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BRAIN IN THE DATA: NEUROTECHNOLOGY IN AI SYSTEMS AND MANAGEMENT APPLICATIONS

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15.1 Introduction

Among[266] the most important and rapidly developing technologies of artificial intelligence systems (AI) are neurotechnologies. This is a class

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[266] Article translated from Russian. First published in: Агеев А.И. Нейротехнологии в системах искусственного интеллекта и применения в сфере управления, в книге Социогуманитарные аспекты цифровых трансформаций искусственного интеллекта под редакцией В.Е. Лепского, А.Н. Райкова. Москва, Когито-Центр. 2022. 308 с. (201-212). (V.E. Lepsky/

of technologies that helps to understand brain functioning, thinking processes, higher nervous activity, including technologies for enhancing, improving brain and mental activity. One should pay attention to the standard introduced back in 2009[267], which describes practical issues of the work of operators of complex technical systems, as well as their interaction with society. Already 5 years ago it was predicted an exponential growth of the market of neurotechnologies and related products after 202 up to $1.8 trillion in 2035.[268] Neuronet is an essential part of the ensemble of digital transformation processes. There is a lot of exploratory and experimental research and development in this field in all the leading technological powers of the world.

Neurotechnologies can be divided into several groups: 1) invasive, involving implantation of electrodes into the human body, most often into the brain. The main disadvantage of this type of technology, despite the significant results achieved, is interference in the internal environment of the body; 2) mysensors, which involve placing electrodes on the human skin and reading impulses passing through muscle fibers. This type of sensors has a significant delay in action, up to several seconds due to the difference in the speed of nerve and muscle impulses; 3) non-invasive, which are based on different ways of recording the electrical activity of the brain using external devices and, accordingly - the impact on the brain. The main drawback is non-specificity of the obtained information and complexity of its interpretation, which requires working

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A.N. Raikov, Socio-humanitarian Aspects of Digital Transformations and Artificial Intelligence, Kogito Center, Moscow 2022, 201-212). DOI: 10.58863/20.500.12424/4276028

[267] GOST P 43.0.3-2009. Information support of technical and operator activities. Noon-technology in technical activity. General provisions. Moscow: Standartinform, 2010.

[268] Neuro-interfaces for next-generation services and products [Electronic resource] // Basisneuro. 2017. November. URL: https://basisneuro.com/BasisNeuroWhitePaper.pdf.

out of large data sets with subsequent determination of the critical data[269] , and, accordingly, the problem of calibration of the influencing impulse.

Neurotechnology is now enabling the capture and identification of brain signals for further processing in relation to cognitive, neural, or other body responses, as well as ways to improve and correct brain function, including memory restoration or replacement, erasing negative memories, etc.[270, 271, 272.]

However, the human brain is a network of several hundred trillion synapses connecting tens of billions of neurons. Therefore, the creation of a full-fledged, high approximation imitating the human brain requires solving many complex problems in neurobiology, synthetic biology, low-power electronics, photonics, medical technology, etc.[273, 274, 275] It is also necessary to develop mathematical methods to translate sensory

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[269]Neurogress: a platform of neurocontrol systems from the BlueBrain project [Electronic resource] // ITnan. URL: https://itnan.ru/post.php?c=1&p=348498.

[270] Loginov E.L., Loginova V.E., Shkuta A.A. "Design thinking" elements of artificial intelligence to overcome the barriers of obtaining new knowledge in the electronic environment of collaborative scientific super-system // Artificial societies. 2018. № 3. 5 с.

[271] Ovod I.V., Osadchiy A.E., Pupyshev A.A., Fradkov A.L. Formation of neurofeedback based on adaptive model of brain activity // Neurocomputers: Design, Application. 2012. № 2. С. 36-41.

[272] Turovsky J.A., Kurgalin S.D., Adamenko A.A. Modeling the learning of neurochips embedded in the neural tissue // Digital Signal Processing. 2016. № 1. С. 50-56.

