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The Brain Is Processing Information: Then, Why Does Research Into Human Brain Disorders So Firmly Avoids Information Processing Modeling?

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Abstract

Brain disorders are a rapidly growing global health problem affecting millions of people worldwide. To date, however, no effective problem treatment is available because the efforts are directed not at the possible roots of disorders (which are still unknown) but only at the disorders' symptoms. To better understand disorders' causes and their underlying mechanisms, a large amount of scientific research is focused on developing disease models that rely on biological mechanisms taken from various fields of knowledge, such as genetics, molecular biology, neural and behavioral processes. It is extremely surprising that information processing mechanisms are never mentioned in this regard. (despite the fact that the dictum "The brain is processing information" is widely spread and generally accepted in the research community). A possible answer might be – the research community does not know "what information is". To reverse this bizarre situation, I introduced my own definition of information. In biological systems information is represented as text strings written with nucleotide letters and amino acid signs. which makes information a physical entity with distinctive physical properties: length, weight, structure. Consequently, brain information processing is regarded as a chain of interconnected neurons (neuron network) with information flowing between successive network stages. In the course of information processing, only part of the processed information is advanced within the network. The remaining (not used) part of the information must be destroyed, demolished, and led out from the neuron for further recycling and utilization.

Nature has provided the brain with genetic mechanisms for such "information waste" processing and utilization. But over time and especially in course of human aging such mechanisms become damaged and dysfunctional. Consequently, neurons clogged with the "information waste" become damaged and dysfunctional. And the brain disorders mounting.

"Genetical engineering" can serve us as a remedy and the answer to neuronal disorders expansion.

Keywords: Brain disorders, Genetic engineering, Information processing.

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1. INTRODUCTION

When we speak about "Brain disorders", to a large extent we have in mind "Neurocognitive Disorders", and that further guides us to "Neurodegenerative diseases" and "Dementias". Among the last, the most common type is Alzheimer's disease (AD), which accounts for up to 80% of all cases of dementia, [1].

Alzheimer's disease affects today 55 million people (in the world). It is expected that in 2030 this figure will increase to 78 million, and in 2050 to 139 million, [2].

Alzheimer's disease is an incurable disease with a fatal outcome.

Due to the high frequency and severity of the disease, Alzheimer's disease is becoming a serious medical and socio-economic problem in the modern world, and its importance will steadily increase with the aging of the population, [3].

Although Alzheimer's disease was discovered and described as early as 1906, even today the causes of its origin and development remain unclear.

To better understand what causes dementia and what its underlying mechanisms are, a large amount of scientific research is focused on developing disease models (because direct studies of the human brain are prohibited). Models are developed on the basis of different mechanisms taken from various fields of knowledge, such as biology, genetics, molecular, neural and behavioral processes.

Although it is generally agreed and accepted that the brain is busy with processing information, for unknown reasons, information processing mechanisms are never mentioned in this regard. Why? - a possible answer could be: the research community avoids using the concept of "*information processing*" because no one knows what the term "*information*" means and what it is.

2. WHAT IS INFORMATION?

The concept of "information" was first introduced by Shannon in 1948. Then other scientists joined the mission - Kolmogorov, Fisher, Chaitin (see [4, 5, 6] and references therein)However, none defined what "information" is. They defined what is the "measure of information". That was enough to improve the performance and reliability of technical communication systems. In modern sciences, the needs of communication cannot be reduced only to the optimization of the technical parameters of the system. The semantic aspects of the message are of a paramount importance, and thus must be met.

In accordance with the soul and spirit of these requirements, I have developed my own definition of information. (Interested readers can look into the references [4, 5, 6]).

My definition of information can be described as follows:

"***Information is a linguistic description of structures observable in a given data set.***"

In a data set, the data elements are not distributed randomly, but due to the similarity of their physical parameters, are naturally grouped into some kind of clusters or groups. I propose to call these clusters *primary or physical data structures*.

In the eyes of an external observer, these primary data structures are organized into larger and more complex agglomerations, which I propose to call *secondary data structures*.

These secondary structures reflect the observer's view of the grouping of primary data structures, and so they can be called *meaningful or semantic data structures*.

While the formation of primary (physical) data structures is determined by the objective (natural, physical) properties of the data, the subsequent formation of secondary (semantic) data structures is a subjective process governed by the conventions and habits of the observer (or a mutual agreement of an observers' group).

Therefore, *the description of the structures observed in the data set should be called* "*Information*". In this regard, it is necessary to distinguish between two types of information - *physical information and semantic information.*

Both are language descriptions; however, physical information can be described using a variety of languages (e.g., mathematics), and semantic information can be described only using the observer's natural language. (See [5] for more details).

Information processing is carried out in a hierarchical structure, where the semantic information of a lower level is transferred to the next higher level, where it becomes part of a structure of higher complexity. This agglomeration is carried out according to subjective rules fixed in a prototypical (referential) structure stored in the observer's memory.

