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The Brain-Environment Relationship: Part I

Your brain is like a sponge: it absorbs information with ease and holds the potential to retain it if needed. Most of the time, this information arrives in the brain through sensory stimulation (Ogawa et al., 1992). For instance, you know there is a tree in front of you because the colors and the light in the environment manage to stimulate the retina of your eyes. From your retina, this information gets sent into the brain towards a specific area called the visual cortex, an area involved in processing visual information. This is how you see, and a similar pathway can be drawn for most of our senses: hearing, touch, taste, and smell – each having connections to particular areas of the brain.

Inputs and Outputs

What enters your brain affects what comes out. When your senses are stimulated, they can either send a good signal to your brain or a bad one. In special cases (when brain tissue is damaged or when brain functions are not well-developed), the signal can be jumbled, noisy, and incoherent (Yi & Hazell, 2006). As can be predicted, when the signal is good, the response that the brain will produce will also be of good quality. For example, if your hand senses high amounts of heat from your hand being too close to a fire, your brain will quickly organize a motor response that will help your hand retract away towards safety. This reflex occurs because the tiny sensory receptors in the skin of your hand were able to sense heat.

In an individual whose skin receptors have lost sensitivity for X reason; the brain will miss out on important information because it will not receive a heat signal. Thus, the individual might risk burning their hands until their attention is directed towards the fire and a different sense (i.e., vision) warns them that danger is present.

When the Brain Malfunctions

What happens when damage and/or deficits are present in the brain and not at the sensory level? In many brain disorders and injuries, regions of the brain suffer from neuronal cell damage or death (Raghupathi, 2004). When this happens, sensory information reaches the brain, but the brain fails to respond to it properly.

To understand this better, different regions of the brain can be thought of like a lightbulb.

When electricity feeds the bulbs, they light up. In cases of brain damage or underdevelopment, the lightbulb is either non-functional or broken, so even when electricity is present (think of electricity as sensory stimulation), it does not light up.

For the brain to stop functioning optimally, damage, trauma, and developmental problems need not be present. Some forms of malfunctions can be temporary. One such phenomenon is observed when a person consumes alcohol, which is a known neurotoxin (Harper, 2007). Alcohol, often in the form of ethanol, reaches areas of the brain important for thought-processing, attention, movement control, emotion regulation, and much more. Essentially, alcohol works as an inhibitor (akin to an off switch), slowing down the firing of neurons. Similar types of brain inhibition and/or malfunction can occur when one is exposed to toxins that may be present in your environment and the products that you consume.

Neuroplasticity: The Brain Is A Perfect Student

Fortunately, the brain does not function like lightbulbs. Years of evolution have given the brain the ability to survive despite malfunctions. The brain's ability to modify and change its structures in response to external and internal factors is called neuroplasticity (Münte et al., 2002). This is what helps us learn new skills and develop our brains (and finetune them). It was once thought that neuroplasticity could only happen in younger individuals; however, recent studies have shown that older adults can also alter their brains given the right kind of stimulation (Park & Bischof, 2013).

The next part of this article will take a deep dive into the topic of neuroplasticity, factors that can influence it, and how to maximize brain health.

References

Harper, C. (2007). The neurotoxicity of alcohol. *Human & experimental toxicology*, *26*(3), 251-257.

Münte, T. F., Altenmüller, E., & Jäncke, L. (2002). The musician's brain as a model of neuroplasticity. *Nature Reviews Neuroscience*, *3*(6), 473-478.

Ogawa, S., Tank, D. W., Menon, R., Ellermann, J. M., Kim, S. G., Merkle, H., & Ugurbil, K. (1992). Intrinsic signal changes accompanying sensory stimulation: functional brain mapping with magnetic resonance imaging. *Proceedings of the National Academy of Sciences*, *89*(13), 5951-5955.

Park, D. C., & Bischof, G. N. (2013). The aging mind: neuroplasticity in response to cognitive training. *Dialogues in clinical* neuroscience, 15(1), 109.

Raghupathi, R. (2004). Cell death mechanisms following traumatic brain injury. *Brain pathology*, *14*(2), 215-222.

Yi, J. H., & Hazell, A. S. (2006). Excitotoxic mechanisms and the role of astrocytic glutamate transporters in traumatic brain injury. *Neurochemistry international*, *48*(5), 394-403.