[273] Galushkin A.I. Neurochips and Neuromorphic Computers: Problems of Modeling // Information Technologies. 2015. Т. 21. № 12. С. 942-949.

[274] Kalinin P.V., Voyutskaya Yu. On the application of a neuro-interface for contactless control of a mobile device // Information Systems and Technologies. 2016. № 3 (95). С. 53-56.

[275] Tychkov A.Y., Goryachev N.V., Kochegarov I.I. Communication protocols for wireless neural interface // Proceedings of the International Symposium "Reliability and Quality". 2018. Т. 2. С. 366-368.

information from the form in which it is represented in brain neurons into a form suitable for processing on computers[276, 277].

Technologically, Neuronet is a technical package that ensures the connectivity of human minds and artificial agents by means of knowledge transfer, exchange and synthesis protocols. The foci of Neuronet arise, on the one hand, in the networks of the biometric web, saturated with new communication protocols, new types of devices, and new applications. On the other hand, the demand for Neuronet comes from the areas with the highest requirements for collective activity in solving complex tasks (scientific and engineering projects).

Standards for the management of collective activity are being developed. An important role in the emergence of such collectives will be played by "exocortex" technology - artificial parts of the psyche supported by machines and synchronized with the natural psyche[278].

Priority projects implemented in the U.S., EU, China, and Japan are at the intersections of "neuro-cognitive science," "information and communication technology," "social engineering," tele- and neuromedicine markets, and brain-computer interfaces.

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[276] DARPA to fund the creation of high-speed interface between computer and human brain [Electronic resource] // Open Systems Publications. URL: https://www.osp.ru/news/2016/0126/13031430.

[277] Raikov A.N. Convergent synthesis of cognitive model based on deep learning and quantum semantics // International Journal of Open Information Technologies. 2018. T. 6. № 12. C. 43-50.

[278] Approaches to the formation and launch of new industries in the context of the National Technological Initiative on the example of the sphere "Technologies and systems of digital reality and promising "human-computer" interfaces (in terms of neuroelectronics): Analytical report [Electronic resource]. URL: http://rusneuro.net/cambiodocs/media/files/analitijeskii-doklad-podhodyk-formirovaniu-i-zapusku-novyh-otraslei-promyhlennosti.pdf.

More general questions of the current and prospective status of this topic, the impact of neurotechnology on social life, and vice versa, also require attention[279].

15.2 Neurotechnologies in the Management of Human Socialization and Behavior

The expansion of neurotechnology is part of a comprehensive shift in the forms and methods of people's primary and secondary socialization. The formation of personality in society always takes place in the process of dynamic interaction between people (family, clan, multiple small groups, state and other supra-personal systems). In the evolution of personality, society is projected in a complex way, similar to the biological law of repetition of ontogenesis by phylogenesis while maintaining a certain range of variation. Individualization occurs, first, biologically (body, functional systems); second, informationally (primary and secondary socialization with mastering types of literacy, communicative connections, accumulation of erudition, skills and abilities); third, cognitive (knowledge, feelings, understandings, basic value orientations, worldview); fourth, socially (membership in various groups with the possibility of multiple identification and motivation of activity)[280]. There is a relationship between these types of individualization. Violation of any of them can violate the integrity of being a personality, but there is

[279] See more: Ageev A.I., Loginov E.L. Neuromanagement of the Person. 2nd ed. M: INES, 2022.

[280] Ageev A.I., Loginov E.L., Shkuta A.A. Convergent monitoring and personality programming as a tool for operating the intellectual dynamics of behavior of large groups of people // Economic Strategies. 2018. № 2. C. 70-87; Ageev A.I., Loginoa E.L., Shkuta A.A. Neurocontrol: convergent integration of human brain and artificial intelligence [Electronic resource] // Economic Strategies. 2020. № 6. C. 46-57. DOI: 10.33917/es-6.172.2020.46-57.

also the potential to compensate for the weakening or attrition of one or another subsystem.

