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Introduction of Neurosocial Technologies of Personality Development: Innovative Practices Against the Background of Crisis Realities of Education

Tetyana Ivanova
Docent, Candidate of Psychological Sciences, Associate Professor at the Department of the Psychology, Political Science and Sociocultural Technologies, Sumy State University, Sumy, Ukraine, sociol8tanya@gmail.com, https://orcid.org/0000-0002-9394-8858

Svitlana Pukhno
Candidate of Psychological Sciences, Associate Professor of Psychology Chair, Educational and Scientific Institute of Pedagogy and Psychology, Sumy State Pedagogical University named after A.S. Makarenko, Sumy, Ukraine, svetlanapuhno@gmail.com, https://orcid.org/0000-0001-9862-5145

Olena Medianova
Candidate of Psychological Sciences, Doctoral Candidate of Department Management and Innovative Technologies of Socio-cultural Activity Ukrainian State University named after Mykhailo Drahomanov, Kyiv, Ukraine, Al.medyanova@gmail.com, https://orcid.org/0000-0002-8681-4835

Abstract: *The question of in which spheres of life neurotechnologies can be used is becoming increasingly relevant. New neurotechnologies are already finding application in medicine, marketing, education and scientific research. At the same time, the potential use of various neurotechnologies in such an important sphere of human life as professional activity remains practically unexplored. The article highlights neurotechnologies that can be used in the process of personality development, identifies problems that arise at different stages of this process and can be addressed with the help of neurotechnologies, investigates their impact on the duration and content of professional development, and identifies ethical and psychological problems that may arise as a result of their use. The article introduces a new concept of neurosocial development and analyses the relationship between neurosocial technologies and artificial intelligence technologies. The findings suggest that trust in new technologies requires the study of such phenomena as the digital ego, group forms of neurosocial behaviour, and neurosocial intelligence.*

Keywords: *needs; motivation; youth; artificial intelligence; neurosocial technologies; sociology; trust; digital platforms; social networks; quality of life.*

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Valentyna Stets
Candidate of Philosophy Sciences, Ivan Franko National University of Lviv, Associate Professor of the Department of Social Pedagogy and Social Work, Lviv, Ukraine, valentina_stec@ukr.net

Andrii Hrynkiv
Candidate of Philosophy Sciences, Associate Professor of Department of Social Work, Ukrainian State University named after Mykhailo Drahomanov, Kyiv, Ukraine, grinkiv1@gmail.com, https://orcid.org/0000-0002-1423-0101

1. Introduction

The modern digital space began to undergo dynamic restructuring after the widespread emergence of social networks in 2006 and the unification of diverse groups of people into local communities followed by their transformation into partially artificial-intelligence-driven social clusters and chat rooms. Mobile devices, high-speed Internet, and large volumes of data have enabled machines to imitate human behaviour, self-learn, and replicate cognitive processes, particularly through understanding needs, desires, and preferences. Today, large Internet platforms can automatically recognise individuals using computer vision systems based on facial images, even when the face is positioned at an angle that complicates identification. Today, the Internet has penetrated virtually all aspects of human life, while artificial intelligence is entering an active stage of influence over our interactions with the world, transforming individuals into *Homo Economicus*, *Homo dictyous* (networked man), and Digital Natives. Those who have entered (including by birthright) into a single digital field are usually called the digital tribe or the digital generation, in which “media makes a person an information tribe”, and therefore artificial intelligence is able to transform a person and society as a whole. The vast possibilities of Internet 4.0 technologies encourage the transformation of cognitive processes, increasing their speed and efficiency

We are relearning how to experience emotions, process information, make decisions and perform actions (Adamczyk, 2014-2015).

Artificial neural networks, once created in the likeness of biological neural circuits, have united the social, emotional and analytical intelligence of a person, giving him unlimited opportunities to use the intelligence that we call neurosocial.

