technique whereby the participants in two groups are identical in terms of a third variable
- **Matched pairs technique**, which is a technique whereby each participant is identical to one other participant in terms of a third variable
- Third-variable problem refers to the fact that a causal relationship between two variables cannot be inferred from the naturally occurring correlation between them because of the ever-present possibility of third-variable correlation

Manipulation

- The creation of an artificial pattern of variation in a variable in order to determine its casual powers
- Doing this experiment:
- 1. Perform a manipulation
  - ⇒ The variable that is manipulated the independent variable because it is under our control
  - ⇒ Have 2 groups of participants: an **experimental group**, which is the group of people who are treated in a particular way and a **control group**, which is the group of people who are not treated in this particular way
- 2. Having manipulated one variable (exposure), we now measure the other variable (aggression)

    - ⇒ We call the variable that is measured the **dependent variable** because its value depends on what the person being measured says or does
  - 3. We check to see whether our manipulation produced changes in the variable we measured

Random Assignment

- **Self-selection** is a problem that occurs when anything about a person determines whether he or she will be included in the experimental or control group
- **Random assignment** is a procedure that uses a random event to assign people to the experimental or control group

Significance

- Calculating the odds that random assignment has failed
- The calculation must allow us to be 95% certain that random assignment succeeded
- When the odds that random assignment failed are less than 5%, an experimental result is said to be **statistically significant**
- **Inferential statistics**—that tells scientists what kinds of conclusions or inferences they can draw from observed differences between the experimental and control groups
    - ⇒ **Example:** When psychologists report that p **<** .05, they are saying that according to the inferential statistics they calculated, the odds that random assignment failed are less than 5%, and thus the differences between the experimental and control groups were unlikely to have been caused by a third variable

2.12 Drawing Conclusions

- **Internal validity**, which is the characteristic of an experiment that establishes the causal relationship between variables

Representative Variables

- Defining variables (determining your x and y values for your graph)
- **External validity** is a property of an experiment in which variables have been operationally defined in a normal, typical, or realistic way
    - ⇒ You are basically manipulating an experiment in your laboratory, like slowing down a rubber ball with lasers
- Psychologists normally observe a **sample**, a partial collection of people drawn from a population
    - ⇒ Population is signified by "N" and sample is signified by "n"
- **Case method**: method of gathering scientific knowledge by studying a single individual

- **Random sampling**, which is a technique for choosing participants that ensures that every member of a population has an equal chance of being included in the sample
- Representative of the population, which allows us to generalize about that population

2.14 The Ethics of Science: First, Do No Harm

- Yes there are ethics.. you can't just experiment on anyone without consent or hurting them physically, emotionally or internally

2.15 Respecting People

- Research should show respect for persons and their right to make decisions for and about themselves without undue influence or coercion
- Research should be beneficent (it should attempt to maximize benefits and reduce risks to the participant)
- It can't be prejudice towards participants
- **Informed consent:** a written agreement to participate in a study made by an adult who has been informed of all the risks that participation may entail
- **Freedom from coercion**
- **Protection from harm**
- **Risk-benefit analysis**
- **Deception**
- **Debriefing**
- **Confidentiality**

2.16 Respecting Animals

- Ensuring appropriate consideration of he animal's comfort, health, and humane treatment
- Minimize discomfort, infection, illness and pain
- Must use appropriate anesthesia when performing surgery

1) Neurons: The Origin of Behavior (pgs 78 – 82)

- All thoughts, feelings, and behaviors spring from cells in the brain called **neurons** that take in information and produce some kind of output

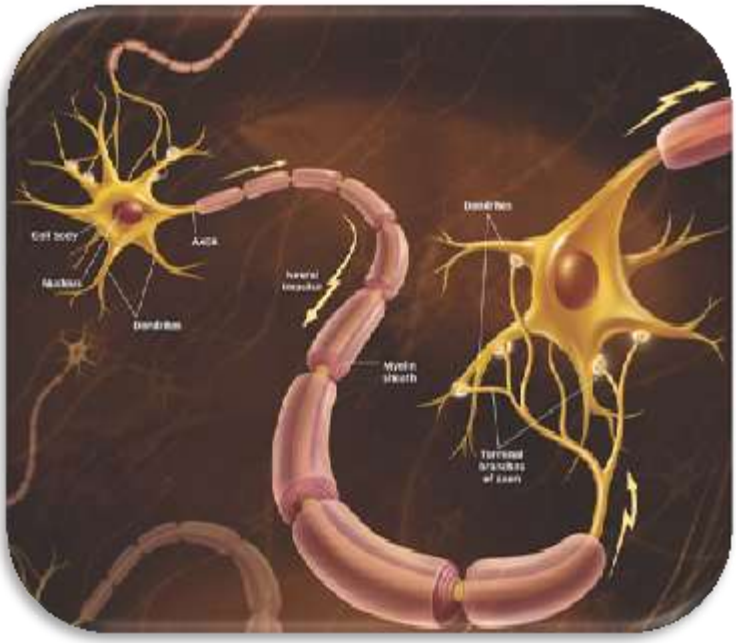
❖ Discovery of How Neurons Function (pg 78)

- **Santiago Ramón y Cajal (1852 – 1934)** learned of a new technique for staining neurons in the brain, called *Golgi-Stained Neurons*.

- Provided important information about the nature and structure of the nervous system.
    - Learned that each neuron was composed of a body with many threads extending outward toward other neurons, but that the threads of each neuron did not actually touch other neurons.
    - Realized that neurons are information-processing units of the brain and even though there was a gap between neurons, they communicated in some way.

❖ **Components of the Neuron (pgs 79 – 80)**

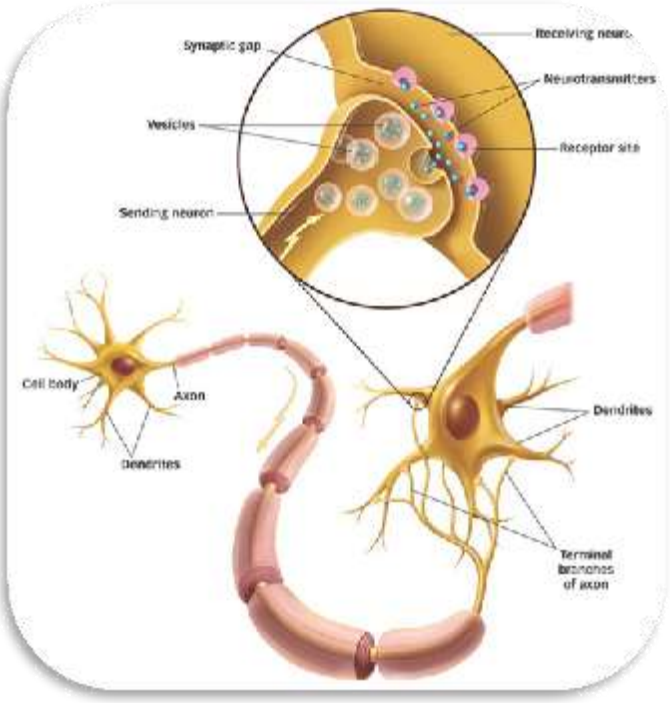
- **Cajal** discovered that neurons are composed of three basic parts: the cell body, the dendrites, and the axon.



- **Cell body** is the largest component of the neuron and coordinates functions such as protein synthesis, energy production, and metabolism to occur within it. Also contains a *nucleus* that houses chromosomes contain DNA. Cell body is surrounded by a *porous cell membrane* allowing molecules to flow in and out of the cell.
- Neurons have two types of specialized extensions of the cell membrane allowing communication: dendrites and axon.
    - **Dendrites** receive information from other neurons → cell body. Look like tree branches; can be many of them.
    - **Axon** transmits information to other neurons, muscles, or glands ← cell body. Each neuron has a single axon.

- Axon is covered by a **myelin sheath**; composed of **glial cells**.
- **Myelin sheath** insulates axon for more efficient transmission of information.
    - **Example:** *Demyelinating diseases like Multiple Sclerosis, myelin sheath deteriorates → slows transmission of information → loss of feeling in limbs, partial blindness, and difficulties in coordinated movement and cognition.*
- **Glial cells** perform variety of functions like digesting parts of dead neurons, providing physical and nutritional support for neurons, and form myelin.

- Small gap between axon of one neuron and, dendrites or cell body of another is called the **synapse**. Provides communication of information between neurons, allowing thinking, feeling, and behaving.



❖ Major Types of Neurons (pg 81)

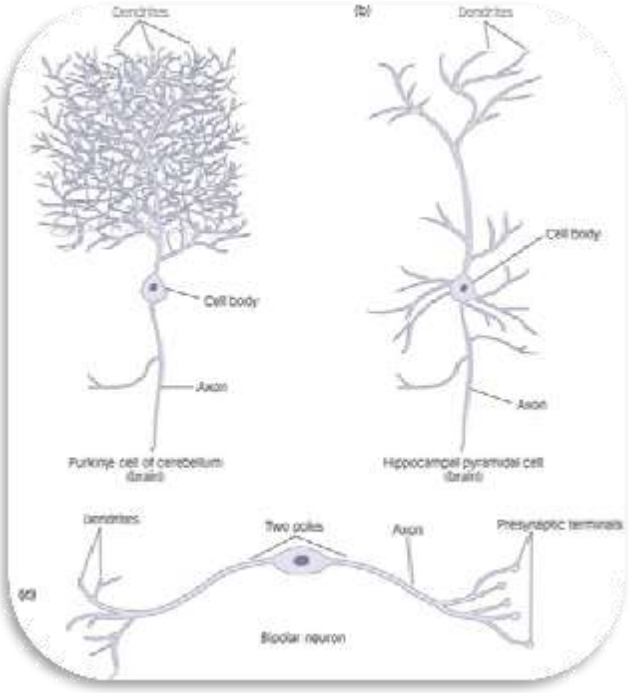
- There are three major types of neurons, each with a distinct function: sensory neurons, motor neurons, and interneurons.
- **Sensory neurons** receive information from external world → spinal cord → brain. Receive signals for five senses.
- **Motor neurons** carry signals to produce movement from spinal cord → muscles

How do the three types of neurons work together to transmit information?

- Most of nervous system composed of **interneurons**: connect sensory neurons, motor neurons, or other interneurons.

❖ Neurons Specialized by Location (pg 82)

- Neurons are also specialized depending on their location; structure changes.
- *Purkinje cells* carry information from cerebellum → rest of the brain/spinal cord. Have dense and multiple dendrites.
- *Pyramidal cells* found in cerebral cortex have a triangular cell body and a single, long dendrite with multiple smaller dendrites.
- *Bipolar cells* have a single axon and single dendrite, and are found in the retinas of the eye.



Summary:

- **Neurons** are the building blocks of the nervous system. They process information received from the outside world, they communicate with one another, and they send messages to the body's muscles and organs.
- **Neurons** are composed of three major parts: **the cell body, dendrites, and the axon**.
- The **cell body** contains the **nucleus**, which houses the organism's genetic material.
- **Dendrites** receive sensory signals from other neurons and **transmit this information to the cell body**.
- Each neuron has only **one axon**, which carries signals **from the cell body to other neurons or to muscles and organs in the body**.
- Neurons don't actually touch: They are separated by a **small gap**, which is part of the **synapse** across which signals are **transmitted from one neuron to another**.
- **Glial cells** provide support for neurons, usually in the form of the **myelin sheath**, which coats the **axon** to facilitate the transmission of information. In **demyelinating diseases**, the myelin sheath deteriorates.
- **Neurons** are differentiated according to the functions they perform. The three major types of neurons include **sensory neurons, motor neurons, and interneurons**. **Examples of sensory neurons and interneurons are, respectively, bipolar neurons and Purkinje and pyramidal cells.**

2) The Electrochemical Actions of Neurons: Information Processing (pgs 83 – 91)

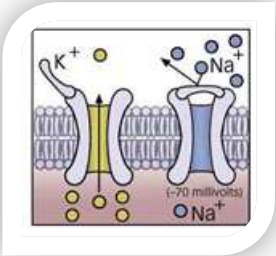
- Communication of information between neurons occurs in two stages: *conduction* and *transmission*. Referred to the *electrochemical action* of neurons.
- During the first stage, *conduction*, an electrical signal is passed along from neurons → dendrites → cell body → axon
- During the second stage, *transmission*, the electrical signal is passed between neurons over the synapse.

❖ Electric Signaling: Conducting Information with a Neuron (pgs 83 – 86)

- Neuron's cell membrane is porous, allowing *ions* to flow in and out of cell.

✓ The Resting Potential: The Origin of the Neuron's Electrical Properties

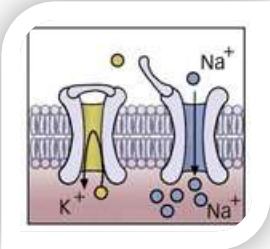
- Neurons have a natural negative electric charge of about – 70 millivolts called the **resting potential**; the difference in charge due to difference in concentration of ions inside and outside of the neuron.
    - In the *resting state*, there is a high concentration of positively charged ions, potassium (K^+) inside the neuron; and a high concentration of positively charged ions, sodium (Na^+) and negatively charged ions, chlorine (Cl^-) outside the neuron.



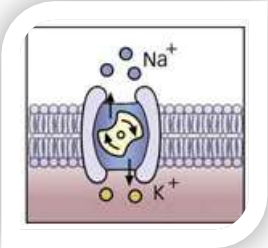
- During the *resting state*, K^+ molecules flow freely across the cell membrane, while Na^+ molecules are kept out of the neuron.

✓ The Action Potential: Sending Signals Across the Neuron

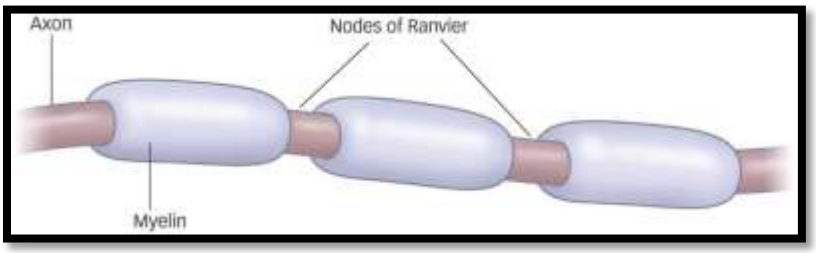
- **Action potential** only occurs when an electrical signal, reaching a *threshold* (about 40 millivolts), is sent to the neuron. The K^+ channel is shut down and the Na^+ channel opens, which allows increasing the positive charge within the neuron.



- After the action potential reaches its maximum, the membrane channels return to original state.
    - At this point, **refractory period** occurs when the ions are imbalanced, and cannot initiate another action potential.
    - The imbalance of ions is reversed by an active chemical "pump", moving Na^+ outside the axon, and moving K^+, inside the axon. This is how the transmission of information is passed along the axon.



- The action potential is spread, initiating an action potential at another nearby location, and so on, thus transmitting the charge down the axon.
- Myelin does cover the entire axon, it clumps around with little break points called the *nodes of Ranvier*



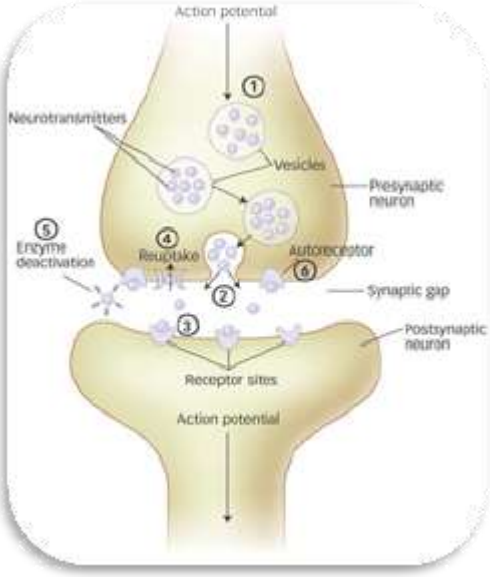
    - Discovered by **Louis- Antoine Ranvier**
    - *Saltatory conduction*: Charge seems to "jump" from node to node, helping speed the flow of information

❖ **Chemical Signaling: Transmission between Neurons (pg 86)**

- Electric charge of the action potential takes form that can cross the synaptic gap.

How does a neuron communicate with another neuron?

- *Synaptic transmission*: Axons sending the action potential end in **terminal buttons** that contain **neurotransmitters**. Dendrites receiving the action potential contain **receptors**.
- As K^+ and Na^+ flow across, they move the sending neuron (*presynaptic neuron*), from a resting potential to an action potential
    - Action potential → Presynaptic neuron → Axon's terminal button → Release of neurotransmitters from vesicles → Synapse
- Moving the presynaptic neuron to the nearby dendrite's receptor site of the receiving neuron (*postsynaptic neuron*)
    - Synapse → Binds to dendrite's receptor site → Postsynaptic neuron → Action potential



    - Neurotransmitters and receptor sites act like a lock-and-key system

What happens to the neurotransmitters left in the synapse after synaptic transmission?

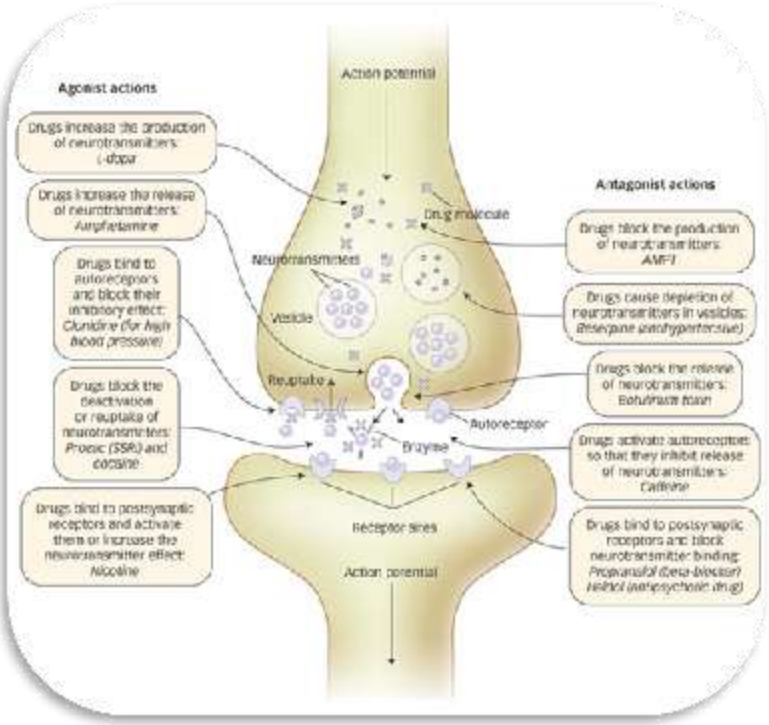
- Neurotransmitters leave the synapse through three processes:
    1) *Reuptake*: Neurotransmitters are reabsorbed by the terminal buttons of the presynaptic neuron's axon.
    2) *Enzyme deactivation*: Neurotransmitters are destroyed by enzymes in the synapse.
    3) *Autoreceptors*: Neurotransmitters can bind to the autoreceptors on presynaptic neurons. They detect how much of a neurotransmitter has been released into a synapse and signal the neuron to stop releasing the neurotransmitter when an excess is present.

❖ Types and Functions of Neurotransmitters (pgs 86 – 87)

- **Acetylcholine (ACh)**: Involved in voluntary motor control. Found in neurons when axons connect to muscle and body organs, like the heart. Also contributes to regulation of attention, learning, sleeping, dreaming, and memory. Alzheimer's disease involving severe memory impairments is associated with deterioration of Ach-producing neurons.
- **Dopamine:** Regulates motor behavior, motivation, pleasure, and emotional arousal. Plays a role in drug addiction, linked to schizophrenia (high levels), and linked to Parkinson's disease (low levels).
- **Glutamate:** A major excitatory neurotransmitter; enhances transmission of information. High levels can overstimulate and cause seizures.
- **GABA (gamma-amniobutyric acid):** A primary inhibitory neurotransmitter; stops the firing of neurons. Low levels can overstimulate and cause seizures.
- **Norepinephrine:** Influences mood and arousal. Involved in states of vigilance and heightened awareness of danger. Low levels implicate mood disorders.
- **Serotonin:** Regulates sleep and wakefulness, eating, and aggressive behavior. Low levels implicate mood disorders.
- **Endorphins:** Act within pain pathways and emotion centers of brain. Dulls the experience of pain and elevates moods. For example, the "runner's high" when athletes push their bodies to painful limits of endurance.
- Imbalance of neurotransmitters can sometimes occur naturally or being actively caused by a person.
    - Naturally caused: Brain not producing enough serotonin → depressed or anxious moods
    - Actively caused: Smoking, drinking alcohol, and taking drugs

❖ How Drugs Mimic Neurotransmitters (pgs 88 – 90)

- Drugs affect nervous system by increasing, interfering with, or mimicking the manufacture or function of neurotransmitters; **agonists** and **antagonists**.



