Scrutinizing the Impact of Music on Attention using Uddin's Typo Revealing Test in Bangladeshi Juveniles: An Empirical Pilot Study

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.

Submitted by

Jannatul Ferdaush Rithy
ID: 2014-1-70-037
Department of Pharmacy
East West University

Submitted to
Mst. Marium Begum
Senior Lecturer
Department of Pharmacy
East West University

Endorsement by the Chairperson

This is to certify that the thesis entitled "**Scrutinizing the Impact of Music on Attention using Uddin's Typo Revealing Test in Bangladeshi Juveniles: An Empirical Pilot Study''** 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 **Jannatul Ferdaush Rithy, ID: 2014-1-70-037.**

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Dr. Chowdhury Faiz Hossain

Professor & Chairperson

Department of Pharmacy

East West University, Dhaka

Certification by the Supervisor

This is to certify that the thesis entitled "**Scrutinizing the Impact of Music on Attention using Uddin's Typo Revealing Test in Bangladeshi Juveniles: An Empirical Pilot Study**'' 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 Jannatul Ferdaush Rithy, ID: 2014-1-70-037**, 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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Mst. Marium Begum

Senior Lecturer

Department of Pharmacy

East West University, Dhaka.

Declaration by the Candidate

I hereby declare that this dissertation entitled "**Scrutinizing the Impact of Music on Attention using Uddin's Typo Revealing Test in Bangladeshi Juveniles: An Empirical Pilot Study"** submitted to the Department of Pharmacy, East West University, in the partial fulfillment of the requirement for the degree of Bachelor of Pharmacy (Honors) is a genuine & authentic research work carried out by me under the guidance of **Mst. Marium Begum**, Senior Lecturer, Department of Pharmacy. The contents of this dissertation, in full or in parts, have not been submitted to any other institute or University for the award of any degree or Diploma of Fellowship.

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Jannatul Ferdaush Rithy

ID-2014-1-70-037

Department of Pharmacy
East West University, Dhaka

Acknowledgement

At first, I would like to thanks the Almighty ALLAH the most gracious and merciful for enabling me to successfully completing my research work soundly and orderly. I would like to express my deepest gratitude to my research supervisor, Mst.Marium Begum, Senior Lecturer, Department of Pharmacy, East West University, who had been always optimistic and full of passion and ideas. Her generous advice, constant supervision, intense support, enthusiastic encouragements and reminders during the research work not only helped shape this study but also molded me into being a better researcher.

I put forward my most sincere regards and profound gratitude to Chairperson Dr. Chowdhury Faiz Hossain, Professor, Department of Pharmacy, East West University, for his inspiration in my study. He also paid attention for the purpose of my research work and extending the facilities to work.

I want to give special thanks to Md. Sohanur Rahman Sohag, Janisa kabir and my all friends specially Nusrat Jahan Anika and Sabekun Nahar who gave me support for my research work and for their extended cooperation for my study.

I express my sincere thankfulness to my family for guiding me all through my life, including that for my research project.

Thank you

Dedication

This research paper is dedicated to

my beloved Parents

and my family members

Abstract

This experiment describes the application of cognitive genetics to the study of attention deficit hyperactivity disorder (ADHD). Participant's age, experience, residual status can affect their attention and different types of songs also have different effects on their attention. This study was designed to determine attention of participants and how the songs affect their brain when they listen to songs of different categories. We have used two validated neuropsychopharmacological testing methods namely Typo Revealing (TR) tests for the determination of attention in healthy aged human participants. TR tests are done on them to check their attention efficiency. In this experiment mentally sound and physically healthy 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. 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 percentage of cognition is 42.70±1.69.In the normal group the participants took the test with the normal music and the percentage of cognition is 45.27±1.90. In the Stimulating group the participants listen to the stimulating music and took the test and the percentage of cognition is 45.97±1.63. In the depression group the participants took the test with the depressing music and the percentage of cognition is 41.54±1.68.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. So these testing methods will be effective for various neuropsychopharmacological assessments in human.

Keywords: Neuropsychopharmacology, Typo Revealing Test (TF), Attention deficit hyperactivity disorder (ADHD)

Content

Chapter one: Introduction

Content

Chapter Two: Literature review

Chapter Three: Rational aims of study

Chapter Four: Materials and Methodology

Chapter Five: Result and Discussion

Figures

Chapter One

INTRODUCTION

1.1. Anatomy of the Brain

The anatomy of the brain is complex due its intricate structure and function. This amazing organ acts as a control centre by receiving, interpreting, and directing sensory information throughout the body. The brain and spinal cord are the two main structures of the central nervous system. There are three major divisions of the brain. They are the forebrain, the midbrain, and the hindbrain. [1]

1.1.1. Brain Division

1.1.1.1 The **forebrain** is the division of the brain that is responsible for a variety of functions including receiving and processing sensory information, thinking, perceiving, producing and understanding language, and controlling motor function. There are two major divisions of forebrain: the diencephalon and the telencephalon. The diencephalon contains structures such as the thalamus and hypothalamus which are responsible for such functions as motor control, relaying sensory information, and controlling autonomic functions. The telencephalon contains the largest part of the brain, the cerebrum. Most of the actual information processing in the brain takes place in the cerebral cortex.

1.1.1.2. The **midbrain** and the hindbrain together make up the brainstem. The midbrain or mesencephalon, is the portion of the brainstem that connects the hindbrain and the forebrain. This region of the brain is involved in auditory and visual responses as well as motor function.

1.1.1.3. The **hindbrain** extends from the spinal cord and is composed of the metencephalon and mesencephalon. The metencephalon contains structures such as the Pons and cerebellum. These regions assist in maintaining balance and equilibrium, movement coordination, and the conduction of sensory information. The mesencephalon is composed of the medulla oblongata which is responsible for controlling such autonomic functions as breathing, heart rate, and digestion. [2]

1.2. Nervous system

The nervous system is a complex network of nerves and cells that carry messages to and from the brain and spinal cord to various parts of the body.The nervous system is divided into central and peripheral systems. The central nervous system (CNS) is composed of the

brain and spinal cord. The peripheral nervous system (PNS) is composed of spinal nerves that branch from the spinal cord and cranial nerves that branch from the brain. The PNS includes the autonomic nervous system, which controls vital functions such as breathing, digestion, heart rate, and secretion of hormones. [3]

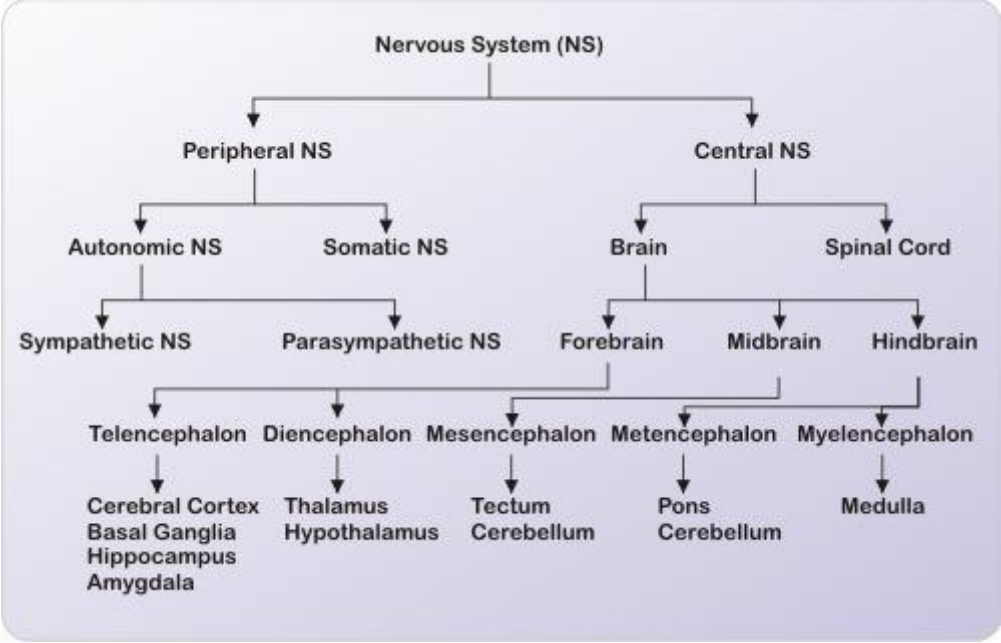


Figure 1a: classification of nervous system (NS)

1.2.1. Central Nervous System

The central nervous system mainly contains the brain and the spinal cord. These two have a very specific bony protective covering, supplemented by the other soft tissues. The brain is divided into forebrain, mid brain, hind brain. Most of the functional mapping for the muscular movements and the sensory perceptions, as well as the executive functions, is distributed throughout the fore brain into discrete regions. The mid brain constitutes a part of the brainstem, which is vital in keeping the person alive such as defensive physiological reflexes, respiration, and cardiac pacemaker control, whereas the hind brain is involved in the formation of the cerebellum, which is essential in maintaining balance of the body.[4]

1.2.2. Peripheral Nervous System

The peripheral nervous system is not protected by an osteolytic cavity or a blood brain barrier. It contains all the nerves and the ganglia for the nerves. There are various divisions

of peripheral nerves. But to include all aspects, we can consider them as being, motor, sensory and autonomic. The motor nerves are again divided as voluntary and involuntary, with the involuntary actions liaised with the autonomic functions. The voluntary motor activities are produced through cranial nerves as well as spinal nerves, and they are transmitted from the cerebral cortex. The involuntary ones are mostly for visceral organs; thus, within the scope of the autonomic nervous system. The sensory nerves are also divided as spinal and cranial, and they perceive sensations of touch, temperature, pressure, cold, vibration, proprioception, etc., which is transmitted to the sensory cortex in the brain. The autonomic nerves that have distributions to cranial nerves, as well as forming spinal nerve plexus on occasion, are classified by their actions of sympathetic and parasympathetic and conduct the actions of visceral organs. [5]

1.2.3. 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. [6]

1.3. Nervous Cells

The nervous system contains two main categories or types of cells:

1. Neurons

2. Glial cells.

1.3.1. 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]

1.3.1.1. 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) [8]

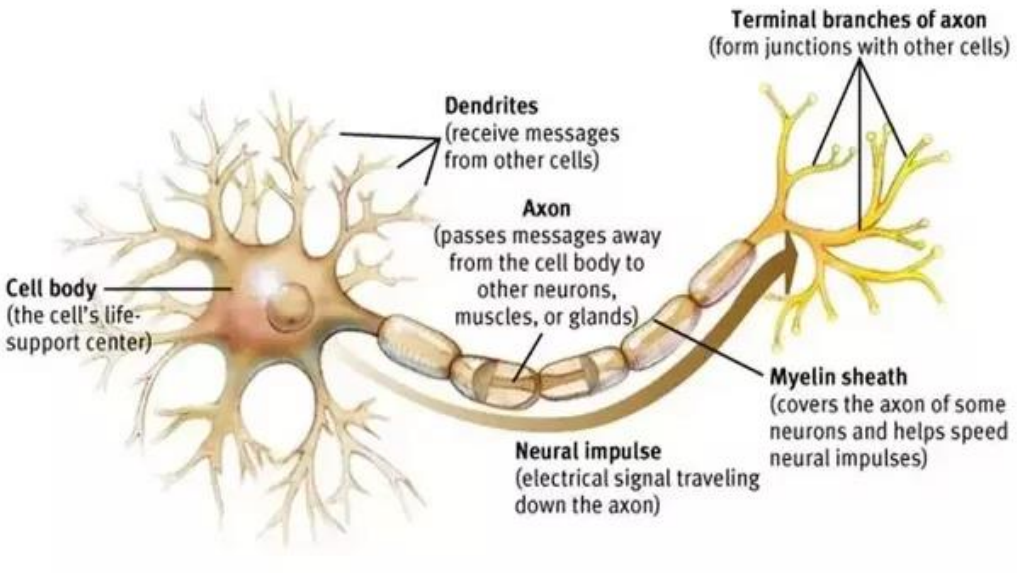


Figure 1b: Different parts of neuron.

1.3.2. 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. [9]

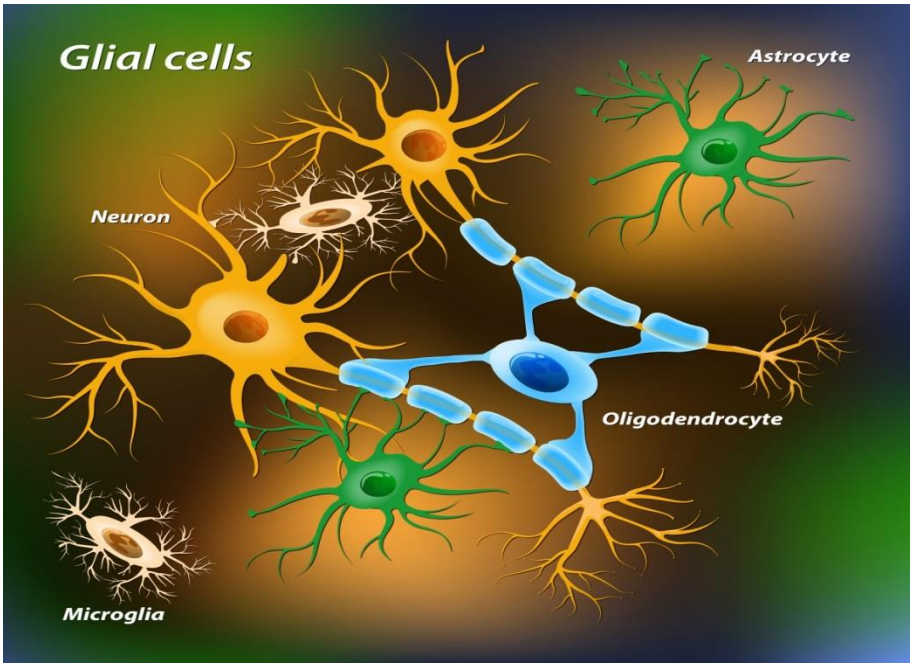


Figure 1c: Glial cells

1.4. 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

bonesincluding the maxilla, zygomatic, nasal, palatine, lachrymal, inferior nasal conches, mandible, and homer.

