

## Analysing the Necessity of Cognitive Enhancement Systems for Humans

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### Abstract

Different medications are used to treat cognitive deficiency in humans. It is also termed cognitive neuro enhancement. the most psychoactive substance in the world consumed by people is caffeine, others are L- Thiamine, creatine, nicotine, etc. its works by increasing blood flow in the brain due to which blood can use more oxygen. in this way, the individual can stay conscious for long hours. It acts as an energy booster and memory enhancer and also enhances the mood. Previous data about cognitive enhancers show that people who use drugs can work tirelessly for long hours rather than people who are not using them. However, it has several side effects which are described in this article. in this article, all the formations are summarized for a better understanding of this drug.

### Keywords

Cognitive enhancer, Memory enhancer, human augmentation, wearable-computing, multi-modal interaction, cross-modal connection, augmented cognition, interaction-paradigms

### Introduction

People to enhance their mood and increase memory consume different drugs. People spend lots of money on these drugs in the name of work better and to improve mental health. Those drugs are termed cognitive enhancers. These drugs can be natural as well as artificially made in laboratories by using chemicals. In this article, all types of cognitive enhancers will be explained. There will be a discussion on whether using the enhancer is good for health or not. Everything should be used in a moderate amount as the excess of anything is bad for both physical as well as mental health. The accurate amount and the time of using these drugs will be discussed.

### Objectives

The objectives of the study are

1. To explain what is cognitive enhancement
2. To reveal that how to enhance cognition
3. To know about how the enhancer works.
4. To identify the types of enhancers
5. To explain the benefits of using this drug
6. To understand the side effects of this drug

### Methodology

At present time due to several mental pressures, due to workload, medical issues, and personal problems, people use various drugs (CE) to reduce their stress levels. All the data about the CE are collected from an internet source and by surveying 40 people from different professional backgrounds. This research followed the primary quantitative method to gather the personal experiences of individuals after using different drugs.

### Significance of Cognitive Enhancement

The major problem facing people nowadays need to be treated therefore CE is important. The mental action or the processing of the mind to gain knowledge and recognize anything through experiences is termed cognition [1]. There are many causes of mental decline like- mental stress, deficiency in nutrition, aging, genes, and history of the family. Dementia is the state of mind, where the brain fails to work properly. The specific brain disease 'Alzheimer's disease' is the most common type of dementia. [2] Loss of memory, difficulties in concentration, difficulties in doing daily tasks, getting confused doing common activities, cannot interpret the correct time and date, changes in mood, etc.

**Caffeine: As a source of CE**

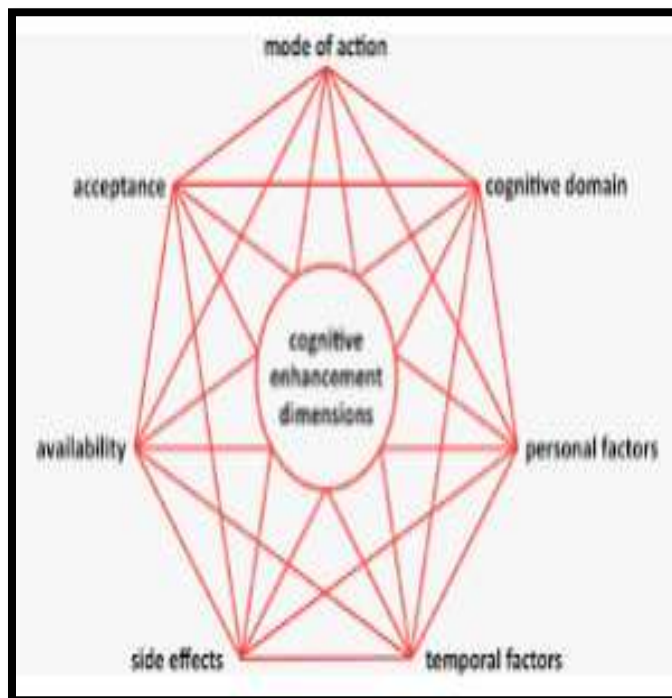


**Figure1: Caffeine-rich food**

(Source: 2)