- **Examples:**
  - L-dopa: *Acts as an agonists by enhancing production of dopamine*
  - MPTP: *Acts as an antagonists by destroying dopamine-producing neurons*
  - Methamphetamine: *Combination of agonist and antagonist effects alters function of neurotransmitters that help perceive and interpret visual images (hallucinations)*
  - Amphetamine: *Agonist action of preventing reuptake of floods synapse with nor-epinephrine and dopamine.*
  - Prozac: *A selective serotonin reuptake inhibitor (SSRI): agonist action of blocking reuptake of serotonin. By blocking reuptake, serotonin remains in the synapse longer and produces greater activation of serotonin receptors → helps to relieve depression.*
  - Beta-blockers: *Obstructs receptor site for nor-epinephrine in heart → heart rate slows → regulates fast and irregular heartbeats.*

Summary:

- The conduction of an **electric signal** within a **neuron** happens when the **resting potential** is changed by an **electric impulse** called an **action potential**.
- The neuron's resting potential is due to **differences in the K^+ concentrations inside and outside** the cell membrane, resulting from **open potassium channels**

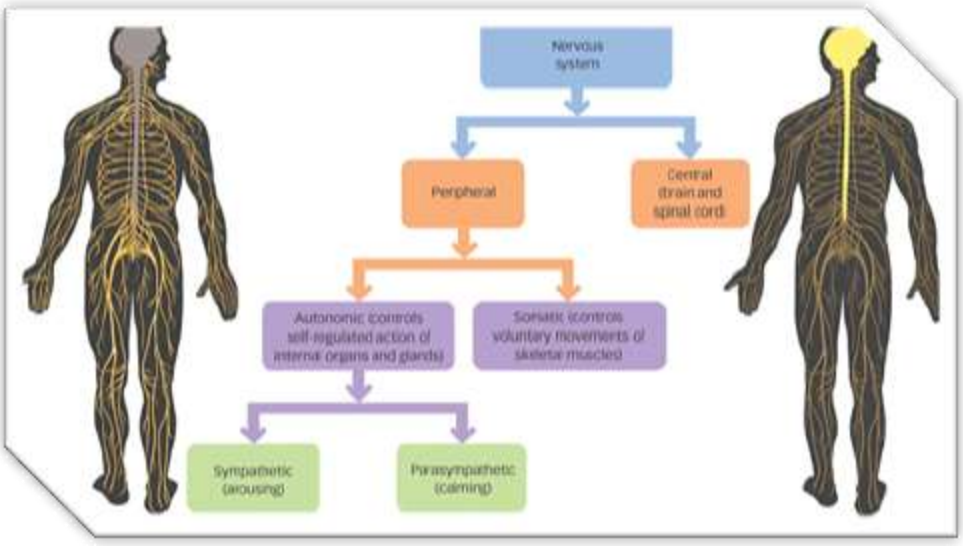
that allow K^+ to flow outside the membrane together with **closed channels for Na^+** and other ions.

- If electric signals reach a **threshold**, this initiates an **action potential**, an **all-or-none signal** that moves down the entire length of the **axon**. The action potential occurs when **sodium channels in the axon membrane open and potassium channels close**, **allowing the Na^+ ions to flow inside** the axon. After the action potential has reached its maximum, the **sodium channels close and the potassium channels open**, allowing K^+ to flow out of the axon, returning the neuron to its **resting potential**. For a brief **refractory period**, the action potential cannot be re-initiated. Once it is initiated, the action potential spreads down the axon, **jumping across the nodes of Ranvier to the synapse**.
- Communication between neurons takes place through **synaptic transmission**, where an action potential triggers **release of neurotransmitters from the terminal buttons** of the sending neuron's axon, which travel **across the synapse to bind with receptors** in the receiving neuron's dendrite.
- Neurotransmitters bind to dendrites based on existing pathways in the brain and **specific receptor sites** for neurotransmitters. Neurotransmitters leave the synapse through **reuptake through enzyme deactivation, and by binding to autoreceptors**.
- Some of the major neurotransmitters are **acetylcholine (ACh), dopamine, glutamate, GABA, norepinephrine, serotonin, and endorphins**.
- Drugs can affect behavior by acting as **agonists**, that is, by facilitating or **increasing the actions of neurotransmitters**, or as **antagonists** by **blocking the action of neurotransmitters**. Recreational drug use can have an effect on brain function.

3) The Organization of the Nervous System (pgs 91 -95)

- Network of neurons refers to the **nervous system**. The nervous system has major divisions and components.

❖ Divisions of the Nervous System (pgs 91 -93)



- Two major divisions of the nervous system: central nervous system and peripheral nervous system.
    - **Central Nervous System (CNS)** is composed of the brain and spinal cord. Receives information from external world, processes, and coordinates this information, and sends commands to skeletal and muscular systems.
    - **Peripheral Nervous System (PNS)** connects the CNS to the body's organs and muscles. It has two major subdivisions: somatic nervous system and autonomic nervous system.
        - **Somatic Nervous System** used to convey information into and out of the CNS. Humans use it to perceive, think, and coordinate their behaviors.
        - **Autonomic Nervous System** used to control blood vessels, body organs, and glands to regulate bodily systems. It has two major subdivisions: sympathetic nervous system and parasympathetic nervous system.
            - **Sympathetic nervous system** is used for action in threatening situations.
            - **Parasympathetic nervous system** is used to return the body to a normal resting state.

❖ Components of the Central Nervous System (pgs 93 – 95)

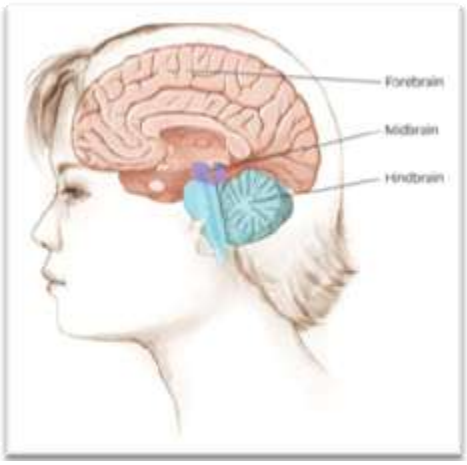
- Central nervous system has only two elements: the brain and the spinal cord.
- Spinal cord doesn't always need input from the brain for some very basic behaviors. Connections between the sensory inputs and motor neurons in the spinal cord mediate spinal reflexes.
    - **Example:** *Placing hand near a hot stove (input sensory neuron) → pull hand away (output motor neuron)*

Summary:

- Neurons make up nerves, which in turn form the **human nervous system**.
- The nervous system is divided into the **peripheral and the central nervous systems**.
- The **peripheral nervous system connects the central nervous system with the rest of the body**, and it is itself divided into the **somatic nervous system** and the **autonomic nervous system**.
- The **somatic nervous system**, which conveys information into and out of the central nervous system, **controls voluntary muscles**, whereas the **autonomic nervous system automatically controls the body's organs**.
- The **autonomic nervous system** is further divided into the **sympathetic and parasympathetic nervous systems**, which complement each other in their effects on the body. The **sympathetic nervous system prepares the body for action in threatening situations**, and the **parasympathetic nervous system returns it to its normal state**.
- The central nervous system is **composed of the spinal cord and the brain**. The spinal cord can mediate some basic behaviors such as **spinal reflexes** without input from the brain.

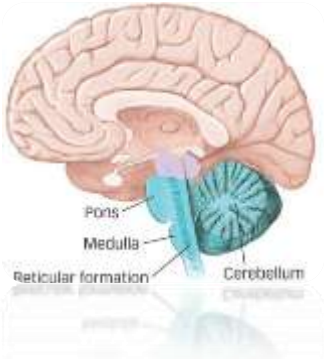
4) Structure of the Brain (pgs 95 – 104)

- Each side of the brain is basically analogous, but one half of the brain specializes in some tasks that the other half doesn't. Yet they are all part of one big, interacting, interdependent whole.
- There are three major divisions of the brain: the forebrain, the midbrain, and the hindbrain



❖ The Hindbrain (pg 96)

- Responsible for information coming into and out of the spinal cord; controls the most basic functions of life like respiration, alertness, and motor skills.
- There are three anatomical structures that make up the **hindbrain**: the medulla, the cerebellum, and the pons.

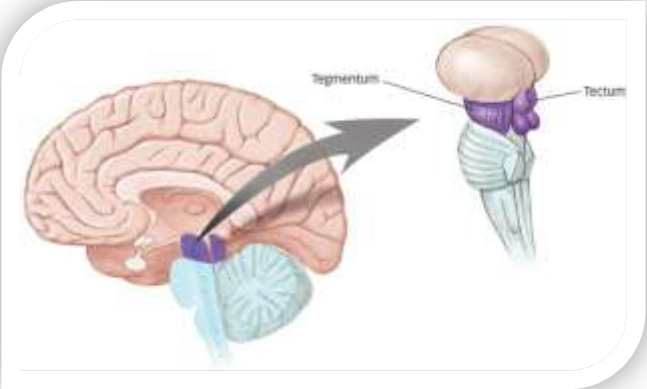


- The **medulla** coordinates heart rate, circulation, and respiration. Inside the medulla is a small cluster of neurons, the reticular formation.
    - **Reticular formation** regulates sleep, wakefulness, and levels of arousal; what most general anesthetics tend to reduce activity in.
- The **cerebellum** controls fine motor skills like riding a bike, playing the piano, or maintaining balance while walking and running to be graceful.

- The **pons** act as a bridge between the cerebellum and other structures in the brain.

❖ The Midbrain (pgs 96 – 97)

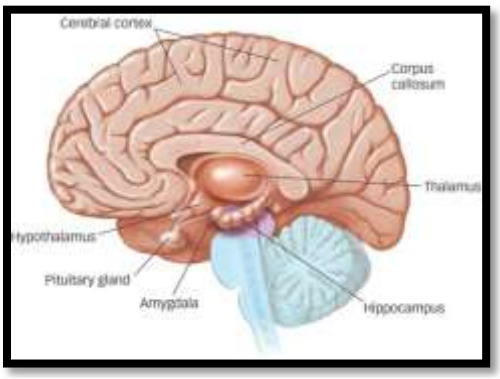
- Important for orientation and movement.
- The central location of neurotransmitters. Made up of two main structures: the tectum and the tegmentum.



- The **tectum** is involved in motivation; receives stimulus input from eyes, ears, and skin and moves the organism in a coordinated way towards the stimulus.
- The **tegmentum** is involved in movement and arousal.

❖ The Forebrain (pg 96)

- The forebrain is the highest level of the brain; it controls complex cognitive, emotional, sensory, and motor functions.
- It is divided into two main sections: the cerebral cortex and the subcortical structures.



- The **cerebral cortex** is the outmost layer which is divided into two hemispheres.
- The **subcortical structures** are housed underneath the cerebral cortex.

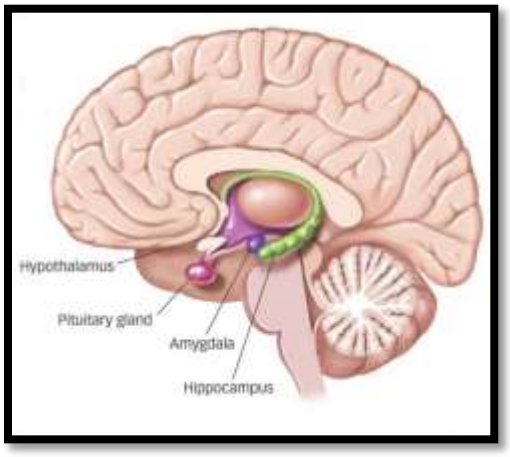
✓ Subcortical Structures

➢ Thalamus, Hypothalamus, and Pituitary Gland

- All located in the center of the brain
- The **thalamus** receives inputs from all the major senses except smell and acts like a computer serve taking in multiple inputs and relaying them to a variety of locations. Also, closes input pathways during sleep.
- The **hypothalamus** regulates body temperature, hunger, thirst, and sexual behavior.
- The **pituitary gland** is the body's hormone-producing system.

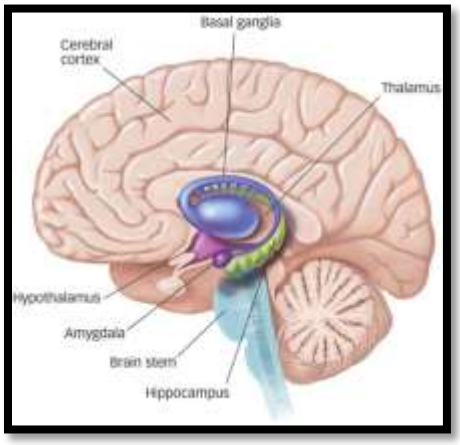
✓ The Limbic System

- Involved in motivation, emotion, learning, and memory. Three structures are part of the limbic system: the hypothalamus, the amygdala, and the hippocampus.



- The **hippocampus** creates new memories and integrates them into what we already know.
- The **amygdala** attaches emotional significance to previously neutral events associated with fear, punishment, or reward.

➢ The Basal Ganglia



- The **basal ganglia** directs intentional movements by sending outputs to the motor center in the brain stem.
- Part of the basal ganglia, the *striatum* controls posture and movement.

✓ **The Cerebral Cortex**

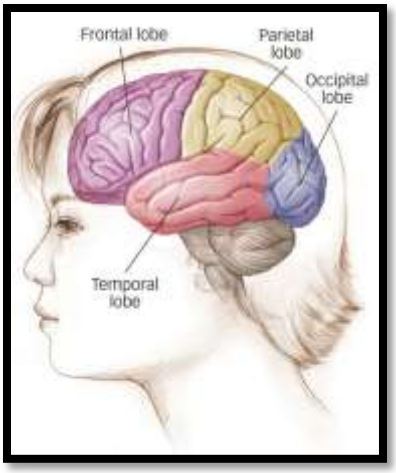
- The cerebral cortex is the highest level of the brain.
- The smooth surfaces are called the *gyri* and the indentations/fissures are called *sulci.* The sulci increase surface area of the brain.
- The cerebral cortex has three levels: separation into two hemispheres, function of each hemisphere, and role of specific cortical areas.

➢ Organization across Hemispheres

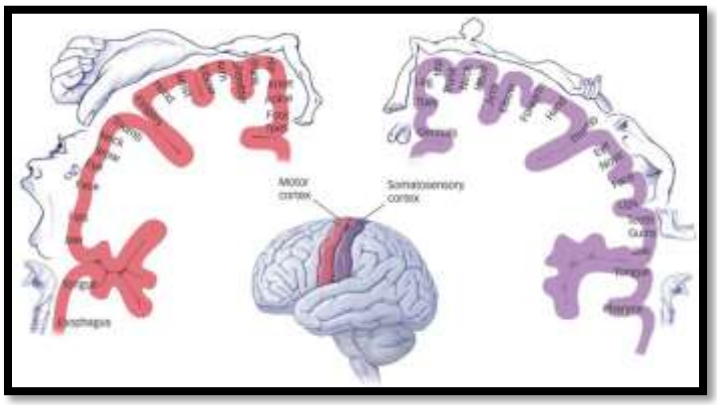
- Cerebral cortex is divided into the left and right hemispheres; each hemisphere controls the functions of the opposite side of the body (*contralateral control*).
- The two hemispheres are connected to each other by *commissures*: bundles of axons. The largest is the **corpus callosum**.

➢ Organization within Hemispheres

- Different regions within each hemisphere of the brain, divided into four *lobes*: the occipital lobe, the parietal lobe, the temporal lobe, and the frontal lobe.



- The **occipital lobe** processes visual information from the eyes → thalamus → occipital lobe.
- The **parietal lobe** processes information about touch with a strip of brain tissue called the *somatosensory cortex*.



  - The *somatosensory cortex* represents the skin areas on the contralateral surface of the body. If a body area is more sensitive, a larger part of the somatosensory cortex is devoted to it. Typically represented through a *homunculus*.
  - Like the somatosensory cortex, there is a parallel strip of brain tissue called the *motor cortex* which initiates voluntary movements and sends messages to the basal ganglia, cerebellum, and spinal cord.
- The **temporal lobe** is responsible for hearing and language with the *primary auditory cortex*; it receives sensory information from the ears based on frequencies of sound → processes into meaningful units like speech and words.
- The **frontal lobe** is specialized in movement, abstract thinking, planning, memory, and judgment. It helps us manipulate information and retrieve memories.

➢ Organization within Specific Lobes

- Representation of information within specific lobes to handle fine details of information are though **association areas** to provide sense and meaning to information.

❖ **Brain Plasticity (pgs 102 – 104)**

- Suggests that the brain can adapt to changes in sensory inputs through a quality of *plasticity*.
- **Example:** *If someone lost a finger, the nerves wouldn't just disappear; eventually, the nerves stimulate the fingers adjacent to the missing one.*

Summary:

- The brain can be divided into the **hindbrain, midbrain, and forebrain**.
- The **hindbrain** generally coordinates information coming into and out of the spinal cord with structures such as the **medulla**, the **reticular formation**, the **cerebellum**, and the **pons**. These structures respectively **coordinate breathing and heart rate, regulate sleep and arousal levels, coordinate fine motor skills**, and communicate this information to the cortex.
- The **midbrain**, with the help of structures such as the **tectum** and **tegmentum**, generally coordinates functions such as **orientation to the environment and movement and arousal** toward sensory **stimuli**.
- The **forebrain** generally coordinates **higher-level functions**, such as **perceiving, feeling, and thinking**. The forebrain houses **subcortical structures**, such as the **thalamus**, **hypothalamus**, **limbic system** (including the **hippocampus** and **amygdala**), and **basal ganglia**; all these structures perform a variety of functions related to **motivation and emotion**. Also in the forebrain, the **cerebral cortex**, composed of **two hemispheres with four lobes each** (**occipital**, **parietal**, **temporal**, and **frontal**), performs tasks that help make us fully human: **thinking, planning, judging, perceiving, and behaving purposefully and voluntarily**.
- Neurons in the brain can be **shaped by experience and the environment**, making the human brain amazingly **plastic**.

5) The Development and Evolution of Nervous Systems (pgs 105 – 110)

- A **gene** is the unit of hereditary transmission.
- **Chromosomes** are strands of DNA wound around each other in a double-helix configuration.
- **Heritability** is a measure of the variability of behavioral traits among individuals that can be account for by genetic factors.

Summary:

- Examining the development of the nervous system over the life span of an individual-its **ontogeny**-and across the time within which a species evolves—its **phylogeny**-presents further opportunities for understanding the human brain.
- **The nervous system is the first system that forms** in an embryo, starting as a **neural tube**, which **forms the basis of the spinal cord**. The neural tube **expands** on one end **to form the hindbrain, midbrain, and forebrain**, each of which folds onto the next structure.
- Within each of these areas, specific brain structures begin to differentiate. The forebrain shows the greatest differentiation, and in particular, the cerebral cortex is the most developed in humans.
- Nervous systems evolved from simple collections of sensory and motor neurons in simple animals, such as flatworms, to elaborate centralized nervous systems found in mammals.
    - The evolution of the human nervous system can be thought of as a process of refining, elaborating, and expanding structures present in other species.
    - Reptiles and birds have **almost no cerebral cortex**. By contrast, mammals have a **highly developed cerebral cortex**.
    - The human brain appears to have **evolved more quickly** compared to other species to become adapted to a more complex environment.
- The **gene**, or the unit of **hereditary** transmission, is built from strands of DNA in a double-helix formation that is organized into chromosomes.
- Humans have **23 pairs of chromosomes**-half come from each parent.
    - A child shares **50%** of his or her genes with **each parent**.
    - **Monozygotic twins share 100% of their genes**, while **dizygotic twins share 50%**, the same as any other siblings. Because of their genetic relatedness, twins are often participants in genetic research.

- The study of genetics **indicates that both genes and the environment work together** to influence behavior. Genes set the range of variation in populations within a given environment, but they do not predict individual characteristics; experience and other environmental factors play a crucial role as well.

6) Investigating the Brain (pgs 111 – 119)

- Scientists use a variety of methods to understand how the brain affects behavior. Three of the main methods are: testing people with brain damage and observing their deficits, studying electrical activity in the brain during behavior, and conducting brain scans while people perform various tasks.
- When testing people with brain damage, it gives a better understanding of normal operation of a process. Also observing damage to certain areas of the brain enables researchers to identify the functions of those areas.
- By studying the brain's electrical activity, it demonstrates which neurons fire when behavior is enacted.
- Conducting brain scans while people perform various tasks, the brain can be scanned, mapped, and coded using a variety of sophisticated instruments.

❖ Learning about Brain Organization by Studying the Damaged Brain (pgs 111 – 116)

- Much research in neuroscience correlates the loss of specific perceptual, motor, emotional, or cognitive functions with specific areas of brain damage. With this neuroscientists can theorize about the functions those areas normally perform.
    - **Example:** ***Paul Broca*** *and* ***Carl Wernicke (1848 -1905)*** *credited for Broca's area and Wernicke's area; providing evidence for the location of speech production and speech comprehension, and that they are separate.*

✓ *The Emotional Functions of the Frontal Lobes*

- **Example:** *Phineas Gage's case (September 13, 1848): was the first case study to allow researchers to investigate the hypothesis that the frontal lobe is involved in emotion regulation, planning, and decision making. Scientists had a better understanding of how the amygdale, hippocampus, and related brain structures interacted with the cerebral cortex.*

✓ *The Distinct Roles of the Left and Right Hemispheres*

- To alleviate the severity of seizures, surgeons can sever the corpus callosum in a procedure called a *split-brain procedure*.
- Would collapse the bridge of information transmission between the two hemispheres.
- In the split-brain experiment, there would be a picture of a key presented on the left and a picture of a ring presented on the right. Patients would be only be able to verbalize ring because the left hemisphere "sees" the ring and language is usually located in the left hemisphere. Patient's left hand would be able to pick

up the key but not the ring, since the left hemisphere is not communicating with the left side of the body.

- The same happens with the *chimeric face* test; a face is assembled from half-face components of full faces. Would only be able to say whose face was on the right (connected to left hemisphere). When asked to point at the face she sees with her left hand, can only point to the face on the left (connected to right hemisphere).

❖ **Listening to the Brain: Single Neurons and the EEG (pgs 114 – 115)**

- **Electroencephalograph's (EEG)** are used as one of the techniques used to record the pattern of electrical activity of neurons.
- Neurons in visual cortex are known as *features detectors* because they selectively response to certain aspects of a visual image.

❖ **Brain Imaging: From Visualizing Structure to Watching the Brain in Action (pgs 116 – 119)**

- There is a wide range of *neuroimaging techniques* that use advanced technology to create images of the living, healthy brain.
- *Structural brain imaging* provides information about the basic structure of the brain and allows clinicians or researchers to see abnormalities in brain structure.
- *Functional brain imaging*, in contrast, provides information about the activity of the brain when people perform various kinds of cognitive or motor tasks.

✓ ***The Distinct Roles of the Left and Right Hemispheres***

- *Computerized axial tomography* (*CT*) *scans* rotate a scanner around a person's head and takes a series of x-ray photographs from different angles; shows different densities of tissue in the brain.
- *Magnetic resonance imaging* (*MRI*) involves applying brief but powerful magnetic pulses to the head and recording how these pulses are absorbed throughout the brain.

✓ ***Functional Brain Imaging***

- Two newer functional-brain-imaging techniques show researchers more than just the structure of the brain by allowing them to watch the brain in action.
- During a *positron emission tomography (PET)* a harmless radioactive substance is injected into a person's bloodstream. Then, the brain is scanned by radiation detectors as the person performs perceptual or cognitive tasks, such as reading or speaking.
- *Functional magnetic resonance imaging (fMRI)*, detects the twisting of hemoglobin molecules in the blood when they are exposed to magnetic pulses.