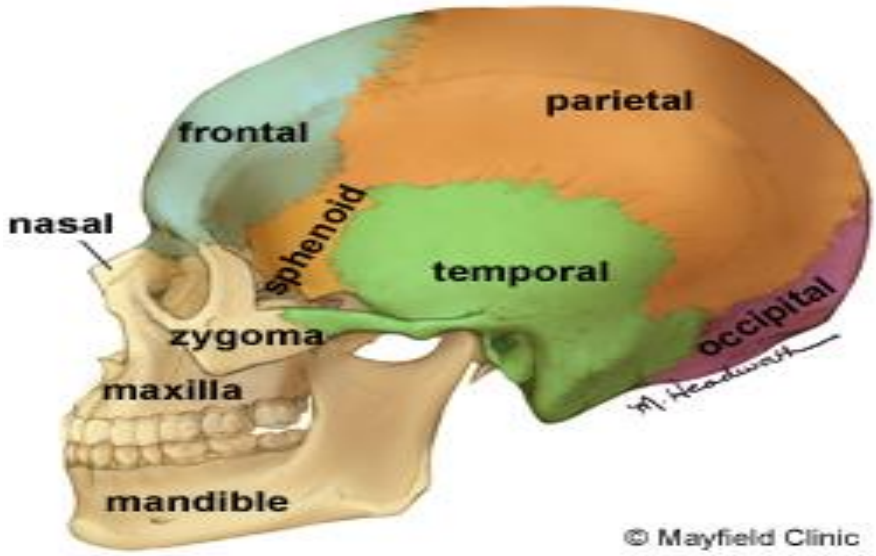


Figure 1d: Eight bones form the skull and fourteen bones form the face

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 meningiomaSimilar 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) iswhere the spinal cord exits. [10]

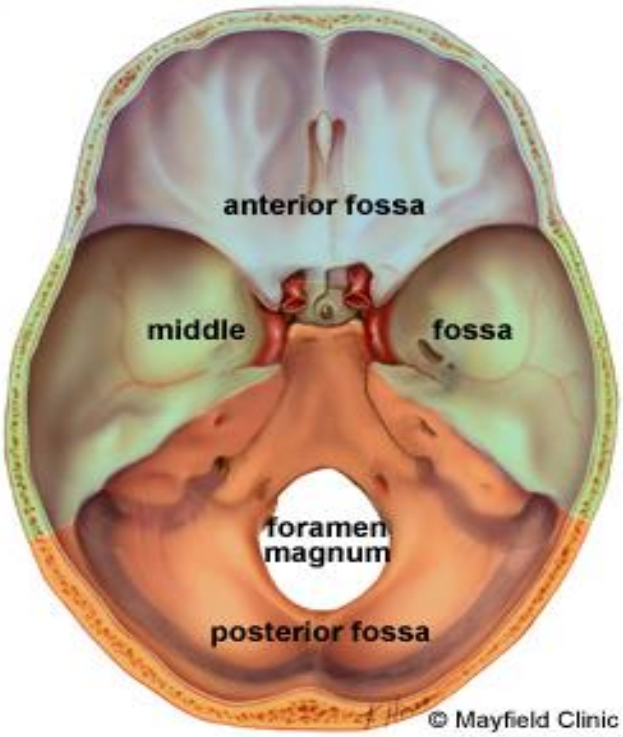


Figure 1e: The inside of the skull is divided into three areas called the anterior, middle, and posterior fossa

1.5. Brain

The brain works like a big computer. It processes information that it receives from the senses and body, and sends messages back to the body. But the brain can do much more than a machine can: humans think and experience emotions with their brain, and it is the root of human intelligence.

The human brain is roughly the size of two clenched fists and weighs about 1.5 kilograms. From the outside it looks a bit like a large walnut, with folds and crevices. Brain tissue is made up of about 100 billion nerve cells (neurons) and one trillion supporting cells which stabilize the tissue. [11]

The brain is one of the most complex and magnificent organs in the human body. Our brain gives us awareness of ourselves and of our environment, processing a constant stream of sensory data. It controls our muscle movements, the secretions of our glands, and even our breathing and internal temperature. Every creative thought, feeling, and plan is developed by our brain. The brain's neurons record the memory of every event in our lives. (12]

1.5.1. 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 [13]

1.5.2. Different part of brain and function

There are various sections of the each with their own functions:

- the cerebrum
- the diencephalon – including the thalamus, hypothalamus and pituitary gland
- the brain stem – including the midbrain, Pons and medulla
- The cerebellum[14]

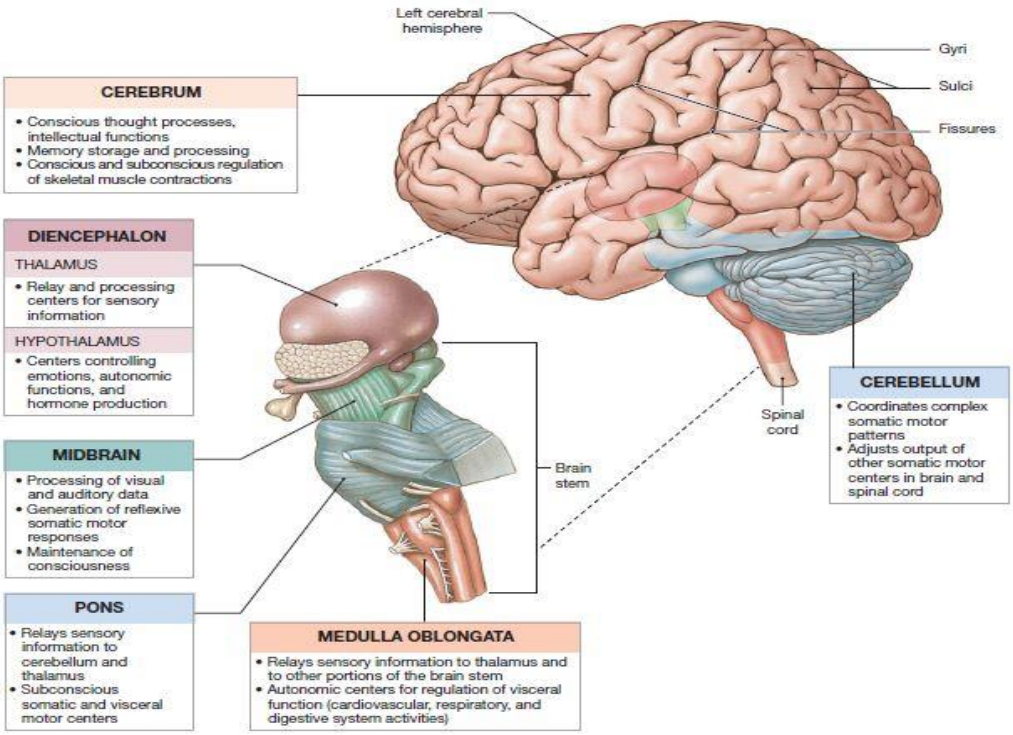


Figure 1f: An Introduction to Brain Structures and Functions

1.5.3. Anatomical classification of the brain

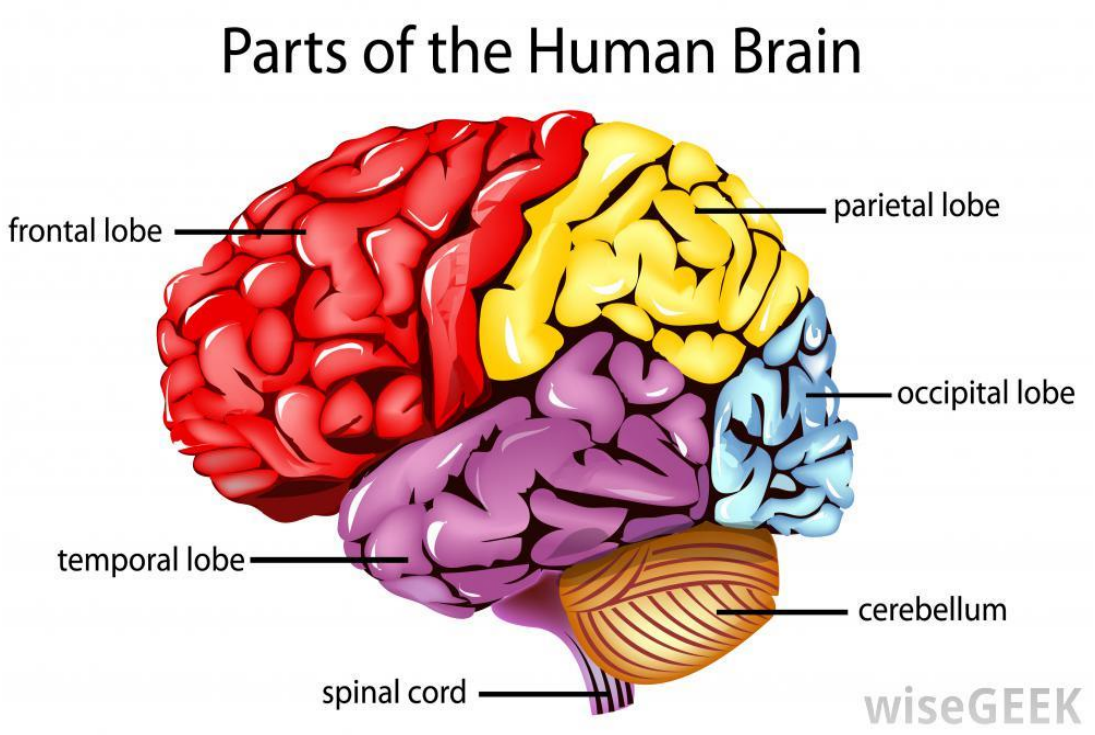


Figure 1g: Parts of the human brain

1.5.3.1. 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.

1.5.3.1.1. 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)

1.5.3.1.2. Observed Problems

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

1.5.3.2. 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.

1.5.3.2.1. Function

- Sense of touch
- Differentiation: size, shape, color
- Spatial perception

- Visual perception
- Academic skills (reading)

1.5.3.2.2. Observed Problems

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

1.5.3.3. 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.

1.5.3.3.1. Functions

- Vision
- Reading (perception and recognition of printed words)

1.5.3.3.2. Observed Problems

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

1.5.3.4. 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.

1.5.3.4.1. Functions

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

1.5.3.4.2. Observed Problems

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

1.5.3.5. 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.

1.5.3.5.1. Functions

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

1.5.3.5.2. 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

1.5.3.6. 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.

1.5.3.6.1. 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)

1.5.3.6.2. 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)[15]

1.6. 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. [16]

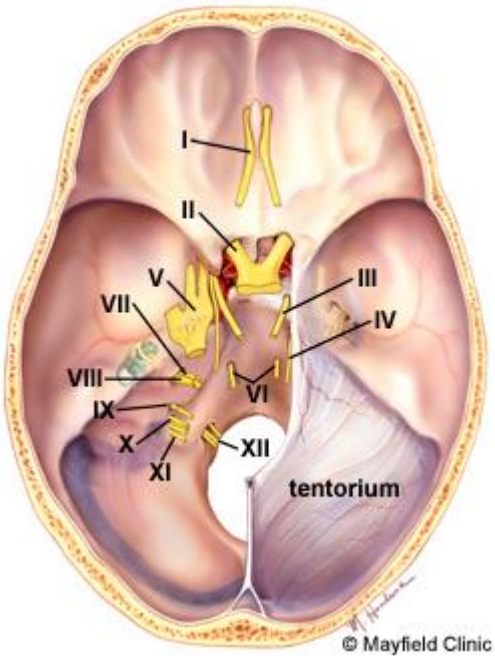


Figure 1h: The Roman numeral, name, and main function of the twelve cranial nerves.

