Analyzing the Linkage of Music and Attention using Uddin's Numeral Finding Test among University Undergraduates: A Cross-Sectional Pilot Study in Bangladesh

Department of Pharmacy
East West University

A Dissertation submitted to the Department of Pharmacy, East West University, Bangladesh, in partial fulfillment of the requirements for the Degree of Bachelor of Pharmacy.

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Endorsement by the Chairperson

This is to certify that the thesis entitled **“Analyzing the Linkage of Music and Attention using Uddin’s Numeral Finding Test among University Undergraduates: A Cross-Sectional Pilot Study in Bangladesh”** submitted to the Department of Pharmacy, East West University for the partial fulfillment of the requirement for the award of the degree Bachelor of Pharmacy, was carried out by **Janisa Kabir , ID: 2014-1-70-065.**

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This is to certify that the thesis entitled **"Analyzing the Linkage of Music and Attention using Uddin's Numeral Finding Test among University Undergraduates: A Cross-Sectional Pilot Study in Bangladesh"** submitted to the Department of Pharmacy, East West University for the partial fulfillment of the requirement for the award of the degree Bachelor of Pharmacy, was carried out **by Janisa Kabir, ID: 2014-1-70-065**, under the supervision and guidance of me. The thesis has not formed the basis for the award of any other degree/diploma/fellowship or other similar title to any candidate of any university**.**

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Declaration by the Candidate

I, **Janisa Kabir** hereby declare that the dissertation entitled **"Analyzing the Linkage of Music and Attention using Uddin's Numeral Finding Test among University Undergraduates: A Cross-Sectional Pilot Study in Bangladesh"** submitted by me to the Department of Pharmacy, East West University, in the partial fulfillment of the requirement for the award of the degree of Bachelor's of Pharmacy is a complete record of original research work carried out by me during 2017, under the supervision and guidance of **Mst. Marium Begum**, Senior Lecturer, Department of Pharmacy, East West University. The thesis has not formed the basis for the award of any other degree/diploma/fellowship or other similar title to any candidate of any university.

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Thank you

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Dedication

This research paper is dedicated to

my beloved Parents

and my family members

Abstract

The NF test is test where the attention cognition efficiency is checked by the listening to different genre of music. In this study, it was designed to determine attention of participants and how the songs affect their brain when they listen to songs of different categories. Participant's age, residential status and year of study were taken into account to see whether it affects the attention cognition or not. We have used a validated neuropsychopharmacological testing methods namely Numeral Finding (NF) for the determination of attention in healthy aged human participants. The place of the experiment was East West University, North South University, Southeast University and Atish-Dipankar University of Science and Technology, Dhaka, Bangladesh. The participants were randomized into four groups with 70 participants in each as follows: N = 280 for each group. In control group the participants took the test without music and the result is71.61±1.981.In the normal group the participants took the test with the normal music and the result is 74.32±1.592. In the Stimulating group the participants listen to the stimulating music and took the test and the result is 75.54±1.691. In the depression group the participants took the test with the depressing music and the result is 70.77±1.75.It is seen from these test that participants who listen to the stimulating song have highest attention cognitive efficiency than the normal group which is the second efficient group than the control group being the third efficient group and the last and the poor efficient group is the depression group. People who don't listen to music have better attention cognitive efficiency than the people who listens to the depressing music.

Keywords: Neuropsychopharmacology, Numeral Finding Test (NF), Attention deficit hyperactivity disorder (ADHD)

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Chapter One

INTRODUCTION

1.1. Anatomy of the Brain

The human brain is the command center for the human nervous system. It receives input from the sensory organs and sends output to the muscles. The human brain has the same basic structure as other mammal brains, but is larger in relation to body size than any other brains.

1.1.1. Facts about the human brain

- The human brain is the largest brain of all vertebrates relative to body size
- It weighs about 3.3 lbs. (1.5 kilograms)
- The brain makes up about 2 percent of a human's body weight
- The cerebrum makes up 85 percent of the brain's weight
- It contains about 86 billion nerve cells (neurons) — the "gray matter"
- It contains billions of nerve fibers (axons and dendrites) — the "white matter"
- These neurons are connected by trillions of connections, or synapses

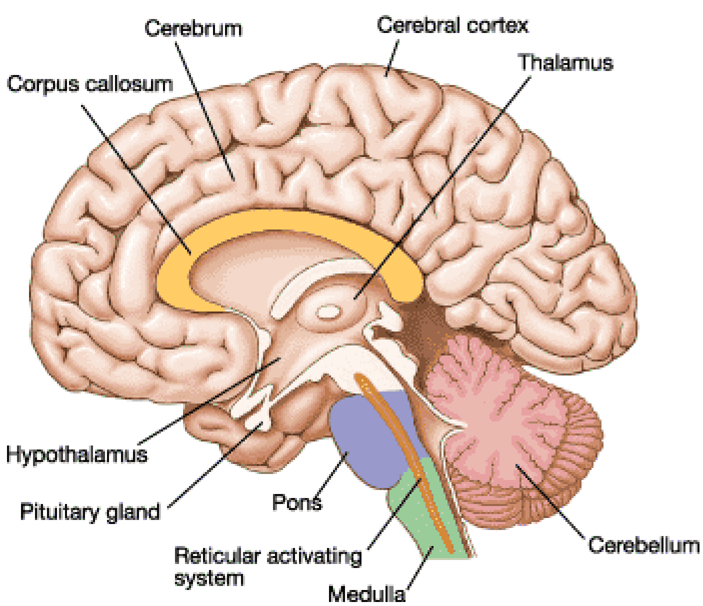


Fig 1a: Brain

1.2. Skull

The purpose of the bony skull is to protect the brain from injury. The skull is formed from 8 bones that fuse together along suture lines. These bones include the frontal, parietal, temporal, sphenoid, occipital and ethnocide. The face is formed from 14 paired bones including the maxilla, zygomatic, nasal, palatine, lachrymal, inferior nasal conches, mandible, and homer.

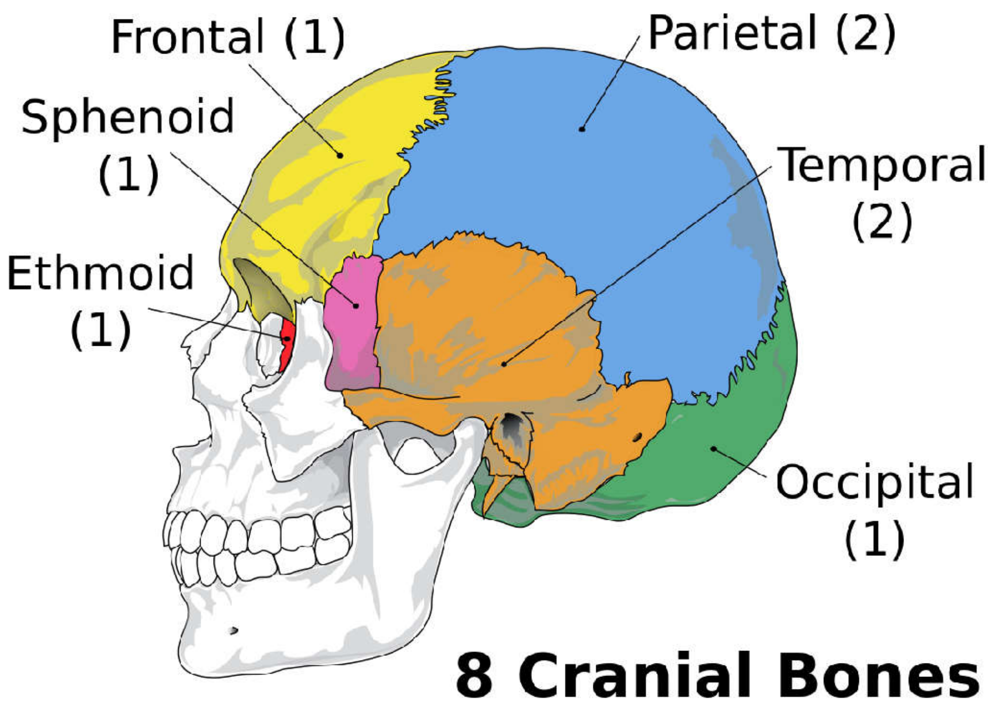


Figure 1b: Eight bones form the skull and fourteen bones form the face

Inside the skull are three distinct areas: anterior fossa, middle fossa, and posterior fossa. Doctors sometimes refer to a tumor's location by these terms, e.g., middle fossa meningioma Similar to cables coming out the back of a computer, all the arteries, veins and nerves exit the base of the skull through holes, called foramina. The big hole in the middle (foramen magnum) is where the spinal cord exits.

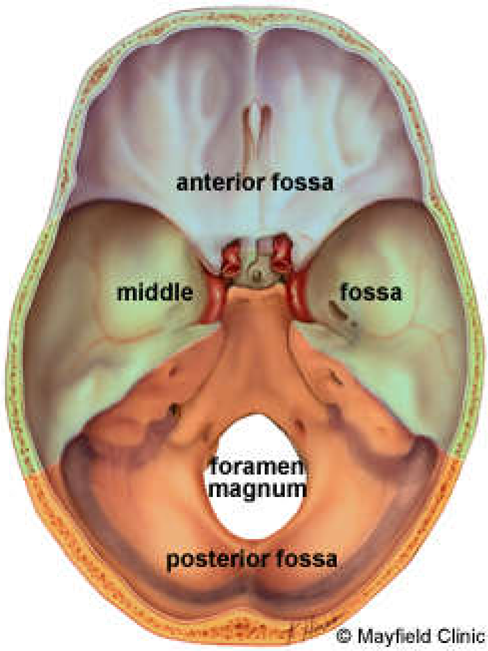


Figure 1c: The inside of the skull is divided into three areas called the anterior, middle, and posterior fossa

1.3. Nervous system

The nervous system

The nervous system allows organisms to sense, organize, and react to information in the environment. The basic unit of the nervous system is the neuron. Synapses form between the neurons, allowing them to communicate to other neurons or other systems in the body. The general flow of information is that the peripheral nervous system (PNS) takes in information through sensory neurons, then sends it to the central nervous system (CNS) to be processed. After processing, the CNS "tells" the PNS what to do—what muscles to flex, whether the lungs need more oxygen, which limbs need more blood, any number of biological processes—and the PNS makes it happen through muscle control. The neurons responsible for taking information to the CNS are known as afferent neurons, while the neurons that carry the responses from the CNS to the PNS are known as efferent neurons.

The nervous system can be divided into two major parts—the central nervous system (CNS) and the peripheral nervous system (PNS). [1]

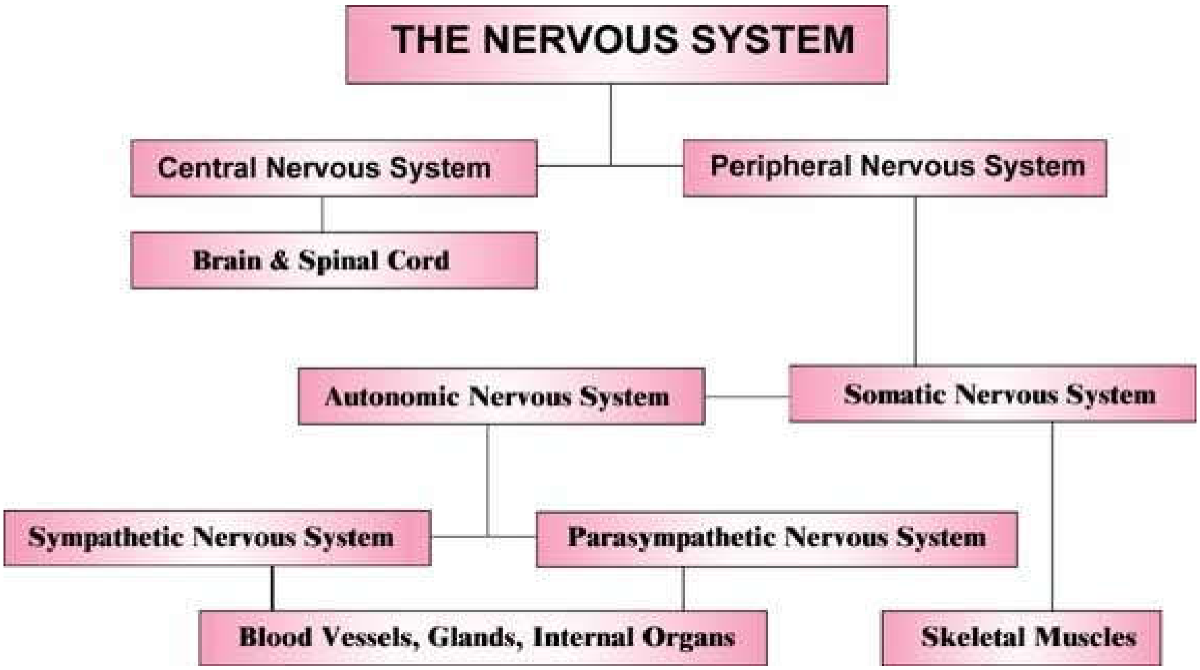


Figure 1d: classification of nervous system (NS)

1.3.1. Central Nervous System

The central nervous system includes the spinal cord and the brain. The brain is the body's main control center. The main function of the CNS is the integration and processing of sensory information. It synthesizes sensory input to compute an appropriate motor response, or output. The central nervous system (CNS) is one of the two major subdivisions of the nervous system. The CNS includes the brain and spinal cord, which together comprise the body's main control center. Together with the peripheral nervous system (PNS), the CNS performs fundamental functions that contribute to an organism's life and behavior. The nervous system has three main functions: gathering sensory information from external stimuli, synthesizing that information, and responding to those stimuli. The CNS is mainly devoted to the "information synthesizing" function. During this step in the process, the brain and spinal cord decide on appropriate motor output, which is computed based on the type of sensory input. The CNS regulates everything from organ function to high-level thought to purposeful body movement. Thus, the CNS is commonly thought of as the control center of the body.