Hemoglobin is the molecule in the blood that carries oxygen to our tissues, including the brain.

- fMRIs unlike PETs, don't require any exposure to a radioactive substance. They can also localize changes in brain activity across briefer periods than PET.

✓ *Insights from Functional Imaging*

- PET and fMRI provide insights into the type of information processing that take place in specific areas of the brain.
- **Example:** *When people look at faces, fMRIs reveal strong activity in a region located near the border of the temporal and occipital lobes call the fusigorm gyrus.*

Summary:

- There are **three major approaches** to studying the link between the brain and behavior.
    - **Observing how perceptual, motor, intellectual, and emotional capacities are affected following brain damage**. By carefully relating specific psychological and behavioral disruptions to damage in particular areas of the brain, researchers can better understand how the brain area normally plays a role in producing those behaviors.
    - **Examining global electrical activity in the brain and the activity patterns of single neurons**. The patterns of electrical activity in large brain areas can be examined from outside the skull using the **electroencephalograph (EEG)**. Single-cell recordings taken from specific neurons can be linked to specific perceptual or behavioral events, suggesting that those neurons represent particular kinds of stimuli or control particular aspects of behavior.
    - **Using brain imaging to scan the brain as people perform different perceptual or intellectual tasks.** Correlating energy consumption in particular brain areas with specific cognitive and behavioral events suggests that those brain areas are involved in specific types of perceptual, motor, cognitive, or emotional processing.

Glossary

- **Neuron:** Cells in the nervous system that communicate with one another to perform information-processing tasks.
- **Cell body:** The part of a neuron that coordinates information-processing tasks and keeps the cell alive.
- **Dendrite:** The part of a neuron that receives information from other neurons and relays it to the cell body.
- **Axon:** The part of a neuron that transmits information to other neurons, muscles, or glands.
- **Myelin Sheath:** An insulating layer of fatty material.
- **Gilal Cells:** Support cells found in the nervous system
- **Synapse:** The junction or region between the axon of one neuron and the dendrites or cell body of another.
- **Sensory neurons:** Neurons that receive information from the external world and convey this information to the brain via the spinal cord.
- **Motor neurons:** Neurons that carry signals from the spinal cord to the muscles to produce movement.
- **Interneurons:** Neurons that connect sensory neurons, motor neurons, or other interneurons.
- **Resting potential:** The difference in electric charge between the inside and outside of a neuron's cell membrane.
- **Action potential:** An electric signal that is conducted along a neuron's axon to a synapse.
- **Refractory period:** The time following an action potential during which a new action potential cannot be initiated.
- **Terminal buttons:** Knoblike structures that branch out from an axon.
- **Neurotransmitters:** Chemicals that transmit information across the synapse to a receiving neuron's dendrites.
- **Receptors:** Parts of the cell membrane that receive the neurotransmitter and initiate or prevent a new electric signal.
- **Acetylcholine (ACh):** A neurotransmitter involved in a number of functions, including voluntary motor control.
- **Dopamine:** A neurotransmitter that regulates motor behavior, motivation, pleasure, and emotional arousal.

- **Glutamate:** A major excitatory neurotrans-mitter involved in information transmission throughout the brain.
- **GABA (gamma-aminobutyric acid):** The primary inhibitory neurotransmitter in the brain.
- **Norepinephrine:** A neurotransmitter that influences mood and arousal.
- **Serotonin:** A neurotransmitter that is involved in the regulation of sleep and wakefulness, eating, and aggressive behavior.
- **Endorphins:** Chemicals that act within the pain pathways and emotion centers of the brain.
- **Agonists:** Drugs that increase the action of a neurotransmitter
- **Antagonists:** Drugs that block the function of a neurotransmitter.
- **Nervous system:** An interacting network of neurons that conveys electrochemical information throughout the body.
- **Central nervous system (CNS):** The part of the nervous system that is composed of the brain and spinal cord.
- **Peripheral nervous system (PNS):** The part of the nervous system that connects the central nervous system to the body's organs and muscles.
- **Somatic nervous system:** A set of nerves that conveys information into and out of the central nervous system.
- **Autonomic nervous system (ANS):** A set of nerves that carries involuntary and automatic commands that control blood vessels, body organs, and glands.
- **Sympathetic nervous system:** A set of nerves that prepares the body for action in threatening situations
- **Parasympathetic nervous system:** A set of nerves that helps the body return to a normal resting state.
- **Spinal reflexes:** Simple pathways in the nervous system that rapidly generate muscle contractions.
- **Hindbrain:** An area of the brain that coordinates information coming into and out of the spinal cord.
- **Medulla:** An extension of the spinal cord into the skull that coordinates heart rate, circulation, and respiration.
- **Reticular formation:** A brain structure that regulates sleep, wakefulness, and levels of arousal.
- **Cerebellum:** A large structure of the hindbrain that controls fine motor skills.
- **Pons:** A brain structure that relays information from the cerebellum to the rest of the brain.
- **Tectum:** A part of the midbrain that orients an organism in the environment.

- **Tegmentum:** A part of the midbrain that is involved in movement and arousal.
- **Cerebral cortex:** The outermost layer of the brain, visible to the naked eye and divided into two hemispheres.
- **Subcortical structures:** Areas of the forebrain housed under the cerebral cortex near the very center of the brain.
- **Thalamus:** A subcortical structure that relays and filters information from the senses and transmits the information to the cerebral cortex.
- **Hypothalamus:** A subcortical structure that regulates body temperature, hunger, thirst, and sexual behavior.
- **Pituitary gland:** The "master gland" of the body's hormone-producing system, which releases hormones that direct the functions of many other glands in the body.
- **Limbic system:** A group of forebrain structures including the hypothalamus, the amygdala, and the hippocampus, which are involved in motivation, emotion, learning, and memory.
- **Hippocampus:** A structure critical for creating new memories and integrating them into a network of knowledge so that they can be stored indefinitely in other parts of the cerebral cortex.
- **Amygdala:** A part of the limbic system that plays a central role in many emotional processes, particularly the formation of emotional memories.
- **Basal ganglia:** A set of subcortical structures that directs intentional movements.
- **Corpus callosum:** A thick band of nerve fibers that connects large areas of the cerebral cortex on each side of the brain and supports communication of information across the hemispheres.
- **Occipital lobe:** A region of the cerebral cortex that processes visual information.
- **Parietal lobe:** A region of the cerebral cortex whose functions include processing information about touch.
- **Temporal lobe:** A region of the cerebral cortex responsible for hearing and language
- **Frontal lobe:** A region of the cerebral cortex that has specialized areas for movement, abstract thinking, planning, memory, and judgment.
- **Association areas:** Areas of the cerebral cortex that are composed of neurons that help provide sense and meaning to information registered in the cortex.
- **Gene:** The unit of hereditary transmission.
- **Chromosomes:** Strands of DNA wound around each other in a double-helix configuration.

- **Heritability:** A measure of the variability of behavioral traits among individuals that can be accounted for by genetic factors.
- **Electroencephalograph (EEG):** A device used to record electrical activity in the brain.

- Chapter 4:
- - Our senses are the means by which we experience the world; everything we learn is detected by sense organs and transmitted to our brains by sensory nerves
- - **Milner and Goodale:** "Vision evolved to provide distal sensory control of the movements that the animal makes in order to survive and reproduce in that world"
- - Sense systems do that depending on (1) specific modality of the information (2) characteristics of the information and the state of the brain at the time it receives it
- - Visual system provides stability in the face of rapid shifts in its input.
- - Sound is not so variable, and is more gradual. Our auditory sense has more time to process signals
- - When we feel an object, the experience is active, not passive
- Sensory processing:
- - **Experience** is studied by distinguishing between **sensation** (detection of simple properties of stimuli, such as brightness, colour, warmth and sweetness) and **perception** (detection of objects both animate and inanimate, their locations, movements and backrounds).
- - Ex: seeing the colour red is a sensation, but seeing a red apple is a perception
- Transduction:
- - **Sense organs** detect stimuli, provided by light, taste, sound, odor or mechanical contact with the environment. Information about these stimuli is transmitted to the brain through **neural impulses** – action potentials carried by the axons in sensory nerves
- - The task of these sense organs is to transmit signals to the brain of the events that have happened in the environment. The task of the brain is to analyze this information and to reconstruct what has occurred
- - transduction (leading across): process by which the sense organs convert energy from environmental events (physical stimuli) into neural activity (changes in the activity of receptor cells of sensory organs)
- - in most senses, specialized neurons called receptor cells (a neuron that directly responds to a physical stimulus, such as light, vibrations, or smell) release chemical transmitter substances that stimulate other neurons, thus altering the rate of firing their axons
- Sensory coding
- - we can tell apart 7.5 million different colours and recognize 10 000 odors
- - A **code** is a system of symbols or signals representing information (ex: spoken English, written French, traffic lights…)
- - if we know the rules of a code, we can convert a message from one medium to another without losing any information
- - we do not know the precise rules by which the sensory systems transmit information to the brain, but we know that they take two general forms: **(1) Anatomical coding** and **(2) Temporal coding**
- - Firing of a particular set of neurons tells where the body is being touched (anatomical coding), and the rate at which these neurons fire (temporal coding) tells how intense the touch is. **1)** since the brain has no direct information about the physical energy impinging on a given sense organ, it uses anatomical coding to interpret the location and type of sensory stimulus according to which incoming nerve fibers are active. Ex: if you rub your eye, you will mechanically stimulate the light-sensitive receptors located there. This stimulation produces action potentials in the axons of the nerves that connect the eyes with the brain (the optic nerves)
- - **Anatomical coding:** a means by which the nervous system represents information; different features are coded by the activity of different neurons **2)** temporal coding is the coding of information in means of time. Simplest form is **rate**. Ex: light touch to the skin can be encoded by a low rate of firing.

- - **Temporal coding:** a means by which the nervous system represents information; different features are coded by the pattern of activity of neurons.
- - all sensory systems use rate of firing to encode the intensity of stimulation Psychophysics
- - a branch of psychology that measures the quantitative relation between physical stimuli and perceptual experience (sensations they produce)
- - to study perceptual phenomena, scientists used two methods to measure peoples sensations**: (1) the just-noticeable difference** and **(2) procedures of signal detection theory 1) JND:** the smallest difference between two similar stimuli that can be distinguished; also called **difference threshold**
- - in germany, **Ernst Weber** investigated the ability of humans to discriminate between various stimuli. He measured the JND – the smallest change in the magnitude of a stimulus that a person can detect, and discovered that the JND is directly related to the magnitude of the stimulus.
- - Different senses had different ratios (ex: ratio for detecting differences in the brightness of white light is 1 in 60). These ratios are called **Weber Fractions**
- - **Gustav Fecher** used Weber's concept of the JND to measure peoples sensations.
- - His contribution to psychology was to show how a logarithmic function could be derived from Weber's principle
- - 100 years after Fechner's work, **S. S. Stevens** suggested a power function to relate physical intensity to the magnitude of sensation **2) signal detection theory:** a mathematical theory of the detection of stimuli, which involves discriminating a signal from the noise in which its embedded and which takes into account participants' willingness to report detecting the signal
- - Psychological methods rely heavily on the concept of **threshold** (the point in which a stimulus, or a change in the value of a stimulus, can just be detected …. The line between perceiving and not perceiving). The JND can also be called a difference threshold (the minimum detectable difference between two stimuli). An **absolute threshold** is the minimum value of a stimulus that can be detected --- that is, discriminated from no stimulus at all.
- - By convention, the threshold is the point at which a participant detects the stimulus 50% of the time
- - According to the signal detection theory, every stimulus event requires discrimination between signal (stimulus) and noise (consisting of both background stimuli and random activity of the nervous system)
- - **Receiver operating characteristic curve (ROC curve)**: a graph of hits and false alarms of participants under different motivational conditions; indicates people's ability to detect a particular stimulus.
- - Named for its original use in research at the Bell Labratories to measure the intelligibility of speech transmitted through a telephone system Vision
- - **Wavelength**: the distance between adjacent waves of radiant energy; in vision, most closely associated with the perceptual dimension of hue
- - Wavelength of visible light ranges from **380 to 760** nanometers.
- - Entire range of wavelengths is known as the **electromagnetic spectrum**
- - The part we see as light is called the **visible spectrum**
- The Eye and its Functions
- - **Cornea**: the transparent tissue covering the front of the eye
- - **Sclera**: the tough outer layer of the eye; the "white" of the eye
- - **Iris:** consists of two bands of muscles (controlled by the brain) that control the amount of light admitted into the eye / the size of the pupil
- - **Aqueous humour**: the watery fluid filled in the space space immediately behind the cornea
- - **lens**: the transparent organ situated behind the iris of the eye; helps focus an image on the retina. Contains no blood vessels and is functionally dead tissue
- - cornea and lens help image to be focused on the inner surface of the back of the eye
- - **accommodation**: changes in the thickness of the lense of the eye that focus images of near or distant objects on the retina
- - **nearsighted**: people who's eyes are too long (front to back); they need a concave lense to correct the focus

- - **farsighted**: people whos eyes are too short. They need a convex lens
- - **retina**: the tissue at the back inside surface of the eye that contains the photoreceptors and associated neurons, performs the sensory functions of the eye
- - **photoreceptors**: specialized neurons that transducer light into neural activity in the retina
- - information from the photoreceptors is transmitted to neurons that send axons toward one point at the back of the eye – the **optic disc**. All axons leave the eye at this point and join the optic nerve, which travels to the brain.
- - **Johannes Kepler** is credited with the suggestion that the retina, not the lens, contained the receptive tissue of the eye.
- - **Christoph Scheiner** demonstrated in 1625 that the lens is simply a focusing devise. Recorded the functions of the eye from an ox's eye
- - Retina has **3 principle layers**. Light passes through the **ganglion cell** layer (front), the **bipolar cell** layer (middle), and the **photoreceptor** layer (back)
- - Photoreceptors are transparent
- - Photoreceptors respond to light and pass the information on by means of a **transmitter substance** to the bipolar cells (a neuron in the retina that receives information from photoreceptors and passes it on to the ganglion cells, from which axons proceed through the optic nerves to the brain). Bipolar cells transmit this information to the ganglion cells (neorons whos axons travel across the retuna and through the optic nerves)
- - **Visual information: photoreceptor à bipolar cell à ganglion cell à brain**
- - Human retina contains two general types of photoreceptors: 125 million **rods** (function mainly in dim light; are very sensitive to light but cannot detect change in hue. Visual info they provide lacks sharpness) and 6 million **cones** (function when the level of illumination is bright enough to see things clearly. Responsible for acute daytime vision and for colour perception)
- - **Fovea**: a small pit near the centre of the retina containing densely packed cones; responsible for the most acute and detailed vision
- - Farther away from the fovea, the number of **cones decreases** and the number of **rods increases** Transduction of light by photoreceptors
- - A molecule derived from vitamin A is the central ingredient in the transduction of the energy of light into neural activity
- - In the absence of light, this molecule is attached to a protein. The two molecules together form a **photopigment** (a complex molecule found in photoreceptors; when struck by light, it splits and stimulates the membrane of the photoreceptor in which it resides)
- - **Intact photopigments** have a characteristic colour. **Rhodopsin**, the photopigment of rods, is pink
- - **Franz Boll** discovered that once the photopigments are split by the action of light, they lose their colour and become bleached. Adaptation to light and dark
- - **Detection of light** requires the photons to split molecules of rhodospin or one of the other photopigments.
- - **Dark adaptation**: the process by which the eye becomes capable of distinguishing dimly illuminated objects after going from a bright area to a dark one. Eye Movements
- - Our eye makes three types of "purposive" movements: **1) Vergence movements**: the co-operative movements of the eyes, which insures that the image of an object falls on identical portions of both retinas. Assist in depth perception – the perception of distance **2) saccadic movements:** the rapid movement of the eyes that is used in scanning a visual scene, as opposed to the smooth pursuit movements used to follow a moving object. Enhance McCollough effect **3) pursuit movements**: the movement that the eyes make to maintain an image of a moving image upon the fovea Colour vision
- - Among mammals, **only primates** have full colour vision
- - Most colours can be described in terms of **wavelength, intensity and purity**
- - **Hue, brightness and saturation** – corresponding to these physical dimensions describe what we see
- - **Hue** is determined by wavelength, brightness is determined by the intensity, and **saturation** is almost equal to purity.
- - Vision is a synthetic **sensory** modality, while the auditory system is **analytical**

- - **Colour mixing**: the perception of two or more lights of different wavelengths seen together as light of an intermediate wavelength
- - **Thomas Young** noted that the visual system can synthesize any colour from various amount of almost any set of three colours of different wavelengths. This is called the **trichromatic theory**. He said that the eye contains three types of colour receptors sensitive to blue green and red ("pure")
- - **Hermann von Helmholtz** elaborated this theory
- - Experiments have shown that cones in the human eye can detect 3 pigments, absorbing wavelengths 420, 530 and 560 nm. Even though these wavelengths correspond to blue-violet, green and yellow-green, investigators refer to these receptors as blue, green and red cones
- - **Ewal Hering** said that the four primary hues appeared to belong to pairs of opposing colours: **red/green** and **yellow/blue**. This hypothesis was wrong, but this principle describes the characteristics of the information that the retinal ganglion cells send to the brain.
- - If a spot of red light shines on the retina, excitation of the red cones causes the red/green ganglion cells to begin to fire at a high rate. If a spot of green light shines on the retina, excitation of the green cones causes the red/green ganglion cells to begin to fire at a slow rate.
- - **Opponent process:** the representation of colours by the rate of firing of two types of neurons: red/green and yellow/blue (and their opposite effects on the rate of firing)
- - The retina contains red/green and yellow/blue ganglion cells because of the nature of the connections between the cones, bipolar cells and ganglion cells
- - We cannot perceive colours such as reddish green or bluish yellow because an axon that signals red or green or yellow or blue) can either increase or decrease its rate of firing, not both at the same time
- - **Negative afterimage**: the image seen after a portion of the retina is exposed to an intense visual stimulus' a negative afterimage consists of colours complimentary to those the physical stimulus
- - cause of negative afterimages is adaptation to the rate of firing of retinal ganglion cells.
- - When ganglion cells are excited or inhibited for a prolonged period of time, they later show a rebound effect, firing faster or slower than normal. Defects in colour Vision
- - 1 in 20 males have some form of defective colour vision
- - Males are more affected than females because many of the genes of producing photopigments are located on the X chromosome, which males have only one of.
- - Three forms of colour defect: **1) Protanopia**: A form of hereditary irregular colour vision; caused by defective "red" cones in the retina
- **2) deuteranopia**: A form of hereditary irregular colour vision; caused by defective "green" cones in the retina **3) tritanopia**: a form of hereditary irregular colour vision; caused by a lack of "blue" cones in the retina Sound
- - Sound consist of rhythmical pressure changes in air
- - Sound waves are measured in frequency units of cycles per second called **hertz (Hz)**
- - Human ear perceives vibrations between 30 and 20 000 Hz
- - Figure 5.22 page 147
- - When people refer to the ear, they usually mean what anatomists call the **pinna**. The pinna helps funnel sound through the ear canal towards the middle and inner ear, where the business of hearing gets done
- - The **eardrum** is a thin, flexible membrane that vibrates back and forth in response to sound waves and passes these vibrations on to the receptor cells in the inner ear.
- - **Ossicle:** one of the three bones of the middle ear (the **hammer, anvil** and **stirrup**) that transmit acoustical vibrations from the eardrum to the membrane behind the oval window of the cochlea
- - **Cochlea**: a snail-shaped chamber set in bone in the inner ear, where auditory transduction takes place
- Perceiving pitch:
- **Place code**: the cochlea encodes different frequncies at different locations along the basilar membrane.
-
- **Temporal code**: the cohlea registers low frequencies via the firing rate of action potentials entering the auditory nerve.
-

- **Oval window**: an opening in the bone surrounding the cochlea. The stirrup presses against a membrane behind the oval window and transmits sound vibrations into the fluid within the cochlea
- **Basilar membrane**: one of two membranes that divide the cochlea of the inner ear into three compartments; the receptive organ for audition resides here
- **Round window**: an opening in the bone surrounding the cochlea. Movements of the membrane behind this opening permit vibrations to be transmitted through the oval window into the cochlea
- **Auditory hair cell**: the sensory neuron of the auditory system; located on the basilar membrane. Sounds are detected by these
- **Cilium:** a hair-like appendage of a cell; involved in movement or transducing sensory information. Cilia are found on the receptors in the auditory and vestibular systems.
- **Tectorial membrane**: a membrane located above the basilar membrane; serves as a shelf against which the cilia of the auditory hair cells move
- ears ability to distinguish sounds by their timbre depends on its ability to distinguish loudness and pitch
- sounds of different frequencies stimulate different groups of auditory hair cells located along the basilar membrane
- **harmonic**: a component of a complex tine; one of a series of tones whose frequency is a multiple of the fundamental frequency. In music theory, also known as an overtone
- **fundamental frequency**: the lowest, and usually most intense, frequency of a complex sound; most often perceived as the sounds basic pitch
- **timbre:** a perceptual dimention of sound, determined by the complexity of the sound
- significant hear loss doesn't usually occur until the sixth or seventh decade of life
- if you are trying to hear a tone against some backround noise, your threshold is better if the noise goes to both ears rather than one. The difference is called the **masking-level difference (MLD)** and it can be measured in various ways
- **Pichora-Fuller and Schneider** have found that older listeners show small MLD's than younger listeners over a wide range of noise levels Gustation
- We have two senses specialized for detecting chemicals in our environment: **taste and smell**. Together they're called **chemosenses**.
- **Taste or Gustation** is the simplest of the sense modalities. Taste is not the same thing as flavour
- Bumps on tongue are called **papillae**
- Taste bud: a small organ on the tongue that contains a group of gustatory receptor cells
- Cells have hairlike projections called **microvili** that go through the pore of the taste bud into the saliva that coats the tongue and fills the trenches of the papillaie
- **Taste: umami** – refers to the taste of the monosodium glutamate; genes that code for its receptors have been identified Olfaction
- **Olfaction**: the snese of smell
- **Second olfactory system**: accessory olfactory system
- **Pheromones**: chemical signals, usually detected by smell or taste, that regulate sexual and social behaviours between animals
- **The olfactory mucosa:** the mucus membrane lining the top of the nasal sinuses; contains the cilia of the olfactory receptors
- **Olfactory bulbs:** stalk-like structures located at the base of the brain that contain neural circuits that perform the first analysis of olfactory information
- There are 5 qualities of taste and colour can be specified in terms of hue, brightness and saturation The Somatosenses
- The **body senses, or Somatosenses** include our ability to respond to touch, vibration, pain, warmth, coolness, limb position, muscle length and stretch, tilt of the head and changes in the speed of head rotation
- Three major categories of Somatosenses are: the **skin senses**, the **internal senses** and the **vestibular senses** The Skin Senses
- All somatosensory information is detected by the **dendrites of neurons;** the system uses no separate receptor cells