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

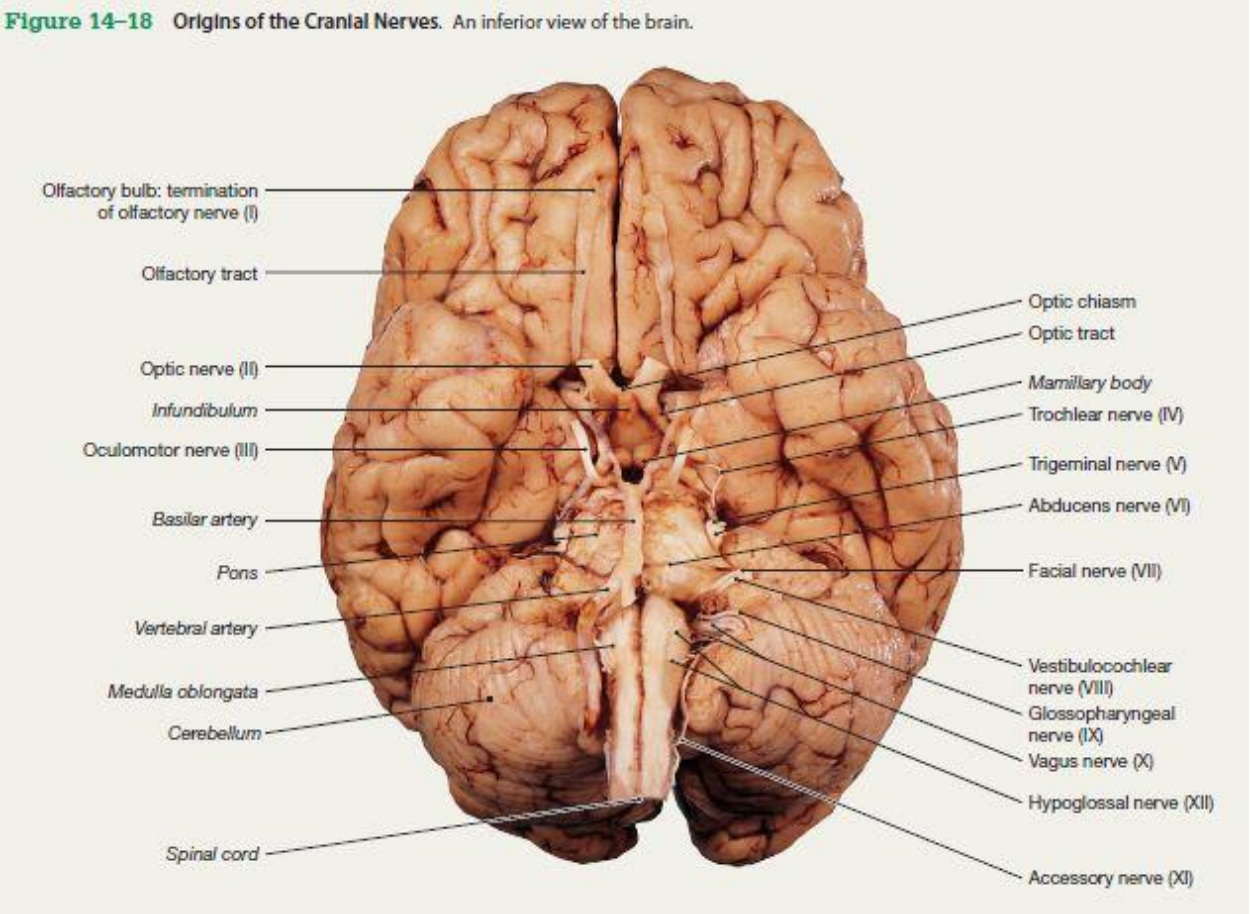


Figure 1i: Origins of cranial nerves

1.7. The Vestibulocochlear Nerves (VIII)

1.7.1. Primary function: Special sensory: balance and equilibrium

(Vestibular branch) and hearing (cochlear branch)

1.7.2. Origin: Monitor receptors of the internal ear (vestibule and Cochlea)

1.7.3. Pass through: Internal acoustic meatus of temporal bones

1.7.4. Destination: Vestibular and cochlear nuclei of Pons and medulla oblongata.Thevestibulocochlear nerves (VIII) are also known as the acoustic nerves, the auditory nerves, and the state-acoustic nerves. We will use vestibulocochlear, because this term indicates the names of the two major branches: the vestibular branch andthe cochlear branch. Each vestibulocochlear nerve lies posterior to the origin of the facial nerve,

straddling the boundarybetween the Pons and the medulla oblongata. This nerve reaches the sensory receptors of the internal ear by entering the internal acoustic meatus in company with the facial nerve. Each vestibulocochlear nerve has two distinct bundles of sensory fibers. The vestibular (vestibule, cavity) branch originates at the receptors of the vestibule, the portion of the internal ear concerned with balance sensations. The sensory neurons are located in an adjacent sensory ganglion, and their axons target the vestibular nuclei of the Pons and medulla oblongata. These afferents convey information about the orientation and movement of the head. The cochlear (cochlea, snail shell) branch monitors the receptors in the cochlea, the portion of the internal ear that provides the sense of hearing. The cell bodies of the sensory neurons are located within a peripheral ganglion (the spiral ganglion), and their axons synapse within the cochlear nuclei of the Pons and medulla oblongata. Axons leaving the vestibular and cochlear nuclei relay the sensory information to other centers or initiate reflexive motor responses. [17]

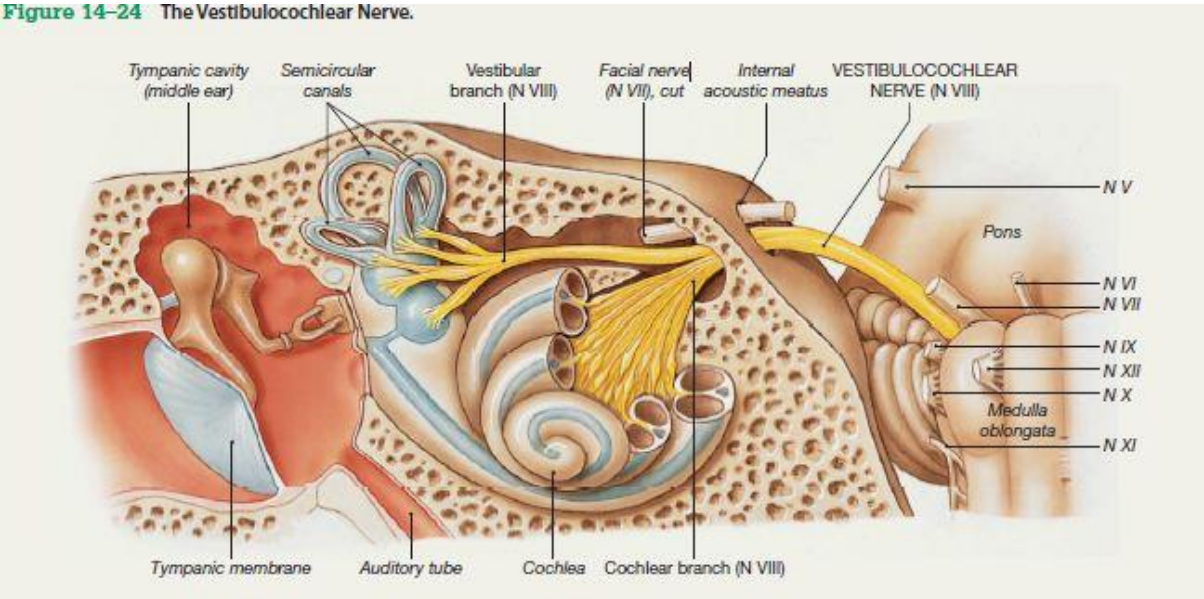


Figure 1j: The vestibulocochlear nerve

1.8. 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). [18]

1.8.1. 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. [19]

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. [20]

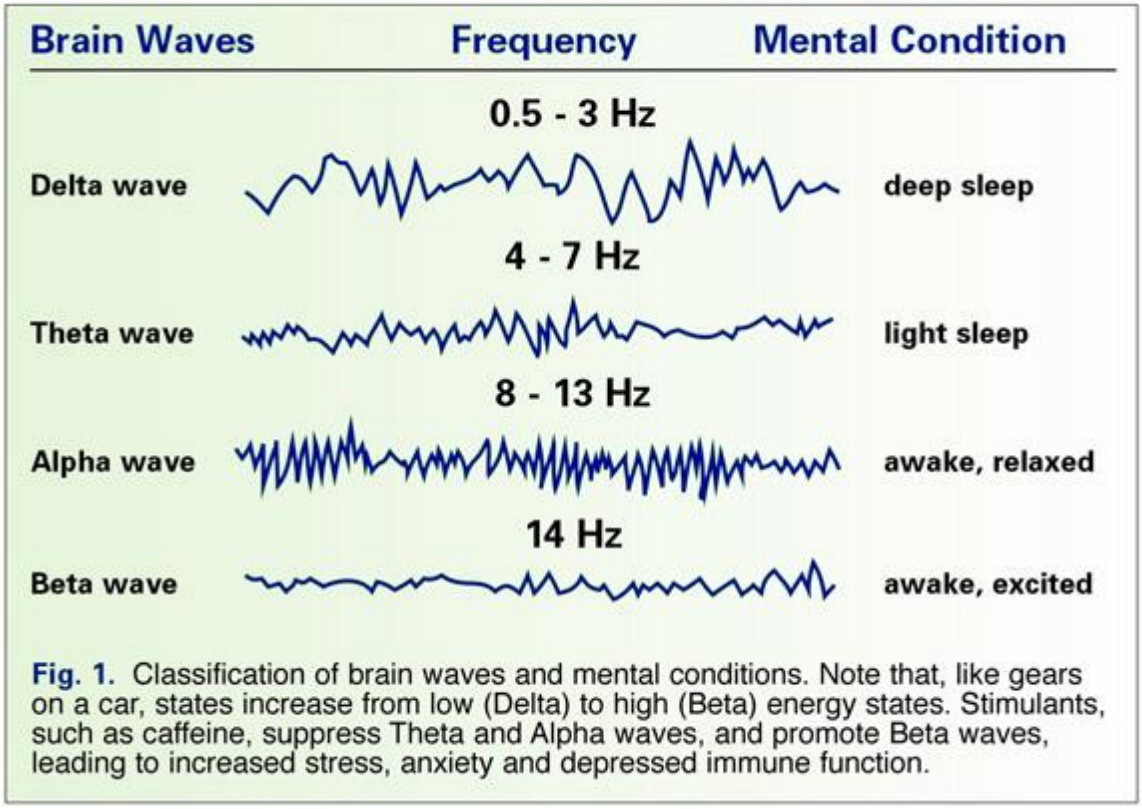


Figure 1k: Different types of brain waves.

1.9. 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. [21]

1.9.1. Classification of memory

Two classes of memories are recognized.

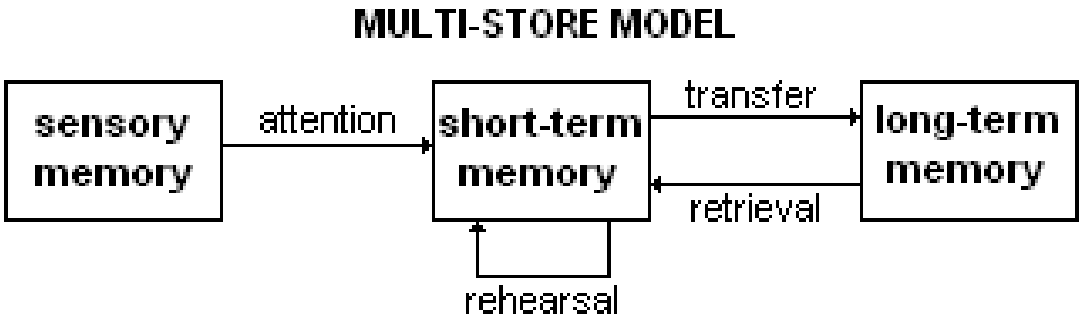


Figure 1L: Multi store model of memory.

1.9.1.1. 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. [22]

1.9.1.2. 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

animals have 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

upto several weeks. These mechanisms are so important that they deserve special description. [23]

1.9.1.3. 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. [24]

1.9.2. Mechanism of synapse

Research on other animals, commonly those with relatively simple nervous systems, has indicated that the following mechanisms may be involved:

1.9.2.1. Increased Neurotransmitter Release

A synapse that is frequently active increases the amount of neurotransmitter it stores, and it releases more on each stimulation. The more neurotransmitter released, the greater the effect on the postsynaptic neuron.

1.9.2.2. Facilitation at Synapses

When a neural circuit is repeatedly activated, the synaptic terminals begin continuously releasing neurotransmitter in small quantities. The neurotransmitter binds to receptors on the postsynaptic membrane, producing a graded depolarization that brings the membrane closer to threshold. The facilitation that results affects all neurons in the circuit.