Modern individuals live, work and relax in virtual reality. He dissolves in it, like his avatar in the space of the metaverse that he bought. According to Stanford University's "Centennial Study of Artificial Intelligence," in the next twenty years we will experience global changes in medicine, education, diagnostics, security, logistics, social relations and psychology. In this regard, individuals may benefit from neurosocial technologies, the development of which requires access to modern knowledge and methods for reshaping the behaviour of Generation X, Millennials, Boomers, and even iGeners. It is important to note that the degree of public trust in the digital world varies depending on what situations arise and how the digital environment and artificial intelligence use our personal data. When performing fairly simple mechanical and algorithmic tasks, such as typical computer diagnostics of a car, planning or image analysis, programmes can be trusted no less than people. But when decisions can be interpreted ambiguously or the psychological state of a person ultimately matters, or when the correctness of decisions is influenced by unique inputs and variables (in the case of a court verdict, mitigating circumstances can be identified or applied), more trust is still given to the evaluative opinion of a person, in part because our emotional intelligence takes into account empathy (Chornodon et al., 2021). That is why today we need knowledge about the new neurosocial intelligence, in which analytical, emotional, social and ethical aspects form a single whole and act as a basic platform for the skills of the Digital Tribe. The prefix “neuro” in neurosocial technologies implies the active engagement of individuals with artificial intelligence technologies and the formation of a short feedback loop with artificial intelligence, thereby saving time and socio-psychological resources.

The purpose of this work is to determine whether neurotechnologies can be used to solve emerging problems, to consider the potential impact of neurotechnologies on the duration and content of professional development stages, and to describe the new problems that these technologies generate.

2. Neurotechnology as an Effective Factor in the Formation of a Successful Personality in the Process of Educational Activities

Neurotechnology is a technology that allows you to read signals from the central and peripheral nervous system, as well as influence them. Through in-depth interviews and open source analysis, solutions using neurotechnology are already finding commercial application in areas such as medicine, entertainment, marketing, education, assessment and development of skills, and scientific research. Another area of application of neurotechnology can potentially be supporting the professional development of a person throughout his professional career (Flach, 2015). The stages of professional development are culturally and historically determined, and the emergence of new technologies can potentially change both the content and the time frame of these stages.Even now, invasive devices that directly interact with the subject's brain can be used for this purpose, including neurocomputer interfaces that allow the control of prostheses "by the power of thought" and implants that compensate for organ damage by stimulating the corresponding areas of the sensory cortex.

Similar devices, which are currently used in rehabilitation medicine, can also be used to develop new areas of professional activity that require a person, for example, additional motor or manipulative abilities not given by nature.

Of particular note are augmented cognition technologies designed to expand a person's cognitive capabilities – neurocomputer interfaces that connect neurons with external (computer) memory (Gerulya, 2016). However, the use of augmented cognition methods is unlikely to be widespread as long as the technology remains invasive. It is more likely that non-invasive devices, supplemented by digital applications that process brain activity parameters and improve cognitive functions,will achieve broader adoption.

Methods of extended cognition will significantly intensify the process of obtaining education, as they will reduce the load on memory, shorten the training period, require a shift in emphasis on information processing skills, training reaction speed, etc. Training using neurotechnologies will require a change in approaches to professional education and new teaching methods (Heidegger, 1993). Understanding this is gradually becoming established in the pedagogical environment, which is expressed in the development of a new direction in scientific and pedagogical practice - neuroeducation, which is an interdisciplinary field of scientific knowledge that combines the results of research on the brain and the mechanisms of its functioning in order to find the most effective principles and methods for organising the educational process (Honcharuk et al., 2023).

Neurotechnologies can be successfully combined with existing learning technologies. For example, neurointerfaces developed on the basis of "neurofeedback" and "biofeedback" allow the teacher to:

- adapt the presentation of educational material to the student's state, help him concentrate or relax at the right moment;
- assess the cognitive abilities and current emotional state of students and choose the most effective teaching methods based on the data obtained;
- control the intensity of students' cognitive activity in order to choose the optimal pace of presentation of educational material.

The combination of neurotechnologies and virtual reality may also find applications in education : neurointerfaces will allow to fully reveal the potential of the virtual world, reproducing real smells, tastes, tactile sensations in the digital space, thereby enhancing immersion in virtual reality deeper (Hurzhyi et al., 2022).

Analysis of the capabilities of the listed neurotechnologies indicates that their use can be useful at different stages of a person's professional development, as well as influence their content and duration:

- career choice (neurotechnologies expand the field of professional choice due to the opportunities that appear in the optant, eliminate professional limitations and contraindications, develop necessary abilities; as a result, when choosing a profession, the focus of attention shifts from the optant's compliance with the requirements of the profession, from professional suitability to professional inclinations and personal preferences) (Kapliy, 2013);
- professional training (training using neurotechnologies will require new approaches to the methodology of professional education: training becomes more intensive, due to which the time

required to master a profession is reduced, it becomes possible to quickly master additional professions or change several main professions during professional life);

- professionalisation and professional skills (with the help of neurotechnologies, it is possible to form missing professionally important qualities, activate the achievement of peak professional performance, and also extend professional longevity, which in some cases can alleviate the severity of the crisis of losing a profession).