- - **Free nerve ending**: most common type of skin receptor. A dendrite of smatosensory neurons. Infiltrate the middle layers of both smooth and hairy skin and surround the hair follicles in hairy skin
- - **Pacinian corpuscle**: the largest of the special receptive endings and visible to the naked eye. A specialized somatosensory nerve ending that detects mechanical stimuli, especially vibrations
- - Most sensitive regions of touch are the lips and the fingerstips
- - **Two-point discrimination threshold**: the minimum distance between two small points that can be detected as separate stimuli when pressed against a particular region of the skin.
- - A receptor that is sensitive to ranges of temperatures close to body temperature, is found in the anterior hypothalamus, the region of the brain that's responsible for measuring and maintaining our body temperature
- - Menthol stimulates cooling
- - Pain and temperature receptors are accomplished by the networks of free endings in the skin
- - Three types of pain receptors (nociceptors)
- - **Phantom limb**: sensations that appear to originate in a limb that has been amputated The internal senses
- - Sensory endings located in our internal organs, bones and joints, and muscles convey painful, neutral, and in some cases pleasurable sensory information
- - **Muscle spindle**: a muscle fibre that functions as a stretch receptor; arranged parallel to the muscle fibres responsible for contraction of the muscle, it detects muscle length The Vestibular Senses
- - **Vestibular apparatus**: the receptive organs of the inner ear that contribute to balance and perception of head movement
- - The **three semicircular canals** – located in the inner ear – oriented at right angles to one another, detect changes in rotation of the head in any direction
- - **Vestibular sac:** one of a set of two receptor organs in each inner ear that detect changes in the tilt of the head. Very useful in maintaining an upright head position

CHAPTER 5 – CONSCIOUSNESS

Consciousness – *a person's subjective experience of the world and mind*
- Altered states of consciousness → intoxication, hypnosis, medication

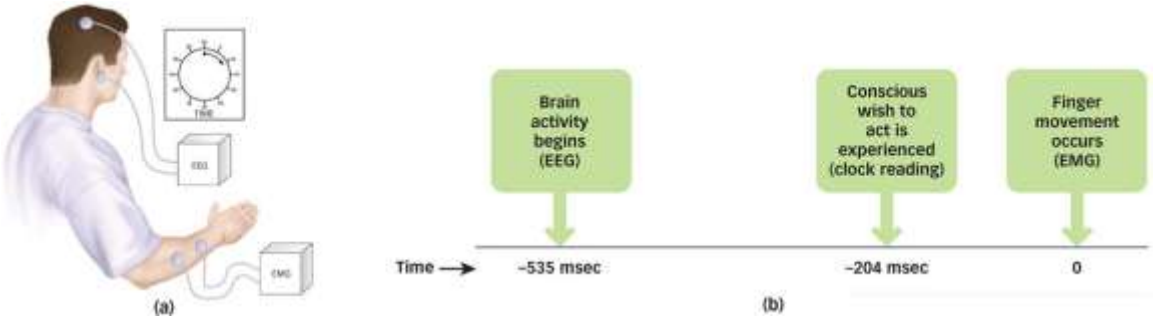
CONSCIOUS AND UNCONSCIOUS
What are the great mysteries of consciousness?
Psychologists have a tough time grasping the subjective perspectives of people they study

Phenomenology – *how things seem to the conscious peon,* in their understanding of mind and behaviour

Mysteries of Consciousness:
Problem of other minds – *the fundamental difficulty we have in perceiving the consciousness of others*

Mind/Body Problem – *the issue of how the mind is related to the brain and the body*
- René Descartes: human body is a machine made of matter but human mind or soul is a separate entity of a "thinking substance"
    - Proposed that the mind has its effect on the body through the pineal gland

Mental events are intimately tied to brain events, such that every thought, perception, or feeling is associated with a particular pattern of activation or neurons in the brain. Studies suggest that the brain activities precede the activities of the conscious mind



The Timing of Conscious Will: (a) In Benjamin Libet's experiments, the participant was asked to move fingers at will while simultaneously watching a dot move around the face of a clock to mark the moment at which the action was consciously willed. Meanwhile, EEG sensors timed the onset of brain activation and EMG sensors timed the muscle movement. (b) The experiment showed that brain activity (EEG) precedes the willed movement of the finger (EMG) but that the reported time of consciously willing the finger to move follows the brain activity.

What comes first: brain activity or thinking?
- The brain begins to show electrical activity around half a second before voluntary action (535msec)
- Brain also started to show electrical activity before the person's conscious decision to move
- Brain becomes active more than 300msec before participants report they are consciously trying to move
    - Your brain is getting started before either the thinking or the doing, preparing the way for both thought and action

The Nature of Consciousness

4 Basic Properties of Consciousness:
- **Intentionality** – *the quality of being directed toward an object*
- **Unity** – *resistance to division*
- **Selectivity** – *the capacity to include some objects but not others.* Consciousness filters out some info, but can also work to tune in other info
    - **Cocktail party phenomenon** – *people tune in one message even while they filter out others nearby*
- **Transience** – *tendency to change*

- The mind wanders incessantly from one "right now" to the next "right now"

Levels of Consciousness

Minimal consciousness – *a low-level kind of sensory awareness and responsiveness that occurs when the mind inputs sensations and may output behaviour*

- When someone pokes you in your sleep and you turn over → you experience it but you may not think at all about having had that experience

What is full consciousness?

Full consciousness – *consciousness in which you know and are able to report your mental state*

- Being aware of having a mental state while you are experiencing the mental state itself
  - Involves not only thinking about things but also thinking about the fact you are thinking about things

Self-consciousness – *distinct level of consciousness in which the person's attention is drawn to the self as an object*

- Focuses on the self to the elusion of almost everything else
  - Ex. embarrassment

What part of the brain is active during daydreaming?

When people are not busy, they still show a widespread pattern of activation in many areas of the brain – now known as the *default network.* This network becomes activated whenever people worked on a mental task that they knew so well that they could daydream while doing it.

Mental control – *the attempt to change conscious states of mind*

- Ex. A troubled university student may be troubled by current issues (grades, exams, finals) and may try to not think about it because it causes anxiety and uncertainty

Thought suppression – *the conscious avoidance of a thought.*

- Eliminates worry and allows the person to move on and think about something else

Rebound effect of thought suppression – *the tendency of a thought to return to consciousness with greater frequency following suppression*

Ironic processes of mental control – *ironic errors occur because the mental process that monitors errors can itself produce them*

- The ironic monitor is a process of the mind that works outside of consciousness, making us sensitive to all the things that we do not want to think, feel, or do, so that we can notice and consciously take steps to regain control if these things come back to mind.
- As this unconscious monitoring whirs along in the background, it unfortunately increases the person's sensitivity to the very thought that is unwanted

The Unconscious Mind

Freudian Unconscious

Dynamic unconscious – *an active system encompassing a lifetime of hidden memories, the person's deepest instinct and desires, and the person's inner struggle to control these forces*

Repression – *a mental process that removes unacceptable thoughts and memories from consciousness and keeps them in the unconscious*

What do Freudian slips tell us about the unconscious mind?

Freud looked for evidence of the unconscious mind in speech errors and lapses of consciousness, or what are commonly called "Freudian Slips". Freud believed that errors are not random and instead have some surplus meaning that may appear to have been created by an intelligent unconscious mind, even though the person consciously rejects them.

Cognitive Unconscious

Cognitive unconscious – *the mental processes that give rise to a person's thoughts, choices, emotions, and behaviour even though the person does not experience them*

Subliminal perception – *thought or behaviour is influenced by stimuli that a person cannot consciously report perceiving*

- The cognitive unconscious is at work when subliminal perception and unconscious decision processes influence thought or behaviour without the person's awareness

Freud attributed great intelligence to the unconscious, believing it harbors complex motives and inner conflicts and that it expresses these in an astonishing array of thoughts and emotions, as well as psychological disorders.
In some cases, the unconscious mind can make better decisions than the conscious mind.

SLEEP AND DREAMING

Sleep

- As you begin to fall asleep, the busy, task-oriented thoughts of waking mind are replaced by wandering thoughts and images. This pre-sleep consciousness is called the *hypnagogic state.* On some rare nights you may experience a *hypnic jerk,* a sudden quiver or sensation of dropping. Eventually, your presence of mind goes away entirely. Time and experience stop, you are unconscious. Dreams come, and finally the glimmerings of waking consciousness return in a foggy and imprecise form as you enter post-sleep consciousness (the *hypnopompic state*) and then awake.

Sleep Cycle

Circadian rhythm – *naturally occurring 24-hour cycle*

What are the stages in a typical night's sleep?

The EEG recordings revealed a regular pattern of changes in electrical activity in the brain accompanying the circadian cycle. During waking, these changes involve alternation between high-frequency activity (beta waves) during alertness and low-frequency activity (alpha waves) during relaxation. The largest changes in EEG occur during sleep.

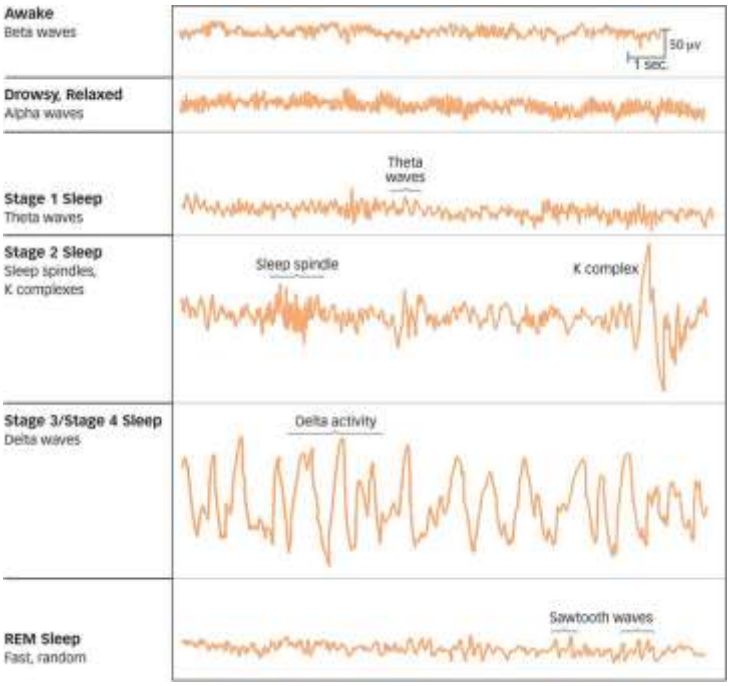
First Stage → the EEG moves to frequency patterns even lower than alpha waves (theta waves)

Second Stage → These patterns are interrupted by short bursts of activity called *sleep spindles* and *k complexes*, and the sleeper becomes somewhat more difficult to awaken

Third and Fourth Stage → slow-wave sleep, EEG patterns show activity (delta waves)

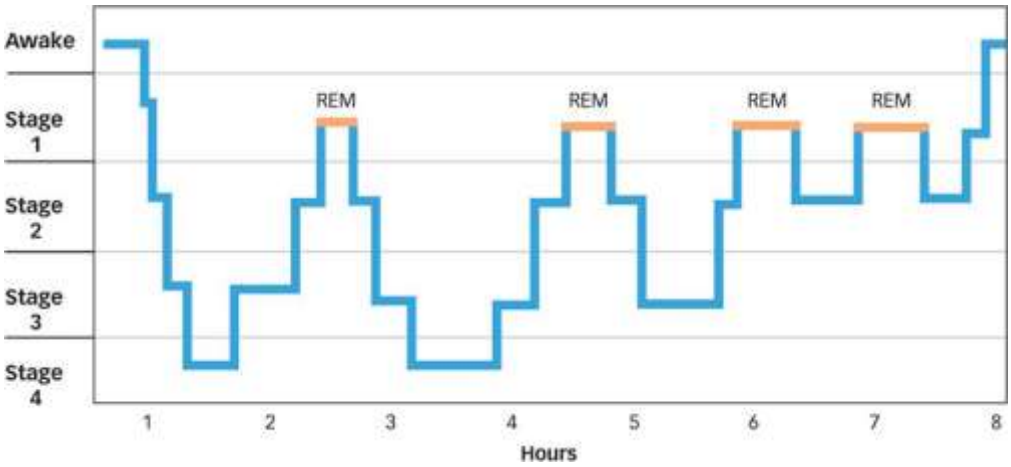
Fifth Stage → **Rem Sleep** – *a stage of sleep characterized by rapid eye movements and a high level of brain activity*.

- During REM sleep, the pulse quickens, blood pressure rises, and signs of sexual arousal.



In first hour of the night, you fall from waking to the 4th and deepest stage of sleep (marked by delta waves). These slow waves indicate a general synchronization of neural firing, as though the brain is doing one thing at this time rather than many. You return to lighter sleep stages, eventually reaching REM and dreaming. Although REM sleep is lighter than that of lower stages, it is deep enough that you may be difficult to awaken. You then continue to cycle between REM and slow wave sleep stages every 90 min or so throughout the night. Periods of REM last longer as the night goes on, and lighter sleeps stages predominate between these periods, with the

deeper slow-wave stages 3 and 4 disappearing halfway through the night.



Sleep Needs and Deprivation

What is the relationship between sleep and learning?

It is as though memories normally deteriorate unless sleep occurs to help keep them in place. Studying all night may help you cram for the exam, but it won't make the material stick.

Studies of REM sleep deprivation indicate that this part of sleep is important psychologically, as memory problems and excessive aggression are observed in both humans and rats after only a few days of being awakened whenever REM activity starts. Deprivation from slow-wave sleep (stage 3 and 4) has more physical effects (fatigue, muscle and bone pain).

Sleep Disorders

- **Insomnia** – *difficulty falling asleep or staying asleep*
  - What are some problems caused by sleeping pills? → Most sleeping pills are addictive. Even in short-term use, sedatives can interfere with the normal sleep cycle. Although they promote sleep, they reduce the proportion of time spent in REM and slow-wave sleep, robbing people of dreams and their deepest sleep stages. As a result, the quality of sleep achieved with pills may not be as high as without.
- **Sleep Apnea** – *a disorder in which the person stops breathing for brief periods while asleep*
  - Involves an involuntary obstruction of breathing passage → snoring followed by apnea followed by awakenings resulting in sleep loss or insomnia
- **Somnambulism** – *sleepwalking; a person arises and walks around while asleep.* It is safe to wake sleepwalkers or lead them back to bed.
- **Narcolepsy** – *a disorder in which sudden sleep attacks occur in the middle of waking activities*
  - Involves the intrusion of a dreaming state of sleep (with REM) into waking and is often accompanied by unrelenting excessive sleepiness and uncontrollable sleep attacks lasting from 30 seconds to 30 minutes.
- **Sleep Paralysis** – *the experience of waking up unable to move*
- **Night Terrors** – *the abrupt awakenings with panic and intense emotional arousal;*
  - Happen most often in NREM sleep early in the sleep cycle and do not usually have dream content the sleeper can report

Dreams

Dream Consciousness

What distinguishes dream consciousness from the waking state?

- We intensely feel *emotion*
- Dream *thought* is illogical
- *Sensation* is fully formed and meaningful
- Dreaming occurs with *uncritical acceptance*

- We have *difficulty remembering* the dream after it is over

Dream Theories

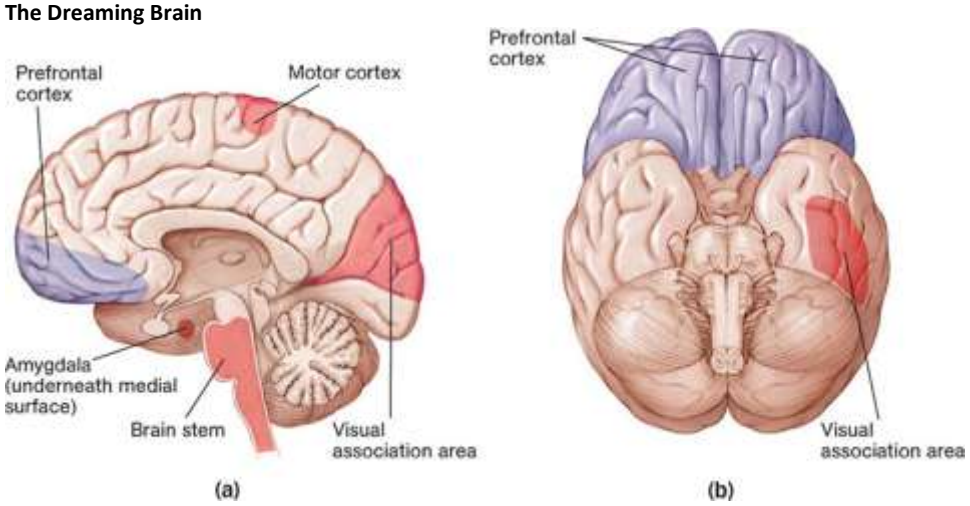
Freud's Approach → proposed that dreams are confusing and obscure because the dynamic unconscious creates them precisely to be confusing and obscure. Dreams represent wishes and some of these wishes are so unacceptable, taboo, and anxiety producing that the mind can only express them in a disguised form. Freud believed that many of the most unacceptable wishes are sexual, so he interpreted a dream of a train going into a tunnel as a symbolic of sexual intercourse. According to Freud, the **manifest content** of a dream a – *dream's apparent topic or superficial meaning*, is a smoke screen for its **latent content** – *a dream's true underlying meaning*.

- For example, a dream about a tree burning down in the park across the street from where a friend once lived (the manifest content) might represent a camouflaged wish for the death of the friend (the latent content).
    - In this case, wishing for the death of a friend is unacceptable, so it is disguised as a tree on fire.
- The problem with Freud's approach is that there are an infinite number of potential interpretations of any dream and finding the correct one is a matter of guesswork—and of convincing the dreamer that one interpretation is superior to the others.

Activation-synthesis model – *dreams are produced when the mind attempts to make sense of random neural activity that occurs in the brain during sleep*.

- During waking consciousness, the mind is devoted to interpreting lots of information that arrives through the senses.
- In the dream state, the mind doesn't have access to external sensations, but it keeps on doing what it usually does: interpreting information. Because that information now comes from neural activations that occur without the continuity provided by the perception of reality, the brain's interpretive mechanisms can run free.

The Dreaming Brain



- Brain areas shaded red are activated during REM sleep; those shaded blue are deactivated. (a) The medial view shows the activation of the amygdala, the visual association areas, the motor cortex, and the brain stem and the deactivation of the prefrontal cortex. (b) The ventral view shows the activation of other visual association areas and the deactivation of the prefrontal cortex
- The brain areas for fear and emotion somehow work overtime in dreams. The amygdala is involved in responses to threatening or stressful events, and indeed the amygdala is quite active during REM sleep.
- The areas of the brain responsible for visual perception are NOT activated during dreaming, whereas the visual association areas in the occipital lobe that are responsible for visual imagery DO show activation
- During REM sleep, the motor cortex is activated, but the spinal neurons running through the brain stem inhibit the expression of this motor activation → prevent you from acting out a dream

- The brain specifically inhibits movement during sleep (people who move around during sleep are probably not dreaming), perhaps to keep us from hurting ourselves

DRUGS AND CONSCIOUSNESS

Psychoactive Drugs – *chemicals that influence consciousness or behaviour by altering the brain's chemical message system.*

- Drugs alter these neural connections by preventing the bonding of neurotransmitters to sites in the postsynaptic neuron or by inhibiting the reuptake of or enhancing the bonding and transmission of neurotransmitters. Different drugs can intensify or dull transmission patterns, creating changes in brain electrical activities that mimic natural operations of the brain

Drug Use and Abuse

- People usually do not become addicted to a psychoactive drug the first time they use it. They may experiment a few times, then try again and eventually find that their tendency to use the drug increases over time due to several factors, such as drug tolerance, physical dependence, and psychological dependence.
  - **Drug Tolerance** – *the tendency for larger drug doses to be required over time to achieve the same effect*
    - With increased tolerance comes the danger of drug overdose

What problems can arise in drug withdrawal?

- Withdrawal symptoms are prompted when drug use is abruptly discontinued
- Withdrawal symptoms that signal *physical dependence* include:
  - Pain, convulsions, hallucination
- Other withdrawal symptoms result from *psychological dependence*, a strong desire to return to the drug even when physical withdrawal symptoms are gone.

