Proprioception vs the EMS Machine

Sunaina Ajit Kumar and Mckesey Cullimore

Dr. Farhad Dastur

PSYC 2375: Perception (S10)

July 6th, 2022

Introduction

The skull holds one of the most important organs necessary for the creation and control of perception. Perceiving things around us is detrimental to our functionality and survival in the world. We perceive in many ways. We see, hear, smell, taste, and feel all the environmental stimuli around us and our brain uses an attention filter to register, recognize, and react to the stimuli that is most meaningful in that circumstance. “Data is relayed to the brain which uses it to formulate ideas, opinions, generate reactions and store what it has learned as memories.” (Sweeney & Restak, 2009).

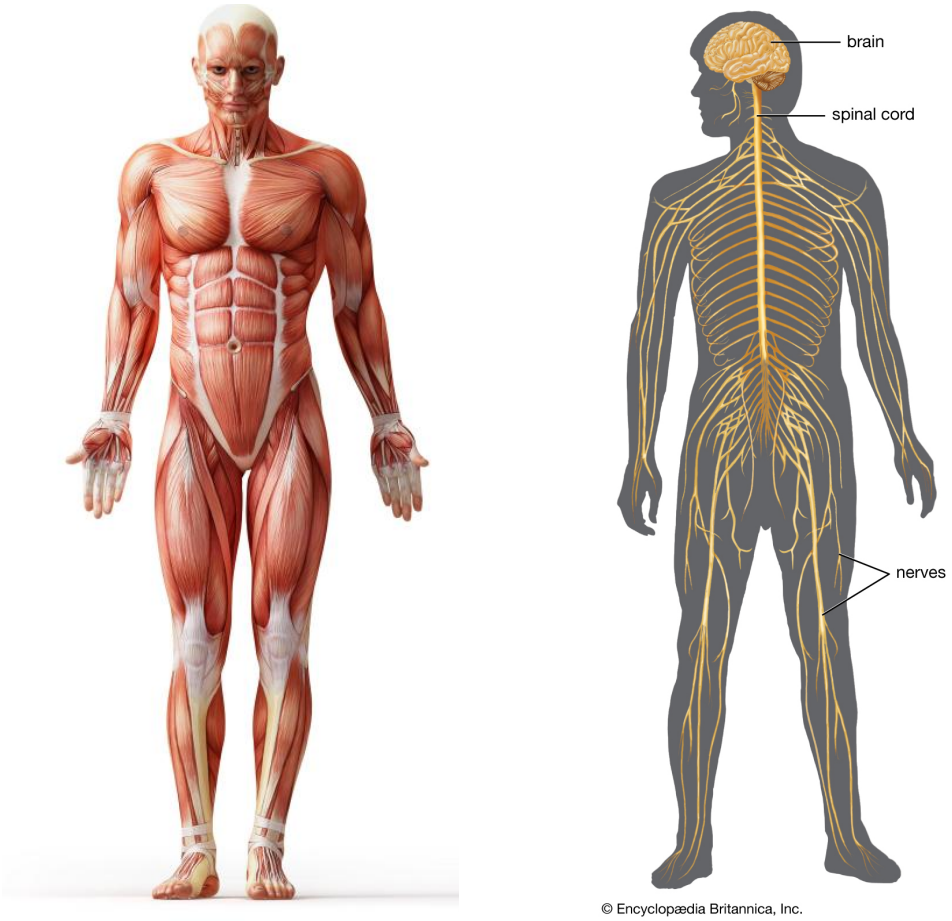
One example for the co-relationship between our senses is receptors in the eye send electrical signals to the visual cortex which then forwards it to the temporal lobe. Milner and Goodale suggested that, “this be called the perception pathway and the pathway from the visual cortex to the parietal lobe be called the action pathway.” (Goldstein, 2014). The parietal lobes use the visual information to plan a visually guided movement of the limbs, thus activating the proprioceptive sense.

Proprioception

Proprioception is the sense responsible for our ability to move our muscles, joints, tendons and even organs using specialised receptors called proprioceptors in those areas causing conscious and non-conscious reactions. It also helps generate the temporospatial location of one’s self. That is demonstrated by a person’s gait which is a coordination of visual stimuli, neural feedback, proprioception, balance, and breathing. These proprioceptors are found throughout our neuro-muscular system (Fig 1). It uses the same system of action potential to communicate with the brain and back and operates at speeds above 3500 m/s (cite molecular devices).

Figure 1

Muscular and Neurological System

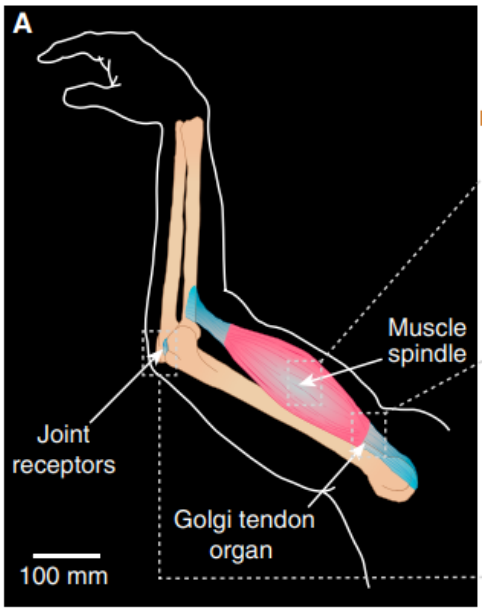


Note. From martanfoto (n.d.). *Male Anatomy of Muscular System - Front and Back View.* Adobe Stock. (https://stock.adobe.com/ca/images/male-anatomy-of-muscular-system-front-and-back-view/61972480) and Matthews, Peter B.C. 1998. *Human Nervous System Anatomy.* Encyclopaedia Britannica Inc. (Retrieved from https://www.britannica.com/science/human-nervous-system July 1st, 2022).