1.9.2.3. The Formation of Additional Synaptic Connections.

Evidence indicates that when one neuron repeatedly communicates with another, the axon tip branches and forms additional synapses on the postsynaptic neuron. As a result, the presynaptic neuron has a greater effect on the transmembrane potential of the postsynaptic neuron. These processes create anatomical changes that facilitate communication along a specific neural circuit. This facilitated communication is thought to be the basis of memory storage. A single circuit that corresponds to a single memory has been called a memory engram. This definition is based on function rather than structure. We know too little about the organization and storage of memories to be able to describe the neural circuits involved. Memory engrams form as the result of experience and repetition. Repetition is crucial that's why you probably need to read these chapters more than once before an exam [25]

1.9.3. 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.[26]

1.9.4. Cognitive, Consciousness, and Memory

Our most difficult problem in discussing consciousness, thoughts, memory, and learning is that we do not know the neural mechanisms of a thought and we know little about the mechanisms of memory. We know that destruction of large portions of the cerebral cortex does not prevent a person from having thoughts, but it does reduce the depth of the thoughts and also the degree of awareness of the surroundings. Each thought certainly involves simultaneous signals in many portions of the cerebral cortex, thalamus, limbic system, and reticular formation of the brain stem. Some crude thoughts probably depend almost entirely on lower centers; the thought of pain is probably a good example because electrical stimulation of the human cortex seldom elicits anything more than mild pain, whereas stimulation of certain areas of the hypothalamus, amygdale, and mesencephalon can cause excruciating pain. Conversely, a type of thought pattern that does require large involvement of the cerebral cortex is that of vision, because loss of the visual cortex causes complete inability to perceive visual form or color. We might formulate a provisional definition of a thought in terms of neural activity as follows:

A Thought results from a "pattern" of stimulation of many parts of the nervous system at the same time, probably involving most importantly the cerebral cortex, thalamus, limbic system, and upper reticular formation of the brain stem. This is called the holistic theory of thoughts. The stimulated areas of the limbic system, thalamus, and reticular formation are believed to determine the general nature of the thought, giving it such qualities as pleasure, displeasure, pain, comfort, crude modalities of sensation, localization to gross areas of the body, and other general characteristics [27]

1.9.5. Intellectual function and different parts of brain

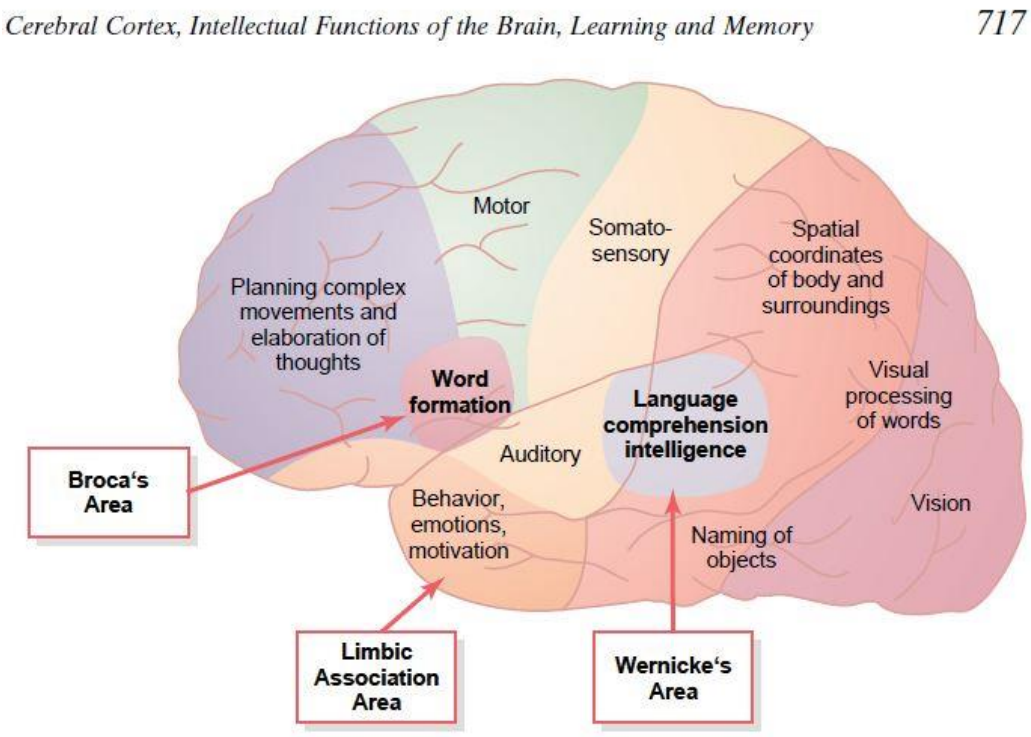


Figure 1m: Intellectual functions of brain, learning, memory.

1.9.5.1. Analysis of the Spatial Coordinates of the Body

An area beginning in the posterior parietal cortex and extending into the superior occipital cortex provides continuous analysis of the spatial coordinates of all parts of the body as well as of the surroundings of the body. This area receives visual sensory information from the posterior occipital cortex and simultaneous somatosensory information from the anterior parietal cortex. From all this information, it computes the coordinates of the visual, auditory, and body surroundings.

1.9.5.2. Language Comprehension

The major area for language comprehension, called Wernicke's area, lies behind the primary auditory cortex in the posterior part of the superior gyrus of the temporal lobe. We discuss this area much more fully later; it is the most important region of the entire brain for

higher intellectual function because almost all such intellectual functions are language based.

1.9.5.3. Reading

Posterior to the language comprehension area, lying mainly in the anterolateral region of the occipital lobe, is a visual association area that feeds visual information conveyed by words read from a book into Wernicke's area, the language comprehension area. This so-called angular gyrus area is needed to make meaning out of the visually perceived words. In its absence; a person can still have excellent language comprehension through hearing but not through reading.

1.9.5.4. Naming Objects

In the most lateral portions of the anterior occipital lobe and posterior temporal lobe is an area for naming objects. The names are learned mainly through auditory input, whereas the physical natures of the objects are learned mainly through visual input. In turn, the names are essential for both auditory and visual language comprehension (functions performed in Wernicke's area located immediately superior to the auditory "names" region and anterior to the visual word processing area). [28]

1.9.6. Visual memory

Visual memory has been demonstrated to play a role in both visual search and attention prioritization in natural scenes. However, it has been studied predominantly in experimental paradigms using multiple two-dimensional images. Natural experience, however, entails prolonged immersion in a limited number of three-dimensional environments. The goal of the present experiment was to recreate circumstances comparable to natural visual experience in order to evaluate the role of scene memory in guiding eye movements in a natural environment. Subjects performed a continuous visual-search task within an immersive virtual-reality environment over three days. We found that, similar to two-dimensional contexts, viewers rapidly learn the location of objects in the environment over time, and use spatial memory to guide search. Incidental fixations did not provide obvious benefit to subsequent search, suggesting that semantic contextual cues may often be just as efficient, or that many incidentally fixated items are not held in memory in the absence of a specific task. On the third day of the experience in the environment, previous search items

changed in color. These items were fixated upon with increased probability relative to control objects, suggesting that memory-guided prioritization (or Surprise) may be robust mechanisms for attracting gaze to novel features of natural environments, in addition to task factors and simple spatial saliency [29]

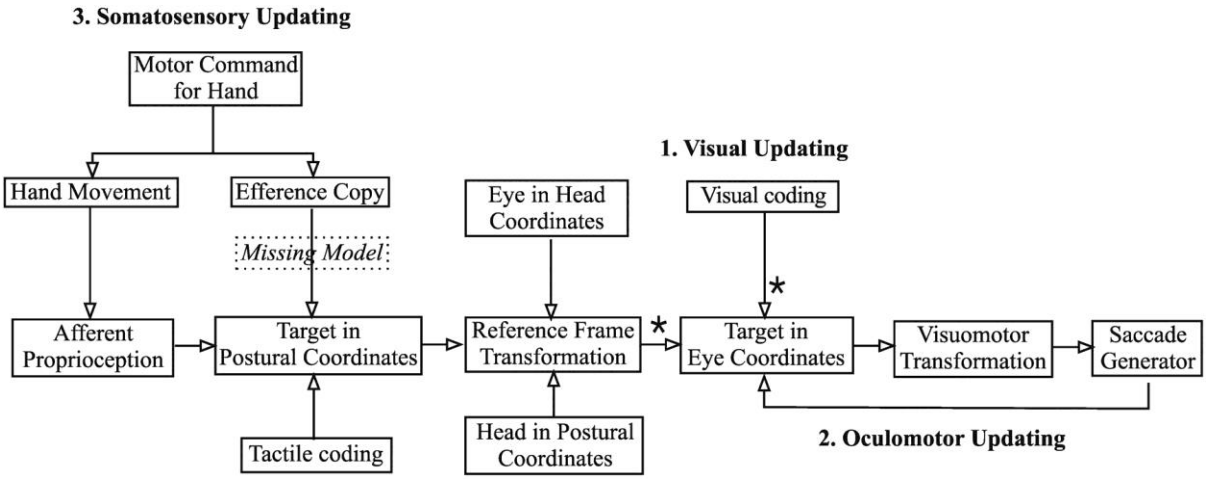


Figure 1n: Visual memory

1.10. 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.

My 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. It is in these silences, where our focus is total and complete, that true balance and healing can occur, as our brain and heart move into coherence.

On the other hand, we have all experienced how certain types of music, while affecting our mood, can also distract us or make us inattentive to tasks at hand.

This makes complete sense. Unlike the attentive silences of the previous study, some songs can negatively engage our attention, as we become part of the song's story or scene. Lyrics are descriptive and engage our analytical mind, and lyrically heavy music could divide the attention of many people's brains. [30]

1.10.1. 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.[31]

Figure 1o: Hand and eye coordination

1.10.2. 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.

ADHD medications increase activity in the prefrontal cortex and attention-related areas of the parietal cortex during challenging mental tasks; these are the same areas that the study I cited yesterday demonstrated to be underactive in ADHD brains. However, there may be different forms of ADHD and there is an urgent need to develop more effective drugs to regulate these two different frequencies in order to improve attention for specific forms of the disorder. [32]

1.11. Attention-deficit hyperactivity disorder (ADHD)

1.11.1. 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. [33]

1.11.2. 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 [34]

1.11.3. 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 [35]

1.11.4. 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

1.11.5. 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. [36]

1.11.6. To see a doctor

If you're concerned that your child shows signs of ADHD, see your paediatrician or family doctor. Your doctor may refer you to a specialist, but it's important to have a medical evaluation first to check for other possible causes of your child's difficulties.

1.11.7. Causes

While the exact cause of attention-deficit/hyperactivity disorder is not clear, research efforts continue. Factors that may be involved in the development of ADHD include:

- **Genetics:** ADHD can run in families, and studies indicate that genes may play a role.
- **Environment:** Certain environmental factors, such as lead exposure, may increase risk.
- **Development:** Problems with the central nervous system at key moments in development may play a role.

1.11.8. Risk factors

Risk factors for attention-deficit/hyperactivity disorder may include:

- Blood relatives, such as a parent or sibling, with ADHD or another mental health disorder
- Exposure to environmental toxins — such as lead, found mainly in paint and pipes in older buildings
- Maternal drug use, alcohol use or smoking during pregnancy
- Premature birth

Although sugar is a popular suspect in causing hyperactivity, there's no reliable proof of this. Many issues in childhood can lead to difficulty sustaining attention, but that's not the same as ADHD. [37]

1.11.9. 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

1.11.10. 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 [38]

1.12. Focusing your attention

Focusing your attention on what you are reading or studying is another skill that can be learned and used to improve your concentration. There are a number of tricks and techniques you can use to direct your attention to what you are reading or studying. As you apply these techniques, you will find that your mind wanders less often and that you are able to complete reading and studying assignments more efficiently. Give Yourself a Goal: Psychologically, reaching or achieving a goal is a positive, rewarding experience. For each reading assignment you have to do or exam you have to study for, give yourself a goal to work toward. Instead of just sitting down and beginning, first figure out how much you can accomplish in a specific amount of time. Set a time limit and work toward meeting it. [39]

1.13. Improve Attention

1.13.1. Meditation

Meditation is one of the best ways to improve your focus, as it is the mental training of your attention. Similar to the effect weight lifting has on your muscles, meditation trains your 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.

1.13.2. Exercise

Exercise doesn’t just improve your physical fitness; it increases your 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.

1.13.3. Stay dehydration

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

1.13.4. Listening music

Break out the Beethoven; classical music helps you 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.

1.13.5. Drinking tea

Coffee might make you alert, but tea can help you 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. [40]

1.14. 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. [41]

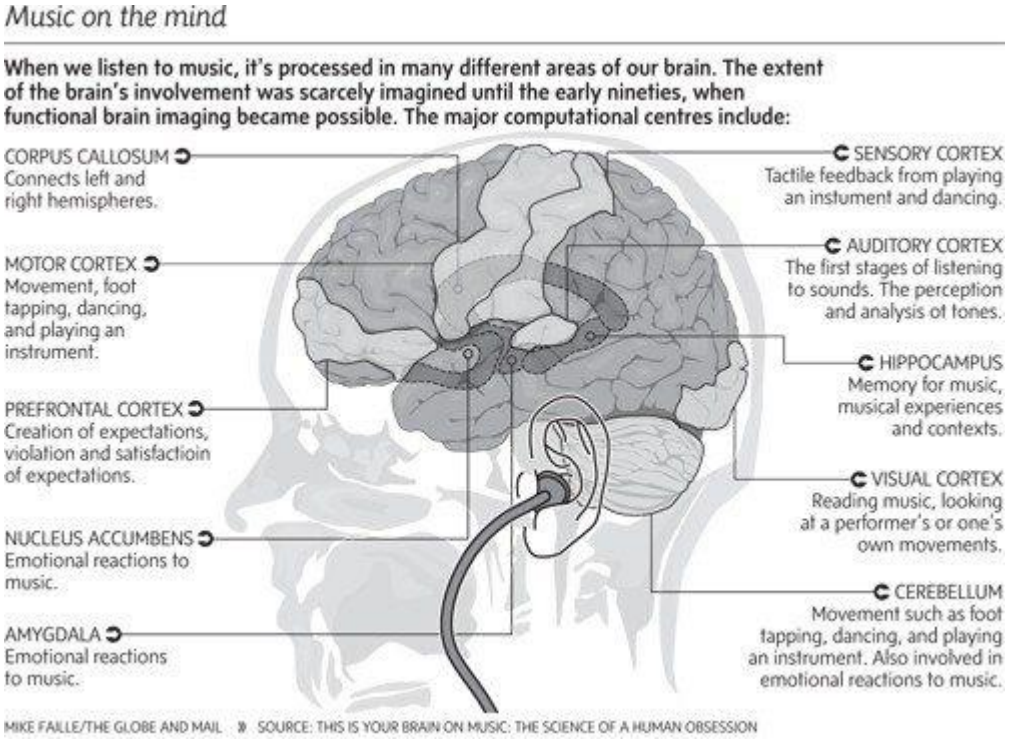


Figure 1p: Music on the brain

1.14.1. A headache and Migraine

Music can help migraine and chronic headache sufferers reduce the intensity, frequency, and duration of the headaches.