Types of Psychoactive Drugs

- **Depressants** – *substances that reduce the activity of the central nervous system*

  →Alcohol:
  - Can produce both physical and psychological dependence
  - Why do people experience being drunk differently?
    - **Expectancy Theory** – *the idea that alcohol effects can be produced by people's expectations of how alcohol will influence them in a particular situation*
    - **Balanced placebo design** – *behaviour is observed following the presence or absence of an actual stimulus and also following the presence or absence of a placebo stimulus*
      - Experiments show that the belief that one has had alcohol can influence behaviour as strongly as the ingestion of alcohol itself
    - **Alcohol myopia** – *a condition that results when alcohol hampers attention, leading people to respond in simple ways to complex situations*

  →Barbiturates, Benzodiazepines and Toxic Inhalants:
  - These drugs are prescribed by physicians to treat anxiety or sleep problems, but they are dangerous when used in combination with alcohol because they can cause respiratory depression
  - Physical dependence is possible since withdrawal from long-term use can produce severe symptoms (including convulsions), and psychological dependence is common as well
  - Toxic inhalants are perhaps the most alarming substances in this category,
    - These drugs are easily accessible even to children in the vapors of glue, gasoline, or propane. Sniffing or "huffing" these vapors can promote temporary effects that resemble drunkenness, but overdoses are sometimes lethal, and continued use holds the potential for permanent brain damage
- **Stimulants** – *substances that excite the CNS, heightening arousal and activity levels*

- Stimulants increase the levels of dopamine and norepinephrine in the brain, thereby inducing higher levels of activity in the brain circuits that depend on these neurotransmitters.
  - As a result, they increase alertness and energy in the user, often producing a euphoric sense of confidence and a kind of agitated motivation to get things done.
- Stimulants produce physical and psychological dependence, and their withdrawal symptoms involve depressive effects such as fatigue and negative emotions

- **Narcotics (or opiates)** – *drugs derived from opium that are capable of relieving pain*
  - Why are narcotics especially alluring?
    - These drugs are especially alluring because they are external mimics of the brain's own internal relaxation and well-being system.
    - The brain produces endorphins or endogenous opioids, which are neurotransmitters that are closely related to opiates
    - Endorphins play a role in how the brain copes internally with pain and stress. These substances reduce the experience of pain naturally
    - Endorphins are secreted in the pituitary gland and other brain sites as a response to injury or exertion, creating a kind of natural remedy that subsequently reduces pain and increases feelings of well-being
    - When people use narcotics, the brain's endorphin receptors are artificially flooded, however, reducing receptor effectiveness and possibly also depressing the production of endorphins.
    - When external administration of narcotics stops, withdrawal symptoms are likely to occur.
- **Hallucinogens** – *drugs that alter sensation and perception and often cause visual and auditory hallucinations*
  - These include: LSD or acid, mescaline, psilocybin, PCP, and ketamine
  - Some are derived from plants
  - Produce profound changes in perception
  - Do not induce significant tolerance or depends and overdose deaths are rare
- **Marijuana** – *the leaves and buds of the hemp plant*
  - Active ingredient: THC
  - Produces an intoxication that is mildly hallucinogenic
  - Affects judgment and short-term memory and impairs motor skills and coordination
  - Receptors in the brain that respond to THC are normally activated by the neurotransmitter called *anandamide* that is naturally produced in the brain → affects moods, memory, appetite, and pain perception
  - Tolerance does not develop therefore addiction potential is not strong → minimal physical withdrawal symptoms
  - Psychological dependence is possible

HYPNOSIS

Hypnosis – *an altered state of consciousness characterized by suggestibility and the feelings that one's actions are occulting involuntarily*

Induction and Susceptibility

In hypnosis, a series of behaviour suggestions can induce in some people a state of mind that makes them susceptible to very unusual suggestions.

What makes a person easy to hypnotize?

Not everyone is equally hypnotizable. Susceptibility varies greatly, such that while some hypnotic "virtuosos" are strongly influenced, most people are only moderately influenced, and some people are entirely unaffected. One of the best indicators of a person's susceptibility is the person's own judgment. So, if you think you might be hypnotizable, you may well be. People with active, vivid imaginations, or who are easily absorbed in activities such as watching a movie, are also somewhat more prone to be good candidates for hypnosis.

Hypnotic Effect

- The real effects of hypnosis are often clouded, however, by extravagant claims—that hypnotized people can perform extraordinary physical stunts, for example, or that they can remember things they have forgotten in normal consciousness.
- In further examinations of this phenomenon, participants who were not hypnotized were asked to simulate being hypnotized. They were instructed to be so convincing in faking their hypnosis that they would fool the experimenter.
- Hypnosis also has been hyped as a cure for lost memory. The claim that hypnosis helps people to unearth memories that they are not able to retrieve in normal consciousness, however, seems to have surfaced because hypnotized people often make up memories to satisfy the hypnotist's suggestions
- Hypnosis can also undermine memory. People susceptible to hypnosis can be led to experience **posthypnotic amnesia** – *the failure to retrieve memories following hypnotic suggestions to forget.*
- However, research does not find that people can retrieve through hypnosis memories that were not originally lost through hypnosis. Instead, hypnotized people try to report memories in line with the hypnotist's questioning
- Hypnosis does not enhance the accuracy of memory and instead only increases the person's confidence in false memory reports
- Why do some argue that hypnosis is indeed a different state of consciousness?
    - Although all the preceding claims for hypnosis are somewhat debatable, one well-established effect is hypnotic analgesia, the reduction of pain through hypnosis in people who are hypnotically susceptible.
        - For example, one study found that for pain induced in volunteers in the laboratory, hypnosis was more effective than morphine, diazepam (Valium), aspirin, acupuncture, or placebos.
    - For people who are hypnotically susceptible, hypnosis can be used to control pain in surgeries and dental procedures, in some cases more effectively than any form of anesthesia.
    - Evidence for pain control supports the idea that hypnosis is a different state of consciousness and not entirely a matter of skillful role-playing on the part of highly motivated people.
- Although many claims for hypnosis overstate its effects, hypnosis can create the experience that one's actions are occurring involuntarily, create analgesia, and even change brain activations in ways that suggest that hypnotic experiences are more than imagination.

MEDITATION AND RELIGIOUS EXPERIENCES: HIGHER CONSCIOUSNESS

Meditation – *the practice of intentional contemplation*.

What are some positive outcomes of meditation?

- The time spent meditating can be restful and revitalizing, and according to meditation enthusiasts, the repeated practice of meditation can enhance psychological well-being
- The evidence for such long-term positive effects of meditation is controversial, but meditation does produce temporarily altered patterns of brain activation.
- Meditation influences EEG recordings of brain waves, usually producing patterns known as alpha waves that are associated with relaxation

Ecstatic Religious Experience → in some religious traditions, people describe personal experiences of altered consciousness – feelings of ecstasy, rapture, conversion, or mystical union.

What is the relationship between religious fervor and epilepsy?

Like meditation, certain brain activation patterns are associated with ecstatic religious experiences. Some people who experience religious fervor show the same type of brain activation that occurs in some cases of epilepsy. Several prophets, saints, and founders of religions have been documented as having epilepsy—St. Joan of Arc, for example, had symptoms of epilepsy accompanying the religious visions that inspired her and her followers.

Memory – *the ability to store and retrieve information over time*

3 Key Functions of memory → **encoding, storage, retrieval**

ENCODING

How is making a memory like following a recipe?

Memories are made by combining information we already have in our brains with new information that comes through our senses.

Memories are constructed, not recorded, and **encoding** – *is the process by which we transform what we perceive, think, or feel into an enduring memory*

3 Types of Encoding Processes:

- **Elaborate Encoding**
  - How do old memories influence new ones? Memories are a combination of old and new information, so the nature of any particular memory depends as much on the old information already in our memories as it does on the new information coming through our senses
  - *Semantic judgment* → meaning of the word (deeper processing than other two), *rhyme judgment* → sound of the word, *visual judgment* → the appearance of the words
  - **Elaborate Encoding** → *the process of actively relating new information to knowledge that is already in memory*
  - Elaborate encoding takes place in the lower left part of the frontal lobe and the inner part of the temporal lobe
- **Visual Imagery Encoding**
  - **Visual imagery encoding** – *the process of storing new information by converting it into mental pictures*
  - How does visual encoding influence memory? Two ways:
    - Visual imagery encoding does some of the same things elaborative encoding foes: when you create a visual image, you relate incoming information to knowledge already in the memory.
    - When you use visual imagery to encode words and other verbal information, you end up with two different mental "placeholders" for the items – a visual one and a verbal one – which gives you more ways to remember them than just a verbal placeholder
- **Organizational Encoding**
  - **Organizational encoding** – *the process of categorizing information according to the relationships among a series of items*
  - Why might mentally organizing the material for an exam enhance your retrieval of that material? Organizing words into conceptual groups and relating them to one another makes it easier to reconstruct the items from memory later

Memory mechanisms that help us to survive and reproduce should be preserved by natural selection, and our memory systems should be built in a way that allow us to remember especially well encoded information that is relevant to our survival. To test this idea researchers present participants with three different encoding tasks:

- Survival encoding
- Moving encoding
- Pleasantness encoding

STORAGE

Storage – *the process of maintaining information in memory over time*

3 Kinds of Storage:

- **Sensory Storage**
  - **Sensory memory** – *a type of storage that holds sensory information for a few seconds or less*
    - Because we have more than one sense, we have more than one kind of sensory memory
  - **Iconic memory** – *a fast-decaying store of visual information*
  - **Echoic memory** – *a fast-decaying store of auditory information*
- **Short-Term Storage & Working Memory**
  - **Short-term memory** – *holds nonsensory information for more than a few seconds buy less than a minute* (15-20 sec)
  - We can use a trick that allows us to get around the natural limitations of our short-term memory:

        - **Rehearsal** – *the process of keeping information in short-term memory by mentally repeating it*
        - **Chunking** – *combining small pieces of information into larger clusters or chunks*
    - **Working memory** – *active maintenance of information in short-term storage.* Differs from short-term memory in the sense that it includes the operations and processes we use to work with information in short-term memory.
        - Includes subsystems that store and manipulate visual images or verbal information, as well as a central executive that coordinates the subsystems.
- **Long-Term Storage**
    - **Long-term memory** – *a type of storage that holds information for hours, days, weeks, or years.*

Sesory input → Sensory memory (unattended information is lost) attended information → short-term memory (unrehearsed memory is lost) encoding → long-term memory (retrieval from short-term memory) some information may be lost over time.

Anterograde amnesia – *the inability to transfer new information from the short- term store into the long-term store*
Retrograde amnesia – *the inability to retrieve information that was acquired before a particular date, usually the date of an injury or operation*

The **hippocampal-region index** links together all of these otherwise separate bits and pieces so that we remember them as one memory. It is critical in when a new memory is first formed, it may become less important as the memory ages.

Consolidation – *the process by which memories become stable in the brain.*

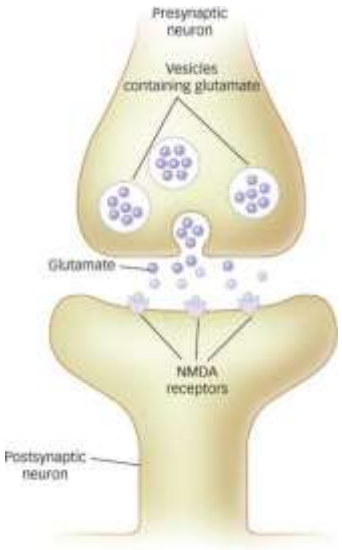
- How does memory become consolidated? The act of recalling a memory, thinking about it, and talking about it with others probably contributes to consolidation.

Reconsolidation – *memories can become vulnerable to disruption when they are recalled, requiring them to become consolidated again.*

MEMORIES, NEURONS, AND SYNAPSES
Why are the spaces between neurons so important to memory?
A *synapse* is the small space between the axon of one neuron and the dendrite of another, and the neurons communicate by sending neurotransmitters across these synapses. This act of sending neurotransmitters changes the synapse, specifically strengthens the connection between the two neurons, making it easier for them to transmit to each other the next time. Any experience that results in memory produces physical changes in the nervous system.

Long-term Potentiation (LTP) – *a process whereby communication across the synapse between neurons strengthens the connection, making further communication easier.*

- Properties of LTP:
    - It occurs in several pathways within the hippocampus
    - Can be induced rapidly
    - Can last for a long time



Long-Term Potentiation in the Hippocampus – the presynaptic neuron releases the neurotransmitter glutamate (a major excitatory neurotransmitter in the brain) into the synapse. Glutamate then binds to the **NDMA** – *(a receptor site on the hippocampus that influences the flow of information between neurons by controlling the initiation of long-term potentiation)* receptor sites on the postsynaptic neuron. At the same time, excitation in the postsynaptic neuron takes place. The combined effect of these two processes initiates long-term potentiation and the formation of long-term memories.
Together these two events initiate LTP, which in turn increases synaptic connections by allowing neurons that fire together to wire together.

RETRIEVAL

Retrieval Cues – *external information that is associated with stored information and helps bring it to mind*

Encoding Specificity Principle – *states that a retrieval cue can serve as an effective reminder when it helps re-create the specific way in which information was initially encoded*

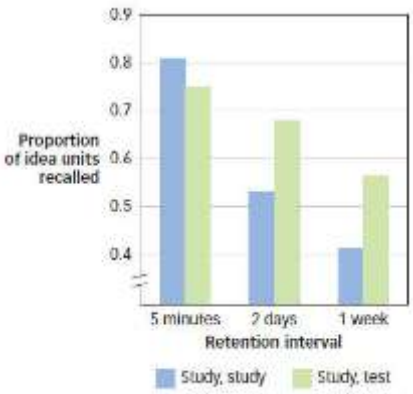
Why might it be a good idea to sit in the same seat for an exam that you say in during lecture?
The feel of the chair and the sights you see may help you remember the information you learned while you sat there.

State-dependent Retrieval – *the tendency for information to be better recalled when the person is in the same state during encoding and retrieval*

- A person's psychological or physiological state at the time of encoding is associated with the information that is encoded

Transfer-appropriate Processing – *memory is likely to transfer from one situation to another when the encoding context of the situations match*

Retrieval can improve subsequent memory:



With 5-minute retention interval, the study-study condition results in slightly higher recall. But the results change dramatically with retention intervals of 2 days and 1 week: at these longer delays, the study-test condition yields much higher levels of recall than does the study-study condition.

Retrieval can impair subsequent memory:
Retrieval-induced forgetting – *a process by which an item from long-term memory impairs subsequent recall of related items.*

- Even if you don't successfully retrieve the target, the act of suppressing the competitors while you attempt to retrieve the target still reduces your ability to retrieve the competitors at a later time

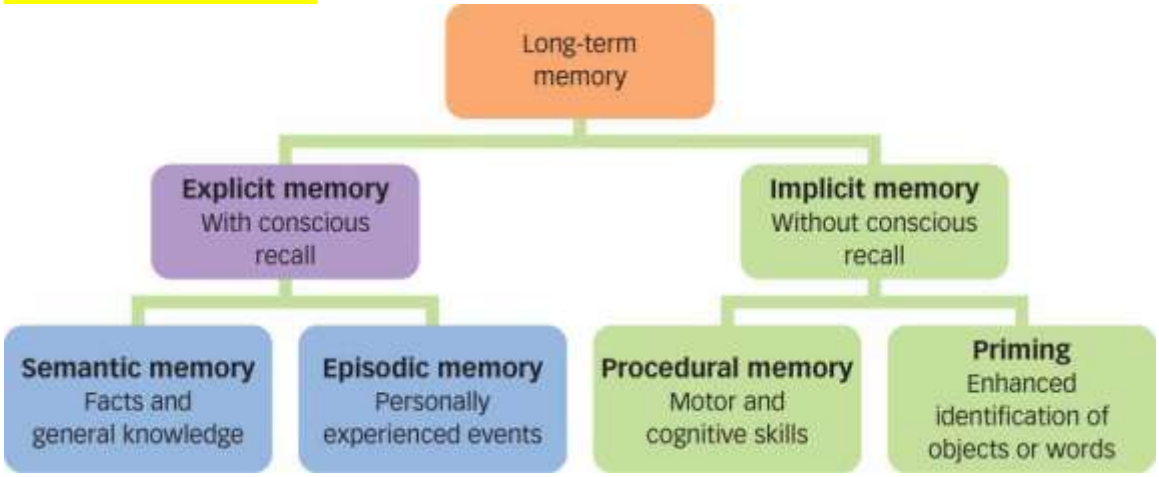
Examples:

- When a speaker selectively talks about some aspects of memories shared with a listener and doesn't mention related information. The listener later has a harder time remembering the omitted events
- Retrieval induced forgetting can affect eyewitness memory. When witnesses to a crime are questioned about some details of the crime scene, their ability to later recall related details that they were not asked about is impaired compared with witnesses who were not questioned at all initially

Separating the Components of Retrieval
How is the brain activity different when trying to recall versus successfully recalling?
Trying to recall an incident and *successfully* recalling one are fundamentally different processes that occur in different parts of the brain.

- Regions in the left frontal lobe show heightened activity when people are *trying* to retrieve information that was presented earlier
- Regions of the hippocampal region show activity when people *successfully* recall
- Successful recall also activates parts of the brain that play a role in processing the sensory features of an experience.

MULTIPLE FORMS OF MEMORY



Explicit memory – *occurs when people consciously or intentionally retrieve past experiences*

Semantic memory – *a network of associated facts and concept that make up our general knowledge of the world* (hippocampus NOT required)

Episodic memory – *the collection of past personal experiences that occurred at a particular time and place* (hippocampus required)

- We rely heavily on episodic memory to envision the future
- Episodic memory is well suited for this task because it is a flexible system that allows us to recombine elements of past experiences in new ways
- Animals possess extensive memory abilities, but it is still a matter of debate as to whether they can engage in the "mental time travel" characteristics of human episodic memory

Implicit memory – *occurs when past experiences influence later behaviour and performance, even though people are not trying to recollect them and are not aware that they are remembering them*

What type of memory is it when you just "know how" to do something?
Procedural memory – *the gradual acquisition of skills as a results of practice, or "knowing how" to do things*

- You know how to do things like ride a bike or tie a tie, but you can't describe how to do the
- Things that you remember are automatically translated into actions

How does priming make memory more efficient?
Priming – *an enhanced ability to think of a stimulus, such as a word or object, as a result of a recent exposure to the stimulus* (implicit memory → being shown a list of words, people showed priming for studied words even when they failed to consciously remember that they had seen them earlier)

If hippocampal region isn't required for procedural memory and priming, what parts of the brain are involved? Experiments have revealed that priming is associated with reduced activity in various regions of the cortex that are activated when people perform unprimed tasks. Priming makes it easier for parts of the cortex that are involved in perceiving a word or object to identify the item after recent exposure to it, and in doing so the brain "saves" processing time after priming.

- Perceptual priming – reflects implicit memory for the sensory features of an item (visual characteristics) → right cerebral hemisphere
- Conceptual priming – reflects implicit memory for the meaning of a word or how you would use an object → left cerebral hemisphere

MEMORY FAILURES: 7 SINS OF MEMORY

Transience – *forgetting what occurs with the passage of time*

- Occurs during the storage phase of memory, after an experience has been encoded and before it is retrieved
- Ebbinghaus trained himself to memorize lists of nonsense syllables, and then kept track of how long he could retain the information.
- Gradual switch from specific to more general memories
- **Retroactive interference** – *occurs when later learning impairs memory for information acquired earlier*
- **Proactive interference** – *occurs when earlier learning impairs memory for information acquired later*

Absentmindedness – *a lapse in attention that results in memory failure*

- One common cause is lack of attention → attention plays a vital role in encoding information into long-term memory, without proper attention, material is less likely to be stored properly and recalled later.
- Researchers observed less activity in participants' lower left frontal lobe when their attention was divided. Greater activity in the lower left frontal lobe region during encoding is associated with better memory.
- Dividing attention prevents the lower left frontal lobe from playing its normal role in elaborative encoding, and the result is absentminded forgetting
- Failures of the prospective memory are a major source of absentmindedness
    - **Prospective memory** – *remembering to do things in the future*

Blocking – *a failure to retrieve information that is available in memory even though you are trying to produce it* (tip of the tongue experience)

- Name blocking usually results from damage to parts of the left temporal lobe on the surface of the cortex, most often as a result of a stroke

Memory Misattribution – *assigning a recollection or an idea to the wrong source*

- **Source memory** – *recall of when, where, and how information was acquired*
- People sometimes correctly recall a fact they learned earlier or accurately recognize a person or object they have seen before but misattribute the source of this knowledge
- **False recognition** – *a feeling of familiarity about something that hasn't been encountered*

Suggestibility – *the tendency to incorporate misleading information from external sources into personal recollections*

- Why can childhood memories be influenced by suggestion?
    - People develop false memories in response to suggestions for some of the same reason memory misattribution occurs. We do not store all the details of our experiences in memory, making us vulnerable to accepting suggestions about what might have happened or should've happened

Bias – *the distorting influence of present knowledge, beliefs, and feelings on recollection of previous experiences*

- *Consistency bias* – the bias to reconstruct the past to fit the present
- *Change bias* – the tendency to exaggerate difference between what we feel or believe now and what we felt or believed in the past
- *Egocentric bias* – the tendency to exaggerate the change between the present and the past in order to make ourselves look good in retrospect

Persistence – *the intrusive recollection of events that we wish we could forget*

- Persistence frequently occurs after disturbing or traumatic incidents
- Emotional experiences tend to be better remembered than non-emotional ones
- Emotional arousal seems to focus our attention on the central feature of an event
- **Flashbulb memories** – *detailed recollections of when and where we heard about shocking events*
- Why do our brains succumb to persistence? → the amygdala influences hormonal systems that kick into high gear when experience an arousing event; these stress-related hormones (such as adrenaline and cortisol mobilize the body in the face of threat – and they also enhance memory for the experience
    - Patients with amygdala damage do not remember emotional events any better than non-emotional events

7.2 The Development of Classical Conditioning: Pavlov's Experiments

- Involved dogs in a harness to administer the foods and to measure the salivary response
- **Unconditioned stimulus (US):** something that reliably produces a naturally occurring reaction in an organism
- **Unconditioned response (UR):** a reflexive reaction that is reliably produced by an unconditioned stimulus
- Make the dogs salivate to stimuli that don't usually make animals salivate
- **Conditioned stimulus (CS):** a stimulus that is initially neutral and produces no reliable response in an organism
- **Conditioned response (CR):** a reaction that resembles an unconditioned response but is produced by a conditioned stimulus

7.3 The Basic Principles of Classical Conditioning

- Behaviourist psychology John B. Watson was proposing: an organism experiences events or stimuli that are observable and measureable, and changes in that organism can be directly observed and measured
- There was no need to consider the mind in this classical-conditioning paradigm, which appealed to Watson and the behaviourists
- **Acquisition:**
    - ⇒ The phase of classical conditioning when the CS and the US are presented together
    - ⇒ During the initial phase of classical conditioning, typically there is a gradual increase in learning: It starts low, rises rapidly, and then slowly tapers off
    - ⇒ After learning has been established, the CS by itself will reliably elicit the CR
- † **Second-Order Conditioning**:
    - ⇒ Conditioning where the stimulus that functions as the US is actually the CS from an earlier procedure in which it acquired its ability to produce learning
    - ⇒ Helps explain why some people desire money to the point that they hoard it and value it even more than the objects it purchases
- † **Extinction:**
    - ⇒ The gradual elimination of a learned response that occurs when the US is no longer presented
    - ⇒ CR is extinguished and no longer observed
- † **Spontaneous Recovery:**
    - ⇒ The tendency of a learned behavior to recover from extinction after a rest period
    - ⇒ Recovery takes place even though there have not been any additional associations between the CS and US
    - ⇒ The ability of the CS to elicit the CR was weakened, but it was not eliminated