The CNS is comprised of the brain, brain stem, and spinal cord.

Brain

The brain is found in the cranial cavity and consists of the cerebrum and cerebellum. It houses the nerve centers responsible for coordinating sensory and motor systems in the body. The cerebrum, or the top portion for the brain, is the seat of higher-level thought. It is comprised of two hemispheres, each controlling the opposite side of the body. Each of these hemispheres is divided into four separate lobes:

- the frontal lobe, which controls specialized motor control, learning, planning, and speech;
- the parietal lobe, which controls somatic or voluntary sensory functions;
- the occipital lobe, which controls vision;
- the temporal lobe, which controls hearing and some other speech functions.

The cerebellum is located underneath the backside of the cerebrum, and governs balance and fine motor movements. Its main function is maintaining coordination throughout the body.

Brain Stem

The brain stem is connected to the underside of the brain. It consists of the midbrain, pons, and medulla. The midbrain is found in between the hindbrain and the forebrain. It regulates motor function and allows motor and sensory information to pass from the brain to the rest of the body. The pons houses the control centers for respiration and inhibitory functions. The medulla also helps regulate respiration, as well as cardiovascular and digestive functioning.

Spinal Cord

The spinal cord connects the brain and brain stem to all of the major nerves in the body. Spinal nerves originate from the spinal cord and control the functions of the rest of the body. Impulses are sent from receptors through the spinal cord to the brain, where they are processed and synthesized into instructions for the rest of the body. This data is then sent back through the spinal cord to muscles and glands for motor output.[2]

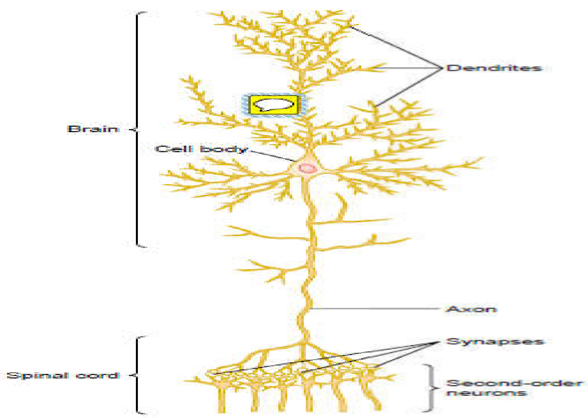


Figure: 1e Parts of Central nervous system

1.3.2. Peripheral Nervous System

The peripheral nervous system connects the central nervous system to environmental stimuli to gather sensory input and create motor output.The peripheral nervous system (PNS) is one of the two major components of the body's nervous system. In conjunction with the central nervous system (CNS), the PNS coordinates action and responses by sending signals from one part of the body to another. The CNS includes the brain, brain stem, and spinal cord, while the PNS includes all other sensory neurons, clusters of neurons called ganglia, and connector neurons that attach to the CNS and other neurons.

The PNS can also be divided into two separate systems: the autonomic nervous system and the somatic nervous system.

<u>Autonomic Nervous System</u>

The autonomic nervous system regulates involuntary and unconscious actions, such as internal-organ function, breathing, digestion, and heartbeat. This system consists of two complementary parts: the sympathetic and parasympathetic systems. Both divisions work without conscious effort and have similar nerve pathways, but they generally have opposite effects on target tissues.

The sympathetic nervous system activates the "fight or flight" response under sudden or stressful circumstances, such as taking an exam or seeing a bear. It increases physical arousal levels, raising the heart and breathing rates and dilating the pupils, as it prepares the body to run or confront danger. These are not the only two options; "fight or flight" is perhaps better phrased as "fight or flight or freeze," where in the third option the body stiffens and action cannot be taken. This is an autonomic response that occurs in animals and humans; it is a survival mechanism thought to be related to playing dead when attacked by a predator. Post-traumatic stress disorder (PTSD) can result when a human experiences this "fight or flight or freeze" mode with great intensity or for large amounts of time.

The parasympathetic nervous system activates a "rest and digest" or "feed and breed" response after these stressful events, which conserves energy and replenishes the system. It reduces bodily arousal, slowing the heartbeat and breathing rate. Together, these two systems maintain homeostasis within the body: one priming the body for action, and the other repairing the body afterward.

Somatic Nervous System

The somatic nervous system keeps the body adept and coordinated, both through reflexes and voluntary action. The somatic nervous system controls systems in areas as diverse as the skin, bones, joints, and skeletal muscles. Afferent fibers, or nerves that receive information from external stimuli, carry sensory information through pathways that connect the skin and skeletal muscles to the CNS for processing. The information is then sent back via efferent nerves, or nerves that carry instructions from the CNS, back through the somatic system. These instructions go to neuromuscular junctions—the interfaces between neurons and muscles—for motor output.

The somatic system also provides us with reflexes, which are automatic and do not require input or integration from the brain to perform. Reflexes can be categorized as either monosynaptic or polysynaptic based on the reflex arc used to perform the function. Monosynaptic reflex arcs, such as the knee-jerk reflex, have only a single synapse between the sensory neuron that receives the information and the motor neuron that responds. Polysynaptic reflex arcs, by contrast, have at least one interneuron between the sensory neuron and the motor neuron. An example of a polysynaptic reflex arc is seen when a person steps on a tack—in response, their body must pull that foot up while simultaneously transferring balance to the other leg. [3]

1.3.3. Difference between Central and Peripheral Nervous System

Both these systems are managed by neurons, each having equal physiology and the mode of conducting information, and supported by similar structures. But the main differences lie at the varied differentiations, the proportions of the supportive structure, and the distributed chemical signatures.

• CNS is protected by the bone and a blood brain barrier whereas the PNS is not.

• CNS is concerned with storing, comprehending and executing information appropriately, but the PNS is more about transmission too far away structures.

• The main varieties in the PNS can be classified easily, but the CNS functions are of multiple levels and need greater understanding.

• Damage to a PNS structure will cause only localized damage, but damage to a CNS structure can lead to global damage. [4]

1.4. <u>Histology of Brain:</u>

Brain cells can be broken into two groups: neurons and neuroglia.

Neurons, or nerve cells, are the cells that perform all of the communication and processing within the brain. Sensory neurons entering the brain from the peripheral nervous system deliver information about the condition of the body and its surroundings. Most of the neurons in the brain's gray matter are interneurons, which are responsible for integrating and processing information delivered to the brain by sensory neurons. Interneurons send signals to motor neurons, which carry signals to muscles and glands.

Neuroglia, or glial cells, act as the helper cells of the brain; they support and protect the neurons. In the brain there are four types of glial cells: astrocytes, oligodendrocytes, microglia, and ependymal cells.

- Astrocytes protect neurons by filtering nutrients out of the blood and preventing chemicals and pathogens from leaving the capillaries of the brain.
- Oligodendrocytes wrap the axons of neurons in the brain to produce the insulation known as myelin. Myelinated axons transmit nerve signals much faster than unmyelinated axons, so oligodendrocytes accelerate the communication speed of the brain.
- Microglia act much like white blood cells by attacking and destroying pathogens that invade the brain.
- Ependymal cells line the capillaries of the choroid plexuses and filter blood plasma to produce cerebrospinal fluid.

The tissue of the brain can be broken down into two major classes: gray matter and white matter.

- Gray matter is made of mostly unmyelinated neurons, most of which are interneurons. The gray matter regions are the areas of nerve connections and processing.
- White matter is made of mostly myelinated neurons that connect the regions of gray matter to each other and to the rest of the body. Myelinated neurons transmit nerve signals much faster than unmyelinated axons do. The white matter acts as the information highway of the brain to speed the connections between distant parts of the brain and body.

1.4.1 Types of neurons

1. Neurons
2. Glial cells

1.4.1.1. Neurons

A typical neuron consists of a cell body (soma), dendrites, and an axon. The term neuritis is used to describe either a dendrite or an axon, particularly in its undifferentiated stage. Dendrites are thin structures that arise from the cell body, often extending for hundreds of micrometers and branching multiple times, giving rise to a complex "dendrite tree". An axon (also called a nerve fiber when myelinated) is a special cellular extension that arises from the cell body at a site called the axon hillock and travels for a distance, as far as 1meter in humans or even more in other species. Nerve fibers are often bundled into fascicles, and in the peripheral nervous system. [7]

1.4.1.1.1. Neurons function:

1. Receive signals (or information).

2. Integrate incoming signals (to determine whether or not the information should be passed along).

3. Communicate signals to target cells (other neurons or muscles or glands)

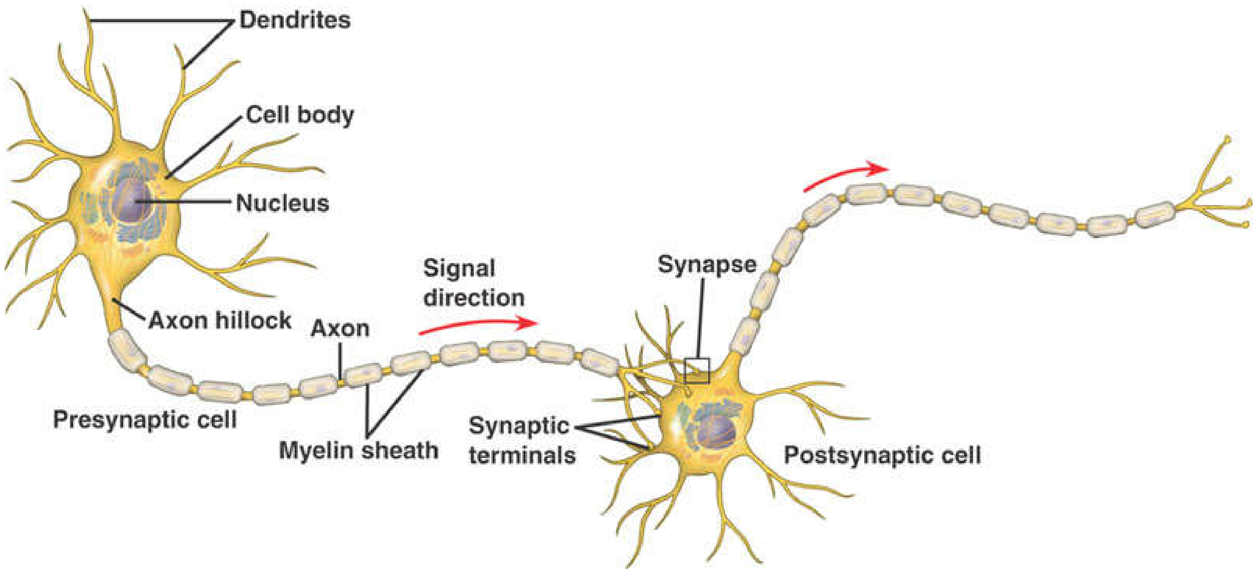


Figure 1f: Different parts of neuron.

1.4.1.2. Glial cells

Glial cells (named from the Greek for "glue") are non-neuronal cells that provide support and nutrition, maintain homeostasis, form myelin, and participate in signal transmission in the nervous system in the human brain, it is estimated that the total number of glial roughly equals the number of neurons, although the proportions vary in different brain areas. Among the most important functions of glial cells are to support neurons and hold them in place; to supply nutrients to neurons; to insulate neurons electrically; to destroy pathogens and remove dead neurons; and to provide guidance cues directing the axons of neurons to their targets. A very important type of glial cell (oligodendrocytes in the central nervous system, and Schwann cells in the peripheral nervous system) generates layers of a fatty substance called myelin that wraps around axons and provides electrical insulation which allows them to transmit action potentials much more rapidly and efficiently.

