
THEORY AND METODOLOGY
ТЕОРИЯ И МЕТОДОЛОГИЯ

Brain. Thought. Word

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The real test of long-term value for any scientific theory is when that theory encounters phenomena that did not exist at the time it was created. Such a test situation for cultural-historical psychology is happening today, in the era of the digital revolution. This article attempts to show the results of this test with a very important caveat: both the digital revolution itself and the studies of its consequences are currently in the process of rapid development, and a general overview can only be preliminary.

Keywords: the digital revolution and cultural-historical psychology, digital media and the brain, brain signals and thought, direct «mind reading».

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Мозг. Мысль. Слово

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Настоящим тестом долгосрочной ценности для каждой научной теории является ситуация, когда эта теория сталкивается с феноменами, которые не существовали во время ее создания. Такая тестовая ситуация для культурно-исторической психологии происходит сегодня, в эпоху цифровой революции. В настоящей статье предпринимается попытка показать результаты этого теста с очень важной оговоркой: и сама цифровая революция, и исследования ее последствий на данный момент в процессе бурного развития, и общий обзор могут иметь лишь предварительный характер.

Ключевые слова: цифровая революция и культурно-историческая психология, цифровые медиа и мозг, мозговые сигналы и мысль, непосредственное «чтение мысли».

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Digital Media and the Brain

Two concepts provide insight into the profound meaning of the digital revolution. The first is by the Canadian media philosopher M. McLuhan. His ideas are summarized in the famous statement "The medium is the message". The main idea: in every media the main thing is not its content, but the nature of media.

Vygotsky formulated these ideas much earlier and in greater depth in his statements on the role of the tool in the development of higher mental functions. Vygotsky expressed the problem of the role of the tool (cultural tool, cultural-psychological tool) more than once in different works and in different years (especially in the text "Instrumental Method in Psychology").

Continuing K. Marx's idea that culture is the "inorganic body" of the person, Vygotsky formulates ideas that mental development represents not only what is in the individual, but also what is embodied in cultural-psychological tools (language, written language, a system of scientific notions, various techniques and technologies - which serve as support, an instrument in the individual's mental processes).

These cultural tools are accumulated in the course of history, and this is the essence of cultural-historical development of human consciousness under relatively constant morphology of the brain of Homo sapiens.

In the light of such Vygotsky's theory it seems productive to attempt an analysis of the nature and role of digital media. Here is how Vygotsky expresses relevant ideas. "The use of psychological tools enhances and expands behavior immeasurably, making the results of the work of geniuses available to all..." [1, c. 125]. And further: "The inclusion of a tool in the process of behavior, first, causes in the activity a whole range of new functions connected with the use of this tool and with the management of it; second, it cancels and makes unnecessary a whole range of natural processes whose work is done by the tool..." [ibid].

So, if digital media are one of the cultural-psychological tools, Vygotsky's quotes say it all: they immeasurably expand the possibilities of behavior, cause a whole range of new functions, make unnecessary a whole range of processes whose work is done by the tool (here Vygotsky seems to be alluding to artificial intelligence and machine learning!). And this is the grand role of the digital revolution in modern society, and Vygotsky's theory is the key to understanding this new phenomenon. If the nature of this phenomenon can be understood in the light of this theory, it seems impossible to predict a foggy future in virtual reality.

Most important for psychology is research into the effects of digital media on the mental development and functioning of the individual.

Often the use of digital media, especially at an early age (there is a lot of data on this), has a powerful influence on the formation and functioning of consciousness.

This influence stems from the main characteristics of this media: the vast amount of information that changes rapidly, the constant interruption of information reception, cognitive overload, and the rapid movement of attention.

There are already enough research data on the effects of such media on human thinking and consciousness [10]: thinking becomes superficial [8], consciousness becomes scattered; great obstacles appear on the way of transferring short-term memory into long-term memory, a mental process very important for learning; serious problems appear in reading and understanding long, continuous texts [10].

If we recall here Vygotsky's concept that the essence of mental development lies not in changes of a single function (memory, thinking, speech), but in changes of

relations between functions, then here, when we are dealing with the action of digital media, a wide field for the study of development as a process of changing relations between functions opens (even in the memory function itself the relations change: between long-term and short-term memory, autobiographical/episodic memory in a situation where an individual has so many documents are forced to change. In general, we can talk about the reprogramming of the brain under the influence of digital media.

Vygotsky said many times that a literate person is not a person who can read and write, but a different person. But a person immersed in digital media has much more reason to be a different person, especially if he is immersed in it from an early age.

A book by a professor at the University of San Diego [13] collected a lot of research data that proves that the generation born after 1997 (the so-called Generation Z), which grew up with smartphones, is characterized by big personality changes in general.

Is it possible to "read thoughts" directly from brain signals?

New methods of brain research, application of various forms of artificial intelligence (complex algorithms) in the analysis of brain signals force a new approach to the research of relations of the brain and mental functions. The very fact that the brain produces electrical potentials (signals) in various activities gives grounds for establishing a relationship (interface) with other devices, especially with the computer.

In this regard, after the advent of digital media comes an era of new areas of research, discoveries, and fantastic products of human creativity.

Here we mention some of them that have considered the possibilities of direct connections between the electrical activity of the brain and external devices: direct connections between brain and computer (in one or two directions), creation of artificial neural networks, machine learning, artificial intelligence, even direct connections between the brains of two individuals...

Many of these connections, especially those that relate to external influences on the brain, have practical therapeutic value in cases of rehabilitation of sensory and motor disorders and represent extremely important advances.

