

Contemporary Trends in Brain Studies: Language and Mind Interdependence

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Abstract:- Repeated actions with a specific purpose create habits in the brain, and thus the speed of information transmission and information storage is improved, which is explained by brain neuroplasticity, or the increase in the number of synapses. The process of learning is the main factor in increasing the number of synapses and is the basis of intelligence. Neurons and synaptic structures, which are the main features of memory, are formed through regular exercise and support our brain's ability to transmit and store information. Based on the neurobiological factors of the brain, this research article tries to explain how this ability to store and express information is the main measure of human intelligence.

Keyword:- Neurotransmitter, neuroplasticity, IQ, executive function, artificial intelligence, psychrometer, memory

I. INTRODUCTION

In modern times, neuroscience has developed into a leading interdisciplinary science of intelligence, studying it at the molecular cellular level. Neuroscience is a rapidly growing field at the intersection of neurophysiology, neurology, molecular biology, chemistry, cell physiology, and quantum physics. The brain is the strangest thing ever discovered by mankind. The brain is the most complex organ that controls the entire human mind and body. About the nature of the brain, what is the difference between humans and animals? Scientists have been arguing about this issue for hundreds of years. Arguing, perhaps, can be seen as confirming that one is different from others. The difference between humans is a more developed brain and human intelligence. Until the Homosapien period, the size of the human brain was constantly increasing, but after the Homosapien period, the brain size gradually decreased, and the modern human brain weighed about 1.3 kg. There are about 120-150 billion neurons in the brain, which control intracellular signal transmission and action mechanisms, and the speed of response in the human brain is 120 m/s.

Individuals differ in their ability to learn new things, adapt to new environments, learn from experience, think abstractly, planning on, and reflect. Psychologists have sought to account for these differences in mental capacity through several closely related constructs, such as general intelligence (or general cognitive ability), and fluid and crystalline intelligence.

Differences in people's ability to find things on the spot, retain what they have learned in the past, and apply it to the current situation are assessed by psychological and intelligence tests. These tests have a high level of reliability and are measured by different types of closely related intelligence tests. In other words, measures such as

intelligence quotient (IQ) have been taken repeatedly from the same subjects for nearly 70 years, and approximate values have been confirmed, indicating a degree of reliability.(January, 2016)(Neubauer, Simon,Hublin, Jean-Jacques,Gunz, Philipp, 2018/01/24).The development of the human mind to its peak is the result of the above evolution and regularity, and nowadays we measure the executive function of the brain by psychometry and measure it by the results of mental functions.

- **The aim of the study:** to define the nature of the basic concepts of human intelligence through a review of ancient and contemporary research examples.
- **Practical importance of the research:** Nowadays, brain science has developed into a leading interdisciplinary science of intelligence, and all branches of knowledge are studied from many aspects. At this time, when artificial intelligence is used in all fields to model the human mind, understanding the nature of the human mind becomes practical.
- **Research methods:** Neuroscience is an interdisciplinary study of the structure and function of living cells at the boundaries of neurophysiology, molecular biology, chemistry, cell physiology, neurobiology, and quantum physics. The process of positively affecting brain function is measured by many aspects of the executive function of the mind, assuming that as new things are learned, the connection between neurons in the brain expands, affecting the plasticity of the brain, and other organ systems are renewed accordingly. Also, knowledge modeling with artificial intelligence is rapidly developing. I tried to explain with examples of my own experimental research based on these research methods.

II. ANCIENT CONCEPTS AND IDEAS ABOUT THE BRAIN AND MIND

The Roman philosopher Galen defined that "the brain is the organ of thought and emotion." In the 4th century BC, Aristotle considered the brain to be "the organ responsible for the refrigerator of the heart and the space in which the soul moves freely." He was the first to use the term *sensus communis*, the space where souls come together. Aristotle famously said, "There is nothing that the human brain does not feel." By the 1st century AD, Alexandrian anatomists such as Rufus of Ephesus made the first physical descriptions of the brain. In addition to the main parts of the brain, the pia mater and dura mater are defined as the pia mater and dura (the soft and hard layers that cover the brain). In the following century, the Roman physician Galen rejected Aristotle's idea that the mind was active in the brain, not the heart. By observing the changes and effects on mental activity during brain disorders, he made that conclusion, and became practical for further research. Galen said that the brain is one of the three "souls" found in the

body, the basis of the animal soul, and is composed of cold, moist, and ovoid cells, each connected to its own organ system.