1.4.1.2.1 Types of Glial cells

a. Astrocytes

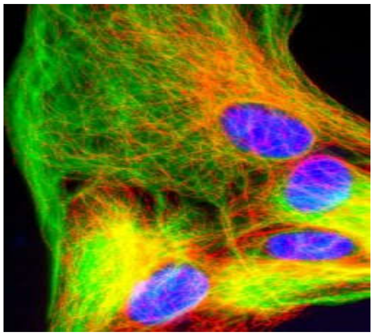


Figure 1g: Astrocytes

Astrocytes belong to the 3 types of glial cells in the CNS (the others are microglia and oligodendrocytes).Astroglia is used as a synonym. These cell exhibt usually a star-shaped mmorphology, with many processes extending from the soma. Astrocytes can be identified histologically since they express the intermediate filament glial fibrillary acidic protein (GFAP). [

Astrocytes perform a plethora of functions (and the list is constantly growing:

biochemical support of neurons and other cell types,

support of endothelial cells which form the blood-brain barrier,

a major role in the repair and scarring process of the brain and spinal cord following mechanical / inflammatory injuries,

a "guidance" for growing neurons / axons during the development of the brain.

Previously in medical science, astrocytes have not been given an active role in the information processing activity of the brain, but this view has recently been challenged.

b. Oligodendrocytes

Oligodendrocytes are a variety of neuroglia cells within the central nervous system. In comparison to astrocytes oligodendrocytes are more gracile and form less cell ramifications.

Their image in a microscopic cross section is reminiscent of trees with only a few branches - hence the name. Their cell processes surround the axons of nerve cells and isolate them from the environment. In analogy to the Schwann cells of the PNS

The cell body (not the branches) of the oligodendrocytes exists predominantly in the white matter, less frequently in the gray matter.

The degeneration of the myelin sheath, which is formed by oligodendrocytes, is a characteristic morphological change in the disease multiple sclerosis.

c. Microglia

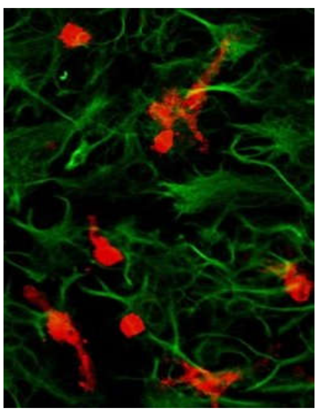


Figure 1h : Microglia

The name microglia was first (1920) introduced by Pio del Rio-Hortega (1882 – 1945). Since the function and ontology of microglia was unknown at that time, and furthermore, the cells of the brain where divided into two types: neurons and “others”, which were termed by the generic expression “glia” (e.g. astroglia and oligodendroglia), the term microglia was a reference 1. to their shape 2. to their obviously non-neuronal characteristics.

Microglia are a cell type, that is only found in the CNS (Central Nervous System; per human definition: brain and spinal cord). Usually microglial cells are in a so called ramified state, in which they are immunologically inactive. However they can be “activated” via various triggers (all caused by some kind of brain injury):

1. elevated levels of pro-inflammatory cytokines (a combination of lipopolysaccharide (LPS) and interferon-gamma is one of the most effective)

2. neuro-inflammatory and neuro-degenerative diseases, including Parkinson's disease, Multiple Sclerosis, Alzheimer's, and Huntington's disease

3. physical injury

Once activated, microglia assume an amoeboid (round, oval) morphology, and display a behavior similar to macrophages. They act as antigen-presenting, phagocytic, and cytotoxic cells, all three a hallmark of cells of the immune system[5]

1.5. Anatomical classification of the brain

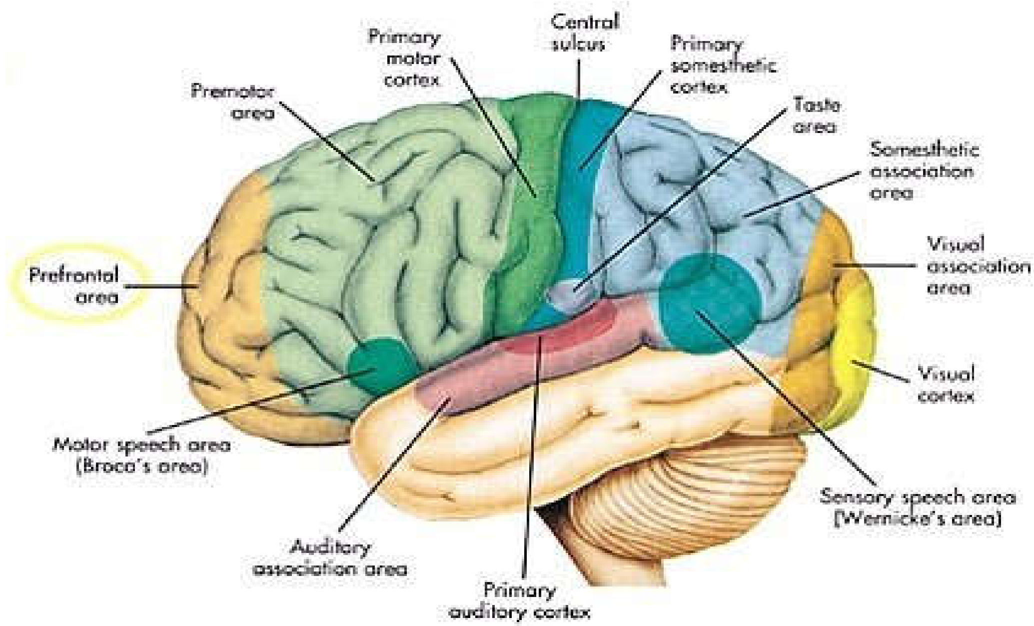


Figure 1i: Parts of the human brain

1.5.1. Frontal Lobe

The frontal lobe links and integrates all components of behavior at the highest level. Emotion and social adjustment and impulse control are also localized here. Injury to parts of the frontal lobe may cause an inability to move part of the body or the whole side of the body. Speech may become halting, disorganized or be stopped except for single explosive words. Personality may change. Social rules of behavior may be disregarded. The executive functions, planning, abstract reasoning, impulse control, sustained attention and insight are all located here. The frontal lobe is highly susceptible to injury.

1.5.1.1. Functions

- Initiation
- Problem solving
- Judgment
- Inhibition of behavior
- Planning/anticipation
- Self-monitoring
- Motor planning
- Personality/emotions
- Awareness of abilities/limitations
- Organization
- Attention/concentration
- Mental flexibility
- Speaking (expressive language)

1.5.1.2. Observed Problems

- Emotion (i.e., depression, anxiety, personality changes, aggression, acting out, and social inappropriateness).

1.5.2. Parietal Lobe

The parietal lobe is largely responsible for construction ability and language. Injury to the front parts of this lobe may cause someone to lose sensation on parts of the body. With an injury in this area, one may become disoriented. Recall of long term memories may be mixed up in time or sequencing. They may become easily lost or confuse left and right. They may have difficulty recognizing or naming what they see. Injury may also produce disorders in the ability to read, write or perform math calculations. This area also includes conscious sensation and voluntary motion.

1.5.2.1. Function

- Sense of touch
- Differentiation: size, shape, color
- Spatial perception
- Visual perception
- Academic skills (reading)

1.5.2.2. Observed Problems

- Sensation (i.e., touch, taste, and smell)

1.5.3. Occipital Lobe

Injury to this area usually results in "blindness" to part or all of the visual field. Usually people experience "holes" or "blind spots" in what they see. There may be problems picking things out of space or they may misperceive pictures or objects. Recognition of colors may also be disturbed.

1.5.3.1. Functions

- Vision

- Reading (perception and recognition of printed words)

1.5.3.2. Observed Problems

- Depth perception
- Color perception
- Difficulty tracking moving objects
- Partial or total blindness

1.5.4. Temporal Lobe

The temporal lobe perceives and recognizes verbal material. It is among the most frequently injured parts of the brain during head injury. A person may have difficulty screening out distractions. Injury to the upper temporal area can cause someone to misunderstand what is said. They may make sounds like words but which are not recognizable as words at all. They may also misunderstand body language. Emotional changes such as unexplained panic or unexpected tearfulness may be noted. Left temporal area includes production of speech, naming and verbal memory. The right temporal area includes musical abilities, foreign languages, visual memory, and comprehension of the environment.

1.5.4.1. Functions

- Memory
- Hearing
- Understanding language (receptive language)
- Organization and sequencing
- Musical awareness

1.5.4.2. Observed Problems

- Thinking (i.e., memory and reasoning)
- Language (i.e., communication, expression, and understanding)

1.5.5. Cerebellum

Obtaining a general understanding of the brain and its functions is important to understanding the rehabilitation process. It is very important, however, to understand that the rehabilitation professional is concerned with the whole person. The identification of individual problems gives the rehabilitation team areas in which to focus treatment plans, all of these plans are designed to work toward the rehabilitation of the whole person. Each problem area affects other areas and many times resolving one problem has a major impact on other problems. For example, reestablishing postural balance and eliminating dizziness greatly enhances concentration and attention which allows for improved cognition and problem solving.

1.5.5.1. Functions

- Coordination of voluntary movement
- Balance and equilibrium
- Some memory for reflex motor acts

1.5.5.2. Observed Problems

- Loss of ability to coordinate fine movements
- Loss of ability to walk
- Inability to reach out and grab objects
- Tremors

- Dizziness (vertigo)
- Slurred speech (scanning speech)
- Inability to make rapid movements

1.5.6. Brain Stem

The brain stem plays a vital role in basic attention, arousal, and consciousness. All information to and from our body passes through the brain stem on the way to or from our brain. Like the frontal and temporal lobes, the brain stem is located in an area near bony protrusions making it vulnerable to damage during trauma.

1.5.6.1. Functions

- Breathing
- Heart Rate
- Swallowing
- Reflexes to seeing and hearing (startling response)
- Controls sweating, blood pressure, digestion, temperature (autonomic nervous system)
- Affects level of alertness
- Ability to sleep
- Sense of balance (vestibular function)

1.5.6.2. Observed Problems

- Decreased vital capacity in breathing, important for speech
- Swallowing food and water (dysphasia)

- Difficulty with organization/perception of the environment
- Problems with balance and movement
- Dizziness and nausea (vertigo)
- Sleeping difficulties (insomnia, sleep apnea)[6]

1.5.7. Cranial nerves

The brain communicates with the body through the spinal cord and twelve pairs of cranial nerves. Ten of the twelve pairs of cranial nerves that control hearing, eye movement, facial sensations, taste, swallowing and movement of the face, neck, shoulder and tongue muscles originate in the brainstem. The cranial nerves for smell and vision originate in the cerebrum. [7]

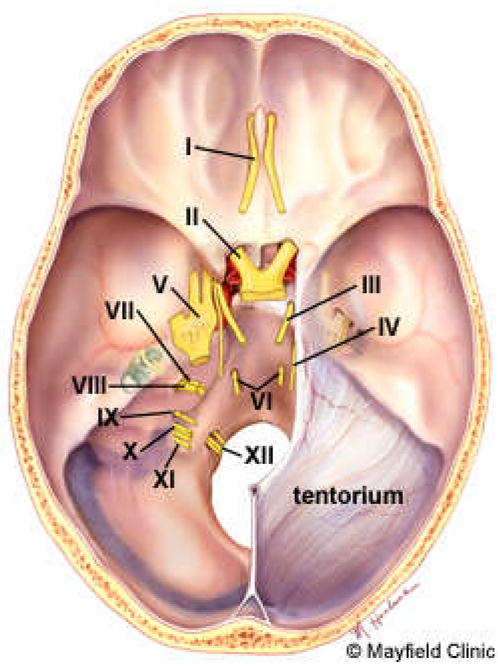


Figure 1j:. The Roman numeral, name, and main function of the twelve cranial nerves.