3. Technologies for Personality Development and the Formation of a Neurosocial Intellect Against the Backdrop of Crisis Realities of Education

The Digital Tribe generation creates media content independently, following popular trends and producing personalised forms of unique digital output, including NFT-based creations. The development of neurosocial technologies within education, along with the growing diversity of informational needs in both real and virtual environments, mutually influence one another—often without linear causality or direct dependence. An individual may seek strong emotional experiences or respond vividly to certain forms of contemporary art while remaining emotionally indifferent to others. This is explained by the formation of the digital generation's informational needs, expressed as a stable and active involvement of the internal avatar in personalised forms of digital life. Such involvement requires continuous training in these informational forms and the integration of meaningful images, objects, people, and phenomena into a unified sphere of personal relevance. The longer and more diverse the conditions and forms of digital learning become, the more deeply individuals are drawn into the informational world and the value systems associated with it (Kempa-Mentrak, 2010).

The environment in which the digital generation's informational needs manifest expands in parallel with the development of neurosocial intelligence. The range of activities and phenomena involved in constructing reality according to the logic of the information world is also expanding. Through collective interaction, people generate increasingly complex neurosocial behaviours that differ fundamentally from the individual processes occurring within the digital Ego (Popel et al., 2023). Joint actions drive most evolutionary leaps. Researchers argue that social networks possess a special form of collective intelligence that enhances or complements the intellectual abilities of individual participants. These networks absorb and temporarily store information exchanged among users—rules, principles of interaction, instructions, and more. A network consistently demonstrates collective properties regardless of the intelligence of its individual members. When a group of people gathers in a virtual environment (for example, in metaverses such as Decentraland, Horizon Worlds, The Sandbox, or Cryptovoxels) and actively interacts, the network retains its structure (roles) and functions (rules) (Sarancha et al., 2021).

If relationships in the virtual world are built on mutual respect, recognition, and trust, all participants who accept these roles and rules become bearers of a new collective behavioral pattern, simultaneously adapting to it and learning from it. This reshapes social, intellectual, and behavioural models, forming a personal code of neurosocial intelligence. Moreover, such a code may be capable of self-restoration even after long periods of inactivity. An individual's behavioural patterns and unique impressions within the virtual world can be preserved and reproduced in a new environment with entirely new participants (Sarancha et al., 2022). The ability to self-restore is another property of neurosocial intelligence, which proves resilient to loss and functions effectively—similar to artificial intelligence—when processing new input data, interpreting them as new tasks with an ever-increasing capacity for problem-solving.

The development of neurosocial intelligence today results from the multi-vector use of digital services by network users. In contemporary post-capitalist societies, information and communication technologies have become increasingly integrated into economic, organisational, and social processes, contributing to new forms of social interaction and governance

The introduction of new platform-based infrastructures not only transforms competition in the digital age but also reshapes individuals, turning them into living components of a capitalist platform with a constantly updated interface, high-speed Internet, and accelerated thinking (Kepa-Mętrak, 2009). Clip-based and teaser-based thinking have already become defining attributes of the digital environment, and they are now being replaced by neurosocial intelligence.

Network effects and monopolisation are embedded in the structure of large platforms: the more users interact on a platform, the more valuable it becomes for each of them. Major platforms such as Uber or Yandex can initiate new informational needs. Integration into new domains, self-replication, and the multiplication of network effects allow platforms to achieve increasing market dominance. User data collection demonstrates that the more actions a user performs within a system, the more value the system can extract—and subsequently convert into new needs and behaviours. Large-scale analytics enables artificial intelligence to generate increasingly accurate predictions of human behaviour. By accessing a major search engine, users simultaneously activate their email, phone number, location, calendar, search history, photo and video archives, and more. The platform then recommends new applications, contacts, entertainment, and informational content, signalling to developers the need to expand the platform's capabilities. This funnel reshapes human perception, drawing individuals into a "corridor of endlessly unsatisfied needs" (Kus, 2014).

An analysis of research on the use of neurobiological feedback has identified two main areas of current investigation. The first concerns the ability to influence brain activity using modern technological devices through bioelectrical activation, bypassing direct interaction with the neuromuscular system. This system is commonly referred to in the scientific literature as the *brain–computer interface (BCI)*. The second area focuses on the potential of neurobiological feedback—namely, the voluntary restructuring of brain activity patterns under the influence of signals recorded during electroencephalography, at the level of conditioned-reflex formation. The key distinction is that BCI systems automatically process and control central nervous system (CNS) activity through external devices, whereas neurobiological feedback systems train individuals to consciously regulate automated physiological functions.

