EFFECT OF VISION ON HUMAN BALANCE SYSTEM

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17/ENG08/003

FOR
BME 312

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Introduction

- Balance is the ability to maintain the body's center of mass over its base of support.
- A properly functioning balance system allows humans to see clearly while moving, identify orientation with respect to gravity, determine direction and speed of movement, and make automatic postural adjustments to maintain posture and stability in various conditions and activities.
- It is comprised of a complex system of ear, eyes, jointsand muscles, brain.

How does the human balance system work

- Maintaining balance depends on information received by the brain from three peripheral sources: eyes, muscles and joints, and vestibular organs.

- EYES- Sensory receptors in the retina are called rods and cones. Rods are believed to be tuned better for vision in low light situations (e.g. at night time). Cones help with color vision, and the finer details of our world. When light strikes the rods and cones, they send impulses to the brain

How does the human balance system work

- There are three loops in your inner ear, called semicircular canals. One canal senses up-and-down movement. Another canal senses side-to-side movement. The third canal senses tilting movements.
- Each canal has hair cells and fluid inside. When you move, the fluid and hair cells move. The hair cells send messages to your brain through the acoustic nerve.
- Parts of your inner ear also tell your brain about where your head is when you are not moving.

Muscles and joints input

. With any movement of the legs, arms, and other body parts, sensory receptors respond by sending impulses to the brain. Along with other information, these stretch and pressure cues help our brain determine where our body is in space.

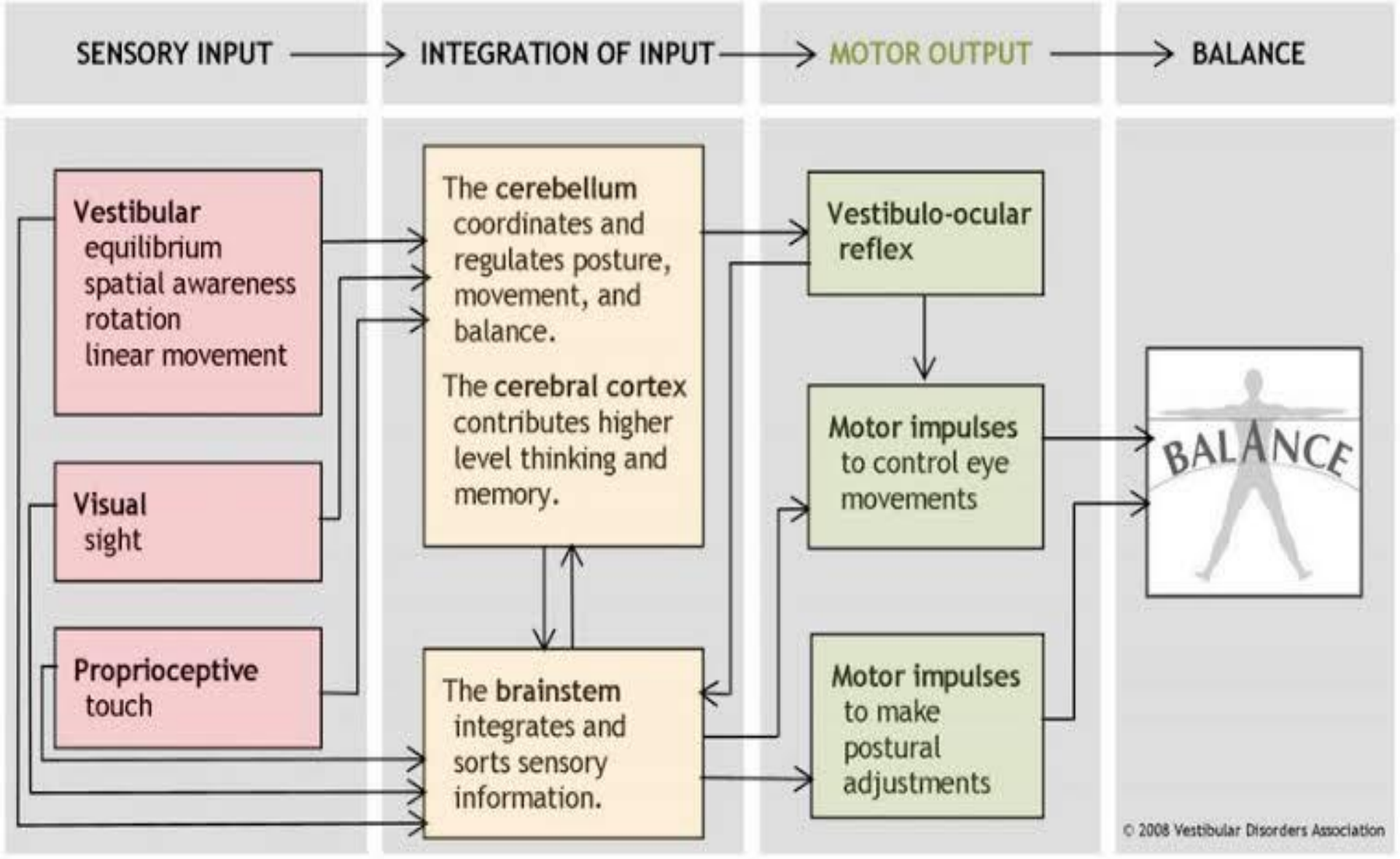
- The sensory impulses originating in the neck and ankles are especially important. Proprioceptive cues from the neck indicate the direction in which the head is turned.