Number	Name	Function
I	olfactory	Smell
II	optic	Sight
III	oculomotor	moves eye, pupil
IV	trochlear	moves eye
V	trigeminal	face sensation
VI	abduces	moves eye
VII	facial	moves face, salivate
VIII	vestibulocochlear	hearing, balance
IX	glossopharyngeal	taste, swallow
X	Vagus	heart rate, digestion
XI	accessory	moves head
XII	hypoglossal	moves tongue

1.6. Memory

Fact memories are specific bits of information, such as the color of a stop sign or the smell of a perfume. Skill memories are learned motor behaviors. You can probably remember how to light a match or open a screw-top jar, for example. With repetition, skill memories become incorporated at the unconscious level. Examples include the complex motor patterns involved in skiing, playing the violin, and similar activities. Skill memories related to program behaviors, such as eating, are stored in appropriate portions of the brain stem. Complex skill memories involve the integration of motor patterns in the basal nuclei, cerebral cortex, and cerebellum. [8]

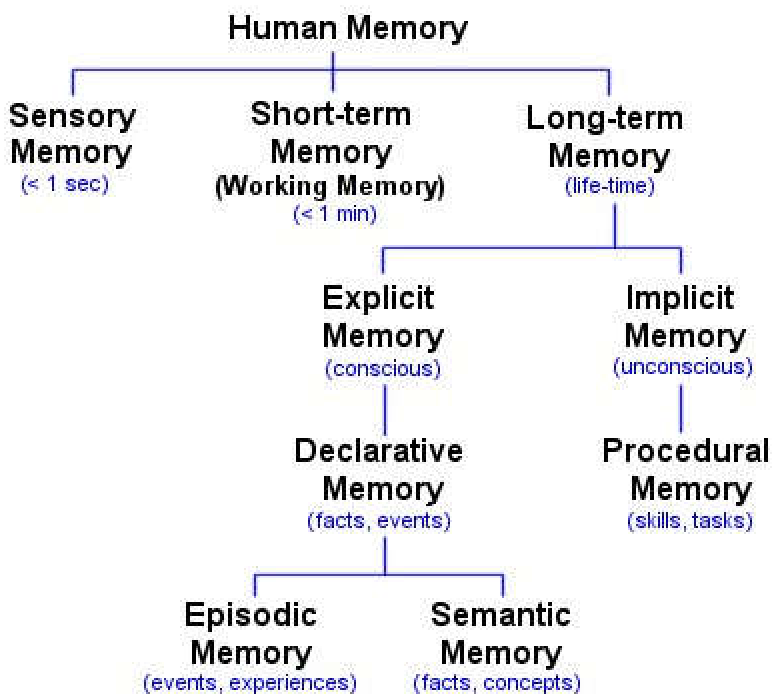


Figure 1k : Types of human memory

1.6.1. Classification of memory

Two classes of memories are recognized.

Short term and long term memories.

1.6.1.1. Short-term memories

Short-term memory is typified by one's memory of 7to 10 numerals in a telephone number (or 7 to 10 other discrete facts) for a few seconds to a few minutes at a time but lasting only as long as the person continues to think about the numbers or facts. Many physiologists have suggested that this short term memory is caused by continual neural activity resulting from nerve signals that travel around and around a temporary memory trace in a circuit of reverberating neurons. It has not yet been possible to prove this theory. Another possible explanation of short term memory is presynaptic facilitation or inhibition. This occurs at synapses that lie on terminal nerve fibrils immediately before these fibrils synapse with a subsequent neuron. The neurotransmitter chemicals secreted at such terminals frequently because facilitation or inhibition lasting for seconds up to several minutes. Circuits of this type could lead to short-term memory. [9]

1.6.1.2. Intermediate Long-Term Memory

Intermediate long-term memories may last for many minutes or even weeks. They will eventually be lost unless the memory traces are activated enough to become more permanent; then they are classified as long-term memories. Experiments in primitive animal shave demonstrated that memories of the intermediate long-term type can result from temporary chemical or physical changes, or both, in either the synapse presynaptic terminals or the synapse postsynaptic membrane, changes that can persist for a few minutes up to several weeks. These mechanisms are so important that they deserve special description. [10]

1.6.1.3. Long-term memories

Long-term memories last much longer, in some cases for an entire lifetime. The conversion from short-term to long-term memory is called memory consolidation.

- There are two types of long-term memory:

- Secondary memories are long-term memories that fade with time and may require considerable effort to recall.

- Tertiary memories are long-term memories that are with you for a lifetime, such as your name or the contours of your own body. Cellular Mechanisms of Memory Formation and Storage Memory consolidation at the cellular level involves anatomical and physiological changes in neurons and synapses. [11] .

1.6.2. Improve memory

- Pay attention and concentrate!

- Relate to the information you are learning. The more personal the information becomes, the easier it is to remember it. Ask yourself how it makes you feel. Ask yourself where else you have heard this. Ask yourself whether there is something in your personal life related to this piece of information.

- Repeat the information: Come back to it more than one time. This has been found in tons of studies: repeated information is easier to recall. Spaced retrieval (a method with which a person is cued to recall a piece of information at different intervals) is one of the rare methods that show some results with Alzheimer's patients.

- Elaborate on the information: think about it. Things that are concrete and have a clear meaning are easier to remember than abstract and vague ones. Trying to attach meaning to the information you are trying to memorize will make it easier to recall later. Your brain will have more cues to look for. For instance, try to picture the information in your head. Pictures are much easier to memorize than words. To remember figures and percentages it is much easier to picture these in a graph for instance. Relate the information to something you know already.[12]

1.7. Monitoring Brain Activity

The Electroencephalogram the primary sensory cortex and the primary motor cortex have been mapped by direct stimulation in patients undergoing brain surgery. The functions of other regions of the cerebrum can be revealed by the behavioral changes that follow localized injuries or strokes, and the activities of specific regions can be examined by a PET scan or sequential MRI scans. The electrical activity of the brain is commonly monitored to assess brain activity. Neural function depends on electrical events within the plasma membrane of neurons. The brain contains billions of neurons, and their activity generates an electrical field that can be measured by placing electrodes on the brain or on the outer surface of the skull. The electrical activity changes constantly, as nuclei and cortical areas are stimulated or they quiet down. A printed report of the electrical activity of the brain is called an electroencephalogram (EEG). [13]

1.7.1. Classification of brain waves

The electrical patterns observed are called *brain waves*.

Alpha waves Occur in the brains of healthy, awake adults who are resting with their eye closed. Alpha waves disappear during sleep, but they also vanish when the individual begins to concentrate on some specific task. During attention to stimuli or tasks, alpha waves are replaced by higher-frequency beta waves. Beta waves are typical of individuals who are either concentrating on a task, under stress, or in a state of psychological tension. Theta waves may appear transiently during sleep in normal adults but are most often observed in children and in intensely frustrated adults. The presence of theta waves under other circumstances may indicate the presence of a brain disorder, such as a tumor. [14]

Delta waves are very-large-amplitude, low-frequency wave's .They are normally seen during deep sleep in individuals of all ages. Delta waves are also seen in the brains of infants (in whom cortical development is still incomplete) and in wake adults when a tumor, vascular blockage, or inflammation has damaged portions of the brain. Electrical activity in the two hemispheres is generally synchronized by a "pacemaker" mechanism that appears to involve the thalamus. Asynchrony between the hemispheres can therefore indicate localized damage or other cerebral abnormalities. For example, a tumor or injury affecting one hemisphere typically changes the pattern in that hemisphere, and the patterns of the two hemispheres are no longer aligned. A seizure is a temporary cerebral disorder accompanied by abnormal movements, unusual sensations, inappropriate behavior, or some combination of these symptoms. Clinical conditions characterized by seizures are known as seizure disorders, or *epilepsies*. Seizures of all kinds are accompanied by a marked change in the pattern of electrical activity recorded in an electroencephalogram. The change begins in one portion of the cerebral cortex but may subsequently spread across the entire cortical surface, like a wave on the surface of a pond.

The nature of the signs and symptoms produced depends on the region of the cortex involved. If a seizure affects the primary motor cortex, movements will occur; if it affects the auditory cortex, the individual will hear strange sounds. [15]

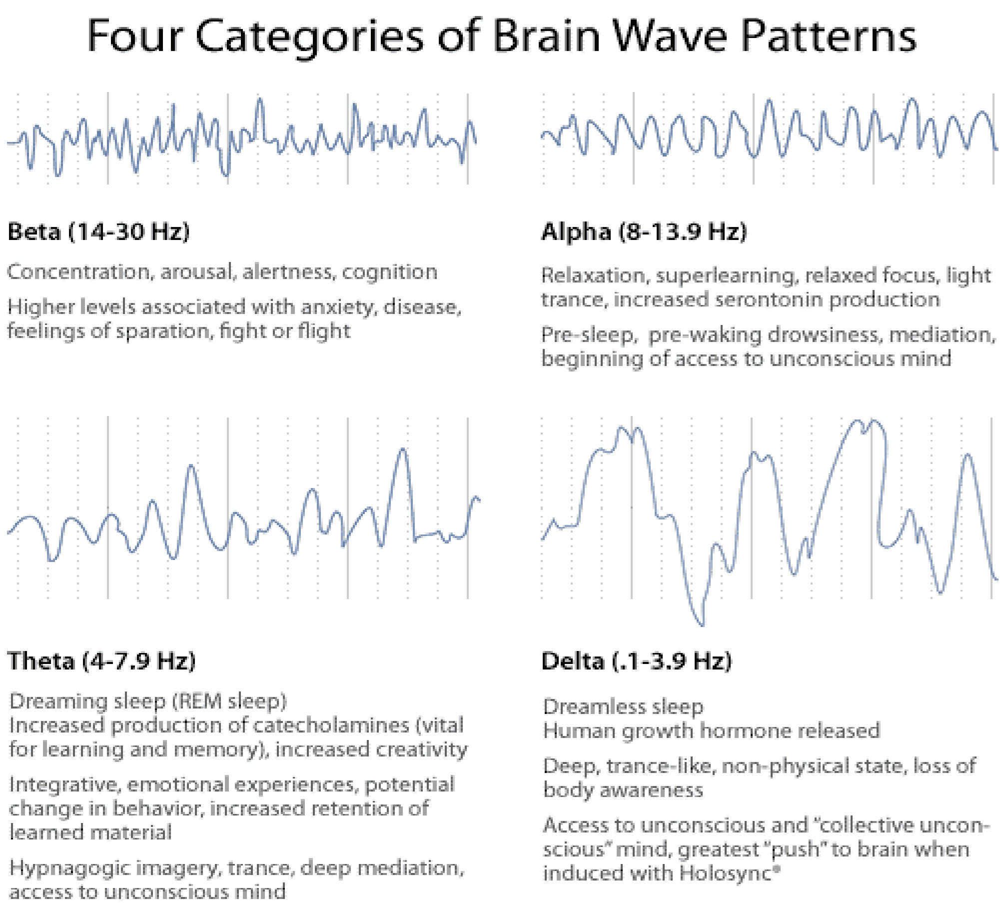


Figure 11 : Types of Brain waves

1.8. Attention

Attention–or concentration– and memory are two critical mental skills and are directly related. In fact, many memory complaints have nothing to do with the actual ability to remember things. They come from a failure to focus properly on the task at hand. Using brain images of people listening to short symphonies by an obscure eighteenth-century composer, a research team from the Stanford University School of Medicine investigated the power between music and the mind to hold our attention and showed that peak brain activity occurred during a short period of silence between musical movements—when seemingly nothing was happening. This lead the researchers to theorize that listening to music could help the brain to anticipate events and hold greater attention, just as the listeners demonstrated when they seemed to pay closest attention during the anticipatory silences between musical movements.

The theory is that these silences are indeed part of each composer's intention to guide the listener in interpreting and integrating the music in their brain. It is the space between the notes that captivates our full attention and allows the busy mind to communicate and integrate with the heart.

On the other hand, the volunteers all experienced how certain types of music, while affecting their mood, can also distract them or make them inattentive to tasks at hand.

This makes complete sense. Unlike the attentive silences of the previous study, some songs can negatively engage their attention, as they become part of the song's story or scene. Lyrics are descriptive and engage their analytical mind, and lyrically heavy music could divide the attention of many people's brains. [16]

1.8.1. Eye-hand coordination

Eye-hand coordination is complicated by the fact that the eyes are constantly in motion relative to the head. This poses problems in interpreting the spatial information gathered from the retinas and using this to guide hand motion. In particular, eye-centered visual information must somehow be spatially updated across eye movements to be useful for future actions, and these representations must then be transformed into commands appropriate for arm motion. In this review, we present evidence that early vasomotor representations for arm movement are remapped relative to the gaze direction during each saccade. We find that this mechanism holds for targets in both far and near visual space. We then show how the brain incorporates the three-dimensional, rotary geometry of the eyes when interpreting retinal images and transforming these into commands for arm movement. Next, we explore the possibility that hand-eye alignment is optimized for the eye with the best field of view. Finally, we describe how head orientation influences the linkage between centric visual frames and body centric motor frames. These findings are framed in terms of our 'conversion-on-demand' model, in which only those representations selected for action are put through the complex vasomotor transformations required for interaction with objects in personal space, thus providing a virtual on-line map of vasomotor space.[17]

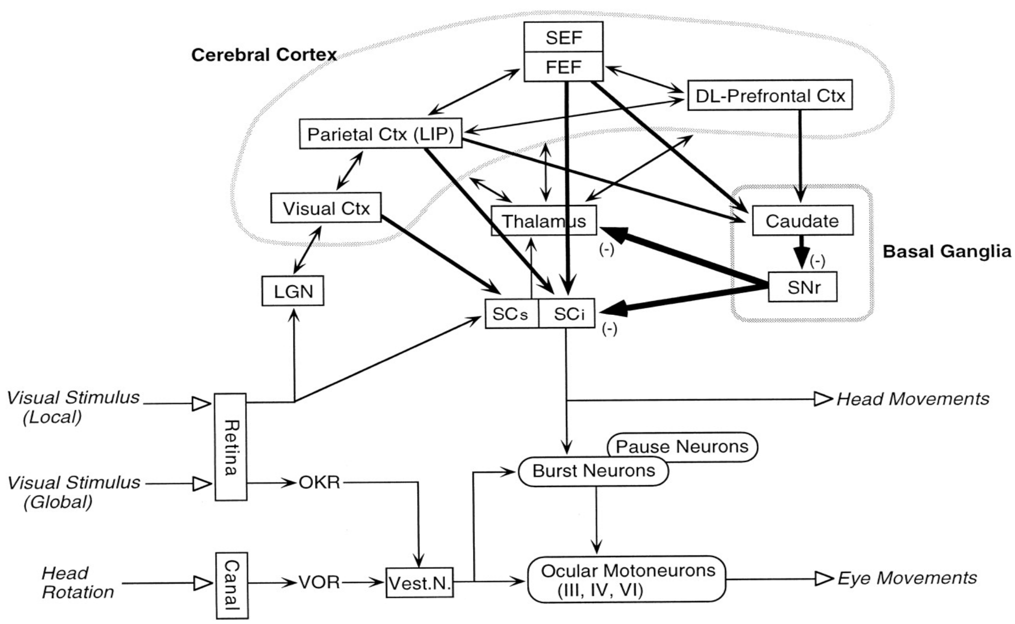


Figure 1m: Hand and eye coordination

1.8.2. Attention In the brain

Attention is the ability of the brain to selectively concentrate on one aspect of the environment while ignoring other things. There are two types of attention in two separate regions of the brain. The prefrontal cortex (directly behind the forehead) is in charge of will full concentration; if you are studying for a test or writing a novel, the impetus and the orders come from there. But if there is a sudden, riveting event – the attack of a tiger or the scream of a child – it is the parietal cortex (behind the ear) that is activated. Scientists have learned that these two brain regions sustain concentration when the neurons emit pulses of electricity at specific rates – faster frequencies for the automatic processing of the parietal region, slower frequencies for the deliberate, intentional work of the prefrontal region.

