Chapter 1: Psychology (Yesterday & Today)

The systematic, empirical study (or science) of selves and others' behavior and mental processes is known as **psychology**. This academic field of research borrows ideas and lends them to neuroscience and medical sciences which together form a firm basis for providing expert advice and guidance in realms of human life, including its disorders, educations and business. As any other science, psychology is ought not to base their knowledge on authority or opinion but on examination of (mostly) **mental processes** (activities of our brain when it is engaged in thinking, observing the environment and using language).

During early history, the primary method to do this was to **introspect** (to study one's own mental states and feelings). For much of the its history, there have been mainly two opposing sides: psychologists studying *mind* or *behavior*.

Psychologist generally have the six following goals in mind: **description, explanation, prediction, control, understanding & personal development.** Several levels of analysis in psychology are **intra-personal** (processes in the brain), **inter-personal** (processes that encounter between individuals), **inter-group** (processes that are affected by group member-ship) & **cultural/societal processes** (processes related to cultural factors). However, these are not mutually exclusive. When looking at 'attraction', we focus on biological programming (**intra**) but also what is socially accepted (**cultural**).

One topic that concerned many Ancient Greeks is what differs and individual from the dead and from each other. Socrates cultivated the idea of living an 'examined' life, during which one must question authority and receive opinion and put arguments to the test through the employment of logic. Plato, his pupil, argued that we live in a cruel world that had to be escaped. Aristotle on the other hand, found the world to be full of wonders. Hippocrates argues that the universe was built up from four elements: fire, water, earth and air. These elements were found in the body as humours (bodily fluids) and the concentration and proportion of these determined one's character. He was the first to correctly identify the brain as the organ of mental life.

Francis Bacon (*Knowledge is Power*) & René Descartes (*In order to seek truth, one must doubt as far as possible of all things in life*). were to first to publically question some of the accepted teachings by the Church starting the Scientific Revolution. Isaac Newton revolutionized physics by showing how diverse events could be understood by his theories (such as gravity). Rationalists ought our senses to provide untrusted knowledge, logic was not; empiricists (John Locke: our mind is a blank page waiting to be sketched) argue that sensory information is of concern since the events that cause them are important; knowledge should be derived from the evidence of our senses.

Eventually, when people started to see humans as natural rather that spiritual beings, psychology took form of a separate scientific field. The approach of **voluntarism** states that our

mental life is not just a recording of what happens around us but rather a motivated selection of our will. Wilhelm Wundt was the first to open a laboratory specialized in (two forms of) psychology (cultural psychology **Völkerspsychology** and experimental psychology).

Sigmund Freud was a Viennese neurologist who suggested that many of our thoughts and feelings existed **unconsciously** (thoughts, feelings and sensations outside human awareness). The **ID** as he described the unconscious mind was the personality element representing basic instinctual drives. Another part of the mind that is geared to self-protection and dealing with reality is the **ego** (a personality element that works to help satisfy the drives of the id while complying with the restrictions of the environment). The part of the mind that generates moral judgements Freud called the **superego.** To examine these, Freud invented **psychoanalysis** (the theory suggesting our psychological functioning is the result of the dynamic interplay of forces of which we are largely unaware).

Pragmatism is the doctrine that knowledge is to be evaluated in terms of its usefulness instead of eternal standards. **Functionalism** is the doctrine that mental processes have purpose and that the focus of study should be on how the mind adapts those purposes to changing environments. Another approach to psychology is **psychometrics** (an approach that uses tests to measure differences between people and provide evidence for evolution). The **gestalt psychology** argues that we perceive things as broad 'perceptual units' rather than as individual sensations (we have inborn tendencies to structure what we see in particular ways). In the early 20th century another area of psychology emerged that was called **behaviorism** (Ivan Pavlov with conditioning the dog; psychology should study only directly observable behaviors as a result of **stimuli** rather than abstract mental processes). Half way the 21st century emerges **humanistic psychology** (a theory that sought to give greater prominence to the uniqueness of human functioning; positive view on how humans can develop themselves; self actualisation). As a result of this approach arose **client-centered therapy** where the therapist establishes a trusting and warm relationship with his client in order to mirror feelings.

Nowadays, the most influential fields of psychology are among others **cognitive psychology** which is the field of research focusing on the means by which information is processed and stored. **Neuroscience** is the study of psychological functions by looking at its biological foundations (biological); subfields are **behavioral genetics** which focuses on how genes may effect behaviors and **sociobiology** (or **evolutionary psychology** which focusses on the importance of the adaption of genes on behavior) which does the same for social interaction. Psychoanalytics still have great influence nowadays. **Embodied & extended cognition** examines how cognitive processes are influenced by concrete physical experiences, and offloaded onto the environment.

Chapter 2: Psychology as a Science

Two core beliefs about the world that science is built on is that the universe operates according to certain natural laws and that such laws are discoverable and therefore testable. The logical approach to do this is the scientific method. Early views on human knowledge were governed by **deductive reasoning**: a process that starts with broad basic principles and applies them in specific situations (when using the broad Pythagorean theorem to calculate one situation). Francis Bacon felt that this kind of reasoning was too easily influenced by the thinker's **biases** (distorted beliefs based on a person's subjective sense of reality) and he came up with the exact opposite: **inductive reasoning** where the reasoning process is proceeded by generalizing a broad truth by proving small, specific situations. In this case, a psychologist would make **empirical observations** (objectively testable) that would construct **theories**. The most trusted theories were however a combination of the two reasoning models in the **hypothetico-deductive approach** where scientists begin with an educated guess about how the world works and then set about designing small controlled observations to support or invalidate that **hypothesis** (a general statement about the way variables relate that is objectively falsifiable). A hypothesis is generally judged to be true when in no case it can be tested wrongly. Hence, we don't talk of something proven to be right, but nearly impossible to be proven wrong. **Reliability** refers to the notion that if something is true it will keep happening; **validity** refers to whether we are testing what we mean to test and if this an answer found actually answers the question. A scientific approach would involve the following steps: **make observations, develop an hypotheses, test the hypotheses** and eventually **build a theory**.

In a hypothesis you are most likely saying that one thing results in another thing. These **variables** is a condition, event or situation. A **variable** that is thought to be a factor in changing another condition is known as an **independent variable.** A **dependent variable** on the other hand is the factor that you expect to change. When you are **operationalizing** the variables you are developing precise definitions of the independent and dependent variables that allow you to measure and test them.

Once you have identified your variables, you need to select the people who will participate in your study. Because researchers can generally not study the whole population, they will use **samples** which are groups of people representing a larger societal group, ideally selected by **random selection** minimalizing **sampling biases.**

Descriptive research methods are studies that allow researchers to demonstrate a relationship between the variables of interest, without specifying a casual relationship. Examples are:

- Case studies: a study focusing on a single person. A disadvantage of a case study is that it can be affected greatly by researcher bias which occurs when investigators only see what they expect to see in their studies and also the researcher cannot confidently generalize to other situations from the study of a single person.
- Naturalistic Observation: a study where researchers watch while people behave as they normally do. An advantage is that it is more reflective on human behavior, however, a disadvantage is that it can too be subject to researcher bias: when the researcher is only noticing that what the hypothesis is stating. Also, as soon as the participants are aware of being examined, they might change their behavior to be more desirable.
- Surveys: a study where researchers ask people a series of questions. A disadvantage is that it might not be reliable when people are answering in a societal desirable way. An advantage is that in this way someone might collect information that is generally inaccessible through other research methods. Also, the results can be states in numbers which makes it easier to come to a firm conclusion when measuring the relationship between two variables.
- Experiments: a controlled observation in which researchers manipulate the presence or amount of the independent variable to see what effect it has on the dependent variable. After stating the hypotheses, the researcher will have to divide his sample into two groups: the experimental group (a group that is exposed to the independent variable) and the control group (a group that has not been exposed to the independent variable). Of great importance is that there is basically no difference between the two groups except for their exposure to the independent variable; this can be achieved by e.g. a pre-survey. Once again, researchers must set up their studies in such a way that they do not unintentionally communicate to participants the outcome that they expect to see (the participants may in no manner be aware of the desired outcome of the study). A way to not let this happen is by double-blind procedure where a study in which neither the participant nor the researcher knows what treatment or procedure the participant is receiving. When using ground theory you naively approach a certain research (method) as if you have no background information or knowledge yet so the outcome emerges from the data found; this is nearly impossible in reality though. Especially in psychological studies people tend to find the outcome they were looking for. Another qualitative approach is the thematic analysis which is a basic form of qualitative analysis involving derivation of themes from a text or interview transcript and the interpretative phenomenological analysis which is an approach to qualitative research that emphasizes interpretation and aims to understand the lived experience of the participants. Another method used in psychology is discourse analysis which focuses on the use of language to construct and shape the world around us. The words we use to describe the world shapes it. We cannot perceive the world as something that is not describable by words.

And if not, this research focuses on how this world is presented (in what way emotional language may describe a certain topic).