Caffeine is a type of nootropic. It is a natural substance for cognitive improvement [3]. While using any medication or drugs, it is necessary to keep in mind that our body is not harmed by it in anyways. Caffeine is present in many foods, beverages, and medicines that we consume daily like- coffee, chocolates, energy drinks, green tea, etc. caffeine has several benefits which people consume it, like-

1. longer life span possible
2. more sugar will be processed by the body
3. risks of heart failure will reduce



**Figure 2: Importance of CE in human**

(Source: 4)

A huge potential unit of more than 550,000 individuals has been observed for 10-12 years showing that there is a connection between consuming higher amounts of caffeine and a reduction in the death rate from all causes.

However, overconsumption of it may cause insomnia. Nervousness and restlessness can be caused by it. The point is why anybody should use an excess amount of caffeine when moderate consumption is connected with many benefits [4]. Aside from its benefits, caffeine is not the right choice for children [8]. People should avoid caffeine intake if they have any medical issues like- high blood pressure, or insomnia. A study has been conducted in 2019 suggested that caffeine intake of more than 400mg per day increases health issues like- agitation, anxiety, and

tremors, another potential study of 2021 shows that consuming more than 300mg of caffeine per day during pregnancy may affect the birth weight of the baby [5].

S.No	Type of factors	Methods & Tools for evaluation	Suggestions
1	Cognitive	Experiments and observation during laboratory test, observation using online & offline Questionnaire, Interview	Changing of interface superficial features, Changing the user system communication level
2	Social	Ethnographic methodology, survey methods based on observation, Interview comparison with multimedia system evaluation	Improvement of interface functionalities for communication and data sharing between users

**Figure 3: Different cognitive factors affect human**

(Source: 14)

In the above table, some examples of social and cognitive factors are impacting human lives and the evaluation of learning systems. Cognitive factors indicate several characteristics of a person that greatly affects their learning and performance. It has been observed that cognitive factors help in modulating and improving human performance [14]. However, these factors encourage different cognitive functions such as attention, memory, as well as reasoning. On the other hand, cognitive factors are addressed as the internal factors of each person and it helps to modify human behavior and behavioral responses to reduce any kind of external stimuli like stress and negative thinking. Hence, these factors affect human performance in different activities of daily life.

**Nicotine: As a source of CE**

It is a drug that occurs naturally in tobacco and it has benefits as well as side effects. The studies by human and preclinical models have illustrated that nicotine plays some role in enhancing mental health conditions. Learning capacity and memory are increased by nicotine, it reduces stress and depression of people therefore it is used by people in a huge amounts [15].

**Comparison between Caffeine and Nicotine**

S.No	Particulars	Caffeine	Nicotine
1	Chemical	It is a chemical mainly present in high amounts in coffee, and tea plants.	It is a chemical mainly present in a high amount in the tobacco plant.
2	Addictive	It is less addictive	It is highly addictive
3	side effects	It has less number of side effects	It has a huge number of side effects

It is one of the most life-threatening and compulsive chemicals. Blood pressure and heart rate can be increased by it. The arteries can become narrow by consuming it. As it is addictive, therefore it is very necessary to avoid using it. Doctors to reduce the addiction to nicotine also prescribe medicines [6]. Data from 2019 shows that tobacco was responsible for the death of 8.71 million people globally. A nicotine-addicted people are prone to covid-19 disease. The number of benefits is higher than its benefits therefore, nicotine consumption should be reduced. Nicotine has more in common with caffeine than other chemicals found in tobacco cigarettes. For example, nicotine and caffeine are both alkaloids derived from plants that naturally stimulate dopamine production in the brain. Both chemicals are stimulants that act on the central nervous system, and they have positive effects when taken in small doses. The biggest difference between them is how they are consumed. No one disputes that nicotine and caffeine can be addictive. People who regularly use either substance may experience withdrawal symptoms such as headaches and fatigue if they suddenly quit cold turkey. Young people may be more prone to nicotine and caffeine since their brains are still developing, so minors shouldn't have access to either substance.