The division of socialization into primary and secondary is connected, first of all, with peculiarities of biological age evolution of a human being, who learns the lion's share of key skills of life in society in the first years of life and in adolescence. Skipping this stage is irreversible for a human being, as examples of human beings who grew up in non-human environment (Mowgli and others) show. Secondary socialization is completed when basic functional parameters of the personality reach mature values (usually - at the beginning of early adulthood, sometimes until 30-40 years of age). It seems to make sense, in the context under consideration, to introduce the concept of tertiary socialization occurring in the period of middle adulthood and beyond (40+), given a noticeable increase in life expectancy and the possibility of significant changes in personal characteristics during this period.

In turn, the behavioral activity of both individuals and their groups is determined by the impact of a group of factors:

- biophysical factors that shape the modes of operation of the brain and nervous and other functional systems of a person;

- psychosemantic characteristics of the personality, which determine the nature of perception, activity and implementation of vital interests (basic attitudes) of the individual in relation to external stimuli;

- imprinted reflexive matrixes - matrixes of key reflexive reactions of conscious and unconscious character determining the interpretation of events (incoming information);

- information stimuli - information coming from the environment external in relation to the person, in the relationship with the communicative characteristics of the channels of information[281].

[281] Ageev A.I., Loginov E.L., Shkuta A.A. Convergent monitoring and personality programming as a tool for operating the intellectual dynamics of behavior of large groups of people // Economic Strategies. 2018. № 2. C. 70-87.

Research on the biophysical factors of human behavior has a long genealogy, as does the experience of tabooing them. In the twentieth century there was also a monstrous scientific and experimental experience in this field, condemned by a series of tribunals for crimes against humanity. While partly forbidden, research and development in this area continue, including for military and police purposes.

In particular, a number of regularities in amplitude-frequency and spatial-temporal rearrangements of bioelectrical activity of the brain were revealed. It was found that desynchronization, massively spread in the urbanized informational environment, underlies most of the autonomic disorders that constitute the physiological basis for the development of neurophysiological and psychoemotional stress[282] and related diseases.

It was also revealed that influence of intensive electromagnetic fields and corresponding frequency ranges taking into account biorhythmics of concrete biological object is able to put a person and group of people into altered state of consciousness close to trance[283]. Such state, among other things, blocks most of conscious reactions of a person (including self-reflection, self-control, self-identity) in case of divergence of received, but outwardly convincing and seemingly true information and

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[282] Butova O.A., Grishko E.A. Features of the formation of bioelectrical activity of the brain neurons of soldiers of Stavropol garrison in the aspect of adaptation // Science. Innovations. Technologies. 2009. № 4. C. 235-241.

[283] Altered states of consciousness (ASC) are qualitative changes in subjective experiences or psychological functioning from certain generalized norms for a given subject, reflected by the person himself or noted by observers (Arnold Ludwig's classic definition). According to A. Revonsuo, the main characteristic feature of altered states of consciousness is systemic changes (relative to the normal state of consciousness) in the connection of the content of experiences with the real world, i.e. there are distortions in the representation of external reality or self-awareness in the form of illusions, and these distortions add up to a global change in representation (Altered states of consciousness [Electronic resource] // Wikipedia. URL: https://ru.wikipedia.org/wiki)

surrounding reality. Thus it is easier to influence a person, including using elements of neurolinguistic programming with correction or even complete replacement of the matrix of key reflective reactions of a person with a corresponding change and fixation of a new model of interpretation of occurring events. The sharply increased number of fraudulent financial actions with the digitalization shows the successful application of such technologies. There are known examples when the external influence of swindlers could last up to several days, until a quite educated person realized the criminal nature of the influence exerted on him and the critical external dependence of his actions.