A predictable relationship between two or more variables is called a **correlation**. Psychologists use **correlation coefficients** (ranging from -1.0 to 1.0) which are statistics expressing the strength and nature of a relationship between two variables. A **positive/negative correlation** is a relationship in which scores on two variables increase/decrease together (more reality TV & being more charitable); the coefficient designates its strength.

If you want to examine differences between groups and determine the cause, you have to do an experimental analysis in which researchers calculate the **mean** (the arithmetic average of a set of scores) and **standard deviation** (statistical index of how much scores vary within a group) of each group. **Replication**, the (differently) repeated testing of a hypothesis, is one of the considerably reliable ways of ensuring that the results achieved in one experiment were not due to chance.

To ensure that researchers follow proper ethical practices, **ethics committees** (compiled by researchers inside and outside the field) now oversee studies conducted in academic settings. They require the following: **informed consent** (participants have the right to know every single detail about the study), **physical and mental protection**, **protect confidentiality** (privacy), **complete debriefing** (information given after the investigation due to result influence).

Chapter 3: Biological and Cognitive Development

Developmental psychology is concerned with complex changes in our behavior and mental processes over time and how various factors affect the course of those changes. The nature-nurture debate is a discussion in which the nature-party argues that a considerable amount of personal identities are fixed genetically, whereas the nurture debate argues that those personal qualities are obtained through development in life (**maturation**) and **stages** (developmental periods that are characterized by a certain level of functioning that is qualitatively different than in other stages). A **critical/sensitive** stage or period is one when an organism is extremely sensitive to environmental input, making it easier for it to acquire certain brain functions and behavior.

When measuring changes in developmental stages, one approach is the **cross-sectional design** in which researchers compare groups of different-aged people. A potential problem in this design is that one can assume that any measured difference are a result of the age difference; therefore, many prefer the **longitudinal design** in which researchers follow the same people over a given period of time and register how their answers and responses change. A combination of the two is the **cohort-sequential design** in which two different age groups are followed over time.

Genes (composed of specific sequence of **deoxyribonucleic acid** arranged in **chromosomes**) are the most basic building blocks of our biological inheritance and its information forms our **genotype**. Our **phenotype** is the observable manifestation of that genotype. **Alleles** are variations of a gene; if both parents contribute the same allele, the offspring is **homozygous**; otherwise **heterozygous.** A dominant trait is a trait which will be expressed in your phenotype regardless of whether it is homo- or heterogeneous. Recessive traits only occur when in they are heterozygously paired or a mixture occurs when they are relatively codominant to the homozygous trait. What makes this subject complex is that traits are most often expressed through combination with others.

As soon as babies are grown, they follow a **proximodorsal pattern** in which growth and development proceed from the center to the extremities (parts close to the center grow faster) followed by a **cephalocaudal pattern** in which growth proceeds from top to bottom. Taste and smell are highly developed in contrast to vision and hearing. In addition to these senses, babies are also 'programmed' with **reflexes** (programmed physical reactions to certain cues that do not require any conscious thought to perform). After the first year babies acquire **motor skills**, the ability to control bodily movements. Two key processes that are responsible for the remarkable development of the brain in the baby's early life is the fact that there is a sheer increase in connections among neurons and therefore more action in the brain's transmission points called **synapses**. The other key principle is the **myelination** process in which fatty deposits on neurons are created that allow electric impulses to pass through neurons more efficiently

through the nods of Ranvier. **Synaptic pruning** is the developmental reduction and evaporation of neuronal connections, allowing stronger connections to flourish.

The **Piaget's Theory** is based on **cognitive development**: the way of thinking changes over the years. According to Piaget, all of us have mental frameworks (**schemata**) or structures for understanding and thinking about the world which may alter or expend through experiences which will eventually balance in **equilibrium**. When gaining knowledge, the schemata change through **assimilation** (inclusion of new information) or **accommodation** (alteration of old information by new information). A major cognitive milestone of the sensorimotor stage (stage in which babies only think about the world in terms of what they see and sense) occurs at around eight months of age: realizing **object permanence** (objects continue to exist even when they are outside the infant's immediate sensory awareness; mental representation).

The **information-processing theory** focuses on how children take in and use information from their environment. Parenting includes **operant conditioning** in which babies learn to perform certain behaviors when they are systematically rewarded for it; eventually they'll display **habituation** in which they pay less attention to a stimulus after it is presented to them repeatedly.

During early and middle childhood, children gain much more basic control over e.g. urination, stabilization processing and coordination. The initial brain growth spurt continues (more myelination etc.). Cognitive development is partially dominated by the ability to obtain **operations** (Piagetian description of a child's ability to store and mentally manipulate a certain idea). Children will go through two cognitive developmental stages these years: the **preoperational** (developmental stage during which the child begins to develop ideas of objects in the external world and the ability to work with them in his or her mind) and **concrete operation stages** (stage during which children are able to talk about complex relationships such as categorization and cause and effect, but are still limited to understanding ideas in terms of real-world relationships). **Egocentrism**, which occurs most often in the first stage, describes flaws in a child's reasoning based on his or her inability to take other perspectives; likewise the lack of **conservation** which is the ability to understand that something can stay the same even though its appearance may change (water in cups example). The **theory of mind** is a recognition that other people base their behaviors on their own perspectives, not on information that is unavailable to them (autism example).

Puberty refers to the physical development of primary (bodily changes that have to do specifically with the reproductive system) and secondary sex characteristics (non-reproductive changes like lowering voice with men); the onset and course of these changes are influenced largely by the (hormone) glands of the body. The brains development proceeds at a higher pace.

According to Piaget, our cognitive development reaches its final stage called the formal operations (the child achieves formal adult, moral reasoning and the ability to think about things that do not have a concrete reality like math's). They also achieve adolescent egocentrism which is the mistaken belief that everyone else is focusing largely on them and their behavior and that they are constantly judged, positively or negatively. Unlike Piaget, who viewed a child's development as a process of individual freedom, Vygotsky believed that constructive interactions with adults helps the children develop ways of thinking about, and functioning, in the world. Scaffolding is the developmental adjustments that adults make to give children the help that they need but not so much that they fail to move forward. The zone of proximal development is the gap between what a child can accomplish alone and what the child can accomplish with help from others. Private speech is believed to be the child's use to regulate behavior and internal processes.

During adulthood, generally, physical attributes such as strength and reaction time are at peak. Later, these will decline in the 30s and 40s. Women go through a major change which is called the menopause (series of changes in hormonal function resulting in the end of menstrual and reproductive capabilities). In our 60s and 70s we become slightly shorter and thinner and our immune system begins to decline in function. The formation and loss of brain nerve cells generally stays the same, however, during our 40s intellectual shifts will occur such as the fact that it will take longer to recount certain memories resulting in, for instance, dementia at a much later stage. One important theory on why we are aging is the cellular clock theory which suggests that ageing is a result of the fact that our cells have built-in limits on their ability to reproduce). The wear-and-tear theory suggests we age because the use of our body wears it out and the free-radical theory suggests we age because special negatively charged oxygen molecules become more chemically prevalent in our body as we get older, destabilizing cellular structures and causing the effect of ageing.

Chapter 4: Social and Emotional Development

Many psychological researchers are interested in trying to determine how much of our behavior is determined by our genetic inheritance; **behavioral genetics**. One of the key areas of focus is **temperament** (biologically based tendencies to respond to a certain situation in similar ways throughout our lifetimes). Very often, babies are categorized in three groups of tendencies: **easy** (open to novelty and playful), **difficult** (easily irritable and negative to new situations) and **slow-to-warm-up** (withdraw from new situations but can change). Two aspects that result from longitudinal studies are that temperament is inborn and that temperament is relatively stable across situations and time; however, variety in this suggests that the environment is of big influence.

Many psychological researchers focus on the importance of the early experiences that children have with their parents since they are at the center of an infant's social world. Theorist John Bowlby believed that human beings are born with a drive to form an **attachment** (a close emotional bond to another person, such as a baby to a caregiver; argued to be inherited since it is a way of surviving the first vulnerable years). He argues that the early positive experiences with this caregiver are critical and fundamental to cognitive development later in life. Three basic attachment styles are **secure attachment** in which the infant uses the mother as a secure base to experiment, when she is gone it is distressed; **avoidant attachment** in which an infant is indifferent when the mother leaves; **ambivalent attachment** in which the infant reacts strongly when the mother leaves and is confused about how to react when she is back and the **disoriented attachment** in which the kid ignores the mother or appear flat and depressed. **Reciprocal socialization** is the transactional relationship between parent and child; how children's behavior might affect parenting styles.

Chapter 5: Behavioral Neuroscience

Neuroscience is the study of the brain and nervous system; **behavioral neuroscience** is the study of how the brain and nervous system control our behavior in an interactive fashion with our organs, glands, skeletal muscles and immune system. This study involves comparative analyses of the brain and central nervous system with the peripheral and autonomic nervous systems. The functions of the brain are to be divided between the sensory systems, which are designed to detect alterations in an ever-changing environment, and motor systems, which are designed to allow humans and animals to alter or manipulate the environment. **Neurotechnology** is the technology on which our understand of neurons is based. Human neuroscience relied on the following methods: examining autopsy tissues; testing the behavior of patients with damage to certain parts of their brand and recording brain activity from the surface of the scalp. Over the past decades, **neuroimaging** has been developed which involves the application of various brain imaging techniques that provide images of the structure and function of awake (or not) humans either directly or indirectly). It's either invasive (e.g. PET) or non-invasive (e.g. Fmri).