**Merits and Demerits of Cognitive Enhancement**

In the above discussion, it is clear what is cognitive enhancement and why it should be done. All the benefits and side effects are mentioned above. Based on these data some advantages and disadvantages of cognitive enhancement are listed below;

S.No	Advantages of CE	Limitations of CE
1	enhances mood	overconsumption leads to restlessness and other health issue
2	boost energy level	treatment might be costly
3	treating diseases like dementia	sometimes it can be addictive

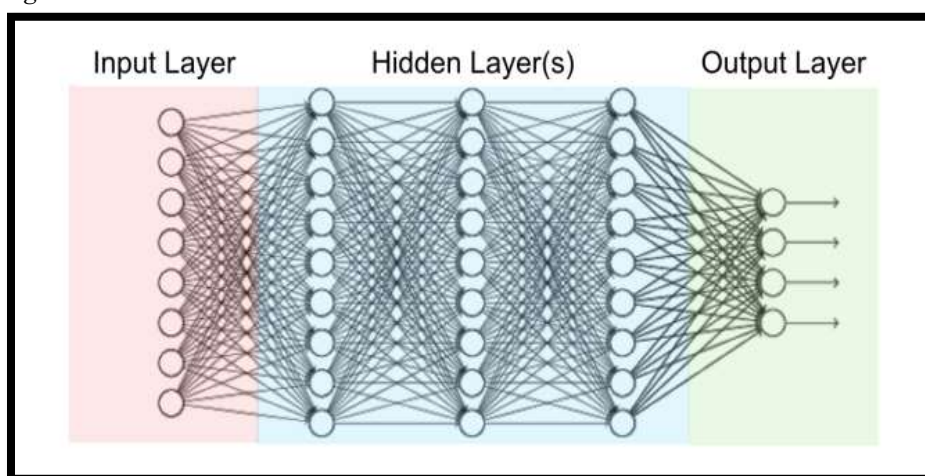
**Cognitive Enhancement Therapy**

Cognition is a mental process of the brain by which knowledge is developed, such as learning, thinking, memory, recognizing, and perception. Cognitive enhancement is an extension or improving the brain's core capacities through the use of drug therapy or other brain treatments. Human development is as old as human civilization. People are trying to raise their physical strength as well as mental efficiency over thousands of years. Sometimes they are successful or sometimes come with tragic results. As a result, "Cognitive Enhancement Therapy" developed. Therapy is characterized by treatment i.e. achieved by correcting the defect of a cognitive subsystem. The enhancement is the intervention of the cognitive subsystem by using another way rather than refitting or cure of dysfunction [11]. In practice, the difference between therapy and enhancement is often difficult to access and it could be argued that it has no practical significance. A cognitively developed person is not necessarily with good brain capacities. Cognitive development includes not only medical treatments but also psychological treatments. It also brings improvement of external technological structures that supports cognition. Here in Table 1, discussed the effects of drugs which are known as cognitive enhancers.

Table 1

Cognitive Enhancers	Effects on Cognition Enhancement
Caffeine	It enhances cognitive and psychomotor functioning. It cans effects on thinking and increases concentration level.
Nicotine	It can affects on cognitive development such as improving fine motor functioning, thinking, attention, etc.
Amphetamine	It is highly addictive drugs and it mainly use in Schizophrenia. D-amphetamine improved language production.
Donepezil	It mainly used in traumatic brain injury, epilepsy, Parkinson’s disease.