- **Generalization and Discrimination:**
  - ⇒ The phenomenon of generalization tends to take place, in which the CR is observed even though the CS is slightly different from the original one used during acquisition
  - ⇒ Conditioning generalizes to stimuli that are similar to the CS used during the original training
  - ⇒ The more the new stimulus changes, the less conditioned responding is observed
  - ⇒ When an organism generalizes to a new stimulus, two things are happening.
  - ⇒ First, by responding to the new stimulus used during generalization testing, the organism demonstrates that it recognizes the similarity between the original CS and the new stimulus
  - ⇒ Second, by displaying diminished responding to the new stimulus, it also tells us that it notices a difference between the two stimuli
  - ⇒ Discrimination: the capacity to distinguish between similar but distinct stimuli

7.4 Conditioned Emotional Responses: The Case of Little Albert

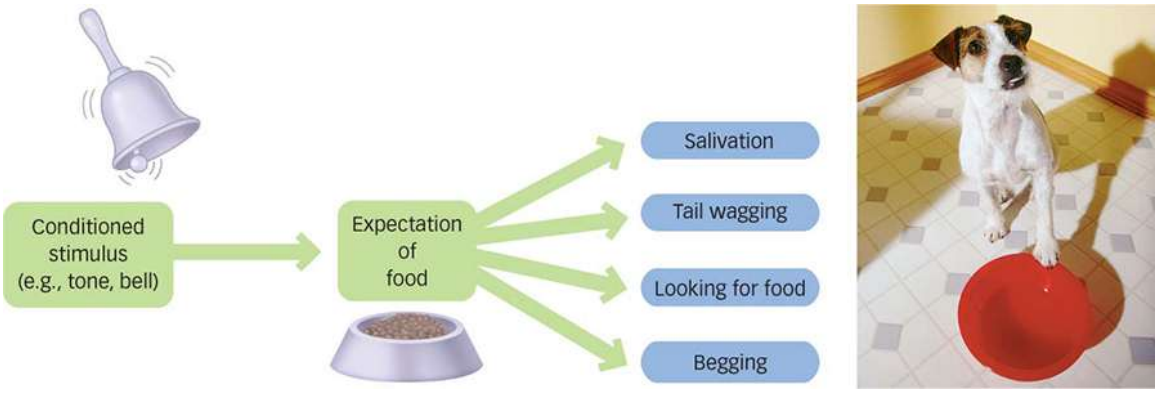
- Classical conditioning demonstrates that durable, substantial changes in behavior can be achieved simply by setting up the proper conditions
- Associating a naturally occurring US with an appropriate CS, an organism can learn to perform a variety of behaviours, often after relatively few acquisition trials
- Don't need to consider internal and cognitive explanations to demonstrate the effects of classical conditioning: the stimuli, the eliciting circumstances, and the resulting behavior are there to be observed by one and all
- Watson and Rayner developed that any behavior though that it was possible to develop general explanations of pretty much any behavior of any organism based on classical-conditioning principles
- 9 month old Little Albert
- See if a child could be classically conditioned to experience a strong emotional reaction (fear)
- Watson proposed that fears could be learned, just like any other behavior
- His experiment went against ethnics
- Jennifer, who experienced fear and anxiety when hearing the previously innocent sound of an approaching helicopter as a result of her experiences in Iraq

7.5 A Deeper Understanding of Classical Conditioning

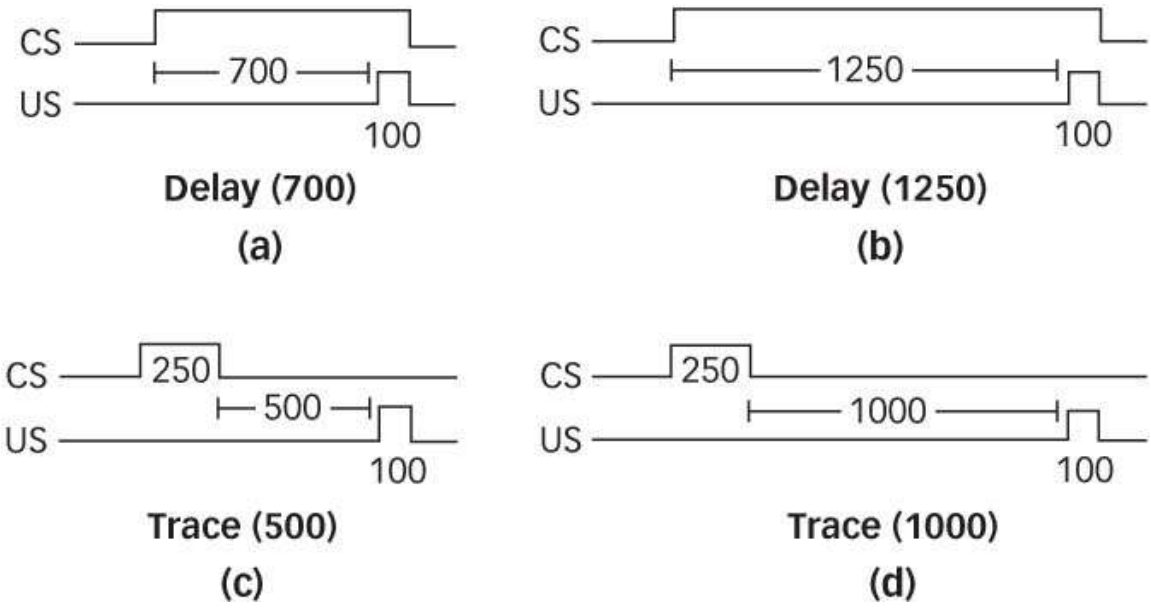
The Cognitive Elements of Classical conditioning

- Why didn't the dogs salivate when they saw Pavlov?
- The dogs were sensitive to the fact that Pavlov was not a reliable indicator of the arrival of food

- He was linked to many things, this these observations suggest that perhaps cognitive components are involved in classical conditioning after all
- Robert Rescorla and Allan Wagner were the first to theorize that classical conditioning only occurs when an animal has learned to set up an expectation



- The Rescorla-Wagner model introduced a cognitive component that accounted for a variety of a classical-conditioning phenomena that were difficult to understand from a simple behaviourist point of view
- The model predicted that conditioning would be easier when the CS was an unfamiliar event than when it was familiar
- Being familiar already have expectations associated with them, making new conditioning difficult
- Classical conditioning might appear to be a primitive and unthinking process, but it is actually quite sophisticated and incorporates a significant cognitive element
- **The Role of Consciousness:**
  - ⇒ Rescorla-Wagner model reflect the operation of non-conscious associative mechanisms that do more than just record co-occurrences of events – they link those co-occurrences to prior experiences, generating an expectation
  - ⇒ Involve nonhuman animals
  - ⇒ In delay conditioning, the CS is a tone that is followed immediately by the US, a puff of air, which elicits an eye blink response. Importantly, the tone and air puff overlap in time – the air puff follows the tone, but the tone remains on when the air puff is delivered, Then, the tone and air puff end at the same time. After a few pairings of the tone and air puff, conditioning occurs and the tone alone elicits an eye blink response.
  - ⇒ Trace conditioning uses the identical procedures, with one difference: In trace conditioning, there is a brief interval of time after the tone ends and the air puff is delivered.



- ⇒ Amnesic patients showed normal delay conditioning of eyeblink responses compared with non-amnesic control subjects
- ⇒ Clark and Squire studied both delay and trace conditioning in healthy volunteers, and after each procedure gave participants a true-false test with questions that probed their awareness of the contingency between the tone and the air puff
- ⇒ Delay conditioning does not require awareness of the contingency between the tone and the air puff, whereas trace conditioning does

† **Implications for Patients in a Vegetative State:**

- ⇒ Examined trace conditioning in 22 patients with a diagnosis of either vegetative state
- ⇒ Used a standard trace conditioning procedure in which the CS (a tone) was followed a half-second later by the US (an air puff), and assessed conditioned responses by measuring changes in the activity of eye muscles
- ⇒ Showed robust trace conditioning

† **Implications for Understanding Schizophrenia**

- ⇒ Pairing a rewarding stimulus such as a sugar solution with nausea will cause the animals to reduce their subsequent intake of sugar
- ⇒ McDannald and Schoenbaum proposed using conditioning procedures to test hypotheses concerning impaired reality testing in schizophrenia

The Neural Elements of Classical Conditioning

† Cerebellum is critical for both delay and trace conditioning
† It is part of the hindbrain and plays an important role in motor skills and learning
† Hippocampus is important for trace conditioning but not delay conditioning

- Amygdala plays an important role in the experience of emotion, including fear and anxiety
- Central nucleus is also critical for emotional conditioning
- Central nucleus of the amygdala plays a role in producing both of these outcomes through two distinct connections with other parts of the brain
- The action of the amygdala is an essential element in fear conditioning, an its link with other areas of the brain are responsible for producing specific features of conditioning
- The amygdala is involved in fear conditioning in people as well as rats and other animals

The Evolutionary Elements of Classical Conditioning

- Could have adaptive value
- Focused on conditioned food aversions
- Case of bad hummus: the hummus was the CS, a bacterium was the US, and the resulting nausea was the UR
- John Garcia and his colleagues illustrated the adaptiveness of classical conditioning in a series of studies with rats
- Used a variety of CSs (visual auditory, tactile, taste, and smell) and several different USs (injection of a toxic substance, radiation) that cause nausea and vomiting hours later
- Found weak or no conditioning when the CS was a visual, auditory, or tactile stimulus
- Strong food aversion developed with stimuli that have a distinct taste and smell
- Developed of technique for dealing with an unanticipated side effect of radiation and chemotherapy

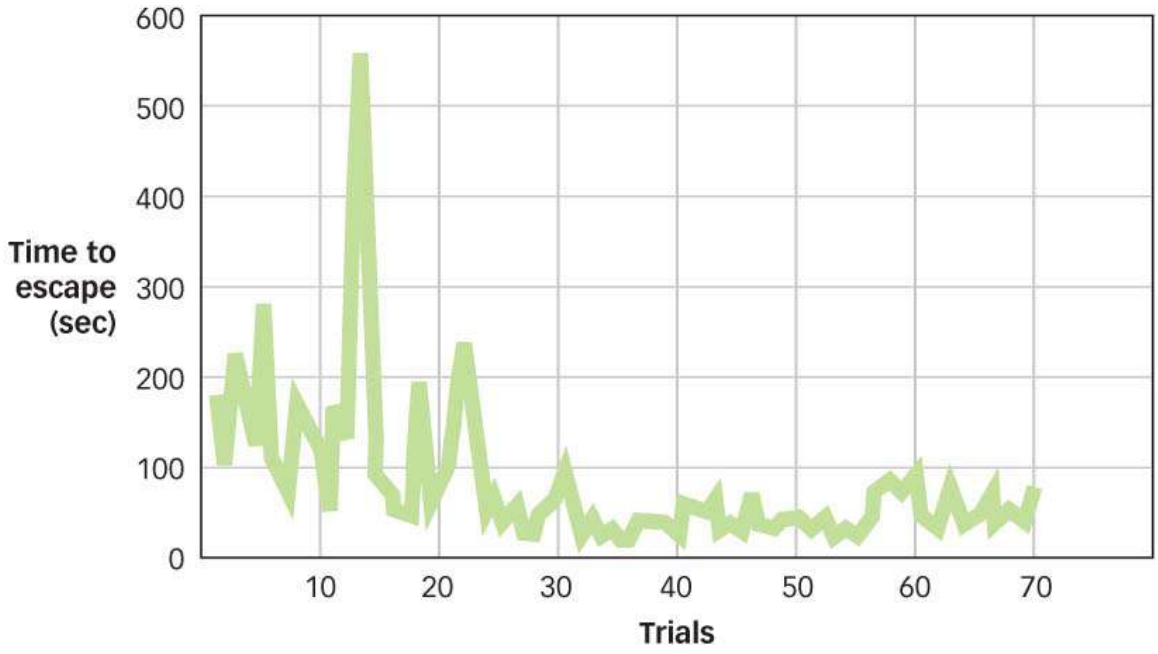
7.7 Operant Conditioning: Reinforcements from the Environment

- The study of classical conditioning is the study of behaviours that are reactive
- These animals exhibit these responses involuntarily during the conditioning process
- **Operant conditioning**: a type of learning in which the consequences of an organism's behavior determine whether it will be repeated in the future
- The study of operant conditioning is the exploration of behaviours that are active

7.8 The Development of Operant Conditioning: The law of Effect

- Thorndike's research focused on instrumental behaviours, that is, behavior that required an organism to do something, solve a problem, or otherwise manipulate elements of its environment
- Used a puzzle box

- Cats became skilled at triggering the lever for their release
- Thorndike developed the **law of effect**, which states that behaviours are followed by a "satisfying state of affairs" tend to be repeated and those that produce an "unpleasant state of affairs" are less likely to be repeated



- In classical-conditioning experiments, the US occurred on every training trial no matter what the animal did
- In Thorndike's work, the behavior of the animal determined what happened next
- If the behavior was "correct", the animal was rewarded with food

- Incorrect behaviours produced no results and the animal was stuck in the box until it performed the correct behaviour

7.9 B. F. Skinner: The Role of Reinforcement and Punishment

- In Skinner's system, all of these emitted behaviours "operated" on the environment in some manner, and the environment responded by providing events that either strengthened those behaviours or made them less likely to occur
- Developed Skinner Box: observe the behavior of small organisms in a controlled environment
- Skinner's approach to the study of learning focused on reinforcement and punishment
- **Reinforcer:** is any stimulus or event that functions to increase the likelihood of the behavior that led to it
- **Punisher:** is any stimulus or event that functions to decrease the likelihood of the behavior that led to it
- Positive reinforcement (where a rewarding stimulus is presented)
- Negative reinforcement (where an unpleasant stimulus is removed)
- Positive punishment (where an unpleasant stimulus is administered)
- Negative punishment (where a rewarding stimulus is removed)

Primary and Secondary Reinforcement and Punishment

- Reinforcers and punishers often gain their functions from basic biological mechanisms
- Secondary reinforcers derive their effectiveness from their associations with primary reinforcers through classical conditioning
- Example: money starts out as a neutral CS that, though I association with primary USs like acquiring food or shelter, takes on a conditioned emotional element
- Rewards can cause exactly the opposite effect: a decrease in performing the behavior
- Extrinsic reinforcement – rewards that come from external sources – don't always capture the reasons why people engage in behavior in the first place
- Overjustification effect happens when external rewards undermine the intrinsic satisfaction of performing a behavior

7.10 The Basic Principles of Operant Conditioning

Discrimination, Generalization, and the Importance of Context

- Thorndike: Learning takes place in contexts, not in the free range of any plausible situation
- Skinner: most behavior is under stimulus control, which develops when a particular response only occurs when an appropriate discriminative stimulus is present
- "Three-term contingency": in the presence of a discriminative stimulus (classmates drinking coffee together in Starbucks), a response (joking

comments about a psychology professor's increasing waistline and receding hairline) produces a reinforce (laughter among classmates)

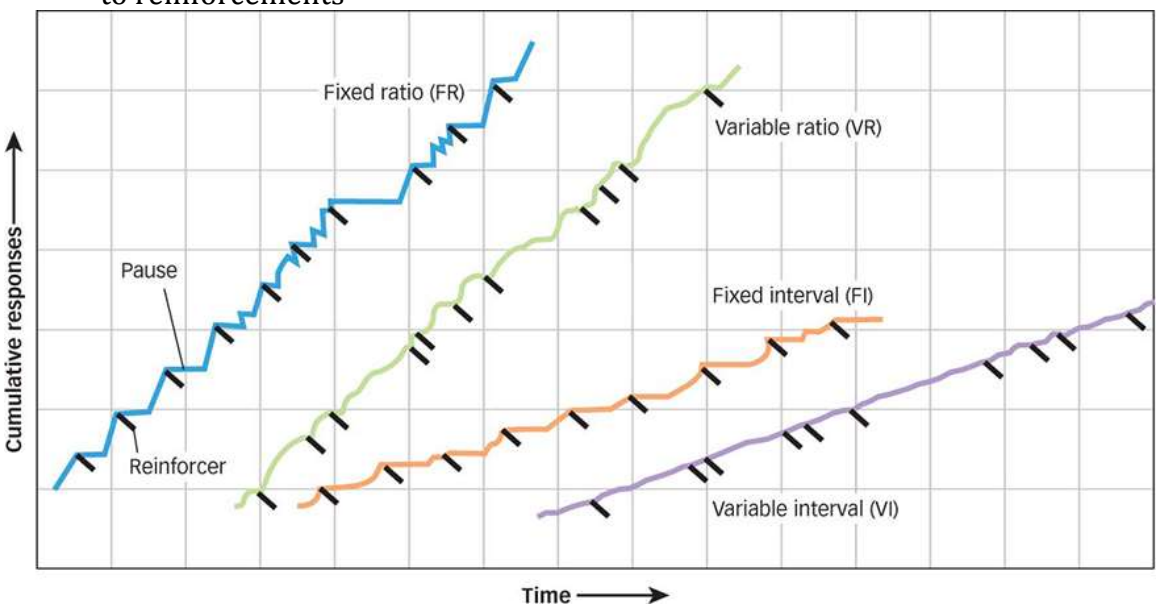
- † The same response in a different context would most likely produce a very different outcome

Extinction

- † In classical conditioning, operant behavior undergoes extinction when the reinforcements stop
- † On the surface, extinction operant behavior looks like that of classical conditioning: The response rate drops off fairly rapidly and, if a rest period is provided, spontaneous recovery is typically seen
- † In classical conditioning, the US occurs on every trial no matter what the organism does
- † In operant conditioning, the reinforcements only occur when the proper response has been made, and they don't always occur even then

Schedules of Reinforcement

- † Skinner stopped giving his rats a pellet for every bar press but instead delivering food on some intermittent schedule
- † Not only did the rats continue bar pressing but they also shifted the rate and pattern of bar pressing depending on the timing and frequency of the presentation of the reinforcers
- † In operant conditioning, the pattern with which reinforcements appeared was crucial
- † Skinner explored with schedules of reinforcement
- † Two most important are interval schedules, based on the time intervals between reinforcements, and ratio schedules, based on the ratio of responses to reinforcements



- † **Interval Schedules:**
  - ⇒ Under a **fixed interval schedule (FI)**, reinforcers are presented at fixed time periods, provided that the appropriate response is made

- ⇒ Example: on a 2-minute fixed interval schedule, a response will be reinforced, but only after 2 minutes have expired since the last reinforcement.
- ⇒ Under a **variable interval schedule (VI)**, a behavior is reinforced based on an average time that has expired since the last reinforcement
- ⇒ Example: on a 2-minute variable interval schedule, responses will be reinforced every 2 minutes on average but not after each 2-minute period.

† **Ratio Schedules:**

- ⇒ Under a fixed ratio schedule (FR), reinforcement is delivered after a specific number of responses have been made
- ⇒ One schedule might present reinforcement after every 4^{th} response, a different schedule might present reinforcement after every 20 response; the special case of presenting reinforcement after each response is called **continuous reinforcement**
- ⇒ Under a **variable ratio schedule (VR)**, the delivery of reinforcement is based on a particular average number of responses
- ⇒ Example: if a laundry worker was following a 10-response variable ratio schedule instead of a fixed ratio schedule, she or he would still be paid, on average, for every 10 shirts washed and ironed but not for each tenth shirt.
- ⇒ Helps casinos stay in business
- ⇒ Variable ratio schedules produce slightly higher rates of responding than fixed schedules primarily because the organism never knows when the next reinforcement is going to appear
- ⇒ A 20-response variable ratio schedule will produce considerably more responding than a 2-response variable ratio schedule
- ⇒ When schedules of reinforcement provide **intermittent reinforcement**, when only some of the responses made are followed by reinforcement, they produce behavior that is much more resistant to extinction than a continuous reinforcement schedule.
- ⇒ The more irregular and intermittent a schedule is, the more difficult it becomes for an organism to detect when it has actually been placed on extinction
- ⇒ **Intermittent-reinforcement effect:** the fact that operant behaviours that are maintained under intermittent reinforcement schedules resist extinction better than those maintained under continuous reinforcement

Shaping through Successive Approximation

† Behavior rarely occurs in fixed frameworks where a stimulus is presented

† Continuously acting and behaving

† Most of our behaviours, then, are the result of shaping, or learning that results from the reinforcement of successive steps to a final desired behavior

- **Successive approximation:** a behavior that gets incrementally closer to the overall desired behavior

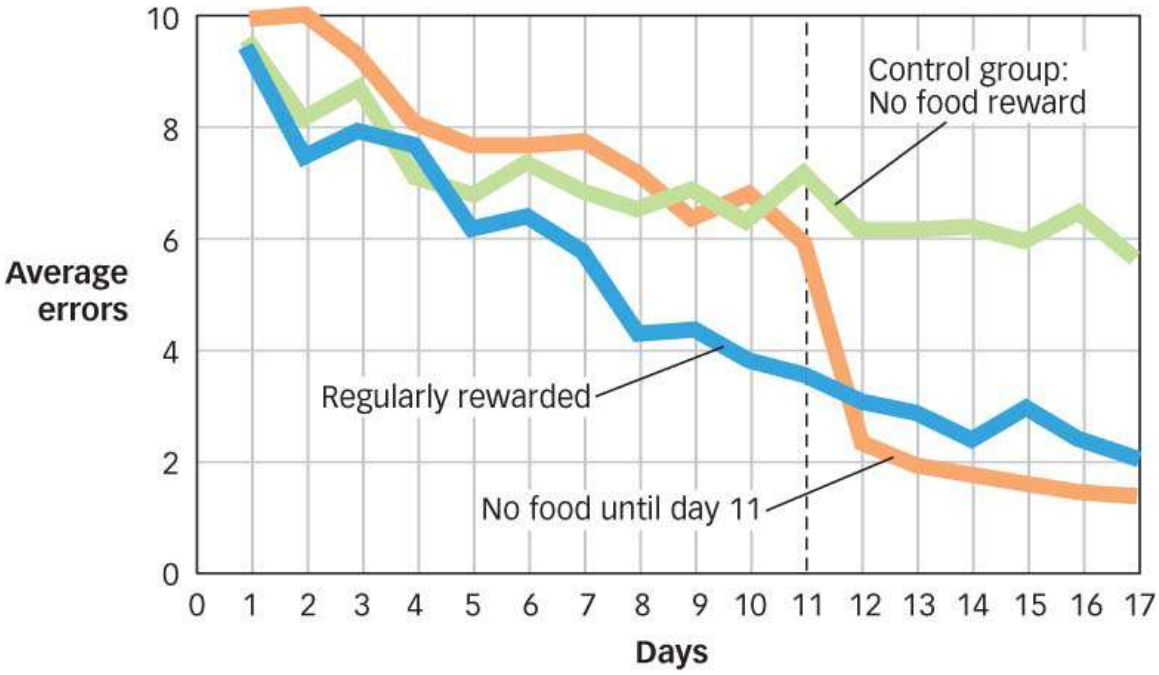
Superstitious Behaviour

- One of the keys to establishing reliable operant behavior is the correlation between an organism's response and the occurrence of reinforcement
- Skinner put several pigeons in the boxes, set the food dispensers to deliver food every 15 seconds, and left the bird to their own devices
- Later he finds the bird aimlessly pecking in a corner or turning in circles
- Referred to these behaviours as "superstitious" and offered a behaviourist analysis of their occurrence
- The pigeons acted as though there was a casual relationship between their behaviours and the appearance of food when it was merely an accidental correlation
- Delusions, like superstitious behaviours, are based on mistaken beliefs regarding causal relationships