The **neuron**, or nerve cell, provides the fundamental structural and functional unit of the nervous system. Along with neurons, the nervous system also contain glial cells (glia). Neurons have a cell body filled with cytoplasm that contains a nucleus and organelles that enable the cell to make proteins and other molecules that can break down or eliminate. They have a variety of specialized structures: small/large/plenty **dendrites** (parts that receive input) and **axons** (parts that conducts information away).

Neurons send messages to one another via electrochemical events; a sudden change in the electrical charge of a neuron's axon. Neurons are covered by a neuronal membrane with extracellular and intracellular fluid surrounding the outside or inside the neuron containing charged particles called ions. The negative charge, that emerges as a result of different concentrations of differently charged particles (K+, Na+, Cl-) on either sides, is called the **resting potential**. Neuronal membrane exhibits selective permeability to ions through **ion channels** (pores in the cell membrane that open and close to allow certain ions). The concentrations of the particles change dramatically when the cell is activated by other neurons. When information received from other neurons induces positively charged events, these are termed **excitatory postsynaptic potentials**, otherwise **inhibitory postsynaptic potentials.** When the number of the first potentials exceeds the other, thereby reaching a threshold, an event begins at the axon, known as the **action potential** that continues to travel across the membrane by the all-or-nothing principle (sudden positive change; sudden change of concentrations; action potential is only fired when it exceeds that certain threshold). **Neurotransmitters** (chemicals that travel across synapses to allow communications between neurons) may induce either potentials. After the potential is fired, it may not fire again for a short time: the **refractory period.** The small gap between neurons, **synapses**, is the place where **synaptic vessels** (membrane bound spheres where neurotransmitters can be stored), hand over their

neurotransmitters. These then bind to **neurotransmitter receptors** which are proteins in the membranes of neurons that bind to neurotransmitters. When they combine, a **postsynaptic potential** is created; if excitatory, the cell will be depolarized and the signal will continue to be transported to the next neuron in the neural network.

The brain is divided into regions that serve varying functions:

- **The brainstem / medulla**: the part which is closest to the spinal cord. Important for basic bodily, unconscious functions, including respiration and heart rate. Critical for survival. Also important for eye, tongue and facial movements. Several neuron groups work together to form a **reticular formation** which is important for sleep and wakefulness. An important neurotransmitter is **serotine**; involved in activity levels and mood regulations.
- **The pons**: above the brainstem. **Noradrenaline** is formed; important for attention/arousal.
- **The cerebellum**: back of the brain. Important for motor coordination, fine-motor control and selective attention.
- **The midbrain**: contains a number of different nuclei including an area called the substantia nigra (region of the brain concerned with fluidity of movement and inhibiting movements) that cell bodies that produce **dopamine** (neurotransmitter with various brain functions, including movement and reward learning).
- **The thalamus**: the area of the brain that serves as a relay/in-between station for incoming sensory information. Two important nuclei are the lateral geniculate nucleus (important for relaying information about visual stimuli) and the medial geniculate nucleus (same for auditory stimuli).
- **The hypothalamus**: beneath the thalamus. Regions are important for a number of motivational processes including eating, drinking sex and maternal behavior. Critical for control of the endocrine, hormonal, system.
- **The Pituitary Gland and the Endocrine System**: pituitary gland (brain structure that plays a central role in controlling the endocrine system) is connected to the hypothalamus through myriad blood vessels. It has two parts: the anterior pituitary (receives signaling molecules (peptides) from neurons of the hypothalamus that can act as hormones or increase the production of them by e.g. ovaries) and the posterior pituitary (activation by neuronal signaling by the hypothalamus causes the release of neuropeptides; important in regulating blood pressure, social behavior and affection).
- **The amygdala**: located deep within the brain. Involved in processing information about emotions and fear. Collection of nuclei that serve different functions. Interesting since it might be involved in the development of phobias and aggressive behavior.
- **The hippocampus**: communicates with the amygdala and is important for certain types of learning and (temporary) memory. Place cells are involved in spatial environment learning. Consists of layers which makes it easy to study; creates new neurons so regenerative.

- The Striatum and Basal Ganglia: Midline of the brain. Works with the substantia nigra to enable fluid movements. Important for memory and learning that doesn't involve conscious awareness. The Basal Ganglia is associated with various more or less essential functions such as voluntary motor control and routine behaviors. Also cognitive and emotional functions.
- The Nucleus Accumbens: important for motivation and reward learning. Receives important inputs from the prefrontal regions.
- The Neocortex: occupies a huge space in the brain; therefore folded on the surface. Involves complex behavior including language and thought. There is a localization of functions; therefore some parts are responsible for certain behavior. It can be divided in four different parts and two major classifications: the primary sensory and/or motor areas where basic information about senses is processed and where signals that lead to voluntary movements are produced. The second is the association cortex which includes complex functions such as a higher order sensory processing system and integrated information from different senses, thinking and planning. The four areas:
    - The Occipital Cortex: at the back of the skull. contains primary sensory regions important for processing very basic information about visual stimuli such as orientation, lines and complex motion. The visual information from each eye that is closest to the midline between the two eyes is actually projected to the opposite side of the brain. Connections to other parts of the neocortex enable us to form associations with smell etc. This serves as an important reminder that no brain region operates entirely on its own.
    - The Temporal Cortex: located on the sides of the head within the temporal lobe. Important for processing sounds, speech, language comprehension (active during auditory hallucinations such as in epilepsy) in the Wernicke's Area which is located at just one side of the brain, and for recognizing complex visual stimuli such as faces.
    - The Parietal Cortex: upper-middle area of the brain. A lobe of the neocortex involved in processing information related to touch and complex visual information, particularly locations. Contains a region known as the somatosensory strip which is a band in the cortex that processes tactile information coming from our body parts and forms a systematic body map where some parts are represented more than others; more tactile information.
    - The Frontal Cortex: front of the brain. Involved in many functions, including movement, coordination and speech production. Contains a region called the Broca's area which is critical for speech production. Up front is the prefrontal cortex which is involved in higher-order thinking, such as memory, moral reasoning and planning.
- The Corpus Callosum: communication from one side of the neocortex to the other (two equal halves of the brain called hemispheres) occurs through this large structure.

The human nervous system may be divided into two main parts: the central nervous system (concerned with analysis and decision-making), which is made up of the brain and the spinal cord, and the peripheral nervous system, which is made up of the somatic and autonomic nervous systems. It ensures information is brought and sent back and forth between the periphery (e.g. your fingers) and the central nervous system.

No brain region can serve a function on its own, rather several regions work together to form a complex system of functions. The spinal cord, for example, extends from the base of the brain down the back. It is very important for gathering information from the body and sending it to the brain as well as for enabling the brain to control the movement of the body. As described earlier, the somatic nervous system works together with the central nervous system to integrate sensory information with motor output (mostly via the brain). However, some basic functions, such as reflexes, involve just the somatic nervous system and the spinal cord. When this spinal cord is involved in injuries, people might for example become paralyzed or incapable of sensing by touch etc.

The peripheral nervous system includes the somatic nervous system (the peripheral nerves that send information about the senses and movement to and from the central nervous system) and the autonomic nervous system. The autonomic nervous system includes the sympathetic nervous system (the part that is active during times of stress, e.g. serves as survival techniques) and the parasympathetic nervous system (the part that is active during restful times, e.g. digestion).

Development of the nervous system begins during the embryonic phase of prenatal life and continues throughout the lifespan. Embryos have three layers of rather undefined tissues that later specialize to become our recognizable body parts, from one of them, the ectoderm, originates the neural tube (from here the nervous system arises). Cells on the lining of the wall will differentiate and obtain the characteristics of neurons, this production is called neurogenesis (of synapses synaptogenesis). Eventually, progenitor cells will form near the center of the neural tube and migrate away from it, eventually they will grow axons and dendrites. Failures are filtered through apoptosis; a large number of neurons that make inappropriate or useless connections will be destructed; thus the brain ensures an effective connection between brain regions. Alcohol may stop the formation of neurons and such connections and may even destruct cells because it blocks the production of an acid that signals the prevention of apoptosis. Brain development continues across the lifespan since our experiences may determine which synapses are maintained and which are pruned during infancy and childhood.
In general, diseases of the nervous system can be divided into two broad classes characterized by the type of physician designated to care for the patient. Psychiatric diseases, such as

depression and schizophrenia, are believed to be a result of a biochemical or neurotransmitter to be imbalance. In the case of neurological illnesses, such as Parkinson's, the main problem is thought to be structural, generally involving the degeneration of neurons. Some key neurological diseases are:

- Multiple sclerosis: disease that causes a loss of myelin on the axons of neurons leading to the inefficient transmission of electrical information among neurons and a range of symptoms, including vision loss, pain and muscle weakness.
- Amyotrophic lateral sclerosis (ALS): disease that causes degeneration of motor neurons in the spinal cord, leading to loss of movement and eventual death.
- Parkinson's disease: a neurological disease that involves the death of dopaminergic neurons in the substantia nigra, leading to tremors, muscle rigidity and motor problems. There is a curing drug, but patients become resistant to the drug over time.
- Huntington's disease: inherited condition that results in the death of neurons in the stratium. People have awkward movements and systems of psychosis.