During the Middle Ages, the anatomy of the brain came to be based on three main "cells" called the conjunctiva and the ventricles. Each cell has a position related to different mental functions. Traditional hypotheses say that imagination is in the anterior ventricle, memory is in the posterior ventricle, and reason and logic lie between them. So where was the "sensus communis"? Islamic philosopher Avicenna wrote at the beginning of the 11th century that "there is a special space for imagination, in which all the functions of the five senses are located and receives signals from the outside" and stores the information received by the memory. Anatomist Mondino de' Liuzzi in his book "Anatomy" (1316) denied that "sensus communis" is in the middle of the brain, he tried to prove that there is only one thing called "sensus communis", which is called "fantasy, imagination, etc." And so on, views of the brain are still openly debated. For example, Avicenna criticized physicians who preferred Galen to Aristotle. Despite these controversies and differences of opinion about the brain over the centuries, Renaissance anatomists frequently dissected the brain from the late 15th century, as evidenced by Charles Estienne's mid-16th century anatomical descriptions. Jacopo Berengario da Carpi said, "If you cut an onion, you reach the soft white matter by removing the layered skin. Similarly, if you cut the human brain, you first see the hair, then the scalp, the muscular part (galea aponeurotica) and the pericranium, then the skull, which contains the aura mater, When it was written in 1543 that the pia mater, the brain, and then again the pia and aura mater would be cut, it is concluded that anatomists have been studying and making cuts for hundreds of years to find out the secrets of the brain.

At this time, Leonardo Da Vinci dissected the brain and it is believed that it became more anatomical. Leonardo's paintings were better anatomical. He is notable for demonstrating dimensional and structural relationships between the brain and the olfactory and visual nerves using wax injections to model the ventricles. He drew the brain from different angles, conducted research aimed at determining the origin and connections of the ventricles of the brain, and left what he found in drawings. It is believed that the main purpose of his drawing of the brain was to see the "sensus communis" and to find and confirm the organ that other researchers hypothesized to be the seat of the soul.

The English physician Thomas Willis published his book *Anatomy of the Brain* (1664), and the Danish anatomist Nicolaus Steno published his book *Lectures on the Anatomy of the Brain* (1669). Both strongly criticized Galen's idea of a spiritual organ. He further researched the cortex and ventricles of the brain and wrote that there is no such thing as "sensus communis". In general, at this time, it was concluded that there is no such thing or organ in the brain, and since then, the brain has been studied from the point of view of neuroscience from the point view of cell chemistry, and biology.

III. BRAIN AND MIND CORRELATION

Hundreds of experiments have been conducted on the question of whether there is a correlation between brain size and human intelligence. The relationship between brain and body size has also been studied (Тархи болон оюун санааны хамаарлын тухайд (brain and mind correlation)(Placeholder1). (Micheal S.Gazzaniga, Richard B.Ivry, George R.Mangun, Megan S. Steven, 2008)Recently, it is believed that the evolution of the cerebral cortex and the increase in its surface area have a positive correlation with human intelligence. This is a new idea from neuroanatomists called the encephalization quotient (EQ). The brown layer of the human brain has many folds due to the concept of storing a lot of information in a small space. It is believed that there are many folds deeper than the folds of the human brain, which is related to the emergence of consciousness. But the question of why people are intelligent remains unclear. The sensory characteristics of most living organisms, such as discrimination, learning, decision-making, planning, and adaptive behaviors, are variable.(Micheal w, Passer, Ronald E. Smith, 2007, 2004)These variables are related to the nervous system and the neuronal system of the brain.

