HYPOTHALAMIC NEWSLETTER

Welcome to this edition's Hypothalamic Newsletter! We will be discussing the trends in posterior hippocampal volume among taxi drivers, the benefits of diet and exercise on neural health, and the effects of light on brain performance.

Structural Changes in the Brains of Taxi Drivers

London taxi drivers must be highly trained in navigating the city before they are licensed to operate, an arduous process that typically takes an average of two years to complete. This extensive navigation experience is why this specific group of individuals was selected for this study on spatial navigation. A diverse range of taxi drivers as well as non-taxi drivers were administered structural brain scans to examine whether the intense navigational demands of London taxi drivers caused any major structural differences in their brains when compared with their non-taxi driver counterparts.

Results

The posterior hippocampi of the taxi drivers were significantly larger relative to the subjects in the control group, while the anterior region of the hippocampus was larger in the control group. A trend was observed between the number of years spent as a taxi driver and the hippocampal volume; typically, more experienced taxi drivers possessed a greater hippocampal volume in the posterior region and a lower hippocampal volume in the anterior region. The posterior region is responsible for storing the spatial representation of an environment and expands to accommodate individuals who depend on navigational skills. The conclusion of the study is that the brain of a healthy human adult is prone to structural change in response to the demands required of them by their surroundings.

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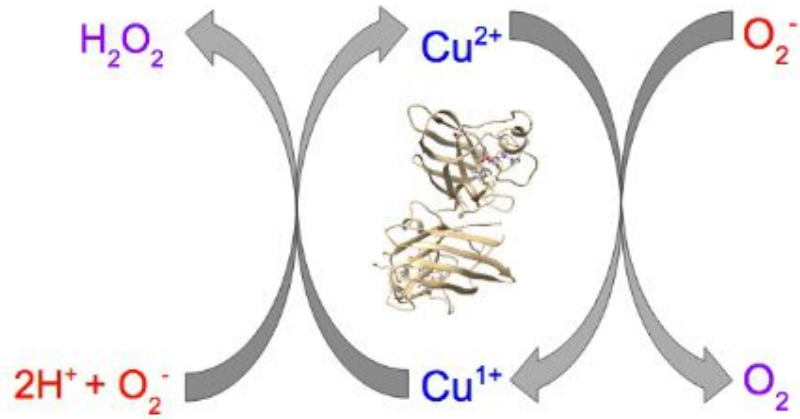
Nerve cells can live for multiple human lifetimes.

A healthy lifestyle may be more important to maintaining neural performance than we think.

Diet and Neural Health

Diet affects the brain's ability to combat illness and respond to challenges. Healthy diets rich in omega-3 fatty acids activate molecular systems in the brain and spinal cord that improve plasticity. On the other hand, unhealthy diets rich in saturated fats and sugars cause neural damage.
Foods containing omega-3 fatty acids can elevate brain-derived neurotrophic factor (BDNF) levels. BDNF is a neural growth factor that promotes synaptic plasticity in the brain by aiding in the regeneration of neurons. This is especially important in controlling neuron development, formation, and differentiation during adolescence. While such foods are beneficial to brain health, diets high in saturated fats and sugar reduce BDNF levels in the brain and lead to lower neuronal plasticity. A research found that rats fed a high-fat diet for 1–2 months did significantly worse on a maze task than rats fed a healthy low-fat diet. Apart from just a decrease in neural plasticity, these results can be also attributed to an increased oxidative stress, which is caused by increased reactive oxygen species like hydrogen peroxide that disrupt neural functions. High saturated fat consumption may even be a risk factor for Alzheimer's disease (AD), since it elevated beta-amyloid proteins, a protein associated with AD, in the brains of mice.