Chapter 7: Perception and the Senses

Some psychologists argue that our senses engage in two important and interacting processes: **sensation** (the act of using our sensory systems to detect environmental stimuli) and **perception** (recognition and identification of a sensory stimuli). However, since they are so closely connected, most often psychologists refer to perception as a whole.

Each of our sensory systems is set up to 'translate' the physical stimuli we receive from the world outside our bodies into the 'language' of neural information. Each of the senses has a set of specialized cells called **sensory receptor cells** that convert a specific form of environmental stimuli into neural impulses; **sensory transduction**. A stimulus must, however, reach a certain level of intensity (**absolute threshold**) before we can detect it. The smallest difference that we are able to notice between two stimuli of the same type, such as the smells wafting from to different meals, is called the **difference threshold** or **just noticeable difference**. **Sensory adaption** (the process whereby repeated stimulation of a sensory cell leads to a reduced response) is very effective because it makes us only sense an alteration in the environment, and not just any detail at a given moment.

Researchers have identified two different ways in which information from our senses is processed: **bottom-up processing** (the perception that proceeds by transducing environmental stimuli into neural impulses that move on to successively more complex brain regions resulting in the recognition of a stimulus) and **top-down processing** (the perception led by cognitive processes, such as memories or expectations based on experience). A **perceptual set** is the readiness to interpret a certain stimulus in a certain way (you see visual imagery in such a way that you expect to see).

The **olfactory system** (sense of smell) and the **gustatory system** (sense of taste) are the chemical senses. The sensation of smell begin when chemicals called **odorants** enter the nose; they are converted to neural signals at **olfactory receptor neurons** which are cells that, when activated through bonding with a lot of odorants, convert chemical signals from odorants into neural impulses that travel to the brain. Receptor neurons will need a time to recover when repeatedly triggered: habituation. Flavor is the combination of smell and taste. The tongue is covered with bumps, **papillae**, that contain clumps of taste buds (sensory receptor cells of the 5 different tastes). What influences our perception of food is also our tactile senses; which sense the consistency, spiciness and temperature of the food. The path of these neural signals is as follows: olfactory receptor neurons travel to the brain via the olfactory nerve to the **olfactory bulb** (the first region where olfactory information reaches the brain on its way from the nose); after that to the cerebral cortex which is important for recognizing and distinguishing odors and the amygdala and the hippocampus (remembrance and emotion). Disorders are **ageusia** (the inability to taste) and **anosmia** (the inability to smell).

Tactile senses record the sense of touch. **Free nerve endings** are located mostly near the surface of the skin and explicitly record touch, pressure, pain and temperature and sends signals to the spinal cord which sends it forwards to the brain's thalamus and somatosensory cortex. Hands

have a bigger collection of these free nerves since we use them every second. When we sense pain, the signals enter a myelinated shortcut to the spinal cord besides the slower pathway up to the brain; this enhances the occurrence of reflexes.

The auditory system is designed to convert **sound waves** (vibrations of the air in the frequency of hearing) into neural impulses. Soundwaves have 2 major qualities that produce our perceptions of different sounds: **frequency** (number of cycles per time period; responsible for a sounds pitch) and **amplitude** (strength of a cycle; responsible for the volume of a sound). Soundwaves are converted to neural impulses via several steps: sound waves enter the outer ear and cause distortions of the eardrum (**tympanic membrane**). These vibrations set in motion a series of three tiny bones called ossicles (hammer, anvil, stirrup) and the stirrup transfers these vibrations to the **oval window** which is a membrane separating the ossicles from the inner ear. This vibration causes pressure waves to form in the fluid-filled **cochlea** in the inner ear; this causes movements in the **basilar membrane** where the hair cells are located; these are the auditory sensory receptors that translate them to electrical activity. The **frequency theory** suggests that different sound frequencies are converted into different rates of firing in our auditory nerves; this leads to a different perception of sounds. Another theory is the **place theory** which holds that differences in sound frequency activate different regions on the basilar membrane.

For survival theories it is important to know from which direction and spatial position a sound is coming. The auditory system uses several cues to localize sounds: **general loudness** (loud sounds are closer than soft sounds); **loudness in each ear** (louder in the right ear suggests that it's coming from the right); **timing** (sounds will hit the right ear earlier if it's coming from the right).

Vision begins when light enters the eye. Muscles in the iris adjust the size of our pupils to let in more or less of the light reflected from objects around us or adjust its shape for focusing the light onto a specialized sheet of nerve cells containing sensory receptors for vision called the **retina**. The retina has two major classes of visual receptors (**photoreceptors**) which are **rods** (very sensitive to small amounts of light to detect light) and **cones** (necessary for color vision and perception of fine details). The rods and cones stimulate the bipolar cells, which in turn cause ganglion cells to fire. The axons of the ganglion cells are bundled together to form the **optic nerve** (carries visual information from the eye to the brain). Rods and cones are not spread evenly; cones near the center and form the so called **fovea**, and rods near the outer edges.

The color of a visual stimulus can be described by three different features: **hue** (linked to the wavelength and describes the color), **saturation** (how pure and deep the color appears) and **brightness** (how much light is reflected from the visual stimulus). Historically, there are two theories of color vision: **trichromatic theory** (holds that the human eye has three sensors of color, each of which responds to different range of wavelengths; a combination of two or more creates different colors) and the **opponent process theory** (holds that color perception depends

on the actions of three systems of color opposite pairs: blue inhibits yellow, red inhibits green, black inhibits white).

Most visual information travels via the optic nerve to the thalamus, synapsing on neurons in the **lateral geniculate nucleus** (part of the thalamus that processes visual information). Visual information is transmitted throughout the brain via partially crossed set axons in such a way that information from the left half of each retina which corresponds with the right half of the **visual field**, goes to the left half of the primary visual cortex. Once it arrives there, it is first processed to allow the detection of very simple features, such as lines and edges. We are able to see complex visual stimuli as a result of circuitry that elaborates on these lines and edges by joining them together, involving additional visual information, such as motion and color, and eventually linking them with other areas of the brain dealing with the higher-order cognitive processes, like memory. It has been suggested that the pathways that process information about complex visual stimuli can be roughly divided into the **what** (regions that help us to determine what it is that they see) and **where** (help us coordinate where it is located) pathways.

Our brains are organized to fil in the missing parts so that we perceive and recognize meaningful stimuli; it assembles visual information into objects and scenes (**top down processing**). Examples of this **Gestalt Theory** are: **proximity** (stimuli near another one tend to be grouped together), **similarity** (stimuli looking alike are grouped together), **continuity** (we tend to see patterns in the way in which stimuli are organized), **good form** (stimuli that together form a shape tend to be shaped together) and **closure** (we tend to fill in small gaps in objects so that they are perceived as a whole object).

Because our eyes are set a slight distance apart, we do not see exactly the same thing with both eyes. This **retinal disparity** provides us with a binocular cue to depth. Another way to sense depth is tactile; we feel changes in the muscles around our eyes as we shift them to look at objects. Closer objects require more **convergence**. Other cues are **monocular** or **pictorial cues** (depth sensing that can be perceived with only one eye): **interposition** (when an object blocks the view, we see the blocked object as further away); **elevation** (objects higher in our visual plane we sense as father away); **texture gradient** (when we see more texture in an object, we sense it's closer to us); **linear perspective** (parallel lines converge in the distance); **shading** (using shadows to determine which one is closer); **familiar size** (using memory); **relative size** (when we know two objects are the same size but look like they're not; one is further away).

Perceptual constancy examples (objects are unchanging in a changing environment): color constancy in which you believe an object is of the same color despite the changing color of the environment; size consistency in which we have knowledge of the size of an object and expect it to stay that size; shape consistency in which we already know the shape of an object.

Chapter 8: Consciousness

Defining consciousness is notoriously difficult and serious progress is frequently hampered by differences of opinion concerning the definition of the thing that we are trying to explain. A qualia is the raw material of conscious experience; what causes what it is like to experience the redness of a red object).