Deep learning model



**Figure 4: Model of deep learning**

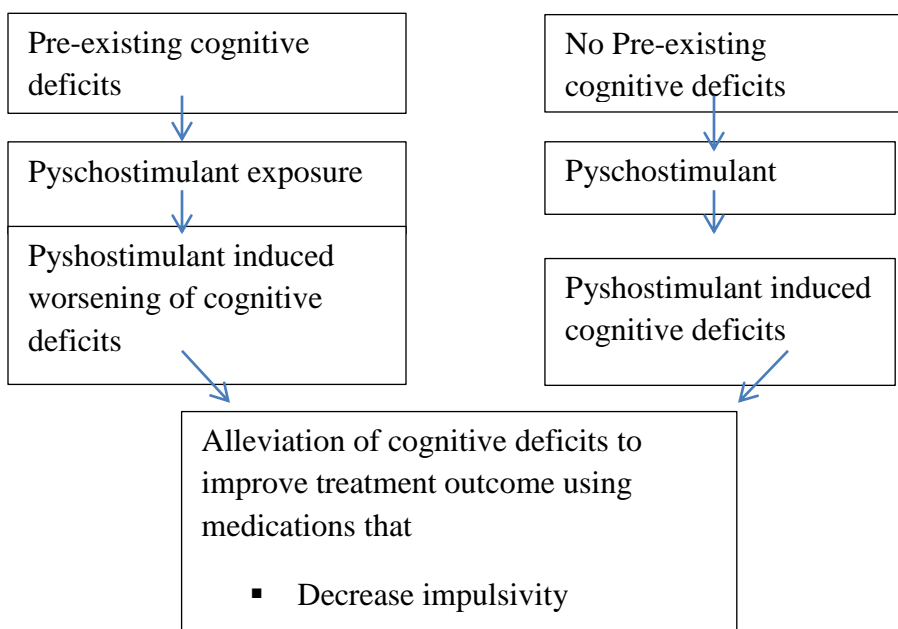
(Source: 15)

The theory or model of deep learning model mainly used for artificial networks. This model provides a computation system through which humans can perform on large amounts of data [15]. According to the deep learning model, machine learning and cognitive system help people to be more innovative and increase the capability of putting more creative things together in a completely new and different way. Moreover, it supports the concept of a machine learning system because it works based on the operation as well as the function of the human barons [16]. Thus, the deep learning model boosts up the cognitive enhancement systems in different industries, health care organizations, e-Commerce, and advertising.

**Cognitive Enhancement System for Humans**

Recently advancement of neuroscience technologies has laid the way to innovative applications that cognitively increased and developed humans. Human enhancement is the approaches and

techniques that are aimed at cognitive functions through drugs, or by computer or other brain therapy for improvement of brain capabilities. There are many techniques that are helping to increase cognitive enhancement. Education is one of the best ways to develop cognition. It reduces crime risks, abuse, and many illnesses. Mental training, visualization techniques, and rehabilitation have a good effect on cognition. Stimulant drugs like nicotine, caffeine, and amphetamine have been used to improvement of cognition. Diet and dietary supplements can also affect cognition development. Human-computer interaction and brain-computer interfaces are helped to enhance cognition. Cognition helps humans to understand all things which are around us and interact with other people and the environment. Cognition has a physical body in the brain with over one hundred billion nerve cells in the human brain. Each of these ten thousand connections with other nerve cells is known as neurons. So, cognition is the most complicated organ. Cognition basically controls our thoughts and behaviours. These are regulated by neurotransmitters in the brain. There are a number of chemicals which has a major impact on regulating cognitive process. This chemical includes dopamine, serotonin, glutamate, GABA, etc.



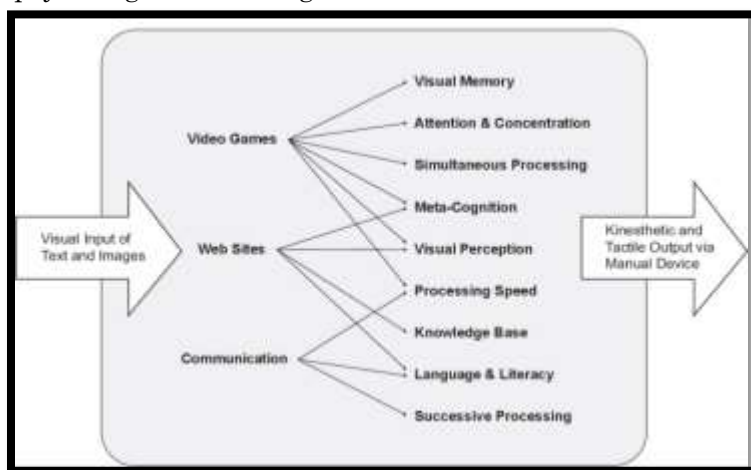
**Figure 5: Relationship between Medicines and Cognition**