7.11 A Deeper Understanding of Operant Conditioning

The Cognitive Elements of Operant Conditioning

- Tolman argued that there was more to learning than just knowing the circumstances in the environment and being able to observe a particular outcome
- Proposed that an animal established a means-ends relationship
- Produced knowledge or belief that, in this particular situation, a specific reward (the end state) will appear if a specific response (the means to that end) is made
- Establishes an internal cognitive state, which then produces the behavior
- These cognitive theories of learning focus less on the SR connection and more on what happens in the organism's mind when faced with the stimulus
- **Latent Learning and Cognitive Maps:**
    - ⇒ In latent learning, something is learned but it is not manifested as a behavioural change until sometime in the future



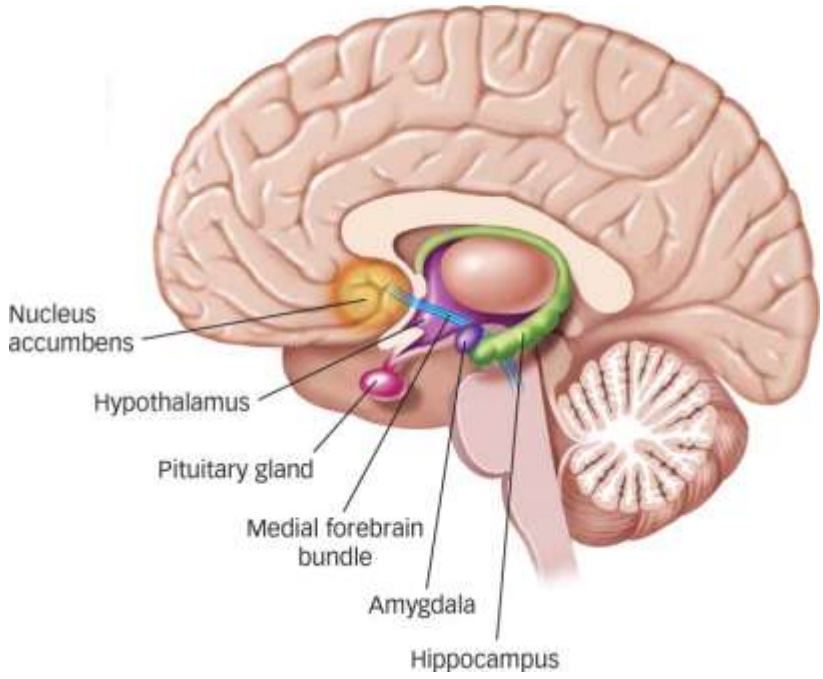
⇒ These results suggested to Tolman that beyond simply learning "start here, end here", his rats had developed a sophisticated mental picture of the maze

† **Future Support for Cognitive Explanations:**
  ⇒ Rat mazes with alternative paths
  ⇒ Latent learning and cognitive maps suggest that operant conditioning involves much more than an animal responding to a stimulus

† **Learning to Trust: For Better or Worse:**
  ⇒ Participants in such experiments typically find out who is trustworthy on the basis of trial-and-error learning during the game, transferring more money to partners who reinforce them by sharing

The Neural Elements of Operant Conditioning

† The first hint of how specific brain structures might contribute to the process of reinforcement came from the discovery of what came to be called pleasure centers
† Limbic system produced what appeared to be intensely positive experiences
† Rats would ignore food, water, and other life-sustaining necessities for hours on end simply to receive stimulation directly in the brain (pleasure centers)



- The neutrons in the medial forebrain bundle, a pathway that meanders its way from the midbrain through the hypothalamus into the nucleus accumbens, are the most susceptible to stimulation that produces pleasure
- Neurons all along this pathway and especially those in the nucleus accumbens itself are all dopaminergic; that is, they secrete the neurotransmitter dopamine
- Higher levels of dopamine in the brain are usually associated with positive emotions
- If drugs that block the action of dopamine are administered to the rats, they cease stimulating the pleasure centers
- Drugs such as cocaine, amphetamine, and opiates activate these pathways and centers, but dopamine-blocking drugs dramatically diminish their reinforcing effects
- fMRI studies show increased activity in the nucleus accumbens in heterosexual men looking at pictures of attractive women and in individuals who believe they are about to receive money
- Rats given primary reinforcers such as food or water or who are allowed to engage in sexual activity show increased dopamine secretion in the nucleus accumbens—but only if the rats are hungry, thirsty, or sexually aroused

The Evolutionary Elements of Operant Conditioning

- Rats are foragers, and like all foraging species, they have evolved a highly adaptive strategy for survival. They move around in their environment looking for food. If they find it somewhere, they eat it (or store it) and then go look somewhere else for more. If they do not find food, they forage in another part of the environment. So, if the rat just found food in the *right* arm of a T-maze, the obvious place to look next time is the *left* arm.

The rat knows that there isn't any more food in the right arm because it just ate the food it found there!

7.13 Observational Learning: Look at Me

- The administration of punishment led to a learned change in his behavior
- **Observational learning:** learning takes place by watching the actions of others

7.14 Observational Learning in Humans

- Children aggressively hitting the Bobo doll
- When children see the adults being punished for behaving aggressively, they showed less aggression
- When children see adults being praised for being aggressive, they showed more aggression
- **Diffusion chain:** individuals initially learn a behavior by observing another individual perform that behavior, and then serve as a model from which other individuals learn the behavior
- Example: sports

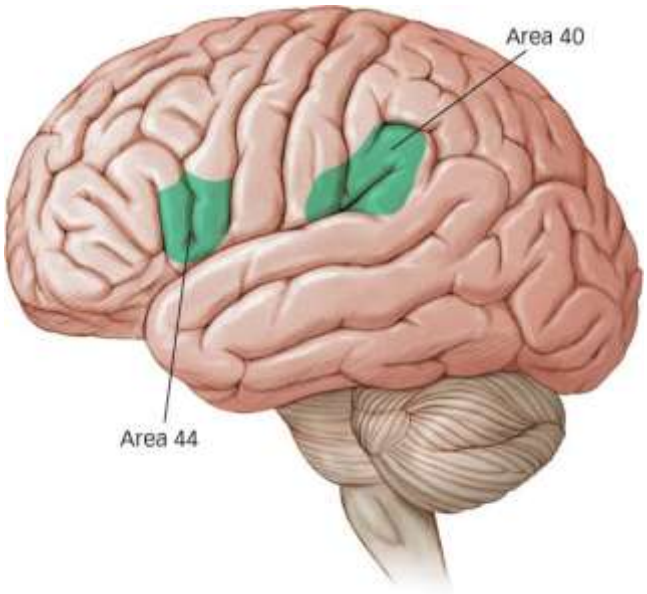
7.15 Observational Learning in Animals

- Monkeys observing fear reaction to snakes
- Monkeys observing how to capture food by using a rake (effective and non-effective ways)
- Chimpanzees raised in a more human-like environment showed more specific observational learning than did those who had been reared by their mothers, performing similarly to human children
- Enculturation hypothesis: being raised in a human culture has a profound effect on the cognitive abilities of chimpanzees, especially their ability to understand the intentions of others when performing tasks such as using tools, which in turn increases their observational learning capacities
- Evidence implies that there is a cultural influence on the cognitive processes that support observational learning, the researchers noted that the effects on observational learning could be attributed to any number of influences on the human-reared monkeys, including more experience with tools, more attention to a model's behavior

7.16 Neural Elements of Observational Learning

- **Mirror neurons** are a type of cell found in the brains of primates (including humans)
- It fires when an animal performs an action
- It also fire when an animal watches someone else perform the same task
- It may play a critical role in the imitation of behavior as well as the prediction of future behavior

- Thought to be represented in specific subregions in the frontal and parietal lobes, and there is evidence that individual subregions respond most strongly to observing certain kinds of actions
- If appropriate neurons fire when another organism is seen performing an action, it could indicate an awareness of intentionality, or that the animal is anticipating a likely course of future actions



- Evidence indicates that observational learning of some motor skills relies on the motor cortex, which is known to be critical for motor learning
- Example: when participants watch another individual engage in a task that involves making a complex reaching movement, significant observational learning occurs
- To examine whether the observational learning depends on the motor cortex, researchers applied transcranial magnetic stimulation, or "TMS," to the motor cortex just after participants observed performance of the reaching movement
- Applying TMS to the motor cortex greatly reduced the amount of observational learning, whereas applying TMS to a control region outside the motor cortex had no effect on observational learning

7.18 Implicit Learning: Under the Wires

- **Implicit learning:** learning that takes place largely independent of awareness of both the process and the product of information acquisition
- It occurs without awareness, implicit learning is knowledge that sneaks in "under the wires"
- Example: driving a car

7.19 Habituation: A Simple Case of Implicit Learning

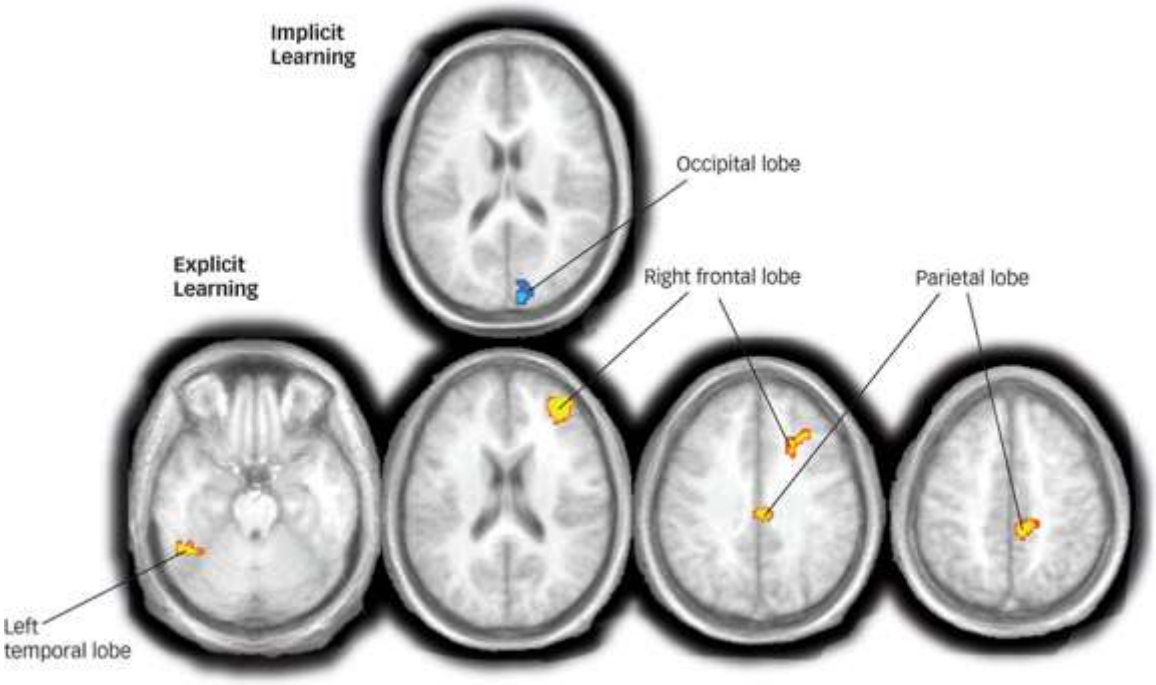
- **Habituation:** a general process in which repeated or prolonged exposure to a stimulus results in a gradual reduction in responding
- Habituation is considered a form of implicit learning in part because it occurs even in the simplest organisms that do not have the brain structures necessary for explicit learning, such as the hippocampus
- Habituation can occur in the absence of explicit learning or memory

7.20 Cognitive Approaches to Implicit Learning

- Implicit learning has some characteristics that distinguish it from explicit learning
- Examples: when asked to carry out implicit tasks, people differ relatively little from one another, but on explicit tasks, such as conscious problem solving, they show large individual-to-individual differences
- Implicit learning also seems to be unrelated to IQ
- It changes little across the life span
- Resistant to various disorders that are known to affect explicit learning

7.21 Implicit and Explicit Learning Use Distinct Neural Pathways

- The fact that patients suffering amnesia show intact implicit learning strongly suggests that the brain structures that underlie implicit leaning are distinct from those that underlie explicit learning
- Amnesic patients are characterized by lesions to the hippocampus and nearby structures in the medial temporal lobe
- Participants saw a series of dot patterns
- The dots varied, which made it impossible or a viewer to guess that they had a common structure
- Participants who were given the explicit instructions showed *increased* brain activity in the prefrontal cortex, parietal cortex, hippocampus, and a variety of other areas known to be associated with the processing of explicit memories
- Those given the implicit instructions showed *decreased* brain activation primarily in the occipital region, which is involved in visual processing
- This finding suggests that participants recruited distinct brain structures in different ways depending on whether they were approaching the task using explicit or implicit learning



- Broca's area plays a key role in language production – is tuned on during artificial grammar learning
- Activating Broca's area by applying electrical stimulation to the nearby scalp enhances implicit learning of artificial grammar, most likely by facilitating acquisition of grammatical rules
- Motor cortex appears critical for sequence learning on the serial reaction time task
- When the motor cortex was temporarily disabled by the application of a recent developed type of TMS that lasts for a long time, so that participants can perform the task without having TMS constantly applied while they are doing so

8.1 Emotional Experience: The feeling Machine

- Leonardo is a 5 year old who experiences no emotions or feelings
- You cant explain what love is, but you can explain what causes the feeling and its consequences

8.2 What is Emotion?

- By asking people to rate the similarity of dozens of emotional experiences, psychologists have been able to use a technique know as **multidimensional scaling**
- Generate a map of the emotional landscape

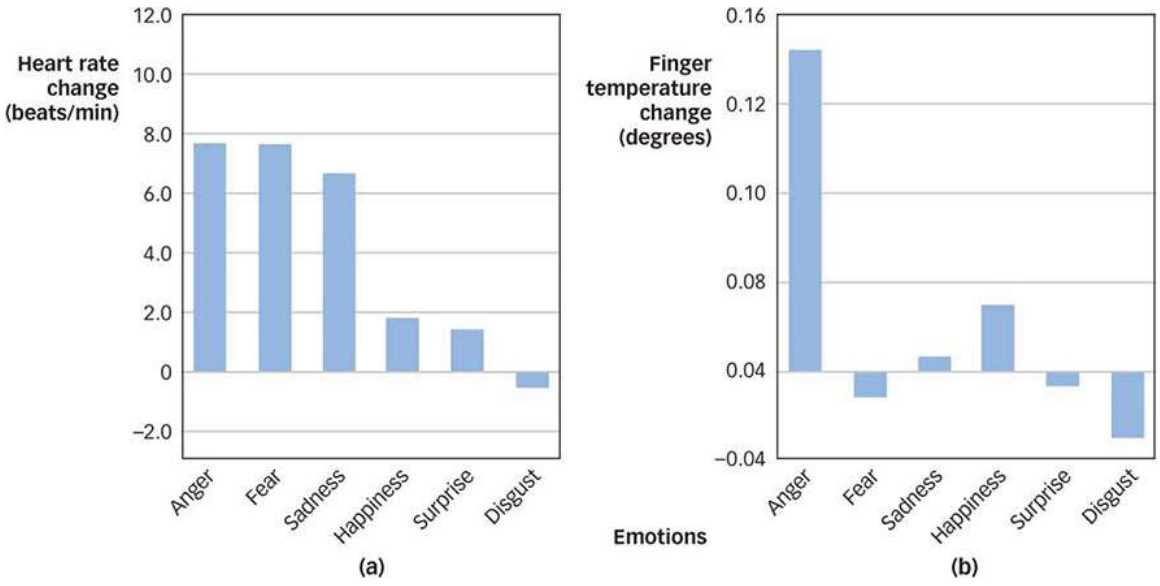
- Assigning smaller distances to those that feel similar and larger distances to those that feel dissimilar

  - This map of emotional experience suggests that any definition of emotion must include two things: first, the fact that emotional experiences are always good or bad, and second, the fact that these experiences are associated with characteristic levels of bodily arousal
  - **Emotion:** a positive or negative experience that is associated with a particular pattern or physiological activity

8.3 The Emotional Body

- William James suggested that the events that produce an emotion might actually happen in the opposite order: First you see the bear, then your heart starts pounding and your leg muscles contract, and *then* you experience fear, which is nothing more or less than your experience of your physiological response
- **James-Lange theory:** stimuli trigger activity in the autonomic nervous system, which in turn produces an emotional experience in the brain
- Emotional experience is the consequence—and not the cause—of our physiological reactions to objects and events in the world
- **Cannon-Bard theory:** stimulus simultaneously triggers activity in the autonomic nervous system and emotional experience in the brain
- Canon favoured his own theory over the James-Lange theory

- First, the autonomic nervous system reacts too slowly to account for the rapid onset of emotional experience
- Second, people often have difficulty accurately detecting changes in their own autonomic activity, such as heart rate
- Third, if non-emotional stimuli- such as temperature- can cause the same pattern of autonomic activity that emotional stimuli do
- James and Lange were right, they claimed, to equate emotion with the perception of one's bodily reactions
- Cannon and Bard were right, they claimed, to note that there are not nearly enough distinct bodily reactions to account for the wide variety of emotions that human beings can experience
- Schachter and Singer's **two factor theory** of emotion claimed that emotions are inferences about the causes of physiological arousal
- Schachter and Singer tested their theory by giving participants an injection of epinephrine, which causes increases in blood pressure, heart rate, blood flow to the brain, blood sugar levels, and respiration
- Participants then interacted with another person who, unbeknownst to them, was a confederate of the experimenter and had been instructed to act in a particular way
- Schachter and Singer predicted that those participants who experienced epinephrine-induced arousal, but who hadn't been informed of the injection's effects, would seek an explanation for their arousal—and that the confederate's behavior would supply it
- Researchers measured participants' physiological reactions as they experienced six different emotions and found that anger, fear, and sadness each produced a higher heart rate than disgust; that fear and disgust produced higher galvanic skin response (sweating) than did sadness or anger; and that anger produced a larger increase in finger temperature than did fear
- Example: a blush is the result of increased blood volume in the subcutaneous capillaries in the face, neck, and the chest, and research suggests that people blush when they feel embarrassment but not when they feel any other emotion



8.4 The Emotional Brain

- Heinrich Kluver and Paul Bucy were studying the effects of hallucinogenic drugs in rhesus monkeys
- Performed brain surgery on Aurora and they noticed she would eat just about anything and have sex with just about anyone
- She had a lack of fear
- During surgery they damaged her amygdala
- Before an animal can feel fear, its brain must first decide that there is something t be afraid of
- **Appraisal:** an evaluation of the emotional-relevant aspects of a stimulus
- Amygdala is critical to making these appraisals
- If visual information doesn't reach the amygdala, then its emotional significance cannon be assessed
- Amygdala is an extremely fast and sensitive "threat detector" that is activated even when potentially threatening stimuli
- It goes through the brain and found that it is transmitted simultaneously along two distinct routes: the "fast pathway," which goes from the thalamus to the amygdala
- In the "slow pathway", which goes from the thalamus to the cortex and then to the amygdala
- When experimental subjects are instructed to experience emotions such as happiness, sadness, fear, and anger, they show increased activity in the amygdala and decreased activity in the cortex, but when they are asked to inhibit these emotions, they show increased cortical activity and decreased amygdala activity
- The amygdala presses the emotional gas pedal and the cortex then hits the brakes

8.5 The Regulation of Emotion

- **Emotion Regulation** refers to the cognitive and behavioural strategies people use to influence their own emotional experience
- Attempt to cheer up – to turn negative emotions into positive ones
- Some are behavioural strategies and some are cognitive strategies
- One of the most effective strategies for emotion regulation is **reappraisal**, which involves changing one's emotional experience by changing the meaning of the emotional-eliciting stimulus
- Reappraisal can activate key areas of the cortex and amygdala can be deactivated

8.7 Emotional Communication: Msgs w/o Wrds

- **Emotional expression:** an observable sign of an emotional state
- Emotional states influence the way we talk
- Observers can also estimate our emotional states from the direction of our gaze, out gait, our posture, and even from a brief touch on the arm
- Underneath every face lie 43 muscles that are capable of creating more than 10 000 unique configurations, which enable a face to convey information about its owner's emotional state with an astonishing degree of subtlety and specificity
- 46 unique movements called action units

8.8 Communicative Expression

- Darwin noticed that human and nonhuman animals share certain facial and postural expressions, and he suggested that these expressions were meant to communicate information about internal states
- Emotional expressions are a convenient way for one animal to let another animal know how it is feeling and hence how it is prepared to act

The Universality of Expression

- **Universality hypothesis**, which suggests that emotional expressions have the same meaning for everyone
- People are quite accurate at judging the emotional expressions of members of other cultures
- People who have never seen a human face make the same facial expressions as those who have
- The facial displays of at least 6 emotions – anger, disgust, fear, happiness, sadness, and surprise – are universal
- Words are symbols, but facial expressions are signs
- Symbols are arbitrary designations that have no casual relationship with the things they symbolize
- Facial expressions are not arbitrary symbols of emotion
- They are signs of emotion because signs are caused by the things they signify
- If you can't tell if a man is feeling joy or sorrow; context may give evidence
- **Facial feedback hypothesis** suggests that emotional expressions can cause the emotional experiences they signify