Materialism is a philosophical position in which it is held that everything can be explained in physical material terms. It's a branch of monism which is the idea that there is one type of fundamental substance from which everything else is made. This can be either physical substance or mental substance. Materialism seeks satisfaction in the fact that the 'mysteriousness' we find nowadays will disappear as soon as we gain full knowledge on how the brain works. There are two forms: the identity theory (holds that brain states are identical to mental states; chemical processes form the state of the brain and thus how we think) and eliminativism (we have not seen a thing that would suggest consciousness, thus it does not exist; things such as qualia do not exist). The identity theory is criticized as a problem of multiple realizability (the idea that identical mental states can be realized by different brain processes; thus there is no one-to-one correlation). Eliminativism has been criticized since the qualia they say doesn't exist, cannot deny that we all have a very subjective, indescribable experience of saying that a red object is red. So even though the idea of a full understanding of the brain is appealing, the materialist approach still does not provide an explanation for our subjective consciousness: the explanatory gap.

Functionalism mainly focusses on what the functions are of mental states and what causes them to be. They say that our mind is a stimuli processing computer and creates functional feelings by syntactic rules. Again their approach does not explain the 'qualia' experience and thus it does not have a valid one-to-one correlation between what the function of feelings is and our mental state. An example of this contradiction is the situation in which you are in an imaginable box with the Chinese dictionary and an input from outside with a Chinese words on cards. You are, with the dictionary, able to output other Chinese words which makes others think that you are able to speak Chinese; thus you are able to compute Chinese words but you are not able to fully understand the Chinese language.

Dualism is a position in the philosophy of mind that states that the world consist of two distinct kinds of thing. Two sub-branches are substance dualism (which holds that these two things are the materialist, physical world and the consciousness which is not part of it) and property dualism (the idea that there is probably only one type of substance, but this can have both physical and non-physical properties). A specific version of property dualism is epiphenomenalism which is an explanation for consciousness based on the idea that it emerges from physical processes but is not reducible to them; consciousness is a process which indeed rises from physical, brain activity but it arises above it; thus this can happen in any system (panpsychism), though it must be complex. Criticism on the dualist approach are very basic: if our consciousness is immaterial, what is it then and where is it? Because when it is on our brain,

it is part of the physical universe and that is contradictory to its definition and why are the reactions that result from consciousness (such as crying) physical?

In addition to attention, the term consciousness refers to the actions of **monitoring** ourselves, using **memories** to relate to the past in order to conceive the present; it provides context, and **control** and **planning** which helps us in our consciousness to predict and manipulate the future. While one set of networks enables us to pay attention to the stimulus, other biological events must also be at work, enabling us to be aware that we are paying attention, monitor, remember and control. The areas that are responsible for this **parallel processing** are **the cerebral cortex** and **the thalamus**. Research has suggested that the **cerebral cortex** is in charge of our awareness of that attention. Areas of the brain that help us to detect and unconsciously see stimuli are different from areas that are explicitly aware of them. After several investigations, found was that the left cortex is responsible for verbal awareness, the right for tactile awareness (non-verbal awareness). The thalamus is a conductor, involved in routing messages along the proper neural networks of our brain.

Different levels of consciousness are **preconciousness** which is the level of awareness at which information can become readily available to consciousness if necessary (getting out of bed and brushing your teeth), if you are fully aware you call it **conscious awareness**. Another variant is the **unconscious state** in which information is not easily accessible to conscious awareness. The concept of **implicit memory** describes the knowledge that we have stored in memory that we are not typically aware of or able to recall at will (such as a skill to do something); **explicit memory** is that knowledge that you know instantly (your birth date).

Being under **hypnosis** is what some people call an altered state of consciousness in which individuals can be directed to act an unusual way or divert from pain. There are two theories supporting hypnosis: **divided consciousness** (a disassociation of consciousness into two dimensions: a fully tuned one which is responsive to the hypnotist's suggestions and the hidden observer which is a subtler, less conscious level processing information that is unavailable to the person hypnotized) and **commons social and cognitive processes** (highly motivated and believed people perform test and fully give themselves to performing them correctly).

Another altered state of consciousness is **sleep**. There are different theories for its purpose: the **adaptive theory of sleep** suggests that organisms sleep for the purposes of self-preservation, to keep away from predators that are more active at night and the **restorative theory of sleep** which suggests that we sleep in order to allow the brain and body to restore certain depleted chemical resources and eradicate chemical wastes that have accumulated during the waking day. A human being's basic pattern of sleep/wake cycles is called the **circadian rhythm** or the **biological clock**. The **suprachiasmatic nucleus** (**SCN**), a small group of neurons in the hypothalamus, is ultimately responsible for coordinating the many rhythms of the body. As soon as daylight fades into night, the SCN notices and directs the pineal gland to secrete hormone melatonin; as soon as there is daylight, this secretion remains low.

Every 90 to 100 minutes while we sleep, we pass 5 stages which can be recorded with use of brain waves. We first encounter the **hypnagogic state** which is characterized by strange, vivid sensory sensations and experiences such as falling and hear voices. After that, our brain waves become smaller and irregular. The first stage of actual sleep represents a bridge between wakefulness and sleep; here we think of irrational things. Falling deeper into sleep we encounter stage 2, in which we encounter **sleep spindles** (sudden bursts of brain activity); here breathing becomes steadily rhythmic. In the end of this change, our brain waves develop into delta waves in addition to theta waves. Stage 3 and stage 4 are characterized by very deep sleep; blood pressure and breathing rates drop to the lowest. After these stages, we encounter the final stage of **rapid eye movement** (**REM**); a sleep pattern characterized by rapid and jagged brainwave patterns, increased heart rate, rapid and irregular breathing, nearly paralyzed body, rapid eye movements and especially dreaming. Dreaming is believed to be the consolation of memories of newly learnt material. There are three considerable theories about dreaming. The **Freudian dream theory** argues that dreams represent the expression of unconscious wishes or desires in which the actual dream is the **manifest content** and the implicit meaning the **latent content**. The **information-processing theory** states the hypothesis that dreams are the mind's attempt to sort out and organize the day's experiences and to fix them in memory. The **activation-synthesis hypothesis** suggests that dreams result from the brain's attempt to synthesize or organize random internally generated signals that are lost in the network of neurons and give them meaning. **Lucid dreams** are dreams in which the sleeper fully recognized that he or she is dreaming, and occasionally actively guides the outcome of the dream.

Psychoactive drugs are chemicals that affect awareness, behavior, sensation, perception or mood. **Addiction** to these drugs consist of psychological of physical compulsion to take that drugs, resulting from regular ingestion and leading to maladaptive patterns of behavior and changes in physical response. **Depressants** are psychoactive drugs that slow the activity of the central nervous system. **Alcohol** is a drug that is absorbed through the lining of the stomach and the intestines and makes people looser and more talkative but irresponsive if taken too much. **Opioids** is a class of drugs derived from the sap of the opium poppy and may, in any form of injection, result in a pleasant rush lasting not determinable. **Stimulants** are substances that increase the activity of the central nervous system (heart rate, blood pressure and overall mental and physical activity). **Hallucinogens** are substances that dramatically change one's state of awareness , causing powerful changes in sensory perception.

Chapter 9: Learning

Learning is defined as a lasting change caused by experience; this may be in behavioral response but may also be unnoticeable. Scientists typically display data from learning studies in learning curves which are graphs showing changes in performance on a learning task over time ('hard' tasks will be less steep than 'easy' tasks). There are two categories of learning. Associative and Non-Associative.

Non associative: a type of learning that does not involve forming associations between stimuli but often only one sensual cue is involved; the easiest type. Habituation is a form of non-associative learning whereby repeated presentation of a stimulus leads to a reduction in response (smell of coffee); sensitization is the opposite: an increase of response strength over time (sound of a dripping tap). The sea slug (aplysia) has been used frequently to study this type of learning since their neurons are among the largest in the animal kingdom and this type of learning is the mostly the only one they obtain.

Associative: a type of learning that involves forming associations between stimuli. Two major types are Pavlovian/Classical conditioning and Operant conditioning. Classical conditioning occurs when a neutral stimulus (flute) is paired with a salient stimulus (food) so that eventually the neutral stimulus predicts the salient stimulus (dog example); lasting changes in the nervous system result. In this case, the food is the unconditioned stimulus (US) since it elicits an unconditioned response (UR) on its own. As soon as the neutral stimulus elicits a response, we call it a conditioned stimulus (CS) leading to a conditioned response (CR). Spontaneous recovery is the re-emergence of a conditioned response some time after extinction has occurred. Stimulus generalization is the situation in which similar stimuli elicit the same response as a conditioned stimulus after classical conditioning has occurred (being afraid of rats and thus all white, fluffy things). Some people believe fear conditioning is the basis for so called phobias. Systematic desensitization is a process used to condition extinction of phobias through gradual exposure to the feared object or situation. Conditioned taste aversion is a form whereby a previously neutral stimulus (odor or taste) elicits an aversive reaction after it is paired with illness. Classical condition is a passive form of learning that does not involve the active participation of the learner.