The central nervous system and the peripheral nervous system of the brain are all systems of neurons. A neuron, the basic unit of the nervous system, is a protozoan with a volume of 0.001mm³ and a weight of 0.00083mg, and these are interconnected to form a neural network. There are about 150 billion neurons in the human brain, and their connections reach about 60 billion. Human intelligence and its capabilities directly depend on the density of its network of neurons.

The human brain continues to grow until it reaches its maximum size in the third and fourth decades of life, according to an MRI examination of European adults (46), the brain volume of men was 1274 (cm³) on average, while the brain volume of women was 1131 (cm³).(Koch, 2016).(January, 2016)(G., Small, Christopher G. (1996). *The Statistical Theory of Shape*. Springer. p. 4. ISBN 978-0-387-94729-7.)

But the human brain is not the largest brain in terms of size, the largest brain is the brain of a whale. Therefore, it was considered that there is no correlation between brain size and intelligence. According to the conclusion of the scientists, the ratio of body weight and brain should match, and having a brain that matches the body may be more intelligent.(Tartarelli, G., Bisconti, M, 2006) *Pic-2*, (Koch, 2016)Although brain size usually increases with body size in animals (larger animals have larger brains than smaller animals), this relationship is not linear. The brain-to-body mass ratio is the ratio of brain mass to weight, using the encephalization coefficient, a complex measure of intelligence.(G., *The Statistical Theory of Shape*. , (1996))(J, (February 2001)) тодорхойдог байна. Тархины эсүүдийг нейрон гэж нэрлэх ба эдгээр мэдрэлийн эсүүдээс их тархины гадар буюу хоёр тал бөмбөлөг бүрддэг.

In the past, when brain structure was studied only for pathological purposes, it was not possible to measure the correlates of brain intelligence. MRI measurements of brain structures are now routine. According to the results of studies on healthy people, total brain volume is weakly correlated with intelligence, ranging from (1.0 to 0.3-0.4). In other words, the size of the brain accounts for 9-16 percent of the total variance of general intelligence. Functional scans used to identify areas of the brain associated with specific cognitive functions show that the size and thickness of the parietal, temporal, and frontal lobes of the cortex correlate with intelligence.

Taking into account the specific connections between neurons in certain areas of the human brain, fluid intelligence (the ability to solve problems in new situations, find patterns, match them, and draw conclusions regardless of a specific field of knowledge) shows about 25% of the variance. Studies conducted in this way have shown that differences in general intelligence are positively related to individuals' life balance, social participation, work performance, achievement, health, and longevity.

IV. MEMORY AS THE MAIN FUNCTION OF THE MIND

Neurolinguistics is a branch of science that studies language centers in the brain, innate and acquired features of language, and language abilities. (Damasio, (2001))

From a neurolinguistic point of view, language centers were thought to belong to Wernicke's area and Broca's area, but are now thought to belong to regions of the cortex. (Poeppl, D.; Emmorey, K.; Hickok, G.; Pytkänen, L. , (October 10, 2012))

Until the seventies of the twentieth century, it was not well established that the two hemispheres of the cerebrum were responsible for different functions. In the study of the University of California, which studied the activity of the cerebrum on a large scale, it discovered that the right and left hemispheres of the cerebrum are responsible for various intellectual activities. Sperry won the Nobel Prize in 1981 for this work. One hemisphere of the cerebrum does not suppress the other, and one does not replace the activity of the other or enjoy exclusive rights. Therefore, according to the above research, it has been proved that each balloon has its own special function.

Brain plasticity is positively related to human intelligence. Most people think that human brain cells don't regenerate, but that's not the case, about 1,000 new memory-related neurons are created every day. Information from experiences, memories, and everyday activities creates new neural connections. But it is often short-term memory, and most neurons die very soon. It is important to process the

signals coming to the brain and recognize the information in a short time. Therefore, it is said that the brain was formed in the closest position to the organ of speech and the organ of vision. Research has shown that neuron plasticity, or the increase in the number of synapses, improves the speed of information transmission. This is the relationship between human memory and general intelligence.