1.9. Attention-deficit hyperactivity disorder (ADHD)

1.9.1. Symptoms

The primary features of attention-deficit/hyperactivity disorder include inattention and hyperactive-impulsive behaviour. ADHD symptoms start before age 12, and in some children, they're noticeable as early as 3 years of age. ADHD symptoms can be mild, moderate or severe, and they may continue into adulthood.

ADHD occurs more often in males than in females, and behaviours can be different in boys and girls. For example, boys may be more hyperactive and girls may tend to be quietly inattentive.

There are three subtypes of ADHD:

- **Predominantly inattentive.** The majority of symptoms fall under inattention.
- **Predominantly hyperactive-impulsive.** The majority of symptoms are hyperactive and impulsive.
- **Combined.** The most common type in the U.S., this is a mix of inattentive symptoms and hyperactive-impulsive symptoms. [18]

1.9.2. Inattention

A child who shows a pattern of inattention may often:

- Fail to pay close attention to details or make careless mistakes in schoolwork
- Have trouble staying focused in tasks or play

- Appear not to listen, even when spoken to directly
- Have difficulty following through on instructions and fail to finish schoolwork or chores
- Have trouble organizing tasks and activities
- Avoid or dislike tasks that require focused mental effort, such as homework
- Lose items needed for tasks or activities, for example, toys, school assignments, pencils
- Be easily distracted
- Forget to do some daily activities, such as forgetting to do chores

1.9.3. Hyperactivity and impulsivity

A child who shows a pattern of hyperactive and impulsive symptoms may often:

- Fidget with or tap his or her hands or feet, or squirm in the seat
- Have difficulty staying seated in the classroom or in other situations
- Be on the go, in constant motion
- Run around or climb in situations when it's not appropriate
- Have trouble playing or doing an activity quietly
- Talk too much
- Blurt out answers, interrupting the questioner
- Have difficulty waiting for his or her turn

1.9.4. Additional issues

In addition, a child with ADHD has:

- Symptoms for at least six months

- Several symptoms that negatively affect school, home life or relationships in more than one setting, such as at home and at school
- Behaviours that aren't normal for children the same age who don't have ADHD

1.9.5. Normal behaviour vs. ADHD

Most healthy children are inattentive, hyperactive or impulsive at one time or another. It's normal for pre-schoolers to have short attention spans and be unable to stick with one activity for long. Even in older children and teenagers, attention span often depends on the level of interest.

The same is true of hyperactivity. Young children are naturally energetic — they often are still full of energy long after they've worn their parents out. In addition, some children just naturally have a higher activity level than others do. Children should never be classified as having ADHD just because they're different from their friends or siblings.

Children who have problems in school but get along well at home or with friends are likely struggling with something other than ADHD. The same is true of children who are hyperactive or inattentive at home, but whose schoolwork and friendships remain unaffected. [19]

1.9.6. Complications

Attention-deficit/hyperactivity disorder can make life difficult for children. Children with ADHD:

- Often struggle in the classroom, which can lead to academic failure and judgment by other children and adults
- Tend to have more accidents and injuries of all kinds than do children who don't have ADHD
- Tend to have poor self-esteem
- Are more likely to have trouble interacting with and being accepted by peers and adults

- Are at increased risk of alcohol and drug abuse and other delinquent behaviour

1.9.7. Coexisting conditions

ADHD doesn't cause other psychological or developmental problems. However, children with ADHD are more likely than others to also have conditions such as:

- **Learning disabilities:** including problems with understanding and communicating
- **Anxiety disorders:** which may cause overwhelming worry, nervousness
- **Depression:** which frequently occurs in children with ADHD
- **Disruptive mood deregulation disorder:** characterized by irritability and problems tolerating frustration
- **Oppositional defiant disorder (ODD):**generally defined as a pattern of negative, defiant and hostile behaviour toward authority figures
- **Conduct disorder:** marked by antisocial behaviour such as stealing, fighting, destroying property, and harming people or animals
- **Bipolar disorder:** which includes depression as well as manic behaviour
- **Tourette syndrome:** a neurological disorder characterized by repetitive muscle or vocal tics [20]

1.10. Focusing attention

Focusing attention on what the volunteers are reading or studying is another skill that can be learned and used to improve their concentration. There are a number of tricks and techniques you can use to direct your attention to what you are reading or studying. As applied these techniques,it is found out that their mind wanders less often and that they are able to complete reading and studying assignments more efficiently. Instead of just sitting down and beginning, first figure out how much they can accomplish in a specific amount of time. Set a time limit and work toward meeting it.

1.11. Improve Attention

1.11.1. Exercise

Exercise doesn't just improve physical fitness; it increases focus, and a short brisk walk will do. A study from the University of Illinois found that physical activity increases cognitive control. Students with ADHD who participated in 20 minutes of moderate exercise were able to pay attention longer and scored better on academic achievement tests, especially in the area of reading comprehension.

1.11.2. Meditation

Meditation is one of the best ways to improve focus, as it is the mental training of attention. Similar to the effect weight lifting has on muscles, meditation trains brain stay at attention for longer periods of time. In a study done at the University of California at Santa Barbara, undergraduate students who took a mindfulness class and meditated for 10 to 20 minutes four times a week for two weeks scored higher on memory tests and exercises requiring attention than students who changed their nutrition and focused on healthy eating as a way to boost brain power.

1.11.3. Stay dehydrated

Being dehydrated isn't just bad for body; it's bad for attention span. A study done at the University of Barcelona, found that mild dehydration-–as little as 2%–can negatively impact ability to concentrate. In fact, a 2% drop in dehydration isn't enough to trigger thirst. So before go into a situation where need to focus, make sure bring along plenty of water. Mild dehydration–as little as 2%–can negatively impact ability to concentrate, but it's not enough to make feel thirsty.

1.11.4. Ask question

Asking questions not only keeps the brain engaged; it allows to contribute to the conversation and learn something new: “Good questions give you information that helps you improve your job performance,” says Cuff. “Bad questions are those where you already know the answer or just want to look smart.”

1.11.5. Listen to music

Break out the Beethoven; classical music helps pay attention. A study done at Stanford University School of Medicine found that listening to short symphonies engages the areas of the brain involved with paying attention, making predictions, and updating the event in memory. While the music is helpful, it’s the short period of silence between musical movements that peak brain activities. “In a concert setting, for example, different individuals listen to a piece of music with wandering attention, but at the transition point between movements, their attention is arrested,” writes Vinod Menon, professor of psychiatry and behavioural sciences and senior author of the study.

1.11.6. Drink tea

Coffee might make the brain alert, but tea can help to pay attention. Black tea contains an amino acid called L-thiamine, which has been shown to directly affect areas of the brain that control attention. In a study done in the Netherlands, tea drinkers were able to pay attention and perform tasks better than those who were given a placebo to drink.

1.11.7. Write something

If trying to pay attention in a meeting or at a conference, leave laptop at home and take notes via pen and paper. Researchers at Princeton and UCLA found that when students took notes by hand, they listened more actively and were able to identify important concepts. Laptops also provide an easy distraction, such as checking email or logging on to social media. Taking notes on a laptop also leads to mindless transcription.

1.12. Music and Brain

The playing and listening to music have positive effects on the brain. It makes one happier and productive at all stages of life and could delay the aging of the brain.

Listening music after stroke not only promotes behavioural recovery but also induces fine-grained neuron-anatomical changes in brain recovery.

Music activates several regions of the brain, including auditory, motor, limb and emotions. The emotional and cognitive benefits of music are due to these activations. [21]

1.13. Memory improve by music

The simultaneous action of the left and right brain maximizes learning and retention of information. The information being studied activates the left brain, while the music activates the right brain. Mozart's music and baroque music, with a 60 beats per minute beat pattern, activates both sides of the brain in unison. The playing of an instrument or singing helps the brain to process more information. The memory or information learned through particular songs could be recalled by mentally playing those songs.

Music training is more beneficial than listening. The children learning music have a better memory than others. The music devoid of the vocal element is more helpful as the words divert the attention. In Finland, the verbal memory and attention improved by listening to music for 2-3 hours a day. The musical keyboard training increased the math reasoning ability of infants. The classical music improved visual attention and aided the children suffering from delayed development, by increasing the synchronization of hands and eyes.

1.14. Music improves attention

Music that is easy to listen to or relaxing classics improves the duration and intensity of concentration in all age groups and ability levels. It's not clear what type of music is better, or what kind of musical structure produces the best results, but many studies have shown significant effects. [30]

1.15. Music Boosts Brain Chemicals

One of the ways music enhances brain function is by stimulating the formation of certain brain chemicals. Listening to music increases the neurotransmitter dopamine.

This is the brain's "motivation molecule" and an integral part of the pleasure-reward system. it's the same brain chemical responsible for the feel-good states obtained from eating chocolate, orgasm, and runner's high.

1.16. Music Helps to Learn

Many schools have cut music programs due loss of funding, and this is widely believed by parents and educators to be a big mistake. Music, whether taught in or outside of school, helps students excel in the following ways:

- improved language development
- small increase in IQ
- improved test scores
- increased brain connectivity
- increased spatial intelligence

1.17. Listening music in working time

1.17.1. Relaxing

"Music at work can contribute to relaxation by channeling your stress and negative emotions and can remind of not being at work. It can also provide a mini-break from being mentally active and allow rest and recover. In this sense, music can create a sense of well-being in offices by putting employees in a good mood.

1.17. 2. Consent:

"Music can aid concentration by suppressing distractions around the office. Some people experience these effects when they do simpler tasks, but it could also help when doing more complex work. It can control sounds cape in the office and replace external interruptions with sounds of choice.

1.17. 3. Emotional management:

"Music can be inspirational; it can encourage thoughts and motivate . It can act as a stress reliever and be a 'fellow sufferer' in a public space, where it might not be appropriate to act out all frustrations. It can also provide a sense of company when working space is too quiet or empty.

1.17. 4. Blocks distractions:

"Being able to block out distractions can be a way to cope with stress, as it gives more control over environment. Headphones in particular help to improve concentration in two ways.

1.17.5. Creates variation:

Music can provide you with a diversion so you don't engage in other distracting behaviors. It's a strategy to manage internal interruptions like daydreams or thoughts that could make you lose your flow. It might also stop you from doing other unproductive things like browsing the internet or chatting with colleagues. [22]

1.18. Foods needed for good memory

1.18.1. Food for Thought

Despite comprising only 2% of the body's weight, the brain gobbles up more than 20% of daily energy intake. So a healthy diet might be as good for brain as it is for overall health, and eating right may in fact be more important than thought. The brain demands a constant supply of glucose which is obtained from recently eaten carbohydrates like whole grains, fruits and greens. Because when the glucose level drops, it results in confused thinking. No, this does not give the license to slurp on sugary drinks. Instead eat throughout the day to optimize brain power- not too much, not too little. Memory super foods include antioxidant-rich, colorful fruits, green leafy vegetables and whole grains which protect brain from harmful free radicals. Choose low-fat protein sources such as fish and drink at least 8 glasses of water daily since dehydration can lead to memory loss and confusion.