Operant/instrumental conditioning, however, is a form of associative learning whereby active behavior is modified depending on its consequences. Skinner's experiment involved putting a hungry animal in a box which is bare except for a bar with food dish under. Animal's initial rate of pressing bar through exploration (baseline line) will increase after frequently pressing the bar and experiencing receiving food. The law of effect is the theory that behaviors leading to rewards are more likely to occur again and behaviors leading to punishment less. In typical experiments, stimuli are provided in response to the animal's behavior; these may be punishments or rewards. When the subject increases a certain behavior, the experiment is called a reinforcer, otherwise punishment. Positive reinforcement is what we consider to be a reward, providing a motivating stimulus; negative reinforcement is the removal of a negative stimulus. Positive punishment is the presentation of a negative consequence; negative

punishment takes away something pleasant. Most reinforcers fulfill biological needs; **primary reinforcers** are intrinsically pleasurable (food). A **secondary reinforcer** is associated with primary reinforcers (money to buy food). A behavior that is reinforced every single time it occurs is said to be an example of **continuous reinforcement**; otherwise **partial reinforcement**. Examples are a ratio schedule, reinforcement is based on the number of behavioral responses; a **fixed** ratio occurs after a specific number of responses where you are rewarded after a predetermined number of responses; a **variable** ratio where you are rewarder on a predetermined number of responses. An interval schedule, reinforcement is based on elapsed time. A **fixed interval** is a reinforcement such as a monthly salary, a **variable interval** provides reinforcement after varying lengths of time have passed. Overall, **shaping** is the introduction of new behavior by reinforcing small approximations of the desired behavior (step by step reinforcement; learn dog to roll over in different steps). One problem that can arise as the result of operant condition is **learned helplessness** which is a situation in which repeated exposure to inescapable punishment eventually produces a failure to make escape attempts (acceptance).

Studies show that learning can occur without reinforcement. An example is **spatial navigation** which is a type of learning that involves forming associations among stimuli relevant to navigating in space. Another type of learning is **insight learning** which is a sudden realization of a solution to a problem or a leap in understanding new concepts. Humans also learn by observing others (**observational learning**) and how the environment reacts to their behavior. Observation leads to **modelling** (mimicking the behavior of others).

Several factors can affect how well each of these learning methods works. **Timing**; repetition over time is crucial to learning something better. **Context**; if you take a test where you studied for it, you'll do better. **Awareness and Attention**; much of our learning happens unconsciously, however for associative learning awareness is often beneficial. **Sleep**; deprivation impairs our abilities to pay attention and thus learn. Getting enough sleep helps you to process information from that day.

One general conclusion that we can draw about the neuroscience of learning is that a single 'learning' center does not exist. However, particular neural systems are involved in some types of learning. Habituation and sensitization arise from changes in the sensory neurons themselves and their related corresponding interneurons and motor neurons. Classical conditioning of the eye-blink response is associated with the cerebellum, while fear conditioning involves the amygdala. Reward learning relies on the midbrain dopamine system, and motor learning involves activation of the basal ganglia, near the thalamus. Spatial navigation learning and episodic learning involve the hippocampus. Neuroscientists suspect that all learning involves some kind of change in the strength of the synapse; a form of synaptic plasticity called **long-term potentiation** (increased activity in the postsynaptic cells after strong, repetitive stimulation) or even a gradual increase in the number of synapses.

Chapter 10: Memory

Memory is the faculty for reproducing past events and past learning using these three basic activities: **encoding** (getting information into memory in the first place); **storage** (retaining memories for future use) and **retrieval** (recapturing memories when we need them). Psychologists have developed two models of explanation for the management of these three stages. The **information-processing model** suggests that information moves among three memory stores during encoding storage and retrieval: sensory memory (short storage of sensory images to judge whether its relevant to remember including the iconic storage and echoic storage), working memory (temporal storage in which we process and manipulate the stimuli in such a way we can remember it later: repetition e.g. a storage of memory codes: visual, phonological, semantic or motor representations) and long-term memory (large storage of information after the **spacing effect** = rehearsal over long period of time; distributed practice). It suggests that there is a central executive system that pays the attention and an episodic buffer that tries to make associations between memories. The second model is the **parallel distributed processing model** which suggests information is represented in the brain as a pattern of activation across entire neural networks. Newly encountered pieces of information immediately join with others to form and grow networks of information (you link an apple to your grandmother, sweetness and redness). Research found that the prefrontal cortex becomes more active when we are engaged in remembering and storing information and the hippocampus for long-term memory storage.

Encoding of information required attention in order to storage the memory endlessly. **Automatic processing** is the encoding of information with little conscious awareness or effort but will remain in the long-term memory (how to get home) and extra effort will have no effect; **effortful processing** is the encoding of information through careful attention and conscious effort (studying). Information can be stored to be encoded in various ways; phonological codes are used when remembering a number, visual codes are used when remembering an image (eidetic memory storage if retrieved perfectly). The **semantic code** is the cognitive representation of information or an event based on the bias or meaning of information: different people experience something differently. Not surprisingly, more (personally) meaningful information and structured information is encoded more easily. **Mnemonic devices** are cognitive techniques used to enhance the meaningfulness of information to make them more memorable. Examples are using imagery or structuring.

There is an exchange in the storage systems. For example, information from the long-term memory system may be used in the working memory system to solve current situations or tasks. As striking as the limited duration of working memory is its capacity; the **memory span** is the maximum number of items that can be recalled in their correct order. **Chunking** is the grouping bits of information together to enhance one's ability to hold that information in working memory (when remembering a series of 18 digits, we divide them into groups of three with which we have connotations).

Various kinds of information are stored in long-term memory. **Explicit memory** is the memory that a person can consciously bring to mind, such as one's date of birth; **implicit memory** are memories that we are largely unaware of such as acquired skills. Two types of explicit memory are **semantic memory** (general knowledge of the world) and **episodic memory** (personal event from his or her life). Examples of implicit memories are **procedural memory** (acquired life skills), **conditioned memory** (phobias, prejudice and attitudes) and **priming** (feelings based on just presented stimuli; being scared after reading a scary novel). Retrieval of information from the long-term memory is essential since it may help us solve problems in present life. This retrieval is aided by **retrieval cues** (words, sights or other stimuli that remind us of the information we need to retrieve from our memory). **Priming** is the activation of one piece of information, which in turn leads to the activation of another piece and ultimately to the retrieval of a specific memory.

The **encoding specificity principle** suggests that memories are best retrieved when the cues overlap with the original trace (homecoming results in old memories). The **state-dependent memory** is a memory retrieval facilitated by being in the same state of mind in which you encoded the memory in the first place. **Flashbulb memories** are detailed and near-permanent memories of an emotionally significant event, or of the circumstances surround the moment we learnt about the event (remembering where you were at September 11).

Forgetting is the inability to recall information that was previously encoded into memory; sometimes mere failures of attention. Some considerable explanations or variable factors causing forgetting are **decay** (theory suggesting memories fade over time owing to neglect or failure to access over time), **interference** (theory suggesting forgetting is influenced by what happens to people before or after they take information; old information interferes with the retrieval or distraction) and **motivated forgetting** (purposely forgetting things that were unpleasant or embarrassing; Freud called it 'repression': when we unconsciously prevent some events from entering our awareness so we don't have to feel the anxiety or sadness of it anymore).

A number of factors may contribute to distortion or manufacture of memories: **source misattributions** (remembering information but not the source it came from, can lead to judging memory to be true since you don't know the source), **exposure to misinformation** (when we are provided with certain information on an event, we apply the same information to our experience even if it's not true), **the effect of imagination** (when we are told to remember something that we haven't experienced; our brain will 'make' this memory).

The prefrontal cortex is an important brain structure located just behind the forehead and implicated in working memory; the hippocampus is believed to convert such memories into long-term status. The PDP, or connectionist, model described the storage of information in long-term memory as a network of associations: a **neural network**. When we activate one piece of information, we relate it to something else thus enabling us to travel through our long-term

memory system rapidly; this goes by neuron to neuron via neurotransmitters and synapses. When these connections are used more often, they become more readily available to us and thus we can remember them more easily.

Some changes in memory have clear organic causes, such as brain injuries or medical conditions. Amnestic disorders are organic disorders in which memory loss is the primary system. Examples are retrograde amnesia which is the inability to remember things that occurred before an amnesia inducing event and anterograde amnesia which is the ongoing inability to form new memories after an amnesia inducing event. Dementias are severe memory problems combined with losses in at least one other cognitive function, such as abstract thinking or language. Alzheimer's disease is the most common form of dementia in which gradual forgetting evolves into a loss of almost all knowledge that is relevant to them.

People with dissociative disorders (psychological disorders characterized by a major loss of memory without a clear physical cause) are categorized into dissociative amnesia, fugue (loss of memory of personal identity), identity disorder (development of two or more distinct personalities: subpersonalities).