Studies of psychosemantic qualities of the personality are conducted within a variety of scientific directions, and their results are used in medicine, forensics and many other practical applications. Thus, the analysis of personal interests and preferences with respect to search and viewing of information and entertainment media programs, computer games, activity in social networks, financial behavior, etc. allows generating and structuring extensive data arrays of electronic content ("big user data"). The result of such analysis can be a cognitive-reflexive model of a particular individual obtained by another interested person. Elements of neuro-linguistic programming can be built into the model, which allows remote and latent creation of templates of perception and interpretation of the occurring flow of events for the target object of influence and that can become a source of motivation and actions of this person. In this case, both individualized actions on creation of given parameters of behavior of a particular person and clustering of influence on target groups are possible. In other words, digital models of personalities can be dissected by target functions and by critical values of parameters, reduced into clusters, in relation to which unified information influences can be applied.[284, 285, 286]

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[284] Volynsky-Basmanov Y.M. Application of neurolinguistic programming methods to identify potentially dangerous individuals // Problems of safety and emergencies. 2010. № 5. C. 124-128.

At present, given the convergence of information, telecommunications and computing services in global information networks, virtually any user's access to electronic content, regardless of equipment, communication channel and communication method, becomes a special case of access to a single distributed electronic database. Traces of access to electronic content are preserved for a long period of time, allowing the application of proven methods of monitoring analysis, user identification, prediction of reactions and behavior, identification of connections with other users, belonging to explicit and implicit groups, etc.

A modern computer, smartphone or TV remote control with intelligent functions allow not only by the fact, but also by the manner and speed of pressing the keys to accurately identify a person, determine the sign of his attitude to the current electronic content on the screen, identify the levels of sympathy, irritation or aggression in relation to this content. The same devices can record not only the geolocation of a person, but also link it to the intensity of electromagnetic fields in this point, change the parameters of equipment located near this point, affecting electromagnetic fields. Gadgets can record temperature, blood pressure, heartbeat rhythms and other biorhythms of a particular person. Monitoring results make it possible to observe the status and dynamics of a person's psycho-semantic subjectivity in conditions of ambiguity or lack of information about it for making one or another pragmatic decision (ad-

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[285] Kovalevskaya A.V. Information wars: classification of suggestive specificity // Theoretical and practical problems of language tools transformation in the context of theaccelerated development of public relations In Theoretical and practical problems of language tools transformation in the context of the accelerated development of public relations // Peer-reviewed materials digest (collective monograph) published following the results of the CXVIII International Research and Practice Conference and I stage of the Championship in Philology. Chief editor V.V. Pavlov. 2016. C. 23-25.

[286] Kuznetsov V. The use of neurolinguistic programming (NLP) during interrogation // Law and Life. 2011. № 152 (2). C. 134-140.

vertising, elections, etc.), analyze and predict the risk of changing states of activity in normal and in extreme conditions[287, 288. 289]

Bringing together data from all possible databases of electronic content into a single package of information on the psycho-semantic subjectivity of a personality, which combines structured, complex structured and conventionally structured data, allows to determine the characteristics of its behavioral activity, including hidden qualities (for example, sociopathic tendencies, political or religious predilections, phobias, ways of informal self-realization, network and hierarchical relationships, role structure in families and communities, the volume of resources to be operated, belonging

The development of digital technologies makes it possible not only to integrate textual data with video and images, but also to reconstruct and forecast in 3D and 4-D formats the course of events, to track dynamic changes in the behavior of individuals and groups associated with them so that an aggregate information cluster of worldview and professional templates of interpretation of reality and the resulting behavior occurs. On this basis, new management tools are formed.

The rapidly increasing potential for operating generalized semantic structures creates unprecedented opportunities for transferring external purposeful influence from the conscious to the unconscious level for the object. This is achieved by implicitly implanting to individual personalities semantic motivational "anchors" that induce certain evaluations and

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[287] Lyakhov A.F., Trishin I.M. Computer modeling of player behavior in an intellectual card game with neural network // Computer instruments in education. 2013. № 5. С. 54-64.