Memory is a higher neural activity in which new connections are formed when groups of neurons are activated. There are about 120-150 billion neurons in the human brain. They receive information and transmit impulses in the form of code. The connection between neurons in the brain is the distribution of synapses for memory and the acquisition of new information as knowledge. A key feature of memory is the structure of neurons and synapses. By regular exercise, the number of synapses increases, in other words, the number of synapses increases during the learning process. For example,; (school(school) input school output) links are linked together to create a stronger link, memory is created.

As a result of repeated actions, the 'school-school' connections in the brain become stronger and become a type of neuron, and knowledge is created. Memorizing words in a foreign language strengthens the connections between neurons in the brain. When you stop learning or don't use the neural connections, the brain "deletes" unnecessary information. The link of all knowledge is the link of neurons. There is very little connection between the birth of the child and the mother. This is where positive and negative sensory links and logical links are not formed.

A. *The results of four experiments on the example of the memory function when determining the relevance of language*

Measures of cognitive executive function have been the main methods used to study perception, memory, reasoning, and imagery. As a result of acquired knowledge and the influence of the external environment, the human brain changes physically, and neuron connections expand and develop as a result. Because bilingual's language systems are always actively competing with each other, control mechanisms are constantly being used. Therefore, we use this research design to test the cognitive abilities of monolingual and bilingual children using these qualities. (Dagiimaa, B. Myagmarjargal, P. "Effect of bilingualism on inhibitory control and working memory. 2017)The study population is 6-9 years old and 10-13 years old. (IQ) average: 6-9- M group (M=106.35, SD= 16.25), 10-13- B group (M=110.19 SD=12.61) IQ test score has no statistically significant difference $t(37)=0.79$, $p = .43$. 10-13-M (M=96.87, SD=10.02), 10-13- B (M=100.80, SD= 12.49), t -test $t(38)= 1.03$, $p = .31$.

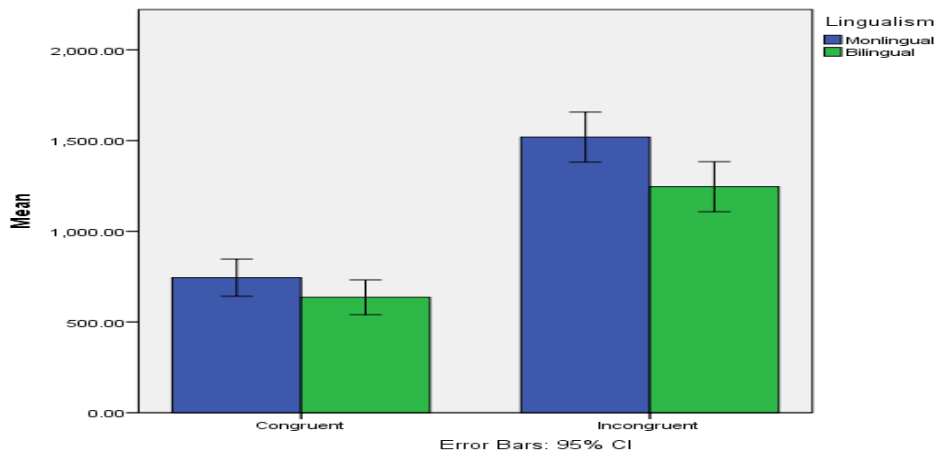


Fig. 1: Mean (milliseconds) and standard deviation of response speed on the Stroop effect test by language group:

Statistically significant differences in test performance were found between language groups $F(1,71)=1.90$, $p= .17$, $\eta^2= 0.26$.

Table 1: Mean (milliseconds) and standard deviations of response speed on the Stroop effect test by language and age group

	Зөрчилгүй (ms)	Зөрчилтэй (ms)	Струуп нөлөөлөл (ms)
6-9			
М	783.50 (297.66)	1678.00 (374.65)	936.50 (428.34)
Б	789.28 (365.94)	1473.57 (425.36)	684.28 (387.51)
10-13			
М	692 (302.56)	1307.33 (341.08)	615.33 (312.04)
Б	553.85 (224.77)	1123.46 (389.95)	621.92 (355.09)

According to the results of the experiment, the main result of the memory and thinking activity is learning a foreign language and the experimental group of children who are learning a foreign language by watching it performed better. Based on this, it is believed that learning and memorizing new things is more important when the connections between neurons in the brain are expanded.