Chapter 11: Language and Thought

Language is a set of symbols used to communicate and can be divided into two main components: **language production** (using movement to produce speech such as moving vocal cords or hands to signal) and **language comprehension** (understanding spoken, written or signed language). The study of speech can be divided into four general areas: phonology, semantics, syntax and pragmatism. A **phoneme** is the smallest unit of language such as an individual sound or letter and the study of how these are put together form the study of **phonology**; **morphemes** are the smallest units of language that convey meaning such as a word or phrase. The study of how meaning is constructed through compilation of words and sentences is referred to as **semantics**. The literal, dictionary meaning of a word is the **lexical meaning**. The way in which words that may have two distinct meanings are grammatically put into sentences is called **syntax**. In the end, **pragmatism** is the practical aspect of language usage such as speech pace, gesturing and body language (non-verbal communication). One influential theory suggests that our language controls and limits our thoughts (the **Sapir-Whorf** theory). An example is the **linguistic relativity hypothesis** that suggests that the vocabulary available for objects or concepts in a language influences how speakers of that language think about them; when there are no negative words to describe something, we might not even think about it negatively. However some thoughts like **spatial navigation** or **mental imagery** don't need language to be thought of which makes the theories controversial.

Acquiring language skills as a child involves several sequences. **Prevocal learning** is the perceiving of all possible phonemes regardless of whether they are present in the native language that will be learned; **babbling** is the babies' production of meaningless sounds; first words through comprehension and/or mimicking; **telegraphic speech** consisting of minimalistic sentences that characterize early toddlerhood such as 'want biscuit'; **pragmatics** learning and eventually **grammar** which is the ultimate state of language comprehension. The ease with which language is acquired by human infants has led many researchers to speculate that language has a biological basis; we have a language acquisition device built into our brains that seems to become less efficient as we age.

One area of the left hemisphere of the brain, known as **Broca's area**, is important for our ability to speak, while another area, called **Wernicke's area**, is important in language comprehension. In a typical conversation, which involves listening and responding, both areas would be active at once, along with other parts of the brain. When people suffer damage in or near Broca's area, they develop a set of symptoms called **Broca's aphasia** where the patient is unable to produce coherent speech mainly because of the lack of control in the muscles that are involved with it regardless of their mental abilities. Damage to this area can also produce an inability to speak with proper grammar: **agrammatism**. Another part of the brain that is even more closely related to language comprehension is **Wernicke's area**. When people suffer from **Wernicke's aphasia**, they obviously have problems in understanding speech.

There are two reading routes in the brain: a direct route that takes us directly from the printed word to the sound and an indirect route where we have to assemble the pronunciations for

new words or non-words; when either of these is damaged we speak of **dyslexia**. There are three forms: **surface dyslexia** (words with other pronunciations than you might think are spoken with difficulty: STEAK); **phonological dyslexia** (difficulty with unfamiliar words) and **deep dyslexia** (deep damage of brain parts involved with reading).

A **concept** is a mental representation, which the brain uses to denote a class of things in the world. A **category** refers to a set of entities that are grouped together. Two sets of properties related to concept: **prototype** is the best example of a concept; a **core** the most important properties for being member of concept. A prototypical piece of furniture would be a chair, and the core property would be having 4 legs. However, we would not call a garden's chair a piece of furniture.

Problem solving is the determination of how to reach a goal. A **deductive reasoning** scheme involves a step by step unfolding of the theory and hypothesis to eventually come to a confirmation (I couldn't think if I didn't exist, and I think, so I exist); **inductive reasoning** involves having an observation and looking for a pattern and eventually deduce a theory from them (if I'm in a lecture, and lectures are for students, I am a student). An **algorithm** is a problem solving strategy that always leads to a solution (such as mathematics), **heuristics** are a shortcut thinking strategy and therefore not explicitly true (estimating). **Representativeness heuristic** is classifying something based on how similar it seems to a typical case in a given category; **availability heuristic** judging easily recalled events as more common (plane crashes). When any of these a lot because they have worked in the past, we speak of a **mental set**. A version of a mental set is the **functional fixedness** which is the tendency to view objects as having only one function such as seeing coins only as a currency instead of tools for opening beers, for instance. **Confirmation bias** is the tendency to look for information that meets our expectations when problem solving which we therefore give me credit; you can overcome this by looking for information that disconfirms your ideas. One of the most complicated forms of thought is **metacognition** (thinking about thinking, self-reflection). Neuroscientists believe that the ability to think about another person's intentions is directly linked to a set of cells in the brain called **mirror neurons**.

Many disorders include problems with thinking and self-control. **Obsessive-compulsive disorder** (OCD) is a mental disorder associated with abnormal anxiety provoking thoughts that can lead to ritualistic behaviors. **Schizophrenia** is a mental disorder characterized by disorganized thoughts, lack of contact with reality and sometimes auditory hallucinations.

Chapter 12: Intelligence

Intelligence is most likely to be defined as the ability to learn, to meet the demands of the environment effectively and to understand and control one's mental activities. However, the exact definition of intelligence is controversial because we are not unanimous about whether intelligence is just one thing or a combination of skills, and what concepts are related to intelligence and how it may be measured.

Spearman's **Factor analysis** is a statistical method for determining whether certain items on a test correlate highly, thus forming a unified set, or cluster, of items. For example, when people tend to be good at grammar, they also tend to be good at reading comprehension and thus asses those people to be having good verbal-reasoning skills. The **s factor** describes to what extent someone is good at some particular cluster; the **g factor** in this form of analysis describes to what extent someone is good at all clusters of subjects and thus is 'intelligent'. The psychologist Louis L. Thurstone criticized Spearman and came with another form of psychological intelligent measurements: seven **primary mental abilities** were the basic components of intelligence and the extent of control determined how intelligent you were. He called **fluid intelligence** the thinking that involves working things out on basis of no previous knowledge (puzzles) and **crystallized intelligence** thinking based on knowledge gained in the real world (vocabulary and general knowledge).

Three theorists – Howard Gardner, Robert Sternberg and Stephen Ceci – have broadened the definition of intelligence and de-emphasized the g-factor to come with something better. Howard Gardner advanced the **theory of multiple disciplines** which states that there is no single, unified intelligence but instead several independent intelligences arising from different portions of the brain creating people that are 'intelligent' at one single task. Robert Sternberg has proposed a **triarchic theory of intelligence** which states that intelligence is made up of three interacting components :internal (analytic), external (creative) and experiential (practical) components. Stephen Ceci has proposed the **bioecological model of intelligence** which suggests that intelligence is a function of the interactions among innate potential abilities (what nature gave to you), environmental context (if the environment will let you use them) and internal motivation (if you are willing to use them). Moreover, other aspects of intelligence are taken into account. **Emotional intelligence** refers to an individual's ability to perceive, express and assimilate emotions and to regulate emotion in the self and others. **Social intelligence** or **interpersonal skills** is the ability to 'charm' your way out of difficult situations and gain affection with everyone with whom you interact. **Wisdom** is the ability to make sound judgements about important, difficult or uncertain situations and to choose the best course of action. **Creativity** is the ability to produce ideas that are both original and valuable.

One of the oldest and most enduring approaches to understanding and assessing intelligence is the **psychometrics approach** which attempts to measure intelligence with carefully constructed psychological tests. But what makes a good test? The first criterion: the process of obtaining a meaningful test score from a large representative sample population through the use of uniform procedures is called **standardization**. Test results from large populations tend to

follow particular patterns, called **distributions**. A **normal distribution** is a symmetrical, bell-shaped distribution in which most scores are in the middle (**median**) with smaller groups of equal size at the end. The **mean** is the average score and the **mode** is the score that occurs most frequently in a distribution; these should be of the same in a properly standardized distribution. The second criterion is that it needs to be **reliable**; producing the same scores over time. The third criterion is **validity** (the extent to which a test accurately measures or predicts what it is supposed to measure or predict). Forms of validity are: **predictive validity** (to what extend does the test product future performance); **concurrent validity** (to what extent does it test current performance); **construct validity** (does it measure what it was supposed to measure; what is the test build of); **content validity** (the extent to which the tests measures all concepts of an aspect); **face validity** (the extent to which the test actually looks as if it is measuring intelligence). The **validity coefficient** is a correlation coefficient that measures validity by correlating a test score with some external criterion (like comparing an intelligent test with school grades).

Francis Galton believed that by studying intellectual development he could learn more about the evolution of the human species in general and in the inheritance of intelligence in particular. Galton, who believed in a general intelligence factor, proposed that two qualities distinguish more gifted from less gifted people: a kind of psychic energy and a heightened sensitivity to external stimuli. This **theory of psychophysical performance**, held that people with more energy can perform more work and, in turn, develop greater intelligence and people that have more highly developed senses can take in more information. Alfred Binet came with the **mental age**: the intellectual age at which a person is functioning, as opposed to chronological age. This would be the basis for Lewis Terman's **intelligence quotient (IQ)** test which measures the ratio of a child's mental age to his or her chronological age multiplied by 100. However it was used wrongly with the **eugenics movement** who sought to discourage people deemed unfit from reproducing while encouraging fit individuals to have children. Eventually, David Wechsler introduced a psychological test called the WIAS which is basically the same as the Binet test however it focusses on different aspects and its score is derived from a normal average distribution rather than form a ratio. People have believed that the **nerve conduction velocity**, which is the speed with which electrical impulses are transmitted along nerve fibred and synapses, is representable for one's IQ. As we age, we lose myelin and thus this velocity becomes slower. That's why we say that older people become 'dumber' as they age. The **Flynn Effect** states that as a world, we are having higher IQ's than we were having. This might be the result of better parenting, nutrition, education etc. It's also believed that intelligence depends on the links between parietal and frontal lobes and people vary on in the efficiency of these connections. **The Bell Curve Controversy** was about a book by Hernstein & Murray that suggested that the IQ predicts success, is heritable highly correlated with cognitive elite and racially deferrable.

