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Mini Review
Published: 22 Feb, 2021

SF Journal of Clinical Neurology and Brain

Human Brain Ideas for Eco-Innovation

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Abstract

Innovation is an important and fundamental principle for the development and even survival of organizations in today's world. The innovation process however, should consider the compatibility of innovations of new products with the environment, while optimizing the resources used, and reducing the potential damage to the environment. Such innovation process is eco-friendly and can increase the quality of life. One approach to achieve this is by applying the biomimicry and using nature's solutions to create eco-friendly products. This article discusses some of the strategies that the human brain uses to optimize energy consumption in performance of its tasks. Also efforts have been made to draw designers' attention to the human brain as a useful resource for inspiring and extracting innovative eco-friendly ideas.

Keywords: Innovation; Eco-innovation; Biomimicry; Human brain; Neuroscience; Design; Product design; Product development; Technology; Cerebrospinal fluid, Myelin sheath

Introduction

Living systems that have existed and evolved on Earth for 3.8 billion years can be considered as models for design and engineering [1]. Living systems in nature rely on information and structures, while human technologies use materials and energy, more [2]. Nature can teach us how reduce the use of substances, especially toxic substances, and then optimize use of energy by focusing on renewable energy and increasing the recycling of materials [3].

Biomimicry is a science that deals with human endeavor, inspired by nature and states of nature. This science can be considered as design concepts, and used with reverse engineering [4]. It can also be a good answer to the challenge of sustainability and lead new technologies in this direction [5]. The solutions found in bio-systems are more environment-friendly and can even be effective in Resuscitation it through positive returns [1]. Bio-systems have so far provided many ideas in the fields of energy saving, design of materials with self-healing and self-cleaning capabilities, etc [5].

In order to pay attention to bio-systems for modeling, the human brain can be considered as the only intelligent system that can perform various cognitive functions with minimal energy. In fact, the human brain consumes energy depending on the event and only where information processing is needed [6]. Since the human brain, with about 100 billion neurons, needs about 20 watts of power. It is considered as the amazing inspiring model in the chip industry [7], as well as artificial intelligence research and the creation of powerful machines [8].

There are a variety of brain-inspired strategies for designing products and creating technologies that use less energy, and here are a few examples. Modeling of voltage-gated ion channels of axon can be useful for the nano electric industry, due to its ability to communicate remotely and consume less energy [7]. Sodium Ion Batteries (SIBs) that are inspired by neurons [9]. Also, the methods used for self-cooling, can be explored in the micro-electric industry and cooling electronic components [10].

But what must be considered most of all, is how the human brain uses the laws of nature itself for its optimal activities. Also how can we use the natural laws embedded in the structures and processes of the human brain. Such question can only be answered with brain-specialized studies that also explore potential applications.

The following section will explain some examples that shows how the human brain uses natural laws to achieve its goals. These examples reveal an interesting aspect of human brain management for implementing optimal and eco-friendly strategies.

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Received Date: *02 Feb 2021*
Accepted Date: *18 Feb 2021*
Published Date: *22 Feb 2021*

Citation: *Gharibzadeh Sh, Ghaemi N. Human Brain Ideas for Eco-Innovation. SF J Clin Neurol Brain. 2021; 2(1): 1007.*

Table 1: Examples of human brain lessons.

Source of inspiration	Basics used	Benefits
Cerebrospinal Fluid	The law of buoyancy	Brain weight loss
		Reduces pressure on the lower parts of the brain
		Operates as a shock absorber
	Chemical properties of materials	Chemical control
Diffusion in the cell	Concentration gradient	Reduce energy consumption in the exchange of substances and effective in the information exchange activities of neurons
Myelin sheath	Natural properties of materials	Faster data transfer
Cooling the brain	Electrically laws	Cooling with optimal energy consumption
	Conduction	
	Convection	
	Radiation	

Examples of Human Brain Strategies

This section explains some of the structural or functional features of the human brain. That can provide designers with interesting ideas for producing optimal products and eco-innovations.

Cerebrospinal fluid (CSF)

By using the principle of buoyancy, cerebrospinal fluid protects the nervous structure by reducing human brain weight from 1500 grams to only 50 grams. This principle, reliefs the pressure on the lower parts of the human brain and also acts as a shock absorber [11].

Use of CSF is a way that is applied to the design of the human brain and provides ideas for designing products with a more desirable structure and better protection policies.

Also the chemical properties of CSF and their role in chemical protection, can be studied and used. In addition, the mechanism for how the CFS is produced and the process of its absorption by arachnoid villi can inspire ideas for industrial applications especially in the field of maintenance and lubrication of industrial machinery.

Concentration gradient

Using the structural properties of materials to reduce the need for energy in perform activities is another human brain strategy. This method can be very effective in formulating policies to reduce energy consumption in new technologies.

The human brain can use the concentration gradient for some of its interactions. So that through the diffusion process, some of its exchanges -such as oxygen delivery- take place without consuming energy [12].

For example, to design adsorbent products, the concentration gradient feature can be used to increase the transfer or/and non-transfer of materials.

Myelin sheath

Utilizing electrical properties and optimizing energy by using an insulating material for optimal consumption, are other human brain teachings that can be considered.

Saltatory conduction, is a process used by the human brain that can speeds up the transmission of neural information and even speeds it up to more than 100 meters per second (i.e. 360 km per hour). This ability is due to the axon being covered by a myelin sheath. This type of transmission is optimal in terms of energy consumption, despite the increase in speed [13]. Since the myelin sheath acts as an insulator, the nerve message jumps more rapidly in areas of the axon that does not have myelin and known as the nodes of Ranvier [12].

Human brain heat transfer mechanisms

Other strategies used in human brain design include convection (transfer of energy from a solid to a liquid or adjacent gas), conduction (transfer of energy between solids), and evaporation of sweat [10].

The fact that the human brain is designed to take advantage of these natural laws and transfer heat from a higher energy level to a lower energy level, are inspiring for product design.

For example, design can be in such a way that the parts with high activity and as a result produce more heat, are not placed next to each other. As a result then the high activity parts can transfer their heat to adjacent parts, or be located near a liquid or air to use the convective conductivity benefits.

Discussion

By considering the human brain as a functionally and structurally unique model, various solutions can be extracted and utilized in product design and other industrial applications. In the previous section, a few of examples were briefly mentioned. Those can be investigated for to identify many general and detailed ideas for optimal design and thus accelerate the path of eco-innovation.

A summary of what has been said is provided in Table 1, which shows which natural principles and laws the human brain uses and how it applies them. Each of these can provide useful lessons for different disciplines.

Table 1 provides ideas for weight and pressure management in the design, configuration, wiring and data transmission equipment, and cooling systems. Also helps designers to consider the structure of materials and chemical and physical laws when designing new products. Because they may have many benefits at the same time simplicity.

Conclusion

In this study, the human brain was introduced as an important source for extracting original ideas and eco-innovations. Brain-inspired approach helps discover valuable laws that can be effective in optimizing energy consumption. The human brain also depicts how natural laws are patterning and their dimensions are explored.

Examples of these extraordinary human brain capabilities expressed that can be used in various disciplines and aspects. In addition with optimal products design, contribute to the development of eco-friendly technology were given. Further research on the human brain processes and strategies can be utilized in different applications like product design and other industrial processes.

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