1.14.2. Cognition, Intelligence, Learning, and IQ

The music makes one smarter and the listening or playing an instrument helps in better learning. The classical music including Mozart increases the performance in reasoning tests. But the new findings prove that any personally enjoyable music has similar effects.

1.14.3. Concentration and Attention

Listening to the relaxing classical music improves the duration and intensity of concentration in all age groups and ability levels. The choice of music may vary from person to person.

1.14.4. Enhances Higher Brain Functions

Music is beneficial for the children with attention deficit or hyperactivity disorder and benefits in mathematics tests. It increases emotional intelligence and helps to recall the autobiographical or episodic information. It alleviates depression, anxiety, and agitation by improving brain functions.

1.14.5. Boosts Dopamine and Oxytocin

The music causes measurable changes in certain neurotransmitters and stimulates the formation of brain chemicals. It increases the neurotransmitter dopamine, a motivation molecule of pleasure which is also derived from eating chocolate, orgasm etc.The formation of brain hormone oxytocin gets stimulated by playing group music and enjoying live musical concerts. This trust or moral hormone helps in trusting and forms a bond with others. It makes the people more generous and trustworthy. [42]

1.14.6. Alzheimer's disease

The patients in advanced stages of Alzheimer's disease lose their ability to have interactive conversations and ultimately stop speaking completely. The familiar music of youthful days reawakens and lights them up. They even start singing and the musical memories seem to outweigh other memories.

1.14.7. Depression and Blues

The high beats of music reduce the negative emotions and distract the attention from stress. It improves the mood, heals the soul and lifts the spirits due to psychotherapeutic benefits. The cheerful tones of Mozart, Vivaldi, bluegrass, Salsa, reggae, etc. are beneficial in blues. According to the British Journal of Advanced Nursing, the music reduces depression by 25%.

1.14.8. Anti-anxiety

Music is best for preoperative anxiety and the anxiety related to dental procedures. It reduces post-surgical stress and pain and decreased the symptoms of depression in elderly people.

1.14.9. Mood

The favourite and upbeat music boosts the mood and increases the work efficiency by giving happiness. The workers work fast and come up with novel ideas than those having no control over the choice of music. It makes us more optimistic, joyful, friendly and relaxed.

1.14.10. Pain relief

The music can reduce the sensation and distress of chronic and postoperative pain. According to the British Journal of Advanced Nursing, the music reduces the pain of osteoarthritis, disc problems and rheumatoid arthritis by 21% and supplements the use of anaesthesia during surgery.

The music affects the pain by creating a repulsive effect or gives a sense of control or induces the body to release endorphin which neutralizes pain or by decelerating the breathing and heartbeat.

1.14.11. Sad music has its benefits too

If you are going through a tough time, listening to sad music is cathartic.

It can help you get in touch with your emotions to help you heal [43]

1.15. Music Improves Memory

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. [44]

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. [45]

1.16. Music improves concentration and 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. [46]

1.17. 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.[47]

Dopamine Boosting Supplements See Amazon.com for best selection and valueplaying music with others or enjoying live music stimulates the brain hormone oxytocinhas been called the "trust molecule" and the "moral molecule" since it helps us bond with and trust others. There's evidence that the oxytocin bump experienced by music lovers can make them more generous and trustworthy. [48]

1.18. Music Helps You 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 [49]

1.19. Listening music in working time

1.19.1. Relaxation

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

1.19. 2. Concentration

"It improves my ability to focus on what I am working on "Music can aid your 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. You can control your sounds cape in the office and replace external interruptions with sounds of your choice.

1.19. 3. Emotional management

"It helps me to remain positive "Music can be inspirational; it can encourage thoughts and motivate you. 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 your frustrations. It can also provide a sense of company when you're working space is too quiet or empty.

1.19. 4. It blocks out distractions

"It helps me concentrate, especially when someone else is in the office, or talking on the phone, or having a meeting nearby "Being able to block out distractions can be a way to cope with stress, as it gives you more control over your environment. Headphones in particular help to improve concentration in two ways.

1.19.5. Helps you think

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. [50]

1.20. 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 your brain as it is for your overall health, and eating right may in fact be more important than you think. After all, you are what you eat. 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 you 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 your 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. [51]

1.20.1. Water

Seriously, sometimes all you really need is a glass of refreshing water to kick off the day, especially if you 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 you further, causing you to feel worse later. So before you do anything, drink a tall 10-ounce glass of water. Squeeze some fresh lemon in it for a little extra kick.”

1.20.2. Eggs

You may be tempted to ditch the yolk when preparing eggs, but some experts actually insist on keeping it. “Whole eggs, yolk included, are a dense source of the omega-3 fatty acid DHA,” says Shemek. “Research has shown that adequate omega-3 intake has a favorable effect upon memory and mood. Eggs also contain chorine, a compound thatcan 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 [52]

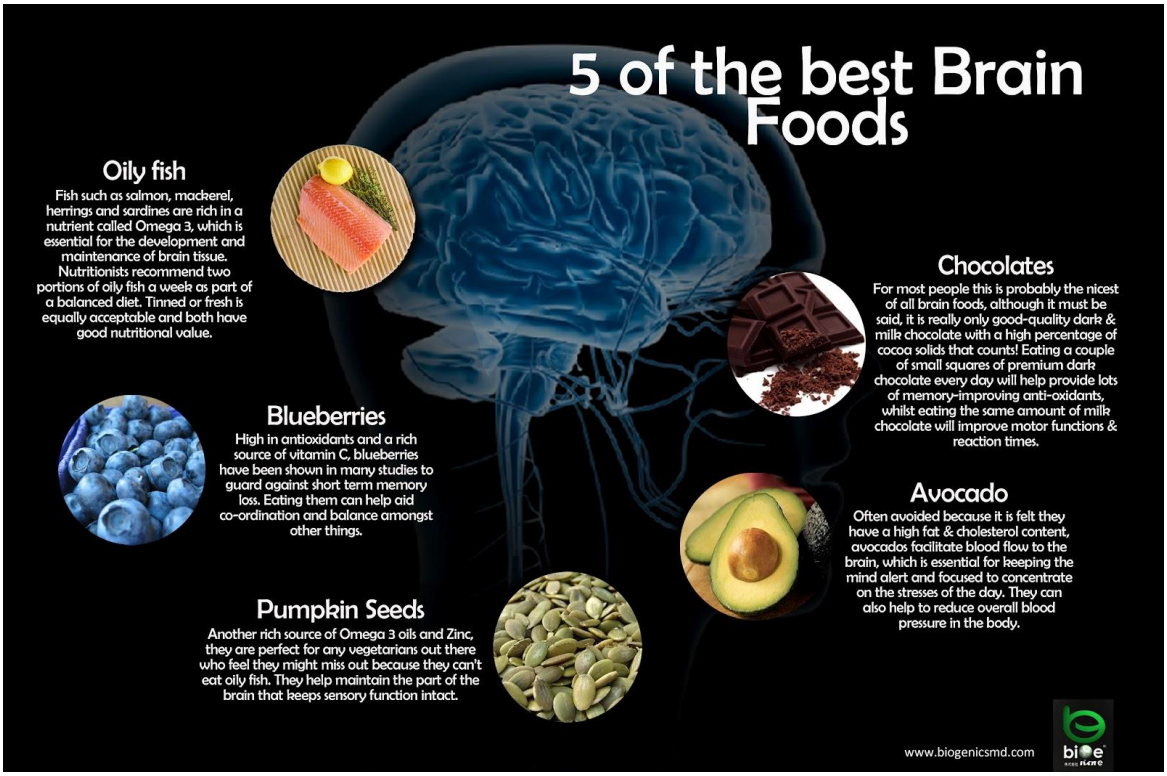


Figure 1Q: Best food for brain development

1.20.3. Nuts

Nuts, especially walnuts and almonds, are extremely good for the brain and nervous system. They are great sources of omega 3 and omega 6 fatty acids, vitamin B6, and vitamin E. Vitamin E has been shown to prevent many forms of dementia by protecting the brain from free radicals, and it improves brain power. Nuts contain some anti-nutrients. Since we consume a relatively small amount of nuts, this isn't a huge problem, but they are far healthier if you soak them overnight (about 8 hours) before eating them.

1.20.4. Whole grains

Like everything else in your body, the brain cannot work without energy. The ability to concentrate and focus comes from an adequate, steady supply of energy - in the form of glucose in our blood to the brain. Achieve this by choosing *whole grains* with a *low-GI*, which release glucose slowly into the bloodstream, keeping you mentally throughout the day. Opt for 'brown' wholegrain cereals, granary bread, rice and pasta. [53]

1.20.5. Avocado

Avocados are a source of monounsaturated fats, omega 3, and omega 6 fatty acids. These increase blood flow to the brain, lower cholesterol, and aid in the absorption of antioxidants. Avocados also come with many antioxidants of their own, including vitamin E, which protect the body and the brain from free radical damage. They are also a good source of potassium and vitamin K—both protect the brain from the risk of stroke.

1.20.6. Coconut Oil

Coconut oil contains medium chain triglycerides that the body uses for energy, leaving glucose for the brain. It also seems to have a beneficial effect on blood sugar, blood pressure, and cholesterol. Anything that benefits the heart and circulation also benefits the brain. Coconut oil acts as an anti-inflammatory as well and has been linked to helping prevent Alzheimer's and dementia.

1.20.7. Dark Chocolate

The flavones in chocolate improve blood vessel function, which in turn improves cognitive function and memory. Chocolate also improves mood, can ease pain, and is full of antioxidants.

1.20.8. Green tea

Green tea helps you focus for two reasons: one, it contains caffeine, and two, it contains thiamine. There is no doubt that caffeine helps you focus and improves your alertness. Good. Which increases tranquility and releases caffeine more slowly, instead of all at once, which can lead to you crashing? The two ingredients also combine to "produce a better ability to focus attention, with improvement of both speed and accuracy". [54]

1.21. Some benefits to listening to music

Enjoyment goes far beyond the present moment, as it directly influences the outcome of our hormones and cognitive functioning. While research has suggested that people who play instruments are smarter, there are also plenty of benefits for the music enthusiasts.

Here is a list of some benefits to listening to music:

1.21.1. Music Increases Happiness

This might seem obvious, but the natural chemical reasoning is pretty incredible to think about. If you are ever in need of an emotional boost, let it be known that it only takes 15 minutes of listening to your favorite tunes to get a natural high. This is because your brain releases dopamine, a neurotransmitter that leads to increased feelings of happiness, excitement, and joy, when you listen to music you like.

1.21.2. Music Improves Performance in Running

Scientists found that runners who listened to fast or slow motivational music ran faster than runners who listened to calm music (or ran without any music at all) in an 800-meter dash. The key to enhancing your running performance lies in the choice of music, that being something that inspires you to move forward.

1.21.3. Music Decreases Stress, While Increasing Overall Health

Music has a direct effect on our hormones. If you listen to music you enjoy, it decreases levels of the hormone cortical in your body, counteracting the effects of chronic stress. Stress causes 60% of all illnesses and diseases, so lower levels of stress mean higher chances of overall well-being. One study even showed that a group of people playing various percussion instruments and singing had boosted immune systems compared to the people who were passively listening; while both groups' health was positively affected by music, the group playing instruments and/or singing had better results. For maximum benefits on a stressful day, turn on some music and sing along. [55]

1.21.4. Music Improves Sleep

Over 30% of Americans suffer from insomnia. A study showed that listening to classical or relaxing music within an hour of going to bed significantly improves sleep, compared to listening to an audio book or doing nothing before bed. Since we know music can directly influence our hormones, it only makes sense to throw on some Beethoven bed when in need of a good night's sleep.

1.21.5. Music Reduces Depression

Music has a direct effect on our hormones; it can even be considered a natural anti-depressant. This is because certain tunes cause the release of serotonin and dopamine

(neurotransmitters) in the brain that lead to increased feelings of happiness and well-being. It also releases nor epinephrine, which is a hormone that invokes feelings of euphoria.

More than 350 million people suffer from depression around the world, and 90% of them also experience insomnia. The above research also found that symptoms of depression only decreased in the group that listened to classical or relaxing music before going to bed. Another study demonstrated that certain types of music can be beneficial to patients with depressive symptoms. Interestingly, while classical and relaxing music increased positive moods, techno and heavy metal brought people down even more.

1.21.6. Music helps to eat less

According to research, the combination of soft lighting and music leads people to consume less food (and enjoy it more).

1.21.7. Music elevates mood

Who isn't guilty of blasting Phish on the highway? A study found that listening to music positively influences your mood while driving, which obviously leads to safer behavior and less road rage. So be sure to turn up the "Reba" jams!