Chapter 13: Motivation

Motivation is the internal state or condition that directs or stimulates behavior. For any given circumstance, your behavior is probably the consequence of a combination of several motives, your particular and specific needs or desires. There are several theories of motivation, each of which takes a different approach to explain what compels individuals to act as they do.

- The instinct theory: maintains that behaviors originate from a set of behavioral blueprints, or instincts (innate behavioral tendencies, activated by stimuli in our environments) that help an individual survive in a changing, social environment. This theory does not account for all behavior however.
- Drive-Reduction theory: tries to explain motivation on the basis of internal biological factors. The homeostasis, a tendency of the body to maintain itself in a state of balance or equilibrium, is a driving force for our behavior. The balance may be in terms of primary needs such as food but also emotion and pain. However, some people seek behavior that keeps us off equilibrium which makes this theory controversial.
- Arousal theory: maintains that motivation comes from a need to achieve an appropriate level of arousal or stimulation which may elicit when arousal is high but also when arousal levels fall too low. In addition, to providing motivation, our arousal levels can systematically affect our performance on tasks we undertake. The Yerkes-Dodson law states that ideal performance on a task occurs when our arousal level is right for the difficulty of the task. People that are over-aroused will stress, under aroused are bored.
- Incentive theory: maintains the idea of intrinsic motivation: engaging in a behavior simply for the satisfaction that is part of doing it (rats like exploring a maze). It also maintains external motivations, or incentives: behavior that is motivated by external incentives is known as extrinsic motivation and can be characterized by that they indirectly indicate reward (rats will find their way through a maze if they are rewarded with food). Incentives can be either primary (rewards or punishments that are innate: pleasure from food punishment from pain) and secondary (work is rewarded with money). Motivational theories that focus on incentives often take into consideration the distinction between linking and wanting whereas liking refers to our experience of reward at the moment while wanting refers to the anticipation of an experience that we expect will cause us pleasure. This is proven to be from brain scans since different fluids are released between liking and wanting.
- Humanistic Approach theory: maintains that different motives can compete with one another in terms of hierarchy where physiological needs such as food weigh more that getting a good grade at a certain point when you are hungry while studying. Interested in an individual's subjective experiences where the focus perspective is put on this individual. Therefore you will go get some food. The hierarchy contains of these physiological needs, safety needs, belonging and love needs, esteem needs and self-actualization needs.

Hunger signals in our brains originate from several stimuli, including how full our stomachs are (**stretch receptors** in the stomach walls), the **level of nutrients** circulating in our bloodstreams (glucose and leptins are representations of how much food is broken down in our body over a certain period) and the activities in our brain (the **lateral hypothalamus** is a region of the hypothalamus important in signaling thirst and hunger by levels of glucose and the **ventromedial region** which is responsible for the feeling of satiety by peripheral signals from the liver, stomach and intestines). Some researchers suggest that we have an individual **body weight set point** which is a weight that individuals typically return to even after dieting or overeating. **Obesity** is a condition of being extremely overweight and is determined on the basis of a weight to height ratio, called the **body mass index**. It may be caused by overeating but genes also play a major role. **Anorexia nervosa** is an eating disorder in which individuals under-eat and have a distorted body image of being overweight, often the result of **objectification** (being worried about how others see you); **bulimia nervosa** is an eating disorder in which individuals binge and then engage in purging behavior.

Chapter 14: Emotion

Emotion is an interpersonal state that occurs in response to either external or internal events and typically involves a physiological, cognitive and behavioral component. **Physiological** components consists of the bodily arousals we feel when experiencing a particular emotion like an increased heart rate or body temperature by the autonomic nervous system that tries to arouse you with its sympathetic nervous system and calm you down the parasympathetic nervous system. The **cognitive** component has two parts: one is evaluative thoughts (feeling positive, neutral or negative) and the other is their appraisal or judgement on the event (this is fun, dangerous, exciting). Lastly, the **behavioral** component consists of the expressions of emotion through verbal or nonverbal channels, such as smiling, whining, laughing or frowning. An emotion is a complex, multi-component episode that creates a readiness to act. Researchers typically use three kinds of information to measure an individual's emotions: behavioral displays of emotion (e.g. fighting), self-reports of emotion (e.g. in surveys) and physiological reactions to situations (e.g. heart rate or skin conductance as a result or respiration).

Emotions can and do serve cognitive, behavioral and social functions. **Cognitive functions** include the organization of memories since they help us link emotional content to memories which makes it easier to remember them. The **behavioral function** of emotions helps us to act in order to minimize our experience of negative emotions (procrastinating or diverting) and maximize our experience of positive emotions. Therefore, happiness makes people engage in rewarding behaviors more often; embarrassment evokes forgiveness and motivates adherence to social norms; anger signals the presence of injustice and prompts aggression; anxiety directs attention towards a potential threat and cope with it; sadness may signal the loss of positive relationships. Another **social function** of emotion appears to be coordination of relationships; the expression of emotions lets us connect positively or negatively to people and because of that we and they know where to stand. Different theories of how emotions work are:

- **The James-Lange Theory**: suggests that felt emotions result from the perception of a stimulus and subsequent physiological changes rather than being the cause. We are aware of our emotions as soon as our heart starts to beat faster, respiration etc.
- **The Cannon-Bard Theory**: assigns an important role to the thalamus. When we perceive an emotionally stirring event, the thalamus simultaneously relays information to the sympathetic nervous system and parts of the brain that are involved in thought and decision making. As a result, the subjective experience of emotion and the activation of the nervous system occur simultaneously.
- **The Schachter and Singer's Two-Factor theory**: suggests that after a stimulus is detected, physiological arousal occurs and as a result of that, by using our cognition we label this arousal either as anger, joy or fear and then the emotional state occurs. We first have to be aware of this bodily arousal and then we 'label' it.

- Cognitive-Mediational Theory: proposes that cognitive interpretations, particularly appraisal of events, are the keys to experiencing emotions. It states that the actual context matters the most. If we are told that people in a film were not hurt, we were to detect less stress in a person's body than if he was told that people were hurt in the exact same film.
- The Facial-Feedback Theory: proposes that subjective experiences of emotions are influenced by sensory feedback from facial muscular activity and may elicit emotions themselves. It's principle is the same as the James-Lange theory except the physiological arousal component is replaced with facial muscular activity.
- The Evolutionary Theory: argues that emotional expression in both people and animals serves as a communicative function that is essential to survival. Innate, genetically firmed traits make us deal and display basic emotions (said to be pre-programmed in all people) in order to bring ourselves to safety, or communicate to others that there is need to do so.
- Lewis's Cognitive Theory of Emotional Development: suggests that most emotions can be experienced and expressed only after particular cognitive abilities have developed. For example, babies seem to have only a few mood states such as distressed or content.
- Izard's Differential Emotions Theory: proposes that particular emotions or sets of emotions become prominent during specific life stages as they serve stage-related developmental processes.

A good deal of research has focused on three features of our emotional responding: the clarity of our emotions (the ability to accurately identify and distinguish one's emotions), the attention to emotion (the amount of attention we spend to understand or deal with emotions) and the emotional intensity (the strength with which an individual typically experiences emotion). People that are hot tempted often have these abilities at high level; people that are easily overwhelmed have for instance high intensity but low clarity. Suppressing our emotions is often referred to as emotion dysregulation. Cultural expectations that prescribe how, when and whom emotions should be expressed are called display rules. Anxiety disorders include phobias, generalized anxiety or panic disorders. Mood disorders include depressions, mania (overly euphoric), bipolar disorder (mania and depression). The Hedonic Treadmill Theory suggests that people quickly return to a basic level (emotional set-point) of happiness after major life events. The perception of our own arousal is called visceral perception.

Chapter 18: Stress, Coping and Health

Stress is a state brought on by any situation (a **stressor**) that threatens or appears to threaten a person's sense of well-being, thus challenging their ability to cope. However, stress needs to be present in order to live healthy, this level we call **eustress**. These stressors can be either **acute** (has a definite end point, short term such as a close call in traffic) or **chronic** (long-term, like a high pressure job). Psychologists have distinguished four kinds of stress: **frustration**, **pressure**, **danger** and **conflict**. There are three types of conflict stress that are an example of two options being incompatible with each other: the **approach-approach conflict** occurs when a person must choose between two equally desirable options; the **avoidance-avoidance conflict** occurs when a person must choose between two equally undesirable options and the **approach-avoidance conflict** that occurs when any available choice has both desirable and undesirable qualities. Different kind of stressors include **daily hassles**, **life changes**, **traumatic events** and **chronic negative situations**.

Responses to stress fall into three general types: **physiological** (the fight or flight response e.g. with a quickened heart rate via the sympathetic nervous system), **emotional** and **cognitive** responses.