[288] Samartsev O.R., Latenkova V.M. Psychosemantic aspects of the perception of interactive discourse in Internet media // Bulletin of Cherepovets State University. 2016. № 2 (71). С. 87-91.

[289] Ponomareva O.S., Ustyuzhanin V.N. On the status and prospects of the use of psychosemantic methods of cognition of the personality of the suspect in the activity of the investigative officer // Bulletin of St. Petersburg University of the Russian Interior Ministry. 2016. № 2 (70). С. 190-194.

then actions. On this basis it is possible to combine, causing resonance effects, a lot of individual actions in information and real space: from rush on commodity markets to political rallies.

In essence, integration of various methods of psychoengineering, remote influence, psychocorrection and psychosounding with synchronization of psychophysiological and psychosemantic influences and convergence of the process of perception of information stimuli is rapidly developing. Concentration of personal attention and interpretation of information are brought together in a single composition within the framework of human interpretation of the picture of the surrounding real and imaginary world with the consequent lines of behavior.

New possibilities for neurocognitive control are created by the application of the NII. A digital model (digital twin) is able to simulate all possible modes of human activity, take into account the influence of external factors and control processes, allows predicting the future state and behavior of a physical object. The digital twin is based on technologies of artificial intelligence, machine learning and analytical programming. The digital twin continuously learns and updates its parameters, receiving information from multiple sensors, representing the state of the physical object. It learns from current data from sensors, controls, and the environment, and combines factual data with knowledge gained from engineers experienced in the field. The digital twin uses historical data accumulated in previous phases.

In fact, traditional methods of social management are currently being transformed into a unified system with new communication interfaces, neuro- and bio-interfaces. Significant research experience has been accumulated to develop methods for predicting the intellectual dynamics of behavioral activity[290]. There are many promising concepts for creating a

[290] Ageev A.I., Loginov E.L. Battle for the Future: Who First in the World to Master Noomonitoring and Cognitive Programming of Subjective Reality? // Economic Strategies. 2017. № 2. C. 124-139; Ageev A.I., Loginov E.L., Shkuta A.A. Convergent monitoring and personality programming as a tool for operat-

multifunctional information monitoring system as a forecasting platform (with feedback) of explicit and implicit deep processes and trends in the society, technosphere and natural environment.

A separate research and practically significant subject is the study of the properties of clusters of factors of biophysical and information-cognitive nature and the prediction of intellectual and behavioral activity going beyond steady states as a source of increased risks of emergencies[291] . Related to this problematics is the task of combining various models of support for the social environment, loyal to legal norms, management key attitudes (including digital, anonymous) and the underlying regulators of life activity ("matrix"). A special issue is the risks of cyber-physical systems failure, which can be caused remotely. At the same time failure can be of program-viral origin, as well as anthropogenic - through the impact on the operator's consciousness. Terrorist acts performed by characters under explicit or latent external control can be inspired in the same way. Modern level of technologies allows to carry

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ing the intellectual dynamics of behavior of large groups of people // Economic Strategies. 2018. № 2. C. 70-87; Ageev A.I., Loginov E.L. Neuromanagement of personality (forthcoming); Lepsky V.E. Evolution of ideas about management (methodological and philosophical analysis). Moscow: Cogito-Center, 2015. 107 p.; Lefebvre V.A. Reflexion. Moscow: Cogito-Center, 2003. 495 p.; Raikov A.N. Modeling of collective unconscious when making decisions // Proceedings of the International Scientific Conference CPT-2014 International Scientific Conference of the Moscow Institute of Physics and Technology (State University), Institute of Physical and Technical Informatics. Moscow: Institute of Physical and Technical Informatics, 2015. C. 146-156; Smirnov I., Beznosyuk E., Zhuravlev A. Psychotechnologies: Computer psychosemantic analysis and psychocorrection at the unconscious level. M.: Publishing Group "Progress" - "Culture", 1995. 416 p.; Kholodov Y.A. Brain in Electromagnetic Fields. Moscow: Nauka, 1982. 123 c. et al.