B. Modeling human knowledge and Ideas with artificial intelligence

Translating ideas expressed through language into numerical values and modeling them has practical significance in the field of intelligence. We have defined the meaning structure of the discourse published by D. Jargalsaikhan on 04.03.2023, "From Smart to Intellectual World" as follows. The main keywords (topics) of the article show the value, frequency (frequency), degree of relevance (influence) of the article and analysis of the topic distribution. <http://baabar.mn/article/ukhaalagaas-oyuunlag-ertunts-ruu>.

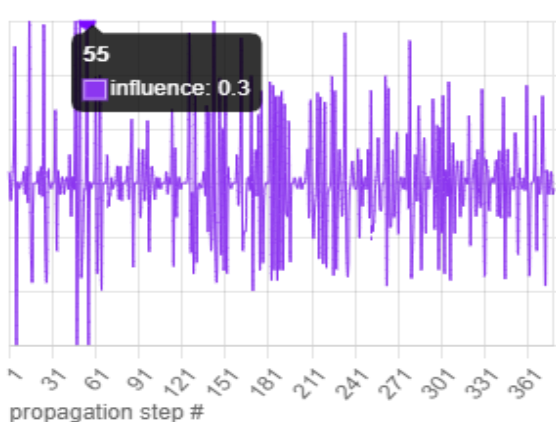


Fig. 2

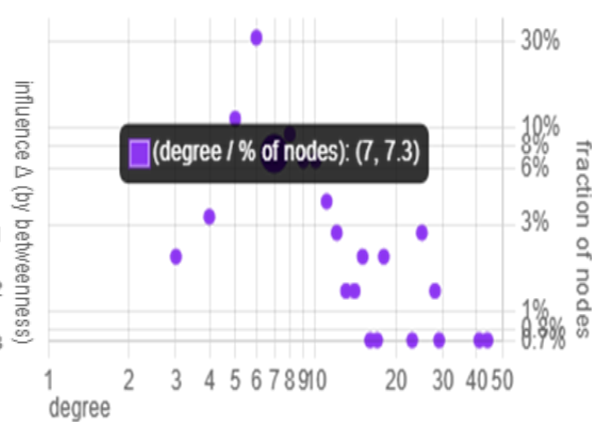


Fig. 3

Fig. 2-3: The influence of Jargalsaikhan's article 'From Smart to Intellectual World', topics degree, and the info propagation has been shown above.