1.18.2. Water

Seriously, sometimes all really need is a glass of refreshing water to kick off the day, especially if had a rough night. “Thirst and dehydration can cause fatigue,” says Mustafa. “If you reach for a cup of coffee or an energy drink, it will actually dehydrate further, causing to feel worse later. So before do anything, drink a tall 10-ounce glass of water. Squeeze some fresh lemon in it for a little extra kick.”

1.18.3. Eggs

“Research has shown that adequate omega-3 intake has a favorable effect upon memory and mood. Eggs also contain chorine, a compound that Can help maintain healthy brain cell membranes.” To save time, Shemek recommends boiling a batch of eggs for the week ahead to have them on hand. [23]

Chapter two

Literature Review

2.1. P1, M. (n.d.). A Review of Joint Attention and Social-Cognitive Brain Systems in Typical Development and Autism Spectrum Disorder. *Eur J Neurosci.*

This article provides a review of the increasingly detailed literature on the neurodevelopment of joint attention. Many findings from this literature support and inform the hypothesis that the neurodevelopment of joint attention contributes to the functional development of neural systems for human social cognition. Joint attention begins to develop by 5 months of age and is tantamount to the ability to adopt a common perspective with another person. It involves a whole-brain system with nodes in the: (a) dorsal and medial frontal cortex, (b) orbital frontal/insula cortex, (c) anterior/ posterior cingulate cortex, (d) superior temporal cortex, (e) precuneus/parietal cortex, and (f) amygdala and striatum. This system integrates triadic information processing about: (a) self-attention/action, (b) information about others' attention/action during social interactions that involve, (c) coordinated attention as well as processing a common referent in space. The results of this new imaging literature have the potential to advance current models of social cognition and the social brain, which rarely consider the contribution of the cognitive neurodevelopment of joint attention. The new neuroscience of joint attention is also extremely valuable for clinical research on social-cognitive neurodevelopmental disorders. This is most clearly the case for autism spectrum disorder (ASD) because it is consistent with the hypothesis of substantial functional neurodevelopmental continuity between the preschool impairments of joint attention, and childhood theory of mind ability that characterize the development of ASD. This article is protected by copyright. All rights reserved. [24] **(MUNDY .P)**

2.2. Alain C., Zendel B. R., Hutka S., Bidelman G. M. (2013). Turning down the noise: the benefit of musical training on the aging auditory brain. Hear. Res. [Pub ahead of print]. 10.1016/j.heares.2013.06.008 [Pub Med] How musical training affects cognitive development: rhythm, reward and other modulating variables

Musical training has recently gained additional interest in education as increasing neuroscientific research demonstrates its positive effects on brain development. Neuroimaging revealed plastic changes in the brains of adult musicians but it is still unclear to what extent they are the product of intensive music training rather than of other factors, such as preexisting biological markers of musicality. In this review, we synthesize a large body of studies demonstrating that benefits of musical training extend beyond the skills it directly aims to train and last well into adulthood. For example, children who undergo musical training have better verbal memory, second language pronunciation accuracy, reading ability and executive functions. Learning to play an instrument as a child may even predict academic performance and IQ in young adulthood. The degree of observed structural and functional adaptation in the brain correlates with intensity and duration of practice. Importantly, the effects on cognitive development depend on the timing of musical initiation due to sensitive periods during development, as well as on several other modulating variables. Notably, we point to motivation, reward and social context of musical education, which are important yet neglected factors affecting the long-term benefits of musical training. Further, we introduce the notion of rhythmic entrainment and suggest that it may represent a mechanism supporting learning and development of executive functions. It also hones temporal processing and orienting of attention in time that may underlie enhancements observed in reading and verbal memory. We conclude that musical training uniquely engenders near and far transfer effects, preparing a foundation for a range of skills, and thus fostering cognitive development. [25](**Alain C., Zendel B. R., Hutka S., Bidelman G. M.)**

2.3. Egbert AH1, W. D. (2017). Attention-Deficit/Hyperactivity Disorder Symptoms Are Associated with Overeating with and without Loss of Control in Youth with Overweight/Obesity. *Child Obes*.

There is growing evidence that attention-deficit/hyperactivity disorder (ADHD) and loss of control (LOC) eating, both prevalent in children and adolescents, may be related to one another. However, the relationship between ADHD and overeating without LOC has been largely unexamined, thus precluding an understanding of the independent contributions of LOC and episode size in these associations. The current study sought to examine associations between ADHD symptoms and maladaptive eating by evaluating three different types of eating episodes characterized by the presence/absence of LOC and the amount of food consumed: objectively large LOC episodes [objective binge eating (OBE)], subjectively large binge episodes [subjective binge eating (SBE)], and objectively large overeating episodes without LOC [objective overeating (OO)]. Participants were 385 youth (M age = 10.89, SD = 2.25) drawn from five different research protocols at institutions across the United States. Participants and their parents completed questionnaires and semi structured interviews to assess ADHD symptoms, OBE, SBE, and OO. As hypothesized, negative binomial regressions revealed that ADHD symptoms were significantly associated with OBE, $\chi^2(1) = 16.61$, $p < 0.001$, and with OO, $\chi^2(1) = 10.64$, $p < 0.01$. Contrary to expectations, they were not associated with SBE.

These results indicate the need for future studies to explore possible shared mechanisms (e.g., impulsivity) underlying associations between ADHD symptoms, OBE, and OO. Clinical implications include support for considering ADHD symptoms in programs that target both prevention of LOC eating and obesity more generally [26]. (**Egbert AH1)**

2.4. Shan, E. (n.d.). Music and the Mind: How the Brain is affected by Song. Retrieved from baylor-ir.tdl.org: How the Brain is affected by Song Elaine Shan

Music is often thought of as a nonverbal language, capable of communicating emotional messages. Areas of the brain have been identified that, when damaged, affect only musical skills. At the same time, while the initial sensation of the sounds that make up music is a predominantly auditory experience, the neural basis of music perception lies in several different areas of the brain and overlaps with those used in language, emotion, and motor tasks. Thus music is a complex experience that utilizes seemingly divergent abilities of the brain. This thesis will describe the systems level processing of music perception and implications for music therapy. [27] (**Shan**)

2.5. Pylyshyn, Z. (n.d.). Is vision continuous with cognition? Retrieved from ruccs.rutgers.edu -zenon pylyshyn/docs/bbs1999_reprint.pdf

Although the study of visual perception has made more progress in the past 40 years than any other area of cognitive science, there remain major disagreements as to how closely vision is tied to cognition. This target article sets out some of the arguments for both sides (arguments from computer vision, neuroscience, psychophysics, perceptual learning, and other areas of vision science) and defends the position that an important part of visual perception, corresponding to what some people have called early vision, is prohibited from accessing relevant expectations, knowledge, and utilities in determining the function it computes – in other words, it is cognitively impenetrable. That part of vision is complex and involves top-down interactions that are internal to the early vision system. Its function is to provide a structured representation of the 3-D surfaces of objects sufficient to serve as an index into memory, with somewhat different outputs being made available to other systems such as those dealing with motor control. The paper also addresses certain conceptual and methodological issues raised by this claim, such as whether signal detection theory and event-related potentials can be used to assess cognitive penetration of vision. A distinction is made among several stages in visual processing, including, in addition to the inflexible early-vision stage, a pre-perceptual attention-allocation stage and a post-perceptual evaluation, selection, and inference stage, which accesses long-term memory. These two stages provide the primary ways in which cognition can affect the outcome of visual perception. The paper discusses arguments from computer vision and psychology showing that vision is "intelligent" and involves elements of "problem solving." The cases of apparently intelligent interpretation sometimes cited in support of this claim do not show cognitive penetration; rather, they show that certain natural constraints on interpretation, concerned primarily with optical and geometrical properties of the world, have been compiled into the visual system. The paper also examines a number of examples where instructions and "hints" are alleged to affect what is seen. In each case it is concluded that the evidence is more readily assimilated to the view that when cognitive effects are found, they have a locus outside early vision, in such processes as the allocation of focal attention and the identification of the stimulus. [28] **(Pylyshyn)**

2.6.Thaung Zaw JJ1, H. P. (2017). Does phytoestrogen supplementation improve cognition in humans? A systematic review. *Ann N Y Acad Sci.*

Recent evidence indicates that resveratrol, a phytoestrogen, can improve cognitive function in postmenopausal women by enhancing cerebral vasodilator responsiveness. We examine the effects of phytoestrogen supplementation on cognition and compare resveratrol with other phytoestrogens. Databases were searched for reports of randomized controlled trials (RCTs) containing terms describing phytoestrogens together with terms relating to cognition. Effect sizes were determined for changes in cognition. We identified 23 RCTs, 15 with is flavone and eight with resveratrol or grape formulations. Six soy is flavone studies showed positive cognitive effects of medium size. Greater benefits were seen in women who were <10 years postmenopausal and supplemented for <6 months. Small-to-medium effect-size cognitive benefits of resveratrol were seen in four studies of older adults of mixed gender and in postmenopausal women who took 150-200 mg resveratrol daily for at least 14 weeks. No benefits were seen in three studies using red clover or grape formulations. Supplementation with either soy isoflavone or resveratrol improved executive function and memory domains of cognitively normal older adults in half of the included studies, mostly with medium effect sizes. The cognitive benefit of resveratrol was related to improved cerebral perfusion. [29] (**Thaung Zaw JJ1)**

2.7. Thoma, M. V. (n.d.). ***The Effect of Music on the Human Stress Response*****. Retrieved from ncbi.nlm.nih.go(pub med)**

Music listening has been suggested to beneficially impact health via stress-reducing effects. However, the existing literature presents itself with a limited number of investigations and with discrepancies in reported findings that may result from methodological shortcomings (e.g. small sample size, no valid stressor). It was the aim of the current study to address this gap in knowledge and overcome previous shortcomings by thoroughly examining music effects across endocrine, autonomic, cognitive, and emotional domains of the human stress response. [30] (**Thoma.M.V)**

Chapter Three

Rational aims of study

3.1 Rational aims of study

One's attention span can have a major impact on your performance at work and ability to deal with the tasks of everyday life - one lapse in attention can result in missing out on important information, errors, or worse. Take this test to find out more about the level of attentiveness. Stress is the condition or feeling experienced when the demands pressing upon an individual exceed the personal coping skills and social resources he or she can mobilize. As it is known, stress plays a prominent role in daily lives, generally evoking negative associations. Aside from being associated with heart disease, a weak immune system, headaches and sleepless nights, stress is also associated with mental health problems. There is considerable evidence that cognitive performance changes when under stress. Symptoms of stress also include depression of intellectual functioning, cognitive distortions and misinterpretations of situations, events and interpersonal exchanges. Stress affects students in multiple ways. This article provides a conceptual overview of the direct (e.g., psychoneuroimmunological, endocrine) and indirect (health behavior) pathways through which stress affects physical health, the psychological effects of stress on mental health, and the cognitive effects of stress (e.g., attention, concentration) on academic success. [31]

3.2. Objectives

The specific objectives of NF and TR tests are offered below:

1. To measure attention in participants (department of pharmacy student) with neurological and or psychological or neuropsychological disorders. Here NF test is efficient.
2. To determine attention problems in participants (department of pharmacy student) with neurological and or psychological or neuropsychological disorders. Here TR test is operative.
3. To confirm the attention enhancing capacity of different kind of song in human. Here NF and TR tests are efficient.
4. To check the attention power of human. Here NF and TR tests are competent.
5. To endorse the presence or absence of attention deficits in participants (department of pharmacy student) with neurological and or psychological or neuropsychological disorders. Here NF and TR tests are impressive.
6. To confirm that effect of different type of songs have different effects on the attention of human. Here NF and TR tests are effective.

7. To determine attention in participants (department of pharmacy student) that how song Affects their brain when they listen to songs of different mood..

8. To check the attention power of participants (department of pharmacy student) how their age, study year, residual status can affect their attention.

Chapter four

Materials and Methodology

4.1. Materials and Methodology

4.1.1. Study Design

The study was carried on the students to see how the students were attentive with or without music. Simple randomization process was used to randomize the participants. The place of the experiment was East West University, North South University, Southeast University and Atish Dipankar University of Science and Technology. The experiment center of this clinical trial was the Department of Pharmacy, East West University, Dhaka-1213, and Bangladesh. The protocol of the experiment was approved by the ethics committee of the Department of Pharmacy, East West University, Dhaka-1213, and Bangladesh.

4.1.2. Study Population

In this experiment healthy mentally and physically 280 male and female participants between the ages of 18 to 25 years old were arbitrarily selected and till last of the experiment all the participants attended. Since it is not possible as well as unethical to create attention deficits in human to validate the proposed methods, as a consequence healthy young participants were chosen. In addition to this, it is not likely to choose participants with attention problems (*i.e.*, ADHD, AD), but able to partake in this experiment. Different year of students were taken into account to see how their attention were varied in the different genre of music. Their residential statuses were taken into account to see whether it affected their attention or not.

4.1.3. Experimental Design

Randomized 240 people were taken for the experiment. The 240 people were divided into four groups according to the different genre of music.