(Source: 16)

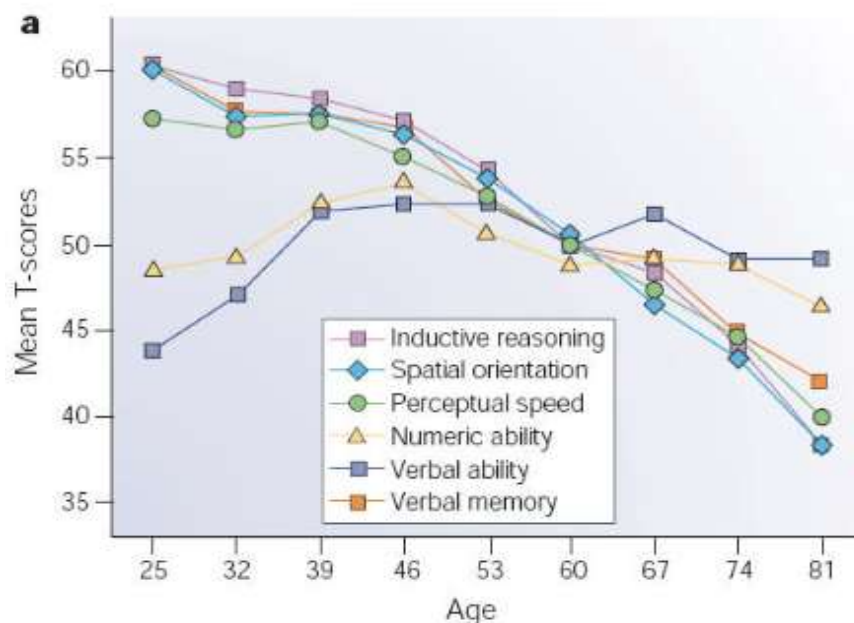
**Internet and Cognitive Enhancement System**

Cognition development is the increase of the mental capacities of human beings. More precisely, In order to make the approach of new cognitive capacities or improvement is relevant of changing the existing capacities. The internet is considered a cognitive enhancement because it is the most easily and biggest information source. It influences human brain structure and function. It helps humans to increase their existing mental capacities like collecting and processing information. Computers and the internet are the best technologies for cognitive development for getting information instantly.

But on the internet, all information sources are online which burdens human cognition development. Anyone can change information and upload new and wrong information easily. This may lead to a psychological "levelling effect".



**Figure 6: Internet effects on Cognitive Development**



**Figure 7: Individual Variability in Cognitive Function**

(Source: 17)

The above graph is demonstrating how cognitive functions get lowered with age. It has been noted that there are almost no changes are found in human verbal ability [17]. On the other hand, the graph is showing completely opposite in some cases that their brain and its functions has improved with age. There are many symptoms that shows a decline of cognitive functions are interconnected with aging like, declines in perceptual speed, people losses their verbal ability, losses in numeric ability.

#### Discussion

As already stated that cognitive enhancement has a major impact on human beings, but there are some risk factors for cognitive development, such as nutrition, environment, maternal-child interactions, etc. Major nutritional risk factors for poor brain child growth include iron deficiency anaemia, iodine deficiency goitre, and stunted growth. Balanced diet and supplementation are given to underweight women for increasing birth weight, reducing the risk of a low birth weight baby, and developing child cognition. Most of the studies say breastfeeding is one of the most protective factors for child development as well as cognition enhancement. The environment is another major risk factor for the development of poor children. Malaria and HIV can lead to decreased mental capacities. Poor maternal mental health is also associated with cognition development.

If depressed mothers interact with their children a result in bad cognition outcome. Recent research says that excessive internet use over a long time negatively hampers cognitive functions such as loss of attention and short-term memory loss.

#### Conclusion

A cognitive Enhancement System is necessary for human development because it enhances thinking ability and mental capacity. In this section, we examined and summarized the most recent articles about the necessity of a cognition development system for human and conduct a survey about the importance of cognition enhancement but also explore the negative impact and risk factors the enhancement of cognition.

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