However, what is of interest to us in this case are the new phenomena that concern the higher mental functions. There are plenty of such phenomena, such as experiments, models in the form of algorithms, attempts, and popular publications. Here are just some of the questions that need to be answered: are there possibilities of direct translation of brain signals into text? Is direct reading of consciousness possible? Do researchers have the ability to decode thoughts, dreams, and intentions

by scanning the brain? Can speech communication be replaced by technology...?

Let us show a critical analysis of the above questions-hypotheses on the example of one, as it seems to us, the most successful experiment.

Employees of the University of California, San Francisco [11] conducted an interesting experiment of direct translation of brain signals into text. Four subjects (suffering from epilepsy) took part in the experiment. A large number of electrodes were connected to the brains of each of them in order to record electrical signals of the brain. The task of the subjects was to read aloud a limited number of sentences (30-50 sentences, 125 different words in total). While they were reading these sentences, brain signals (electrocortigrams) were recorded. This combination of reading and signal registration was repeated several times (the learning phase).

This was followed by a phase of careful data processing: signal amplification and processing, data translation into an artificial neural network (algorithm), in which the data (both reading and signal) was subjected to complex processing, and the transformed data was subjected to an encoding and decoding process based on the techniques used in machine translation from one language to another (with the difference that in the experiment a very limited number of sentences and words were involved).

The result was astonishing: brain signals were directly and accurately translated into text in 97% of cases, and in the rhythm of normal pronunciation! Undoubtedly, this is an outstanding achievement of applying artificial intelligence methods.

In popular publications, this result is presented as the discovery of the ability to "read minds" directly from brain signals.

Not having the competence to analyze mathematical methods for building complex algorithms used in this experiment, we believe that in this respect everything is properly done. But we will make an attempt to analyze the general meaning of the results of this experiment.

The basic tool we use here are the ideas from the final chapter "Thought and Word" in Vygotsky's book "Thinking and Speech" [3].

This text represents a synthesis of the most important achievements in the psychology of thinking and speech and speech thinking, and is still today an inexhaustible treasure trove of ideas for the study of these problems.

In the mentioned work, Vygotsky considers problems of roots, development, these functions and relations between these higher mental functions. Let us try to show how Vygotsky's ideas can also help in understanding the significance of the latest scientific discoveries made with the help of artificial intelligence discussed above.

The original thesis we defend here is formulated by Vygotsky himself: direct communication of consciousness is impossible, not only physically but also psychologically. To this we must now add: it is also impossible with the use of information devices (computers).

Our argument, which relies on Vygotsky's ideas, is theoretical, and if it proves convincing, it will be of more significance than just to understand the findings of the specific study discussed here.

Here are the relevant conclusions of these ideas.

The meaning of a word is the basic unit of verbal thought, and so it contains verbal thought and the meaningful word. The meaning of a word is not fixed, but changes and develops: historically, in ontogenesis, functionally in each concrete act of thinking (let us add that there are great differences between cultures and languages).

A serious question arises from this: can brain signals register all these nuances of meaning?

Internal speech comes from external, social speech. It is a special form of speech, and its basic functions are individual (thinking, control of its own functions, awareness). From this function comes all its characteristics, its structure: it is abbreviated (elliptical) and incomprehensible to others. Its grammar and syntax are special. It is almost always predicative, since the predicate is always known to the subject itself. Internal speech is an intermediate link between thought, which has a special syntax, and external speech, which has an extended grammatical structure; in internal speech the meanings of words change. Now we can add that in addition to words in inner speech, iconic semiotic means also have an important role, which are also pre-stratified in a concise form [5].

All these characteristics of inner speech are such that they can hardly be embodied in differentiated brain signals that can be registered by any electronic device.

The relationship of thought and word in verbal thinking is very complex. Vygotsky expresses his basic idea of this as follows: "Thought is not expressed in words, but is accomplished in words. [p. 305]. In these bilateral relations (from thought to word and from word to thought) consists all the dynamics of inner life; the grammar of thought is not identical with the grammar of speech, thought always represents something more whole than individual words, in thought and in speech, predicate words may not coincide, in thought words often "evaporate"...

Thus, the dynamics of the relation between a thought and a word excludes the possibility of expressing these relations in differentiated brain signals, which can be registered.

After these very brief theoretical considerations, let us return to the interpretation of the results of the experiment on the possibility of direct translation of brain signals into text. The first and most obvious fact is that the experiment uses external sentences with correct syntax that are spoken aloud (and there is no evidence that the subjects understand the meaning of these sentences). But most importantly, there is no internal activity in their behavior, no internal thought processes, which in this case had to be read from brain signals.

On the basis of theoretical considerations and analysis of the results of one particular experiment, it seems that there are sufficient arguments to confirm that there is no reason at all to expect the possibility of decoding complex internal thought and speech processes and verbal reasoning.

Attempting to make the connection between the early results of thinking psychology and the new research that attempts to establish an interface between the brain and digital devices raises the question of whether the results of this new research can be understood without using the crucial results of the "old" general psychology of thinking and speech.

Conclusion

For an understanding of all the phenomena discussed in this article, the work of A.R. Luria - his original works on neuropsychology and neurolinguistics (he was one of the founders of these scientific branches), his subtle studies of the components of speech activity based on clinical studies of the consequences of local brain lesions and the modern concept of the dynamic localization of higher mental functions - is of the greatest importance.

But there was no space here to analyze this great contribution of Luria.

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