1.21.8. Strengthening learning and memory

Listening to music can also help you learn and recall information more efficiently, researchers say. Though it depends on the degree to which you like the music and whether or not you play an instrument. A study showed that musicians actually learned better with neutral music, but tested better with music that they liked; whereas non-musicians learned better with positive music but tested better with neutral music. Therefore, the degree of performance differentiates between learning and memory for musicians and non-musicians.

1.21.9. Increases Verbal Intelligence

A study showed that 90% of children between the ages of 4 and 6 had significantly increased verbal intelligence after only a month of taking music lessons, where they learned about rhythm, pitch, melody, and voice. The results suggest that the music training had a "transfer effect" that increased the children's ability to comprehend words, and even more, explain their meaning. Another study showed similar results in musically trained

adultwomen and children that outperformed a group with no music training on verbal memory tests.

1.21.10. Raises IQ and academic performances

Research suggests that taking music lessons predetermines high academic performance and IQ scores in young children. The study surveyed a group of 6-year-olds who took keyboard or vocal lessons in small groups for 36 weeks. The results showed they had significantly larger increases in IQ and standardized educational test results over that time than children who took other extracurricular activities unrelated to music. The singing group showed the most improvement. [56]

1.22. Song affects our brains and our bodies

1.22.1. Happy or sad music affects ability

Generally, when we hear a sad song, we can identify that it sounds sad and the same goes for happy compositions – but this isn't because it makes us feel particularly happy or sad, it's because our brain responds in a certain way to sad music, and a different way to happy music. One how after hearing a shot piece of music, participants were more likely to interpret a neutral expression as either happy or sad, depending on the tone of music they heard.[57]

1.22.1.1. Types of emotions related to music

Perceived emotions and felt emotions – both of which are very different entities. Sometimes, it is possible to understand the emotions of a piece of music without feeling them ourselves, which explains why some people enjoy listening to sad music where others may find it depressing. [58]

1.22.2. Rock music harmed dendrite patterns

The ability of mice to navigate a food maze was tested by continuously playing the music at low volumes to eliminate behavioural changes. Those subjected to either silence or Strauss waltzes had no problem in the maze with a little advantage for the latter. Those exposed to voodoo drumming performed worse and finally became cannibalistic, hyperactive, aggressive and even confused to complete the maze. The highly abnormal neuronal growth patterns with excessive dendrite branches growing out in all directions and having few

connections with other neurons were found in the hippocampus region of the brains of these mice. This region acts in learning and memory formation. Due to an increase in dendrite branching, the messenger RNA involved in memory formation too increased. It meant that the brain tried to analyse the sound stimulus, but failed. [59]

Chapter two

Literature Review

2.1. Dementia. (n.d.). Music for the ageing brain: Cognitive, emotional, social, and neural benefits of musical leisure activities in stroke and dementia. Retrieved from ncbi.nlm.nih.govUniversity of Helsinki, Finland.Wunderlin 1995

Music engages an extensive network of auditory, cognitive, motor, and emotional processing regions in the brain. Coupled with the fact that the emotional and cognitive impact of music is often well preserved in ageing and dementia, music is a powerful tool in the care and rehabilitation of many ageing-related neurological diseases. In addition to formal music therapy, there has been a growing interest in self- or caregiver-implemented musical leisure activities or hobbies as a widely applicable means to support psychological wellbeing in ageing and in neurological rehabilitation. This article reviews the currently existing evidence on the cognitive, emotional, and neural benefits of musical leisure activities in normal ageing as well as in the rehabilitation and care of two of the most common and ageing-related neurological diseases: stroke and dementia [60](**Wunderlin**)

2.2.Kent, D. (n.d.). MUSIC ON HUMANS. Retrieved from digitalcommons.liberty.edu:the Effect of Music on the Human Body and Mind

Music has a vast influence over the nations and peoples on this planet. It has been used in every culture, and is often connected with anxiolytic and analgesic properties. Today it is used in many hospitals to help patients relax and help relieve or ease pain, confusion and anxiety. Music is also commonly used in counseling. Music therapy techniques may include guided listening or improvisational playing and are used within the context of many theories, and for many types of mental disorders, from depression to schizophrenia. Many of the healing qualities of music in counseling are connected to its use as a nonverbal medium for communication. Music is read differently in the brain than nonmusical tones and is connected to many different areas of the brain. Learning music relegates a larger part of the brain to recognizing and interpreting music. Listening to music has also been found to have an effect on learning. A survey studying the difference in GP A between students who listen to music while studying and those who do not finds no overall significant difference, but does find that students who listen to hip-hop and rap while studying score significantly lower while students who listen to easy listening and classical are likely to have higher GPAs. [61]**(Dawn Kent)**

2.3. 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. [62] (**Shan**)

2.4.Alain C., Zendel B. R., Hutka S., Bidelman G. M. (2013). 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. [63](**Alain C., Zendel B. R., Hutka S., Bidelman G. M.)**

2.5.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. [64] (**Thoma.M.V)**

2.6.Fougnie, D. (n.d.). The Relationship between Attention and Working Memory. Retrieved from psy.vanderbilt.edu:DarylFougnie Vanderbilt University

The ability to selectively process information (attention) and to retain information in an accessible state (working memory) are critical aspects of our cognitive capacities. While there has been much work devoted to understanding attention and working memory, the nature of the relationship between these constructs is not well understood. Indeed, while neither attention nor working memory represent a uniform set of processes, theories of their relationship tend to focus on only some aspects. This review of the literature examines the role of perceptual and central attention in the encoding, maintenance, and manipulation of information in working memory. While attention and working memory were found to interact closely during encoding and manipulation, the evidence suggests a limited role of attention in the maintenance of information. Additionally, only central attention was found to be necessary for manipulating information in working memory. This suggests that

theories should consider the multifaceted nature of attention and working memory. The review concludes with a model describing how attention and working memory interact. [65](**Fougnie, D)**

2.7. Pylyshyn, Z. (n.d.). Is vision continuous with cognition? Retrieved from ruccs.rutgers.edu-zenonpylyshyn/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. [66] **(Pylyshyn)**

2.8. Giesen, v. (2015). Affect and Cognition in Attitude Formation toward Familiar and Unfamiliar Attitude Objects. *plos one* .

At large attitudes are built on earlier experience with the attitude object. If earlier experiences are not available, as is the case for unfamiliar attitude objects such as new technologies, no stored evaluations exist. Yet, people are still somehow able to construct attitudes on the spot. Depending on the familiarity of the attitude object, attitudes may find their basis more in affect or cognition. The current paper investigates differences in reliance on affect or cognition in attitude formation toward familiar and unfamiliar realistic attitude objects. In addition, individual differences in reliance on affect (high faith in intuition) or cognition (high need for cognition) are taken into account. In an experimental survey among Dutch consumers (N = 1870), we show that, for unfamiliar realistic attitude objects, people rely more on affect than cognition. For familiar attitude objects where both affective and cognitive evaluations are available, high need for cognition leads to more reliance on cognition, and high faith in intuition leads to more reliance on affect, reflecting the influence of individually preferred thinking style. For people with high need for cognition, cognition has a higher influence on overall attitude for both familiar and unfamiliar realistic attitude objects. On the other hand, affect is important for people with high faith in intuition for both familiar and unfamiliar attitude objects and for people with low faith in intuition for unfamiliar attitude objects; this shows that preferred thinking style is less influential for unfamiliar objects. By comparing attitude formation for familiar and unfamiliar realistic attitude objects, this research contributes to understanding situations in which affect or cognition is the better predictor of overall attitudes. [67] (**Giesen)**

2.9.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. [68] (**Thaung Zaw JJ1)**

2.10. Jones HA1, E. L. (2017). Attention-deficit/hyperactivity disorder symptom clusters differentially predict prenatal health behaviors in pregnant women. *J Clin Psychol.* .

To date, most investigations of mental health in pregnant women have focused on depression or substance use. This study aimed to (a) delineate the relationships between symptoms of attention-deficit/hyperactivity disorder (ADHD) and prenatal health behaviours and (b) explore whether the symptom clusters of ADHD differentially predict prenatal health behaviours (e.g., physical strain, healthy eating, and prenatal vitamin use).A total of 198 pregnant women (mean age = 27.94 years) completed measures of ADHD symptoms, prenatal health behaviours, and depression. Inattention, hyperactivity, and impulsivity/emotional lability all evidenced significant relationships with the prenatal health behaviours, each differentially predicting different prenatal health behaviours. As decreased engagement in adequate prenatal health behaviours puts both the mother and foetus at risk for negative birth outcomes, future research should work to develop a brief ADHD screen to be used in obstetric clinics and should investigate these relationships within a sample of women with a diagnosis of ADHD.[69](**Jones HA1)**

2.11. 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 [70]. (**Egbert AH1)**

2.12. .Benevides TW1, C. H. (2017). Therapy access among children with autism spectrum disorder, cerebral palsy, and attention-deficit-hyperactivity disorder: a population-based study. *Dev Med Child Neurol.*

This study examined cross-sectional population-based rates in reported need and unmet need for occupational, physical, and speech therapy services in children with autism spectrum disorder (ASD) compared with children with attention-deficit-hyperactivity disorder (ADHD) and cerebral palsy (CP).The 2005-2006 and 2009-2010 (USA) National Survey of Children with Special Health Care data sets were used to compare

therapy need and unmet need among children younger than 18 years with ASD (n=5178), ADHD (n=20 566), and CP (n=1183). Bivariate approaches and multivariate logistic regression using imputed data were used to identify associations between child and family characteristics, and access to therapy services.After adjusting for other variables, children with ASD had a significantly greater likelihood of having an unmet therapy need compared with children with ADHD (odds ratio [OR] 1.66, 95% confidence interval [CI] 1.36-2.03), but a similar unmet need as children with CP (OR 1.30, 95% CI 0.97-1.74). Factors associated with unmet need included survey year, younger child age, no health insurance, and increased functional and behavioural difficulties.Children in our sample had greater unmet therapy needs in 2009 than in 2005. Caregiver-reported reasons for unmet need included cost and school resources. Research examining future trends in therapy access is warranted for children with ASD and CP. [71] (**Benevides TW1)**

2.13. Gulbinaite R1, 2. v. (2017). Individual alpha peak frequency predicts 10 Hz flicker effects on selective attention. *J Neurosci*.

Rhythmic visual stimulation ("flicker") is primarily used to "tag" processing of low-level visual and high-level cognitive phenomena. However, preliminary evidence suggests that flicker may also entrain endogenous brain oscillations, thereby modulating cognitive processes supported by those brain rhythms. Here we tested the interaction between 10 Hz flicker and endogenous alpha-band (~10 Hz) oscillations during a selective visuospatial attention task. We recorded EEG from human participants (both genders) while they performed a modified Eriksen flanker task in which distractors and targets flickered within (10 Hz) or outside (7.5 or 15 Hz) the alpha band. By using a combination of EEG source separation, time-frequency, and single-trial linear mixed effects modelling, we demonstrate that 10 Hz flicker interfered with stimulus processing more on incongruent than congruent trials (high vs. low selective attention demands). Crucially, the effect of 10 Hz flicker on task performance was predicted by the distance between 10 Hz and individual alpha peak frequency (estimated during the task). Finally, the flicker effect on task performance was more strongly predicted by EEG flicker responses during stimulus processing than during preparation for the upcoming stimulus, suggesting that 10 Hz flicker interfered more with reactive than proactive selective attention. These findings are consistent with our hypothesis that visual flicker entrained endogenous alpha-band networks, which in turn impaired task performance. Our findings also provide novel evidence for frequency-

dependent exogenous modulation of cognition that is determined by the correspondence between the exogenous flicker frequency and the endogenous brain rhythms. Significance statement here we provide novel evidence that the interaction between exogenous rhythmic visual stimulation and endogenous brain rhythms can have frequency-specific behavioural effects. We show that alpha-band (10 Hz) flicker impairs stimulus processing in a selective attention task when the stimulus flicker rate matches individual alpha peak frequency. The effect of sensory flicker on task performance was stronger when selective attention demands were high, and was stronger during stimulus processing and response selection compared to the pre-stimulus anticipatory period. These findings provide novel evidence that frequency-specific sensory flicker affects online attentional processing, and also demonstrate that the correspondence between exogenous and endogenous rhythms is an overlooked prerequisite when testing for frequency-specific cognitive effects of flicker. [72] (**Gulbinaite R)**

2.14.S1., S. (2017). Toward Studying Music Cognition with Information Retrieval Techniques: Lessons Learned from the OpenMIIR Initiative. ***Front Psychol.*** **.**

As an emerging sub-field of music information retrieval (MIR), music imagery information retrieval (MIIR) aims to retrieve information from brain activity recorded during music cognition-such as listening to or imagining music pieces. This is a highly inter-disciplinary endeavour that requires expertise in MIR as well as cognitive neuroscience and psychology. The OpenMIIR initiative strives to foster collaborations between these fields to advance the state of the art in MIIR. As a first step, electroencephalography (EEG) recordings of music perception and imagination have been made publicly available, enabling MIR researchers to easily test and adapt their existing approaches for music analysis like fingerprinting, beat tracking or tempo estimation on this new kind of data. This paper reports on first results of MIIR experiments using these OpenMIIR datasets and points out how these findings could drive new research in cognitive neuroscience.[73] (**S1., SOLBET)**

2.15. 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. [74] **(MUNDY .P)**

Chapter Three

Rational aims of study

3.1 Aims of study

One's attention span can have a major impact on your performance at work and your 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 your 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 we all know, stress plays a prominent role in our 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 we are 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. [75]

3.2. Objectives

The specific objectives of TR tests are offered below:

1 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. TR tests are efficient.