The three known proprioceptors are Golgi tendon organs, joint receptors, and muscle spindles (Fig 2). Golgi tendons are most responsive to tension and are located between muscle fibres. “Joint receptors are low-threshold mechanoreceptors embedded in joint capsules” (Tuthill, 2018). Lastly, muscle spindles are stretch detectors.

Figure 2

Three Types of Receptors



Note. From Tuthill, J. C., & Azim, E. (2018, March 5). *Proprioception* . Current Biology. Retrieved from https://www.cell.com/action/showPdf?pii=S0960-9822%2818%2930097-6

The sense of proprioception can be damaged on multiple levels. Such disability can include damage to the receptors, the nervous system or the brain, or a combination of all three. Diabetes, cancer treatment, age, drugs, injuries, hyperthermia are some of the most documented reasons for a deterioration of the proprioception sense. Such damage can cause a perceptual disturbance with subject reporting an inability to move and contrastingly, reporting movement that was uncontrolled.

EMS Machine

A machine called the EMS (electrical muscular stimulation) machine, originally designed in the 1970s, mimics the same electrical signals that the brain uses to stimulate the nerves and cause muscle contraction and relaxation, resulting in movement. Small pads are placed on the skin targeting specific muscles. Timed electrical impulses cause the muscles to contract and allow relaxation between pulses. During electrical stimulation, the nerves are stimulated causing the hand for example to contract or tense up, these movements are correlated to the settings of the machine. EMS sends the electrical signals only downwards without the involvement of the spinal cord or brain. This machine has been used by physiotherapists around the world to provide pain relief, strengthen muscles, and promote wound healing. Studies show that the average voltage required for the machine to override the brain's control is greater than 100mV (Molecular Devices n.d.).

Figure 3

Consumer EMS Machine Used for Demo



Note. From iReliev.com (n.d.) *Premium TENS + EMS Pain Relief & Recovery.* (Retrieved from https://ireliev.com/product/premium-wired-tens-ems-system/ on July 1st, 2022).

Discussion

With the development of modern science, we have technology that enables us to manipulate the human body and the way it senses and perceives stimuli. From Dr. V.S. Ramachandran who studied the effects of perceptual contraction of the phantom limb (Ramchandran & Blakeslee, 2012), to regular people experiencing loss of proprioception due to the EMS machine (Fig 3), suggests we are only scratching the surface of what the sense is capable of.

Proprioception occurs in everyday movement and has a large role in an individual's life in their daily tasks, the usage of an EMS machine may have a potential benefit to users depending on the use due to the many positive factors offered. This topic is relevant as electrical muscle stimulation affects one's proprioception depending on the amount of intensity increased forcing specific muscle groups to contract and work together. Many people may be interested in trying the machine for multiple reasons due to the positive benefits of an EMS machine; whether it is to strengthen specific muscles, help enhance blood flow, relieve pain from an injury and more. Currently, a wave of EMS fitness training has swept the western world in particular with its specific purpose being to tone targeted muscles with its intramuscular penetration.

Related Articles

Rangwani, R., Park, H. A new approach of inducing proprioceptive illusion by transcutaneous electrical stimulation. *J NeuroEngineering Rehabil* 18, 73 (2021). https://doi.org/10.1186/s12984-021-00870-y

References

Goldstein, E. B. (2014). *Cognitive psychology connecting mind, research and Everyday experience*. Cengage Learning.

iReliev.com (n.d.) *Premium TENS + EMS Pain Relief & Recovery.* (Retrieved from https://ireliev.com/product/premium-wired-tens-ems-system/ on July 1st, 2022).

martanfoto (n.d.). *Male Anatomy of Muscular System - Front and Back View.* Adobe Stock. (https://stock.adobe.com/ca/images/male-anatomy-of-muscular-system-front-and-back-view/61972480)

Matthews, Peter B.C. 1998. *Human Nervous System Anatomy.* Encyclopaedia Britannica Inc. (Retrieved from https://www.britannica.com/science/human-nervous-system July 1st, 2022).

Molecular Devices (n.d.) *What is an Action Potential*. Molecular Devices, LLC. (Retrieved from https://www.moleculardevices.com/applications/patch-clamp-electrophysiology/what-action-potential#gref on July 1st, 2022).

Ramachandran, V. S. & Blakeslee, Sandra. (2012). *Phantoms in the brain*. Harper Collins Publishers.

Sweeney, M. S. & Restak, R. (2009). *Brain: The complete mind: How it develops, how it works, and how to keep it sharp*. National Geographic.

Tuthill, J. C., & Azim, E. (2018, March 5). *Proprioception* . Current Biology. Retrieved from https://www.cell.com/action/showPdf?pii=S0960-9822%2818%2930097-6