The participants were randomized into four groups with 70 participants in each as follows:

N = 100 for each group –

Group 1: Subjected to NF tests without any music (Control)

Group 2: Subjected to NF tests using stimulating music (Stimulation)

Group 3: Subjected to NF tests using gentle music (Normal)

Group 4: Subjected to NF tests using depressing music (Depressing)

Sex		**Age**			**Year of Study**				**Residential Status**	
M	**F**	**18-20**	**20-22**	**22-25**	**1**	**2**	**3**	**4**	**With Family**	**Without Family**
Results										
NF										

4.2. Attention Test

4.2.1. Numeral Finding Test

This test is based on finding the wanted numerals among a set of numbers. In this test 100 numbers are placed randomly in a chart that consists of ten columns and ten rows in a printed paper and given to the subject offered in Figure 4a. The numbers must be consisted of double digit (*i.e.*, 10 to 99). From 1 to 100 if single digits (*i.e.*, 1 to 9) and triple digit (*i.e.*, 100) are not considered there are 90 double digits. When these double digits are placed unsystematically in the chart to make 100 numbers, 10 numerals must be added that will serve as wanted numeral (Figure 4b). These wanted numerals must be the repetition of at least three numbers.

83	59	38	22	75	93	14	44	27	86
48	62	71	13	55	89	70	19	52	43
91	78	34	14	15	98	63	79	26	67
50	73	95	40	16	57	62	46	31	90
65	76	29	72	45	81	33	74	62	18
80	94	21	47	50	36	88	53	92	68
24	62	99	56	96	14	39	50	17	58
41	66	50	97	84	37	12	51	30	42
23	85	64	49	11	60	35	54	14	25
69	28	87	20	10	82	62	77	61	32

Figure 4a: Numeral finding test by using set of numerals. Randomly placed numerals in a chart on the printed paper given to the subject to find wanted numerals.

83	59	38	22	75	93	14	44	27	86
48	62	71	13	55	89	70	19	52	43
91	78	34	14	15	98	63	79	26	67
50	73	95	40	16	57	62	46	31	90
65	76	29	72	45	81	33	74	62	18
80	94	21	47	50	36	88	53	92	68
24	62	99	56	96	14	39	50	17	58
41	66	50	97	84	37	12	51	30	42
23	85	64	49	11	60	35	54	14	25
69	28	87	20	10	82	62	77	61	32

Figure 4b:. Numeral finding test by using set of numerals. Wanted numerals from the set of numerals [*i.e.*, Figure 4a] are marked by red circles.

In Figure 4b, numeral 14, 50 and 62 are repeated 3, 3 and 4 times respectively to fill 10 wanted numerals. Since these numerals fall between10 to 99 finally numeral 14, 50 and 62 is repeated 4, 4 and 5 times respectively. So lastly, there are 13 wanted numerals consist of repetition of 3 numerals. The time taken by subject, to find the wanted number is considered as numeral finding time (NFT). The duration of this test is 180 seconds. The background of the sample might influence the duration of this test. So to select the duration one can perform this test to a number of samples and choose the mean time. Gradual decrease in NFT indicates progress of the attention. The percentage of improved attention (IA) is calculated by using the formula given below:

$$\% \text{ of IA} = \text{TNCWNs} \times 100\ \text{TNPWNs}$$

Where, TNCWNs = Total number of correct wanted numerals identified by the subject, TNPWNs = Total number of presented wanted numerals in the chart. An increase in IA is considered as an index of upgraded attention.

- **Finding**

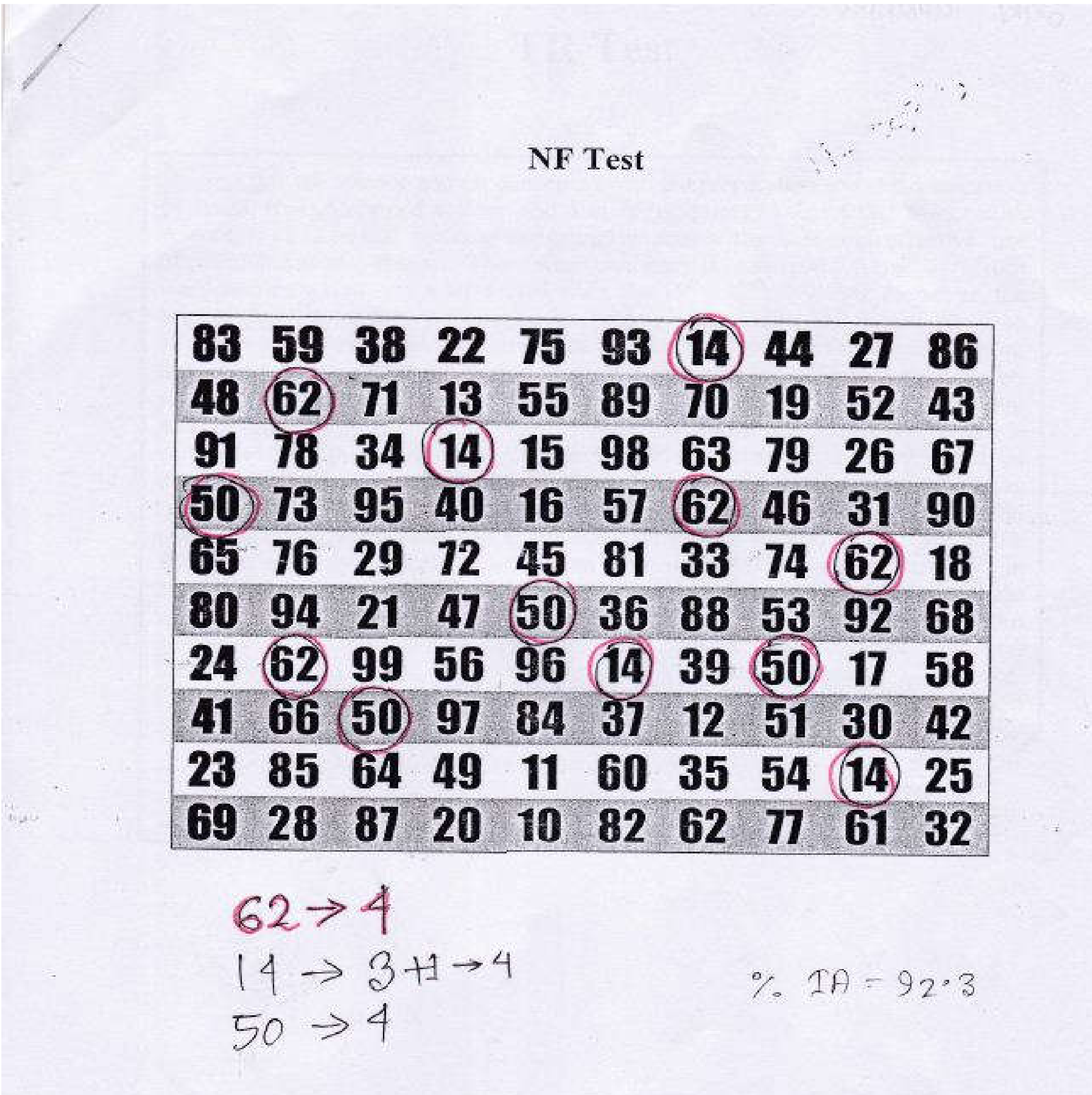
Gradual decrease in NFT indicates progress of the attention.

- **Note**

The background of the sample might influence the duration of this test. So to select the duration one can perform this test to a number of samples and choose the mean time.

4.3. Here is some of the sample of the students who participated in the test. The following sample shows the performance of the students of NF.

4.3.1. Sample of a student who performed excellent:



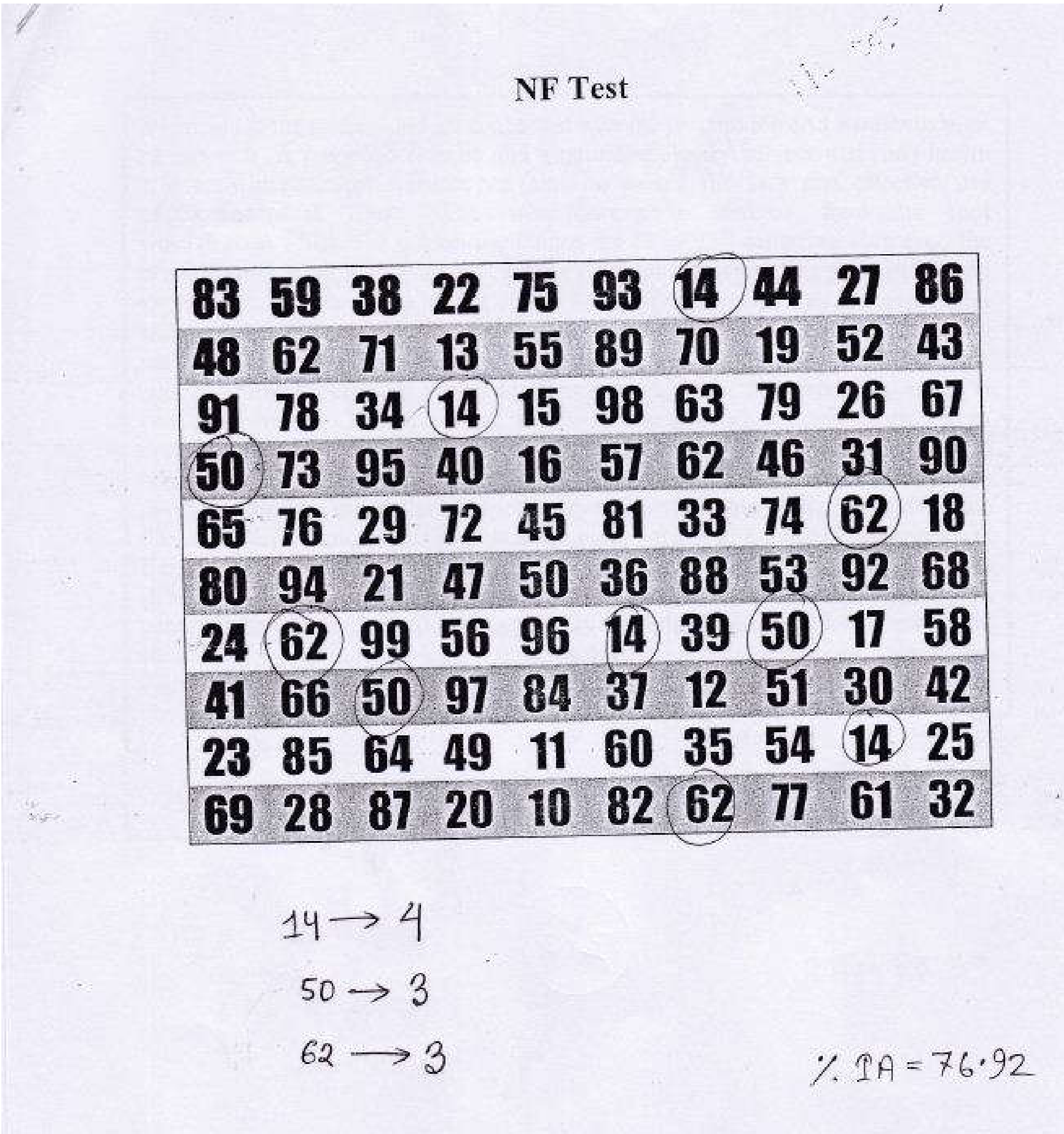
NF Test

83	59	38	22	75	93	14	44	27	86
48	62	71	13	55	89	70	19	52	43
91	78	34	14	15	98	63	79	26	67
50	73	95	40	16	57	62	46	31	90
65	76	29	72	45	81	33	74	62	18
80	94	21	47	50	36	88	53	92	68
24	62	99	56	96	14	39	50	17	58
41	66	50	97	84	37	12	51	30	42
23	85	64	49	11	60	35	54	14	25
69	28	87	20	10	82	62	77	61	32

62 → 4
14 → 3+1 → 4
50 → 4

% IA = 92·3

4.3.2. Sample of a student who performed average:


NF Test

83	59	38	22	75	93	14	44	27	86
48	62	71	13	55	89	70	19	52	43
91	78	34	14	15	98	63	79	26	67
50	73	95	40	16	57	62	46	31	90
65	76	29	72	45	81	33	74	62	18
80	94	21	47	50	36	88	53	92	68
24	62	99	56	96	14	39	50	17	58
41	66	50	97	84	37	12	51	30	42
23	85	64	49	11	60	35	54	14	25
69	28	87	20	10	82	62	77	61	32