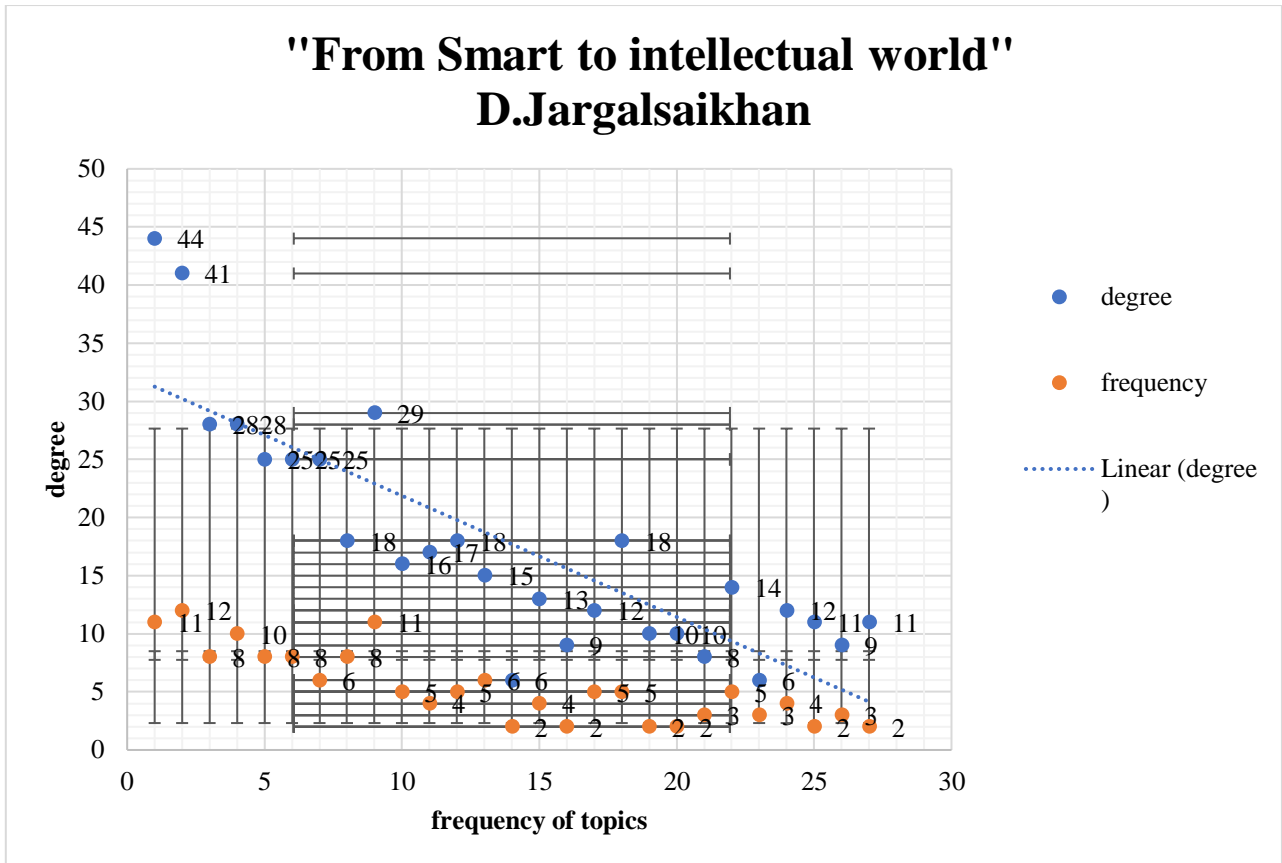


Fig. 4: The location of key words expressing the main idea of Jargalsaikhan's article "From Smart to Intellectual World" and determining the related power