- People unconsciously mimic other people's body postures and facial expressions
- Purpose of mimicry? Main function is to help us figure out what others are feeling
- The expression-causes-emotion effect → when we mimic someone's facial expression, we also feel their emotions

8.9 Deceptive Expression

- Your expressions are moderated by your knowledge that it is permissible to show contempt for your peers but not for your superiors
- **Display rules:** norms for the control of emotional expression
- **Intensification:** involves exaggeration the expression of one's emotion, as when a person pretends to be more surprised by a gift than she really is
- **Deintensification:** involves muting the expression of one's emotion, as when the loser of a contest tries to look less distressed than he really is
- **Masking:** involves expressing one emotion while feeling another, as when a poker player tries to look distressed rather than delighted as she examines a hand with 4 aces
- **Neutralizing:** involves feeling an emotion but displaying no expression, as when a judge tries not to betray his leanings while lawyers ar making their arguments
- **Morphology:** Certain facial muscles tend to resist conscious control, and for a trained observer, these so-called *reliable muscles* are quite revealing. For example, the zygomatic major raises the corners of the mouth, and this happen when people smile spontaneously or when they force themselves to smile. But only a genuine, spontaneous smile engages the obicularis oculi, which crinkles the corners of the eyes
- **Symmetry:** Sincere expressions are a bit more symmetrical than insincere expressions. A slightly lopsided smile is less likely to be genuine than is a perfectly even one.
- **Duration:** Sincere expressions tend to last between a half second and 5 seconds, and expressions that last for shorter or longer periods are more likely to be insincere.
- **Temporal patterning:** Sincere expressions appear and disappear smoothly over a few seconds, whereas insincere expressions tend to have more abrupt onsets and offsets.
- Many aspects of our verbal and nonverbal behavior are altered when we tell a lie
- Example: liars speak more slowly, take longer to respond to questions, and respond in less detail than do those who are telling the truth
- The most widely used lie detection machine is the polygraph, which measures a variety of physiological responses that are associated with stress, which people often feel when they are afraid of being caught in a lie

8.11 Motivation: Getting Moved

- **Motivation:** the purpose for or psychological cause of an action
- Emotions provide people with information about the world and emotions are the objectives toward which people strive

8.12 The Function of Emotion

- Capgras syndrome → people who believe that one or more of their family members are imposters
- This person has sustained damage to the neural connections between her temporal lobe (where faces are identified) and limbic system (where emotions are generated)
- When patients with this particular brain damage are given the opportunity to gamble, they make a lot of reckless bets because they don't feel the twinge of anxiety that tells most of us that we're about to do something stupid
- **Hedonic principle:** the claim that people are motivated to experience pleasure and avoid pain

8.13 The Conceptualization of Motivation

Instincts

- Nature endows us with certain motivations and that experience endows us with others
- William James called the natural tendency to seek a particular goal an instinct, which he defined as "the faculty of acting in such a way as to produce certain ends, without foresight of the ends, and without previous education in the performance"
- Behaviourists rejected the concept of instinct
- They believed that behavior should be explained by the external stimuli that evoke it and not by the hypothetical internal states on which it depends
- Behaviourists wanted nothing to do with the notion of inherited behavior because they believed that all complex behavior was learned

Drives

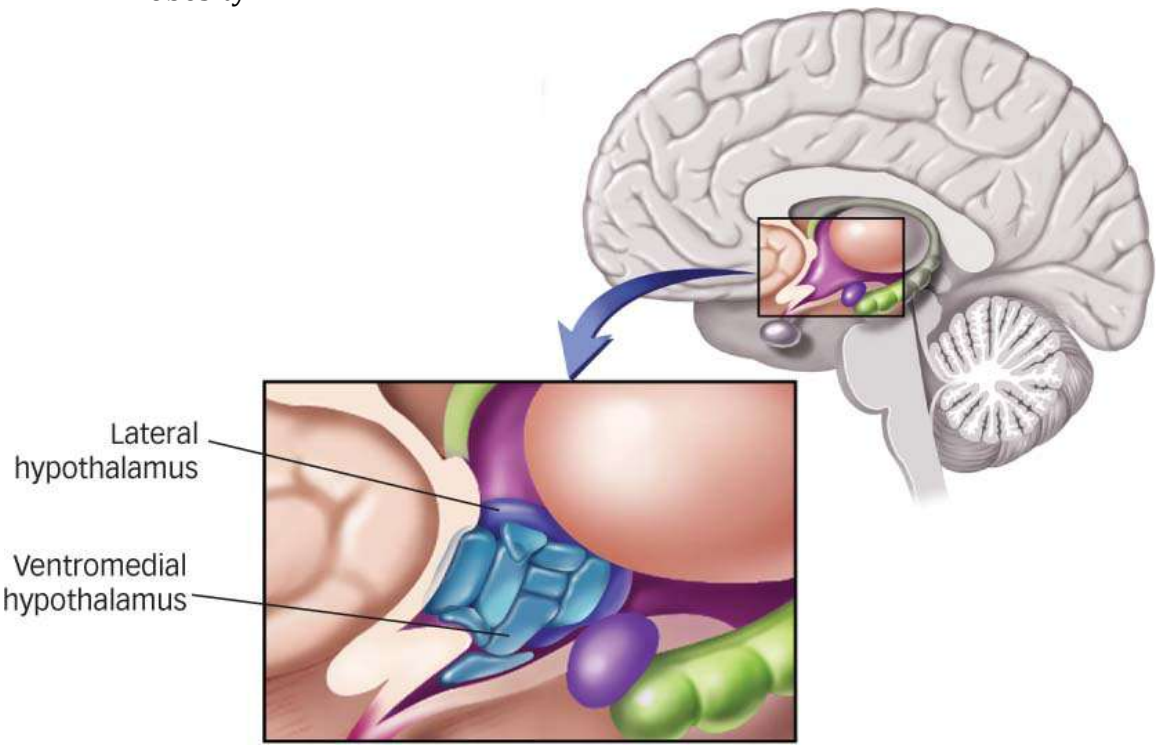
- If all behavior is a response to an external stimulus, then why does a rat that is sitting still in its cage at 9:00 a.m. start wandering around and looking for food by noon?
- The rat is responding to something inside itself
- Homeostasis: the tendency for a system to take action to keep itself in a particular state
- To survive, an organism needs to maintain precise levels of nutrition, warmth, etc
- When these levels depart from an optimal point, the organism receives a signal to take corrective action
- **Drive:** an internal state caused by physiological needs

8.14 Basic Motivations

Motivation for Food

- Hunger

- If your body needs energy, it sends an orexigenic signal to tell your brain to switch hunger on
- If your body has sufficient energy, it sends an anorexigenic signal to tell your brain to switch hunger off
- Example: ghrelin is a hormone that is produced in the stomach and tells the brain to switch hunger on
- It also binds neurons in the hippocampus and temporarily improves learning and memory
- Leptin is a chemical secreted by fat cells, and it appears to be a signal that tells the brain to switch hunger off
- The lateral hypothalamus receives orexigenic signals, and when it is destroyed, animals sitting in a cage full of food will starve themselves to death
- Ventromedical hypothalamus receives anorexigenic signals, and when it is destroyed, animals will gorge themselves to the point of illness and obesity



- Bulimia nervosa → disorder characterized by binge eating followed by purging
- Anorexia nervosa → disorder characterized by an intense fear of being fat and severe restriction of food intake
- People with anorexia have extremely high levels of ghrelin in their blood
- Overeating can result from biochemical abnormalities
- Often leptin-resistent
- We often eat when we aren't really hungry
- Nature designed us to overeat

- We store excess food energy as fat
- Our bodies respond to dieting by decreasing our metabolism, which is the rate which energy is used

Motivation for Sex

- A hormone called dihydroepiandosterone (DHEA) seems to be involved in the initial onset of sexual desire
- Testosterone increases the sexual desire of male rats by acting on a particular area of the hypothalamus, and estrogen increases the sexual desire of female rates by acting on a different area of the hypothalamus
- Estrogen regulates both ovulation and sexual interest in mammals

Sexual Activity

- **Human sexual response cycle:** stages of physiological arousal during sexual activity
- It has 4 phases
- During the **excitement phase**, muscle tension and blood flow increase in and around the sexual organs, heart and respiration rates increase, and blood pressure rises. Both men and women may experience erect nipples and a "sex flush" on the skin of the upper body and face. A man's penis typically becomes erect or partially erect and his testicles draw upward, while a woman's vagina typically becomes lubricated and her clitoris becomes swollen
- During the **plateau phase**, heart rate and muscle tension increase further. A man's urinary bladder closes to prevent urine from mixing with semen, and muscles at the base of his penis begin a steady rhythmic contraction. A man's Cowper gland may secrete a small amount of lubricating fluid (which often contains enough sperm to cause pregnancy). A woman's clitoris may withdraw slightly, and her vagina may become more lubricated. Her outer vagina may swell, and her muscles may tighten and reduce the diameter of the opening of the vagina
- During the **orgasm phase**, breathing becomes extremely rapid and the pelvic muscles begin a series of rhythmic contractions. Both men and women experience quick cycles of muscle contraction of the anus and lower pelvic muscles, and women often experience uterine and vaginal contractions as well
- During the **resolution phase**, muscles relax, blood pressure drops, and the body returns to its resting state. Most men and women experience a *refractory period,* during which further stimulation does not produce excitement. This period may last from minutes to days and is typically longer for men than for women

Psychological Motivations

- Terror management theory, one of the ways that people cope with their existential terror is by developing a cultural worldview – a shared set of beliefs about what is good and right and true
- These beliefs allow people to see themselves as more than mortal animals because they inhabit a world of meaning in which they can achieve symbolic immortality

- **Mortality-salience hypothesis:** the prediction that people who are reminded of their own mortality will work to reinforce their cultural worldviews

8.15 Kinds of Motivation

Intrinsic vs. Extrinsic

- **Intrinsic motivation:** a motivation to take actions that are themselves rewarding
- **Extrinsic motivation:** a motivation to take actions that lead to reward
- In research on the ability to delay gratification, people are typically faced with a choice between getting something they want right now or waiting and getting more of what they want later
- Under some circumstances people take rewards to indicate that an activity isn't inherently pleasurable; thus rewards can cause people to lose their intrinsic motivation
- Threats can suggest that a forbidden activity is desirable, and they can also have the paradoxical consequence of promoting the very behaviours they are meant to discourage

Conscious vs. Unconscious

- **Conscious motivation:** motivations of which people are aware
- **Unconscious motivation:** motivations of which people are not aware
- Need for achievement → the motivation to solve worthwhile problems
- Thematic Apperception test → presents people with a series of drawings and asks them to tell stories about them
- The amount of "achievement-related imagery" in the person's story ostensibly reveals the person's unconscious need for achievement
- When actions are easy, we are aware of our most general motivations, but when actions are difficult, we are aware of our more specific motivations
- Vallacher and Wegner suggest people are usually aware of the general motivations for their behaviour and only become aware of their more specific motivations when they encounter problems

Approach vs. Avoidance

- The hedonic principle describes two conceptually distinct motivations: a motivation to "run to" pleasure and a motivation to "run from" pain
- Approach motivation: a motivation to experience a positive outcome
- Avoidance motivation: a motivation not to experience a negative outcome
- Avoidance motivations tend to be more powerful than approach motivations, but the relative strength of these two tendencies does differ somewhat from person to person
- Research shows that people who are described by the high-approach items are happier when rewarded than those who are not, and that those who are described by the high-avoidance items are more anxious when threatened than those who are not

† People who have a promotion focus tend to think in terms of achieving gains whereas people who have a prevention focus tend to think in terms of avoiding losses

Psychology Chapter Summaries

Chapter One

- **Psychology** is the scientific study of the mind and behavior.
- Philosophers made early psychological theories. Plato believed in **nativism**, which argues that knowledge is innate or inborn. Aristotle believed the opposite and thought that people's mind started out as a blank slate.
- Rene Descartes believed that the mind and body were two different things, or **dualism**. Thomas Hobbes on the other hand believed that the mind was what the brain does.
- Franz Gall developed **phrenology** (specific mental abilities are localized in specific regions of the brain) as a result of observing people's brains who died healthy and from diseases.
- **Wilhelm Wundt** was the first person to open a lab for psychology. He believed in **structuralism**, which is the analysis of the basic elements that constitute the mind.
- **William James** on the other hand was all for **functionalism**, which was the study of the purpose mental processes serve in enabling people to adapt to their environment. He was inspired by natural selection, and thought that mental abilities must have evolved because they are adaptive.
- **Psychoanalysis** came shortly after all of this. It brought the **unconscious** mind (the part of the mind that operates outside of the conscious awareness but still influences thoughts), rather than the **conscious** mind (a person's subjective experience of the world and mind). **Sigmund Freud** was passionate about this, and theorized that many patients' problems come from repressed memories.
- In response to the very negative ways of Freud, **humanistic psychology** was created. This was the approach to understanding human nature that emphasizes the positive potential of human beings.
- **Behaviorism** was probably the most popular at this time though, and it was what it sounds like → the study of observable behavior. **Watson** was big on this, and
- and built a box with levers and buttons to show how rats catch on to the rewards of pressing the right buttons.
- **Illusions** often confused the mind, and created **Gestalt psychology,** which is the approach that we often perceive the whole rather than the sum of the parts. This was all a part of **cognitive psychology** → the scientific study of mental processes, including perception, thought, memory, etc.

- Of course there are other types of psychology, such as **cultural, social** and **evolutionary psychology.**

Lecture Two

- A scientific **theory** is the explanation of the phenomena that took place. All of the tests to gather information should be simple. A **Hypothesis** is the falsifiable prediction of what WILL happen.
- Three things that make people difficult to study → **Complexity, Variability,** and **Reactivity.**
- **Validity** refers to the extent to which a measurement and a property are conceptually related. **Reliability** is the tendency for a measure to produce the same measurement whenever it is used to measure the same thing (consistency).
- **Naturalistic Observation** is observing people by in intruding them. **Demand Observation** is the aspect of an observational setting that cause people to behave as they think they should.
- A **positive correlation** is when the plots on a graph move up and to the right, and a **negative correlation** is the opposite.
- When **r=1 (Perfect Positive Correlation)** the value of a variable increases by a fixed amount, along with the second variable. When **r = -1 (perfect negative correlation)** the first variable increases by a fixed amount, and the second decreases by a fixed amount. For **r = 0** the second variable does not increase or decrease systematically. Other correlations to know → **Natural and Third Variable.**
- A manipulation of data is a creation of an artificial pattern of variation in a variable in order to determine its casual powers. Other problems are selection problems, like with self-selection.
- **Internal Validity** establishes the casual relationship between variables. **External Validity** is when variables have been operationally defined in a normal, typical, realistic way.
- You should probs know the respectful treatments of psychology, but that's fairly self-explanatory, and I am wayyy too lazy to type it out. **Animals and Humans.**

Chapter Five

- The **4 basic properties of consciousness** are → **Intentionality** (the quality of being direct towards an object), **Unity** (resistance to division), **Selectivity** (the capacity to include some objects, but not others), and **Transience** (tendency to change).
- Consciousness includes → **Minimal** (Poked in sleep, so you roll over, but you don't actually go like "dafuq"), **Full, and Self** (Embarrassment).

- Unconsciousness includes → **Dynamic Unconsciousness** (Freudian Unconsciousness), **Repression, Cognitive,** and **Subliminal perception.**
- **REM Sleep** is the stage of sleep characterized by rapid eye movements and a high level of brain activity. The sleep cycle has 5 stages which end in REM. When you hit stage 4 of sleep (1 hour of sleep) your brain does things with Delta waves, and your brain rotates between Delta and REM for periods of time throughout the night, and every rotation REM lasts longer.
- There are different types of sleep disorders such as, **Insomnia, sleep apnea** (Stop breathing for periods of time in your sleep), **Somnambulism** (sleep walking), **Narcolepsy** (sudden attacks in the middle of waking activities), **Sleep Paralysis** (waking up and being unable to move) and **Night Terror!**
- Dreams were and still are very confusing to Psychologists. Freud thought that the dream had a topic (or **Manifest Meaning**), which was there to hide the true meaning of the dream (or the **Latent Meaning**). There is also another theory called the **Activation-synthesis model**, which says that dreams are caused, by the brain trying to make sense of random neural activity while we sleep.
- Drugs also affect the brain. **Psychoactive Drugs** influence consciousness by altering the brain's chemical activity. People end up overdosing on drugs, because our brain grows a tolerance for them. The types of psychoactive drugs are → **Depressants** (reduce the activity of the central nervous system), **Stimulants** (excite the central nervous system), **Narcotics** (capable of relieving pain), and **Hallucinogens** (alter sensation and perception and often cause visual and auditory hallucinogens).
- If drugs don't tickle your fancy, **hypnosis** is always an option! It is an altered states of consciousness characterized by suggestibility and the feelings that one's actions are occulting involuntarily. It can help with memory loss, as it digs deep into the mind and remembers things the conscious mind cannot. People can experience amnesia after being hypnotized though.

Chapter Six

- **Memory** is the ability to store and retrieve information over time.
- **Encoding** is what our mind does to transform what we perceive into memory. There are three types of encoding → **Elaborate Encoding** (actively relating new information to knowledge that is already in memory), **Visual Imagery Encoding** (storing info by converting it into mental pictures), and **Organizational Encoding** (the process of categorizing info by making a list of items).
- **Storage** is the process of maintaining information over time. There are also three different kinds of storage → **Sensory Storage** (holds sensory information for a few seconds or less), **Short Term and Working Memory** (holds non-sensory info for 15-20 seconds), and **Long Term Storage** (holds information for hours, days, weeks, or years). Amnesia is a illness that affects the information trying to be sent from short term into long term. The **hippocampal-region index** links all this stuff together, and creates memory!

- **Retrieval Cues** use external things (such as a chair) to help bring past information to mind. **The Encoding Specificity Principle** states that this is an effective way to remember stuff. **The State Dependent Principle** states that you should be in the same mental state in encoding and retrieval. Items from long-term memory can affect this, making it hard for the brain to retrieve certain things.
- There are multiple forms of memory → **Explicit Memory** (when people consciously or intentionally retrieve past experiences), **Semantic Memory** (facts build up to help you understand the world), **Episodic Memory** (past personal experience collection), **Implicit Memory** (repressed memories affect decisions), **Procedural Memory** (knowing how to do things – riding a bike), and **Priming.**
- **7 sins of Memory:**
    1. **Transience** → Forgetting what occurs with the passage of time.
    2. **Absentmindedness** → A lapse in attention that results in memory failure.
    3. **Blocking** → Failure to retrieve info that is already in memory, even though you are trying to produce it.
    4. **Memory Misattribution** → Assigning a recollection or an idea to the wrong source.
    5. **Suggestibility** → Incorporate unreliable sources.
    6. **Bias** → Distorting memory and beliefs based on past experiences (reconstructing the past to fit the present).
    7. **Persistence** → The intrusive recollection of events that we wish we could forget!

Chapter Seven

- An **Unconditioned stimulus (US)** is something that reliably produces a naturally occurring reaction in an organism, an **Unconditioned response (UR)** is a reflexive reaction that is reliably produced by an unconditioned stimulus, a **Conditioned stimulus (CS)** is a stimulus that is initially neutral and produces no reliable response in an organism, and **Conditioned response (CR)** is a reaction that resembles an unconditioned response but is produced by a conditioned stimulus. This is all in relation to Pavlov's dog.
- **Acquisition** is the stage when CS and US are presented together. **Second-Order Conditioning** is when the stimulus that functions as the US is really the CS. **Extinction** is when the US is no longer presented, and **Spontaneous Recovery** is learned behavior to recover from extinction.
- **Know Stuff about Pavlov's Dog.**
- A **Reinforcer** is any stimulus or event that functions to increase the likelihood of the behavior that led to it. A **punisher** is any stimulus or event that functions to decrease the likelihood of the behavior that led to it.
- **Observational Learning** takes place by watching the actions of others. Children and Animals learn by this.

Chapter Eight

- **Emotion** is a positive or negative experience that is associated with a pattern or activity. The **James-Lange Theory** is that a stimulus triggers the nervous system and produces an emotional experience in the brain. The **Cannon-Bard Theory** says that the stimulus triggers the nervous system and the brain at the same time. The **Two Factor** theory of emotion claimed that emotions are inferences about the causes of physiological arousal.
- **Appraisal** is the evaluation of the emotional-relevant aspects of a stimulus. The Amygdala is the "threat detector" in the brain. There are two pathways info can go → the **Fast pathway**, which goes from the thalamus to the amygdala, or the **slow pathway,** which goes from the thalamus to the cortex to the amygdala.
- **Emotional regulation** is the cognitive and behavioral strategies people use to influence their own emotional experience. **Emotional expression** is an observable sign of an emotional state. Emotional states influence the way we talk.
- The **Universality Hypothesis** is a theory that suggests that emotional expressions have the same meaning for everyone. The human facial displays 6 emotions → anger, disgust, fear, happiness, sadness, and surprise are all universal.
- Deceptive Expression Definitions:
    - **Display Rules:** norms for the control of emotional expression.
    - **Intensification:** involves exaggeration the expression of one's emotion, as when a person pretends to be more surprised by a gift than they really are.
    - **Deintesnification:** a contest loser looks less distressed than they really are.
    - **Masking:** expressing one emotion while feeling another, as in poker.
    - **Neutralizing:** feeling an emotion but displaying no expression.
    - **Morphology:** Certain facial muscles resist conscious control, as in faking a smile, and actually smiling.
    - **Symmetry:** Sincere expressions are a bit more symmetrical than insecure ones.
    - **Duration:** Since expressions tend to last between half a second and 5 seconds.
    - **Temporal Patterning:** Sincere expressions appear and disappear smoothly over a few seconds.
- The **Hedonic Principle** is the claim that people are motivated to experience pleasure and avoid pain! **Drive** is the need for something physiological.
- Hunger issues like anorexia become a problem, as people are afraid of being fat.
- Sex Cycle → **Excitement Stage, Plateau Stage, Orgasm Stage,** and **Resolution Stage** (sleep time for guys).
- **Intrinsic Motivation** are actions that are rewarding, and **Extrinsic Motivation** is taking actions that will lead to a reward. There is also conscious and unconscious motivation, but those are self explanatory.