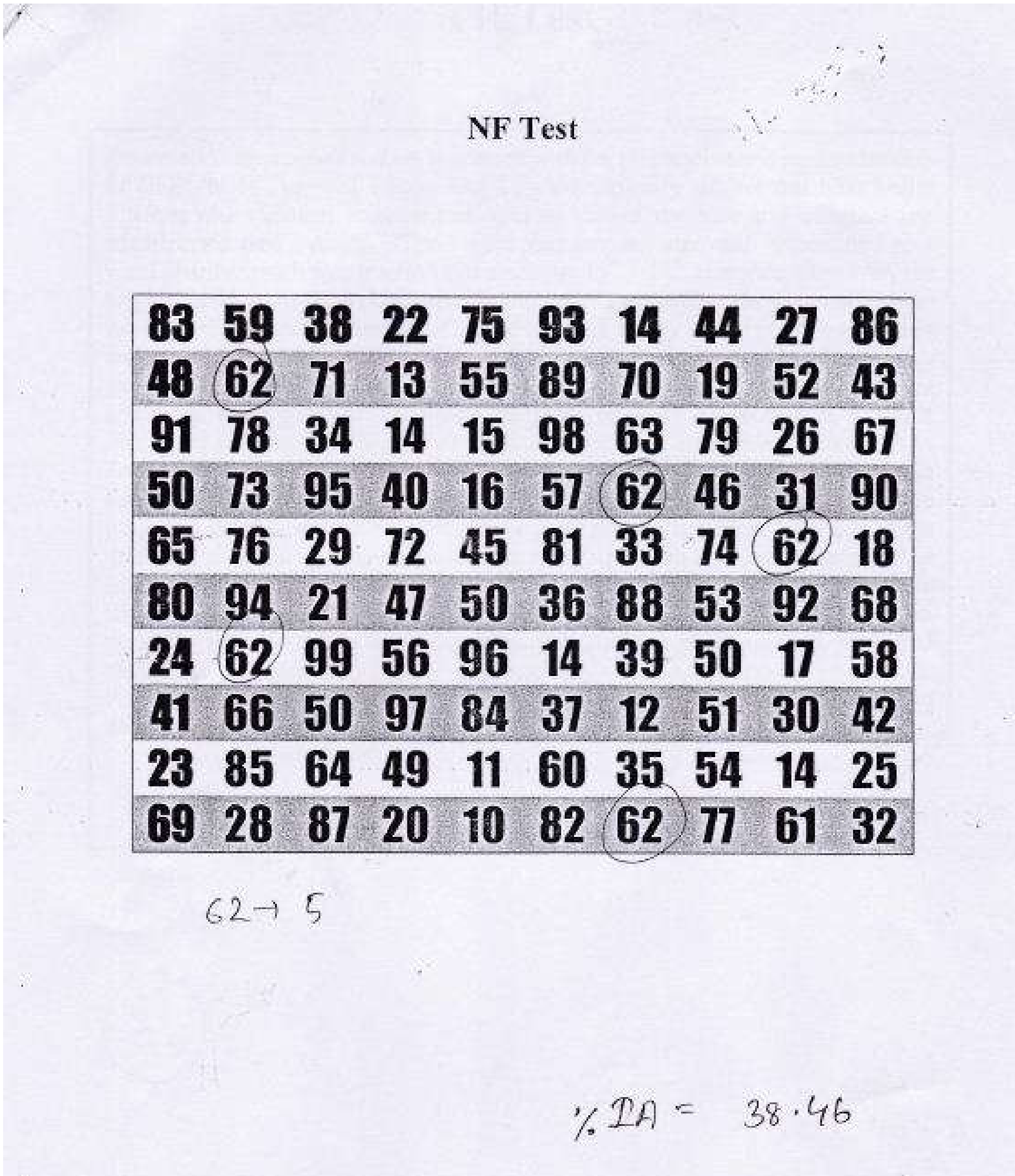
14 → 4

50 → 3

62 → 3

% IA = 76·92

4.3.3. Sample of a student who performed poor:



NF Test

83	59	38	22	75	93	14	44	27	86
48	62	71	13	55	89	70	19	52	43
91	78	34	14	15	98	63	79	26	67
50	73	95	40	16	57	62	46	31	90
65	76	29	72	45	81	33	74	62	18
80	94	21	47	50	36	88	53	92	68
24	62	99	56	96	14	39	50	17	58
41	66	50	97	84	37	12	51	30	42
23	85	64	49	11	60	35	54	14	25
69	28	87	20	10	82	62	77	61	32

62→ 5

% IA = 38.46

Chapter five

Result and Discussion

5.1. NF result:

In this test groups of healthy mentally and physically students were taken as volunteers to carry out this test. This is the type of test to see how attentive the students while listening to different genre of music.

Groups	**Sex**		Age (years)			**Year of Study**				**Residential Status**		NF test
	Male	Female	18-20	20-22	22-25	1	2	3	4	With Family	Without Family	% of Attention (Avg±SEM)
Control	41	29	11	30	29	17	14	23	16	34	36	71.61±1.981
Normal	32	38	4	26	40	3	10	17	40	31	39	74.32±1.592
Stimulating	44	26	13	24	33	10	28	6	26	30	40	75.54±1.691
Depression	38	32	9	29	32	17	8	24	21	37	33	70.77±1.75

5.1.1. NF test result

In control group the participants took the test without music and the result is71.61±1.981.In the normal group the participants took the test with the normal music and the result is 74.32±1.592. In the Stimulating group the participants listen to the stimulating music and took the test and the result is 75.54±1.691. In the depression group the participants took the test with the depressing music and the result is 70.77±1.75.It is seen from these test that participants who listen to the stimulating song have highest attention cognitive efficiency than the normal group which is the second efficient group than the control group being the third efficient group and the last and the poor efficient group is the depression group. People who don't listen to music have better attention cognitive efficiency than the people who listens to the depressing music.

5.2. Discussion

The brain is the control center of the human body [32]. Understanding the relationship of brain learning, attention and consciousness is an interesting area of research for neuroscientists. Attention is recognized as one of the three major co-active processes of the working brain [33]. Music is a crucial element of everyday life. There are a ton of brainy benefits one derives from listening to classical music. From pain management to improved sleep quality, listening to classical music has both mental and physical benefits. In fact, simply listening to classical music as background noise can have a significant impact on your mood, productivity, and creativity. In this experiment we used NF and TR tests for the determination of relationship between attention and music in students.

The brain has many diverse regions, but in case of functioning it operates in a remarkable integrated way [34]. In the attention process brainstem, neurotransmitter, limbic system and neocortex play an important role [35]. The brainstem passively receives incoming sensory information and starts the process of active attention [36]. In the control of arousal and to ignore irrelevant stimuli, reticular formation and locus cerulean are accountable [37]. Among neurotransmitter, nor epinephrine and dopamine is the important neurotransmitter appear to control the processing of attention [38]. Studies suggested that the level of neurotransmitter fluctuations in 90 minute cycles across the 24 hours in the body. In the morning the level of neurotransmitter is higher as a result; many people experience a sharp rise in the attention that causes to wake up. During the afternoon the level of neurotransmitters begins to decline and after midnight reaches the lowest levels as a result sleep becomes unavoidable [39]Optimum level of neurotransmitter is best for proper functioning of attention [40] . The limbic system controls the emotional overtones and motivation for attention [41]. The neocortex is the part of the cerebral cortex that plays a key role in sensory perception, generation of motor commands, spatial reasoning, conscious thought, memory and learning processes etc. [42].

Music is a universal language, present in all human societies. It pervades the lives of most human beings and can recall memories and feelings of the past, can exert positive effects on our mood, can be strongly evocative and ignite intense emotions, and can establish or strengthen social bonds. In this review, we summarize the research and recent progress on the origins and neural substrates of human musicality as well as the changes in brain plasticity elicited by listening or performing music. Indeed, music improves performance in a number of cognitive tasks and may have beneficial effects on diseased brains. The emerging picture begins to unravel how and why particular brain circuits are affected by music. Numerous studies show that music affects emotions and mood, as it is strongly associated with the brain's reward system. We can therefore assume that an in-depth study of the relationship between music and the brain may help to shed light on how the mind works and how the emotions arise and may improve the methods of music-based rehabilitation for people with neurological disorders. [43]

Results of numerous studies showed that listening to music can improve cognition, motor skills and recovery after brain injury. In the field of visual art, brain lesion can lead to the visuospatial neglect, loss of details and significant impairment of artistic work while the lesions affecting the left hemisphere reveal new artistic dimensions, disinhibit the right hemisphere, work is more spontaneous and emotional with the gain of artistic quality. All kinds of arts (music, painting, dancing...) stimulate the brain. They should be part of treatment processes. Work of many artists is an excellent example for the interweaving the neurology and arts. [44]

Understanding brain function and the computations that individual neurons and neuronal ensembles carry out during cognitive functions is one of the biggest challenges in neuroscientific research. To this end, invasive electrophysiological studies have provided important insights by recording the activity of single neurons in behaving animals. To average out noise, responses are typically averaged across repetitions and across neurons that are usually recorded on different days. However, the brain makes decisions on short time scales based on limited exposure to sensory stimulation by interpreting responses of populations of neurons on a moment to moment basis. Recent studies have employed machine-learning algorithms in attention and other cognitive tasks to decode the information content of distributed activity patterns across neuronal ensembles on a single trial basis. Here, we review results from studies that have used pattern-classification decoding approaches to explore the population representation of cognitive functions. These studies have offered significant insights into population coding mechanisms. Moreover, we discuss how such advances can aid the development of cognitive brain-computer interfaces.

In this table we have taken into account the gender, age group, residential status for the test to see how attentive they are in the test. In this test the volunteers were given snacks after they were done with the test. In this test there was no gender discrimination about their attentiveness. In this test it is seen that for every genre of music 70 healthy individual students participated as volunteers. It is also seen from the table that the stimulating songs give more attention to the volunteers than 3 of the other genres. It is likely that people gets attentive when listen to stimulating music rather than other music.

To increase the attention span conceptual development is effective by merging related elements into a single unit [45]. Automatically when we see a face we consider it as a single unit, not as individual eye/ear/nose/mouth. But readers, who primarily focus on individual letters and words, have to learn to read entire phrases as single units . In this experiment, we used NF test for determination of attention that is based on finding wanted numbers among 100 numbers. So in this test there are 100 single units consist of two digits. Among 100 numbers (i.e., 10 - 99), finding of wanted numbers that are repeated several times is tough and in this case more concentration is obligatory for finding and calculation of the each repeating number. Our study suggested that in the NF test percentage of attention was higher in stimulating song's group followed by gentle song's group with respect to control group. In this study percentage of attention was reduced in depressing song's group than control group. Study reported that, if anyone listens to adequate memory-boosting music while studying, chances are he/she'll exceed their own expectations. Verrusio et al., (2015) reported that Mozart's music is able to "activate" neuronal cortical circuits related to attentive and cognitive functions.

The principal attention activity of human being is the constant conscious selection of a current focus.[46] In case of attention factors like focus and intensity can differ broadly [47]. It will be clarified by comparing between a proofreader and a cursory reader of a magazine article. Initially they cautiously focus to scrutinize individual words and punctuation, then concentrates on the general content. Attention system leads itself in anticipation during try to find such specific information [48]. It increases the response levels of the networks that process that information and it inhibits other networks. That's why, the proofreader scrutinizes a page and marks spelling mistakes, while the cursory reader skims the identical page and marks main content words and phrases [49]. TR test is used in this study for the measurement of attention that is based on the finding of typological errors present in the given passage. When readers read the passage to find typos their attention might divide into the time and typos therefore stronger attention and concentration is vital for finding typos. In our study, like we have reported percentage of improved attention in stimulating and gentle song's groups compared to control group. Like previous test, in depressing song's group percentage of decreased attention was reported than control group. Another interesting article shows that there is also a Vivaldi Effect. According to the study of Riby LM (2013), listening to Vivaldi's "Spring" particularly the well-recognized, vibrant, emotive, and uplifting first movement, had the ability to enhance mental alertness and brain measures of attention and memory. Participants in this study listened to all of Vivaldi's "Four Seasons" concerts, but the first portion from "Spring" proved to be the most successful with regards to its memory-boosting properties.

Limitations of this study are:

1. Only one genre of song is given for listening during the test. It must be taken into account that 4 different genre of music must given to that specific participant for listening during taking the test.
2. If the same participant is taking both the NF and TR test one after the other then initially in test it needs time for the attention but once finishing one test and doing the next one the attention is focused so the result might not come accurate.
3. There was no sequence of NF and TR test in each of the groups so this might affect the result of this study.

Conclusion

Conclusion

We all know that brain is the command centre of our body. The attention we get is with help of release of some neurochemicals release a in the brain. In this experiment we have prepared a test which is NF test for the students to see whether the music affects the attention or not. This test is a validated test which not only affects the brain it also differs with the mood of the song. It has been seen that the stimulating songs group have more concentration than the other groups. So basically when people are in joyous mood and listening to stimulating songs they perform very well. The notable feature of these aforementioned testing methods is that these can be performed based on the background of the subject, they are not rigid. Therefore, NF tests will make breakthrough in the compass of neuroscience. In our test we find how different kind of song affects our attention

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