4. To check the attention power of human. Here 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 TR tests are impressive.

6. To confirm that effect of different type of songs have different effects on the attention of human. Here TR tests are effective.

7. To determine attention in participants (department of pharmacy student) that how song Affect 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 AtishDipankar 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 TR tests without any music (Control)

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

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

Group 4: Subjected to TR 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										
TR										

4.2. Attention Test

4.2.1. Typo Revealing Test

This test is based on detecting the typo from a passage. In this test a standard passage contains 250 words is given to the subject to read carefully at a glance presented in Figure 4. After that intentionally some typological mistakes are incorporated to the passage. This type of mistake may addition of any letter/punctuation or deletion of any letter/punctuation (*i.e*., nerve instead of nerve; Alzheimer's disease instead of Alzheimer's disease), substitution of any letter/punctuation (*i.e*., antibiotics instead of antibiotics; N_acetyl-p-aminophenol instead of N-acetyl-p-aminophenol), inversion of any letter (*i.e*., science instead of science), providing capital letter instead of small letter etc. and given to subject to find the typos existing in Figure 5. The time taken by subject, to find the typo is considered as typo finding time (TFT). The duration of this test is 180 seconds. The duration of this test mainly depends on the characters of the sample and the type of the passage used. Consequently, one can select the duration by providing passage to a number of samples to read carefully and select the mean time. Gradual decrease in TFT indicates improvement of the attention. The percentage of improved attention (IA) is calculated by using the formula given below:

$$\% \text{ of IA} = \text{TNCTs} \times 100 \text{ TNPTs}$$

Where, TNCTs = Total number of correct typos identified by the subject, TNPTs = Total number of presented typos in the passage. An increase in IA is considered as an index of greater attention.

- **Finding**

Gradual decrease in TFT indicates improvement of the attention.

- **Note**

The duration of this test mainly depends on the characters of the sample and the type of the passage used. Consequently, one can select the duration by providing passage to a number of samples to read carefully and select the mean time.

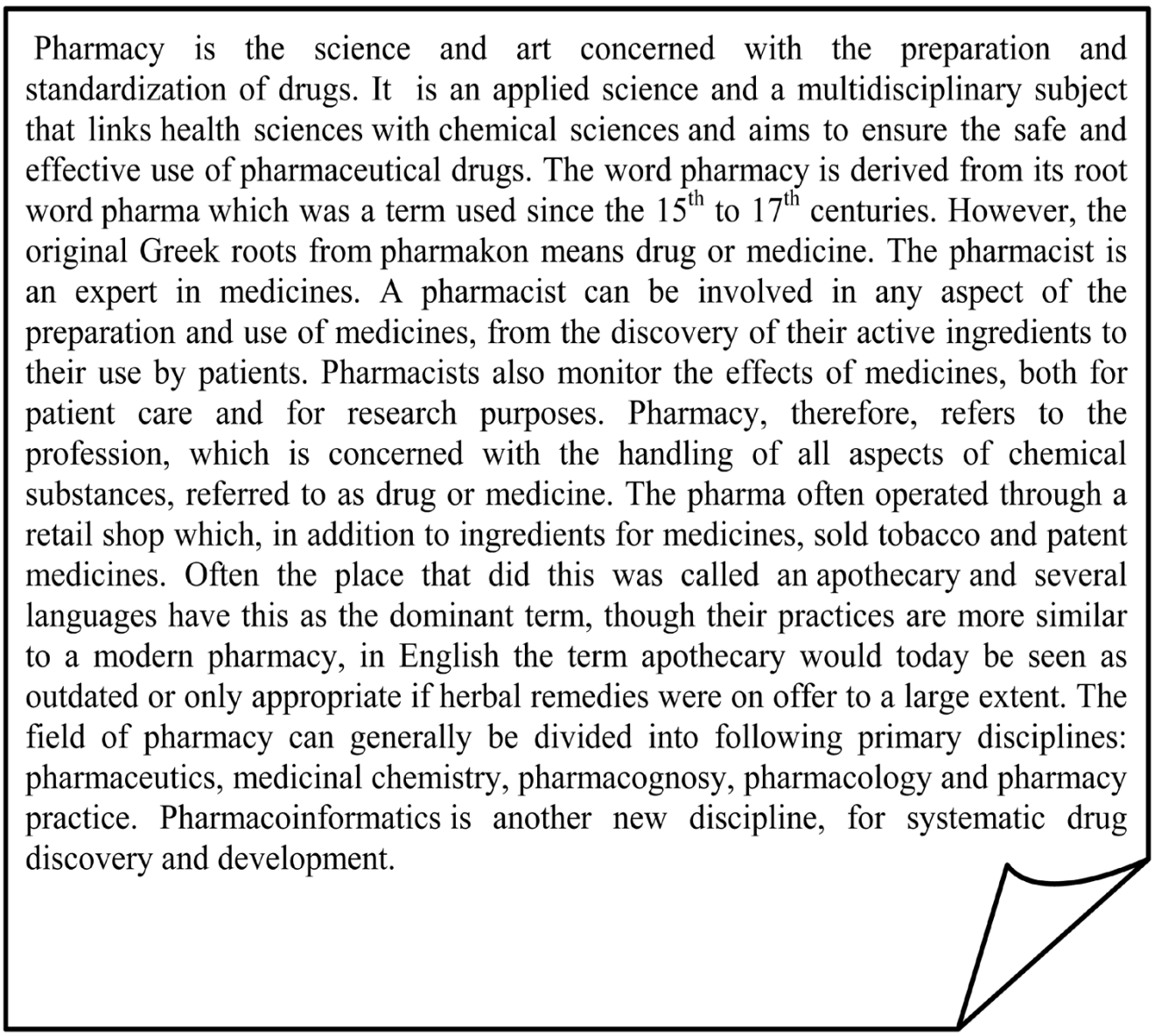


Figure 4a. Typo revealing test by using a passage.Standard passage given to the subject to read carefully at a glance.

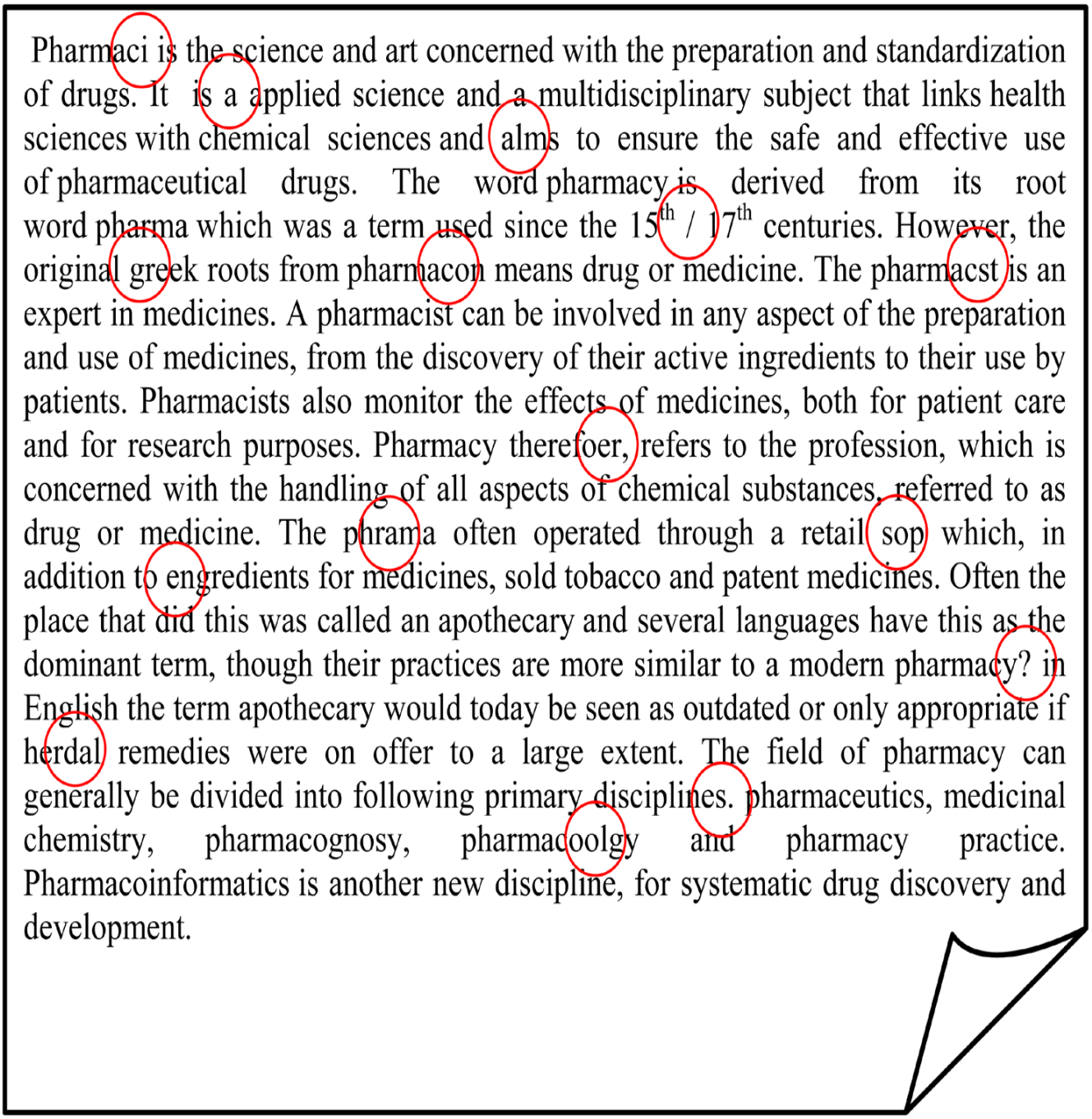
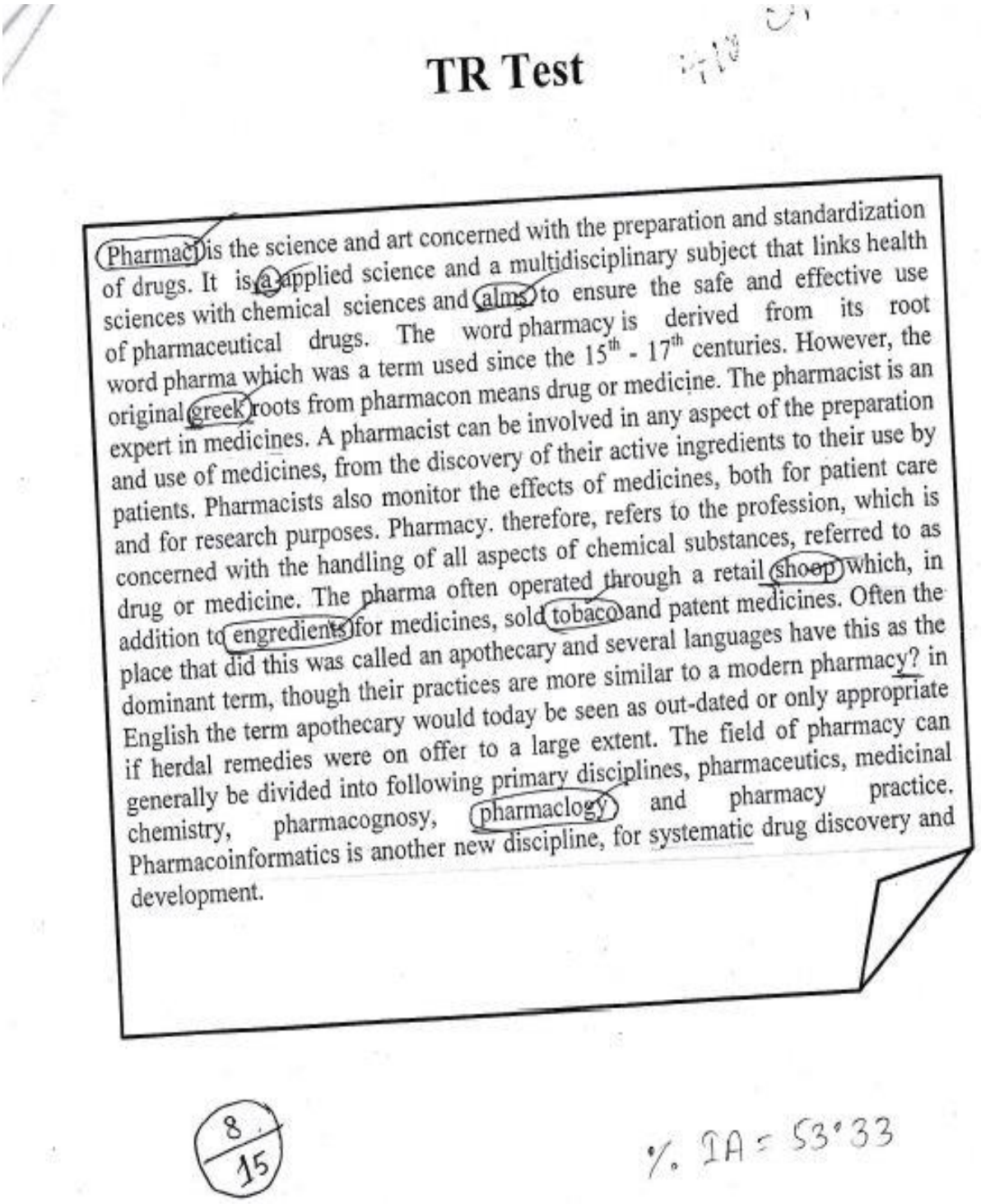


Figure 4b. Typo revealing test by using a passage. Typological mistakes from the standard passage are marked by red circles.