[291] Chukhrova M.G., Chukhrov A.S. Spatial and temporal organization of bioelectrical processes of the brain as an indicator of psychosocial adaptation // World of science, culture, education. 2013. № 5 (42). C. 227-230.

out both probing and influence with the account of psycho-semantic qualities of the personality (official and real political orientation, quality of its professional training, cultural level, interests, volitional qualities, inner motivation, state of health, etc.).

The latest generations of technical devices enable the interested party, relying on automated systems of data collection, accumulation, processing and use, not only to identify and determine the geolocation of the device owner, his emotional attitude to the content of electronic messages, but also to identify the characteristics of the surrounding equipment. Obtaining information about the state of personality through "health gadgets" make it possible to predict transitions of personality states in normal and emergency conditions, if necessary. Identification of personality characteristics by characteristics of information programs viewed by them, activity in social networks, choice of computer games, etc. (a data portfolio of individual electronic content) allows to form a cognitive-reflexive model of the personality. On the basis of such a model it is possible to neuroprogram the worldview and situational reference points and acts of behavior of an individual and groups of people. The facts of tests of such technologies are found practically in many modern local conflicts.

The data obtained from all possible forms of electronic content in the package of information on the psycho-semantic subjectivity of the person allows with a high degree of reliability to detect its behavioral dominants and hidden qualities, as well as belonging to a sociopathic group. The object of human control becomes his digital twin, through the influence on the parameters of which it is possible to adjust his real behavior, thinking, interpretations of events and processes. At the same time the twin itself is continuously actualized in the process of "electronic activity" of the person himself. Application of the MIL allows to carry out all necessary predictive analytics of the doppelganger and his prototype.

Especially important is the prediction and proactive elimination of the possibility of resonance of these factors on the basis of technologies

of remote influence, psycho-correction and psycho-sonding, taking into account the psycho-semantic qualities of the individual extended (official and real political orientation, the quality of her professional training, cultural level, interests, volitional qualities, inner motivation, etc.)[292, 293, 294].

The peak manifestations of behavioral activity can be represented as external and internal manifestations of the resonance vectors of biophysical and information-cognitive factors. [295, 296, 297]The calculation of vectors of this resonance seems to be a nontrivial problem, since its components represent information fields applied to the formation of self-

[292] Vasilevskaya E.A., Mendelevich V.D. Relationship between social intelligence, anticipatory abilities and IQ in patients with schizophrenia // XVI Congress of Psychiatrists of Russia. All-Russian Scientific-Practical Conference with international participation "Psychiatry in the Stages of Reform: Problems and Prospects": Abstracts / Edited by N.G. Neznanov. 2015. C. 280.

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supported resonances of these factors· different in qualitative content, dimensionality and other similar indicators[298].

15.3 Conclusions

Neurotechnology represents one of the fastest growing segments of the all-encompassing world of artificial intelligence systems. Closer than other branches of AI, neurotechnologies and Neuronet in general face the world of a purely human society undergoing fundamental transformations, including digital ones. New technologies for influencing individual and collective consciousness have emerged and are rapidly improving. There is every reason to pay special attention to the problem of truly conscious subjects, which is one of the key issues for the emerging digital society.

The approaching level of development of AI to the ability to operate in different contours of knowledge and to adjust the goal setting of one's activity raises the question of the ethics of artificial systems. It is equally important to recognize the experience of the evolution of the ethics of pre-digital society, especially in the twentieth century and in modern times. There is an almost unavoidable risk of reflecting real ethical relativism and ethical conflict in the architectures and ontologies, software, and learning processes of AI.

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