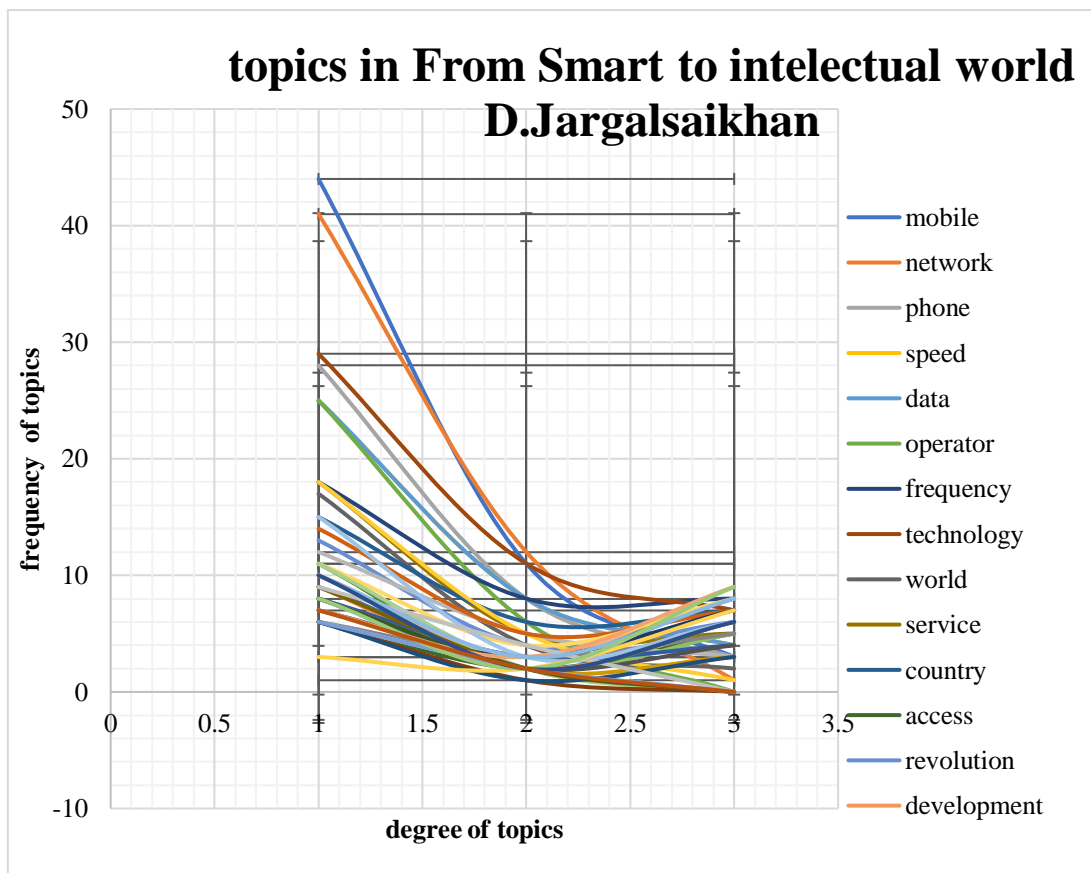


Fig. 5: topics in From Smart to intellectual world D. Jargalsaikhan

Modeling the human mind and then turning it into a simulated expression is emerging as a popular method of artificial intelligence. Our research focuses on language thinking, its non-linear relationships, identifying key words (topics) in discourses, articles, and conversations, and determining their groups with distant and close meaning relationships. This is a study that aims to determine how successful a speech is by using a simple algorithm and research platform. The mental lexicon, memory, and neural network of knowledge, which are behind the influence of the power of language on human thinking and intelligence, are being researched using the above methods to create knowledge models.

V. CONCLUSION

Modern neuroscience has evolved into an interdisciplinary science that studies the mind at the molecular cellular level. Repeated actions with a specific purpose create habits in the brain, and the process of improving the speed of information transfer and information storage is explained by brain neuroplasticity, or the increase in the number of synapses.

One of the popular ways to measure the executive function of the mind from many aspects is the stroop effect method, which is believed to positively affect the brain function as the connection between the neurons of the brain expands and affects the plasticity of the brain as it learns new things. to test.

The results of our simple experiment show that the structure of neurons and synapses, which are the main features of memory, are formed through regular mental exercises and support our brain's ability to transmit and store information. Analyzing differences in the ability to understand, know, retain knowledge, and apply it to the present situation in memory and language learning has a high degree of test-reliability and correlates of different types of closely related mental operations.

As a result of repeated actions, the connections in the brain become stronger and become a type of neuron. According to the results of the experiment, the main result of the memory and thinking activity is learning a foreign language, and the experimental group of children who are learning a foreign language by watching it performed better. Based on this, it is believed that learning and memorizing new things is more important when the connections between neurons in the brain are expanded.

In addition, I tried to explain the knowledge with the example of my experimental research based on artificial intelligence modeling methods. Representation of textual and speech structures through simulation is important for knowledge modeling, and this method of modeling transforms abstract concepts, ideas, and textual content into representations, making it easier to understand the results, interactions, and corresponding meanings of parts.

D. Zhargalsaikhan's article "From Smart to the Intellectual World" analyzes influence, the topics degree, the topics propagation, and location of keywords to model the human mind and then simulate the human mind. Expression rendering is emerging as a popular technique in artificial intelligence.

Our research focuses on language thinking and its non-linear relationships in discourses, articles, and discourses, identifying key (topical) words in speech and articles, a simple algorithm to determine how successful speech is when both the speaker and the listener enter the same frequency, hertz, or force.

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