The system at work

- Balance information provided by the peripheral sensory organs—eyes, muscles and joints, and the two sides of the vestibular system—is sent to the brain stem.
- There, it is sorted out and integrated with learned information contributed by the cerebellum (the coordination center of the brain) and the cerebral cortex (the thinking and memory center).
- Contributions from the cerebral cortex include previously learned information.

Human balance ouput

- As sensory integration takes place, the brain stem transmits impulses to the muscles that control movements of the eyes, head and neck, trunk, and legs, thus allowing a person to both maintain balance and have clear vision
- Even very complex movements become nearly automatic over a period of time. This also means that if a problem with one sensory information input were to develop, the process of facilitation can help the balance system reset and adapt to achieve a sense of balance again.


SENSORY INPUT
INTEGRATION OF INPUT
MOTOR OUTPUT
BALANCE
Vestibular
equilibrium
spatial awareness
rotation
linear movement
Visual
sight
Proprioceptive
touch
The cerebellum coordinates and regulates posture, movement, and balance.
The cerebral cortex contributes higher level thinking and memory.
The brainstem integrates and sorts sensory information.
Vestibulo-ocular reflex
Motor impulses to control eye movements
Motor impulses to make postural adjustments
BALANCE
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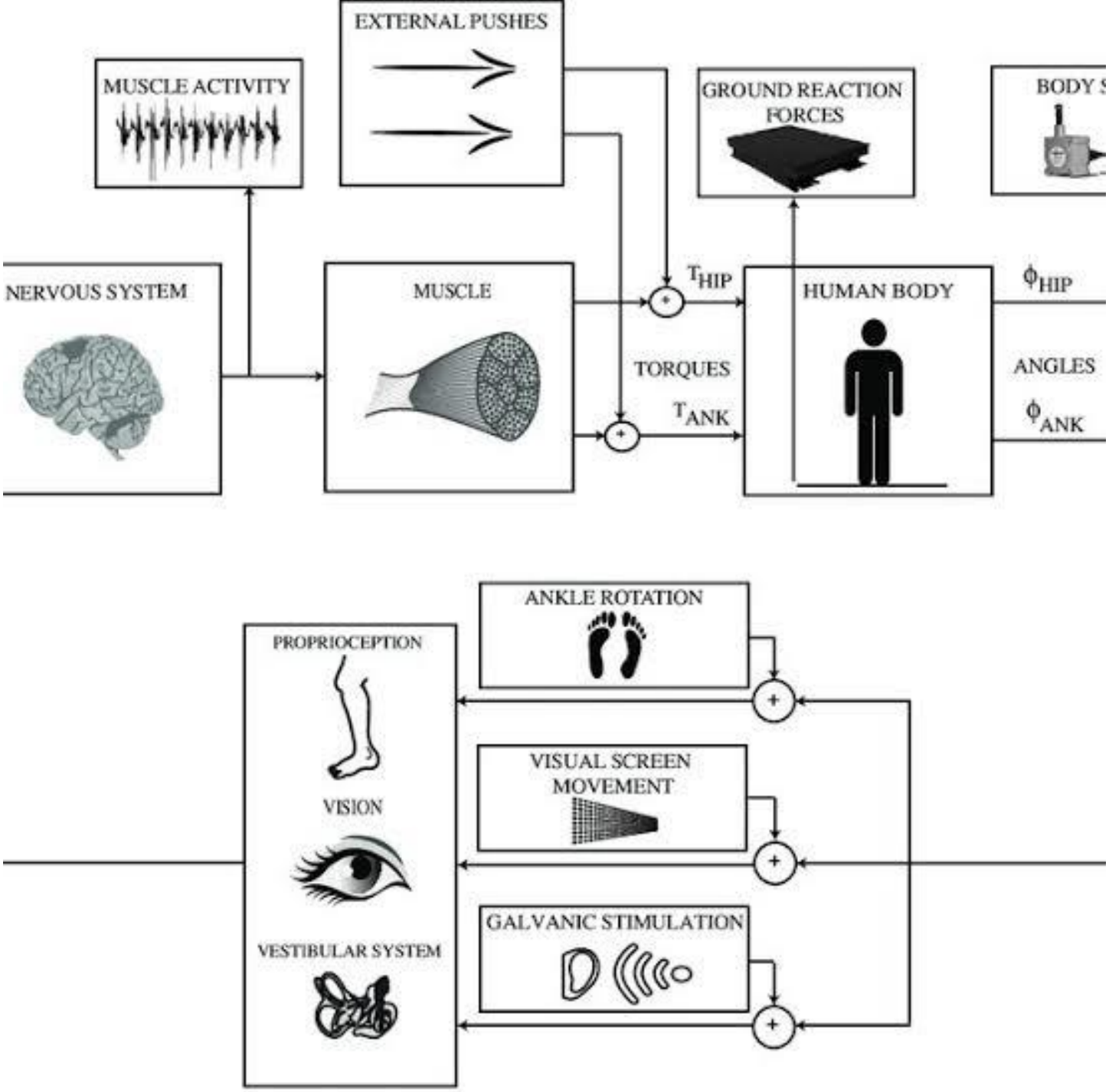
Human balance control system

- Balance control is represented as a closed loop. The position of the human body is perceived by the sensory systems (i.e. proprioceptive, visual and vestibular system).
- The sensory information is sent to the central nervous system.
- Using external disturbances the balance control can be disturbed at different places in the loop (e.g. by external pushes, ankle rotations, visual scene movement or galvanic stimulation) .


EXTERNAL PUSHES
MUSCLE ACTIVITY
GROUND REACTION FORCES
BODY S
NERVOUS SYSTEM
MUSCLE
T_{HIP}
HUMAN BODY
ϕ_{HIP}
TORQUES
ANGLES
T_{ANK}
ϕ_{ANK}
ANKLE ROTATION
PROPRIOCEPTION
VISUAL SCREEN MOVEMENT
VISION
GALVANIC STIMULATION
VESTIBULAR SYSTEM

Effects of poor vision

- Either system, or brain, being out of sync with the eyes can cause a number of problems: the body processing the wrong information, not having enough, or processing it incorrectly. The visual system “calibrates” the others, the absence of which contributes to falls and balance disorders. Studies suggest a relationship between poor

Glaucoma

- Glaucoma is the most common cause of irreversible visual impairment worldwide, increasing in prevalence with advancing age. The condition leads to a characteristic reduction in the visual field (VF).