Exercise and Antioxidants

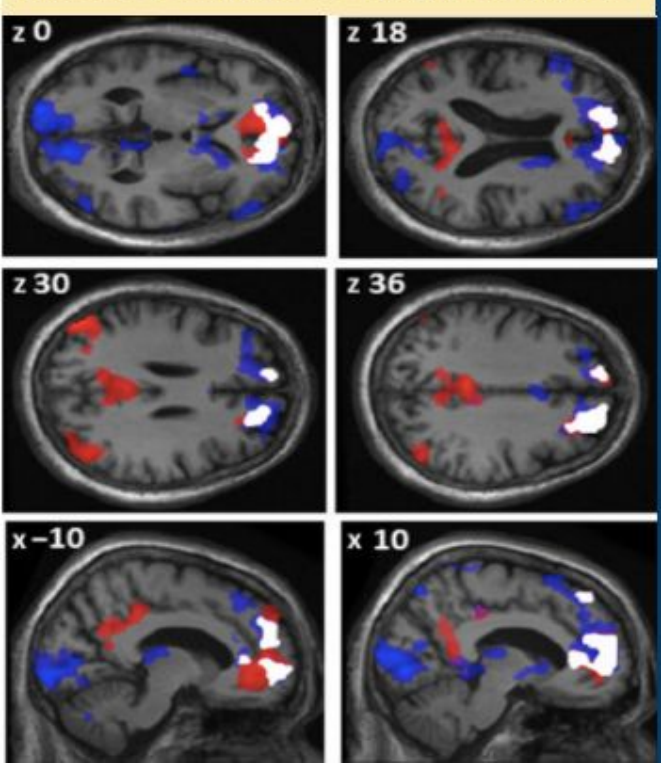
Similar to a healthy diet, physical activity can counteract brain damage by increasing antioxidant activity. A buildup of reactive oxygen species can cause memory loss, decreased reflexes and nerve fatigue, and a host of other problems throughout the body. Fortunately, many studies concluded that training increases the expression of classical antioxidant enzymes such as superoxide dismutase and glutathione peroxidase. These enzymes work to neutralize reactive oxygen compounds like shown in the image above. Therefore, apart from just metabolizing saturated fats, exercise has the capacity to counteract the mental decline that comes with age by providing an innate resistance to oxygen radicals.
Boosting neuron recovery, releasing antioxidants, and preventing harmful proteins from accumulating are just a few examples of the various neurological benefits offered by a healthy lifestyle.

Hypothalamic Newsletter

Your brain uses 20% of the oxygen and blood in your body

How brain regions respond to blue light

Have you ever heard the common belief that looking at your computer screen can hinder your ability to fall asleep at night? Perhaps you've also heard the culprit for this is the blue light produced by screens. Studies show there may be truth to these statements. The question of whether or not light can stimulate higher level brain activity was addressed in a 2013 study. Three completely blind individuals were tested to monitor brain activity in response to blue light. The test subjects were provided with auditory stimuli, and had to name whether or not light was being shined throughout different time intervals (4 seconds, 10 seconds, and 20 seconds.) These tests were performed in normal lighting as well as in darkness. During this time, the participants were hooked up to a fMRI to monitor brain activity. A result of the study showed that brain activity was increased during times of light stimulation.



A piece of brain tissue the size of a grain of sand contains 100,000 neurons and 1 billion synapses

The Process and Results

This process was repeated with sighted individuals. The results were similar, and presented further information regarding the correlation between brain activity and light stimulation. When analyzing the fMRI of each blind participant, higher levels of brain activity were observed during periods of blue light exposure in contrast to darkness. More activity was noted in particular regions of the brain such as the ventrolateral prefrontal cortex (responsible for planning and responses), the medial prefrontal cortex (responsible for decision making and memory), precuneus (recollection and memory), and the anterior cingulate cortex (emotional regulation). All of these parts of the brain are associated with higher cognitive functioning.

Conclusion

Two things can be concluded from the study. For one, the effect of light on blind individuals. For example, although they have no ability to consciously perceive light, the study revealed that it can be perceived non-consciously, and there is a difference in brain performance when there is no light present. An additional EEG (electroencephalography) test confirmed the correlation between brain function and exposure to light. Non-image photoreception can explain this. Although the individuals can make out no clear visual images, their brains can still detect and become stimulated by the presence of light, particularly blue light, as its short wavelengths can be effectively transmitted by ipRGCs. Second, the study revealed that blue light can in fact stimulate the brain. This could be an explanation as to why medical professionals will often recommend we avoid televisions and computer screens before retiring to bed. The blue light emitted likely will unconsciously stimulate specific regions of the brain, heightening one's alertness and comprehension regardless of visual capabilities.

Crossword Puzzle

V Z B T H F A T Q M E S L D I G I G
V U R G B R A I N S T E M J T S U U
J D A S E N S O R Y N E U R O N S O
T J I H O B D E N D R I T E U G W V
M F N X S K U L L L E L G F A R F Y
V H D G C H W B J K C N V O Z Y M Z
R B A S F R P N R C Y W D W F Z K J
B N M D Y D Y C U A M I Z R O R B P
D K A M E M O R Y P I U L J I F R T
T X G N M B L B P O X N L X A T X P
C B E J T R I G G E R L Y R V H E L
E N Y J P V G D K L I L E Y S F L I

Find the following words in the puzzle.
Words are hidden → ↓ and ↘ .

BRAIN
BRAIN DAMAGE
BRAINSTEM
DENDRITE
MEMORY
SENSORY NEURONS
SKULL
TRIGGER