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 TR test.

4.3.1. Sample of a student who performed excellent:



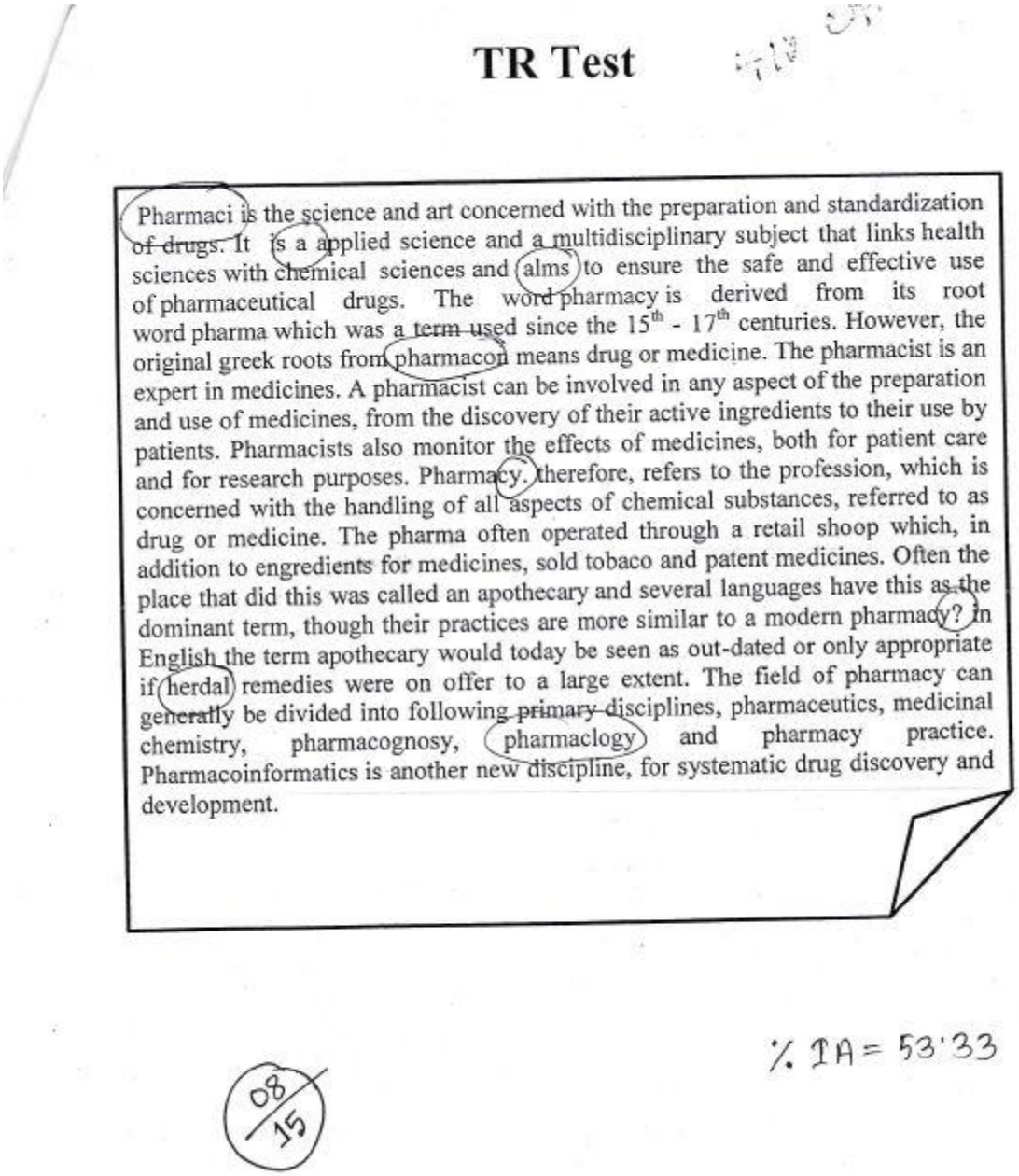
TR Test

Pharmacy is the science and art concerned with the preparation and standardization of drugs. It is a applied science and a multidisciplinary subject that links health sciences with chemical sciences and alms to ensure the safe and effective use of pharmaceutical drugs. The word pharmacy is derived from its root word pharma which was a term used since the 15th - 17th centuries. However, the original greek roots from pharmacon means drug or medicine. The pharmacist is an expert in medicines. A pharmacist can be involved in any aspect of the preparation and use of medicines, from the discovery of their active ingredients to their use by patients. Pharmacists also monitor the effects of medicines, both for patient care and for research purposes. Pharmacy. therefore, refers to the profession, which is concerned with the handling of all aspects of chemical substances, referred to as drug or medicine. The pharma often operated through a retail shoop which, in addition to engredients for medicines, sold tobaco and patent medicines. Often the place that did this was called an apothecary and several languages have this as the dominant term, though their practices are more similar to a modern pharmacy? in English the term apothecary would today be seen as out-dated or only appropriate if herdal remedies were on offer to a large extent. The field of pharmacy can generally be divided into following primary disciplines, pharmaceutics, medicinal chemistry, pharmacognosy, pharmaclogy and pharmacy practice. Pharmacoinformatics is another new discipline, for systematic drug discovery and development.

8/15

% IA = 53'33

4.3.2. Sample of a student who performed average:



TR Test

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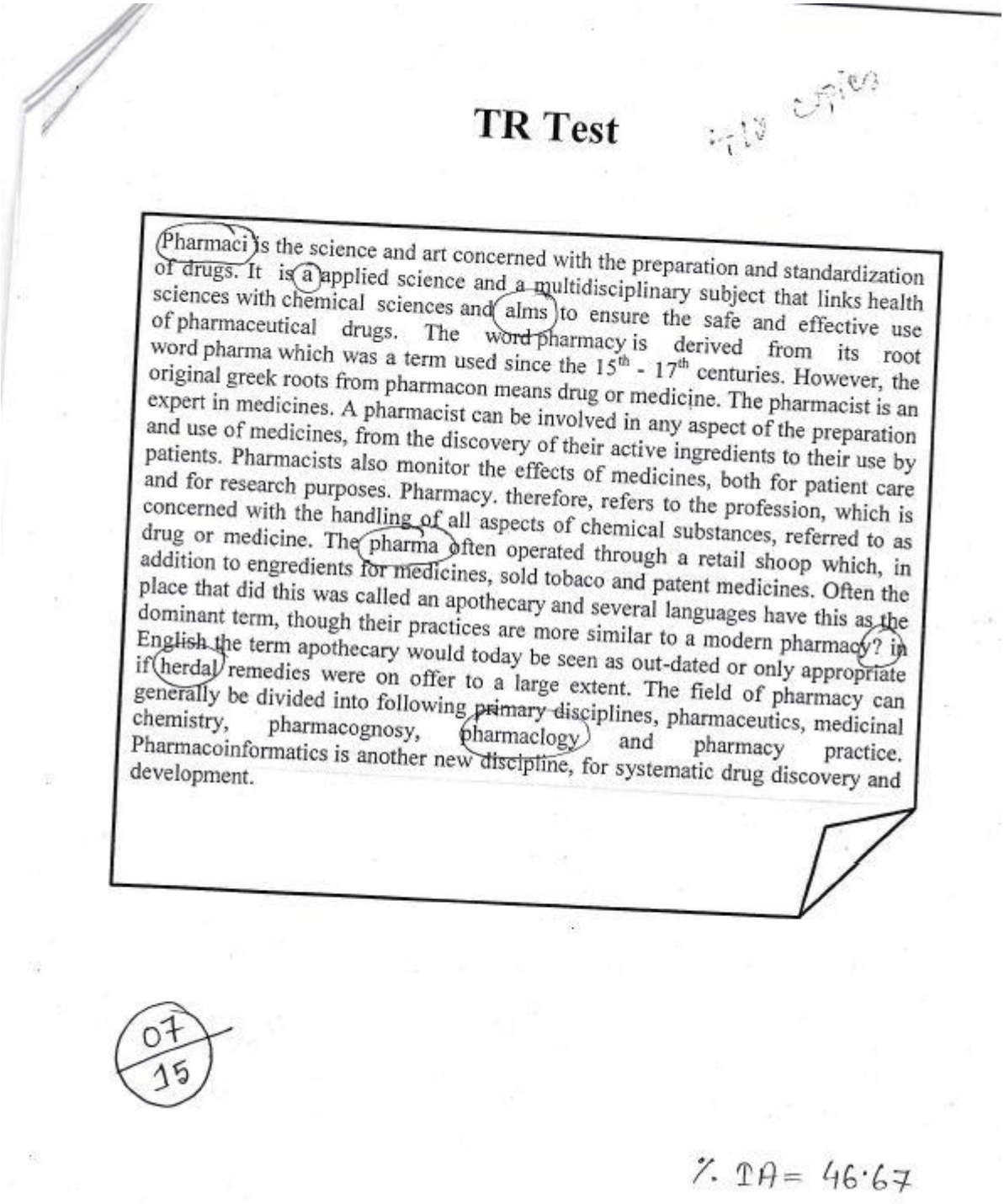
% IA = 53'33

08/15

4.3.3. Sample of a student who performed poor:



TR Test

Pharmaci is the science and art concerned with the preparation and standardization of drugs. It is a applied science and a multidisciplinary subject that links health sciences with chemical sciences and alms to ensure the safe and effective use of pharmaceutical drugs. The word pharmacy is derived from its root word pharma which was a term used since the 15th - 17th centuries. However, the original greek roots from pharmacon means drug or medicine. The pharmacist is an expert in medicines. A pharmacist can be involved in any aspect of the preparation and use of medicines, from the discovery of their active ingredients to their use by patients. Pharmacists also monitor the effects of medicines, both for patient care and for research purposes. Pharmacy. therefore, refers to the profession, which is concerned with the handling of all aspects of chemical substances, referred to as drug or medicine. The pharma often operated through a retail shoop which, in addition to engredients for medicines, sold tobaco and patent medicines. Often the place that did this was called an apothecary and several languages have this as the dominant term, though their practices are more similar to a modern pharmacy? in English the term apothecary would today be seen as out-dated or only appropriate if herdal remedies were on offer to a large extent. The field of pharmacy can generally be divided into following primary disciplines, pharmaceutics, medicinal chemistry, pharmacognosy, pharmaclogy and pharmacy practice. Pharmacoinformatics is another new discipline, for systematic drug discovery and development.

07/15

% IA = 46·67

Chapter five

Results and Discussion

5.1. Result: In this test group 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**		TR 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	42.70± 1.69
Normal	32	38	4	26	40	3	10	17	40	31	39	45.27± 1.90
Stimulating	44	26	13	24	33	10	28	6	26	30	40	45.97± 1.63
Depression	38	32	9	29	32	17	8	24	21	37	33	41.54± 1.68

5.1.2. TR test result

In control group the participants took the test without music and the percentage of cognition is 42.70±1.69.In the normal group the participants took the test with the normal music and the percentage of cognition is 45.27±1.90. In the Stimulating group the participants listen to the stimulating music and took the test and the percentage of cognition is 45.97±1.63. In the depression group the participants took the test with the depressing music and the percentage of cognition is 41.54±1.68.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 [76]. 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 [77]. 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 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 [78]. In the attention process brainstem, neurotransmitter, limbic system and neocortex play an important role [79]. The brainstem passively receives incoming sensory information and starts the process of active attention [80]. In the control of arousal and to ignore irrelevant stimuli, reticular formation and locus cerulean are accountable [81]. Among neurotransmitter, nor epinephrine and dopamine is the important neurotransmitter appear to control the processing of attention [82]. 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 [83]Optimum level of neurotransmitter is best for proper functioning of attention [84] . The limbic system controls the emotional overtones and motivation for attention [85]. 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. [86].

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. [87]

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. [88]

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 [89]. 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 [90]. In this experiment, we used 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 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 [91]. In case of attention factors like focus and intensity can differ broadly [92]. 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 [93]. 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 [94]. 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

Conclusion

Conclusion

The brain is the chair of all intellectual abilities. Attention is the brain-based work supported by specific neuronal networks with the help of neurochemicals. In this experiment, we have developed NF and TR tests for the determination of attention in human and validated the effectiveness of the methods by using a different kind of song that affects the human brain .The results of this experiment suggest that NF and TR tests are highly efficacious for the measurement of the attention . So these testing methods will be effective for various neuropsychopharmacological assessments in human. 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 and TR tests will make breakthrough in the compass of neuroscience. In our test we find how different kind of song affects our attention. In researchers, It is also seen that the stimulating songs give more attention to the volunteers than other genres. It is likely that people gets attentive when listen to stimulating music rather than other music.

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