An important consequence of the above definition of information is the understanding that information descriptions always materialize as a set of words, a fragment of text, a narrative. In this regard, an important note should be made - these text sequences are written with nucleotide letters and amino acid signs. This turns the information into a physical entity, into a "*thing*", with its weight, length, and other physical properties. For the purposes of our discussion, this is an extremely important remark.

3. WHAT IS INFORMATION PROCESSING?

So: The brain is processing information. Neurons are the functional units that perform that duty. Despite their discrete structure, neurons are not separate functional units—successful information processing requires close cooperation between coworkers. For this reason, neurons are connected in a network in which they communicate with each other, transmitting, exchanging, transferring - in a word – jointly processing information. This transition of information between interconnected (at different levels of organization) neurons even received a special brand name "Neural information flow", and became the subject of close study and examination.

The concept of neural information flow, as it is accepted today, assumes different forms of information presentation in different parts of the chain of neural information flow. The input part (dendrites)

is dominated by chemical neurotransmitters and flows of electric charges (ions). The accumulation of electrical potential and the emission of an action potential are characteristic to the somatic part. Propagation of the action potential in the axon and then again converting the action potential into chemical vesicles (at the terminal end of the axon, before being released into the synaptic cleft between neurons) – all these are multiple forms of information representation in a single neuron.

This does not seem plausible: nature is conservative, it is hard to believe that at different stages of one unit of information processing (dendritic input - soma - axon - axon terminal - synaptic gap) one part of the path is realized as a molecular package transmission, and the other part works as a package of action potential spikes transmission that carry information in the axon. It seems absolutely incredible to me. The idea that information can be encoded in the form of large molecular structures (as suggested by the theory of molecular biological communication) seems much more reasonable and acceptable.

Thus, the idea proposed in this article is that information always (at all stages of information flow) appears as a materialized text string (written in letters of nucleotides and amino acids), and as such it is being altered (processed) at all stages of information processing in the information flow chain - this idea seems to me a much more reasonable and plausible.

4. INFORMATION PROCESSING AND BRAIN DISORDERS

What happens (in all the cases described above) with the information that continuously enters the neuron's input? As already mentioned, if there is a prototypical information in the neuron's memory, according to which the received information can be processed and inserted into a more complex new structure, the information processing system will do this and transfer the new structure to the next, higher level of information processing. If not, the further passage of information in this place will be blocked, and the received information will begin to amass at this place and preclude the normal progression of information in the neural stream.

Usually, this does not happen - nature has taken care of the creation and implementation of such an opportunity - the constant and continuous cleaning of the neuron from unused information, which transforms into accumulated garbage. To remove this trash, the cell (neuron) has a special, genetically provided and genetically controlled mechanism - lysosomes and lysosomal functions. There may be other mechanisms designed for this purpose, e.g., genetic garbage-cleaning mechanisms.

But from the available literature we know that such an accumulation of "garbage" (not used and not processed for further utilization of informational text blocks) occurs in all sections of the information flow in each specific neuron, in each specific part of the information flow - in dendrites, in soma, in the axon, [7]. The literature describes the destruction of dendritic spines, swelling of axons, loss of functional elements mobility within the soma. Ultimately, uncontrolled accumulation of debris leads to neuron dysfunction and death, [8]. That is what we observe later as a dysfunction of the nervous system, which we call "Dementia". Since different areas of the brain have different functional purposes, neuronal dysfunction in these areas manifests itself in different ways. And so, we have a whole range of dementias, of which Alzheimer's disease is just one of them (although the most common). However, summarizing everything that has just been said, it is necessary to emphasize the foremost hypothesis - *the main cause, the primary source of all dementias is the dysfunction*

and death of neurons (in different areas of the brain), due to the uncontrolled accumulation of information "garbage" in different parts of the information flow chain in the neuron [8].

5. CONCLUDING REMARKS

The introduction and widespread use of the concepts "information", "information flow", "information waste" (or "information garbage") greatly advances us in understanding the possible ways to combat and treat Alzheimer's disease (and all other dementias). As mentioned above, they all have a common nature - uncontrolled accumulation of information waste - and therefore one treatment will be possible for all of them: stopping the accumulation of information waste, eliminating its further gathering, and accelerating its processing and utilization.

The fact that this is a genetically controlled process is well known. Moreover, what genes are responsible for processing garbage in the soma is also known. However, what genes are responsible for processing the garbage in dendrites and axons is not known yet - but no one, in fact, has looked there and searched for the causes of disturbances while processing and disposal of garbage there.

The ability to control and correct the work of these genes also already exists - it is called genetic engineering. It is already known, and its capabilities have recently been demonstrated by the successful development and implementation of the COVID vaccine (see Google "Genetic engineering of the COVID vaccine").

Possible ways to treat Alzheimer's disease, as clearly stated in this opinion article, is clear: by genetic engineering of spoiled neurons, i.e., the part of them that is responsible for the processing and disposal of "information garbage".

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