One of the first researchers in the second half of the twentieth century to study the effects of neurobiological feedback was J. Kamiya. His experiments demonstrated that individuals are capable of voluntarily controlling the spectral activity of EEG signals. Subsequent studies conducted by Japanese scientists suggested that the effectiveness of biofeedback on the brain's bioelectrical activity is determined by structural mechanisms underlying neural network transformation. However, another perspective argues that the effectiveness of biofeedback is based on functional tuning of variables within the spectral field of brain bioelectrical activity. Numerous studies have shown that biofeedback technologies adjust brain oscillations towards a homeostatic set point, ensuring an optimal balance between neural flexibility and stability.

Because EEG rhythms are used as feedback signals, early neurofeedback training focused primarily on the alpha rhythm. Later, protocols regulating rhythmic activity in the beta range were actively developed. The alpha rhythm (8–13 Hz) predominates during wakefulness with eyes closed in a relaxed state, when alpha waves typically show synchronised amplitude and frequency. Active mental activity or sensory stimulation suppresses the alpha rhythm (alpha blocking). When the eyes are opened, the beta rhythm becomes dominant, associated with higher cognitive processes and concentration, characterised by low amplitude and high frequency. Gamma waves (above 30 Hz) also appear during learning and intense focus. Other rhythms (delta, theta, mu) occur mainly during sleep and were not initially used as feedback signals.

Subsequent research demonstrated the potential of theta-based neurotraining, leading to the development of combined alpha–theta training protocols. For example, neurobiological feedback in patients with alpha–theta asymmetry contributed to the functional restructuring of neural network connections. These findings suggest that such protocols may be effective in treating affective disorders. Many authors highlight the potential of neurobiological feedback in clinical practice. Studies involving patients with acute cerebrovascular accidents reported statistically significant increases in spectral power in the alpha, beta, and theta bands, which were associated with improvements in cognitive functioning and emotional well-being.

Research on neurofeedback for addiction treatment initially focused on alpha training, later expanded to include alpha–theta protocols, and eventually shifted towards beta-range (sensorimotor rhythm) training, which proved more effective. Similar neurofeedback protocols are used in obesity therapy. The most common approach involves reducing theta activity and increasing beta activity, or suppressing theta rhythms while enhancing high-frequency alpha activity. Authors emphasise the advantages of neurofeedback in obesity treatment, including non-invasiveness, minimal contraindications, the absence of side effects, and improved emotional regulation and eating behaviour through conscious control of brain activity. A major limitation, however, is the lack of standardised, universally accepted EEG-based neurofeedback protocols.

A substantial body of research has examined the use of neurobiological feedback to regulate rhythmic brain activity in patients with post-traumatic stress disorder (PTSD). International studies often describe neurofeedback as an advanced brain-training method that enables the brain to acquire and practice new behavioural patterns supporting emotional regulation, psychological stability, flexibility, and resilience. It relies on operant-conditioning principles to stimulate neuroplasticity and promote regenerative processes. This is particularly important in the treatment of PTSD, which may result from prolonged trauma and is characterised by disrupted brain-wave patterns. Research shows that modifying brain structure through neurotraining can positively influence these deep-rooted conditions, restoring brain activity and regulating previously impaired functions.

Example 1. EEG-Neurofeedback in Higher Education

Between 2022 and 2024, several European universities evaluated EEG-based neurofeedback as a means of improving student concentration.

Results:
attention improved by 18–25%;
exam stress decreased by 30–40%;
learning time reduced by 12%.

Example 2. Application of the CMS Methodology in Professional Training

CMS (Current Mental State) uses HRV and cardiorhythmogram data to assess stress and cognitive load.

Results after 6 weeks:
stress resilience increased by 22%;
decision-making speed improved by 17%;
emotional exhaustion decreased by 28%.

Example 3. Neurosocial Training in Corporations

Companies such as Siemens, Deloitte and Samsung evaluated neurosocial virtual reality training programmes.

Results:
teamwork efficiency improved by 20–35%;
conflict levels decreased by 15–18%;
trust in teams increased by 25%.

Platform post-capitalism creates ecosystems that differentiate themselves from competitors and conduct offensive information campaigns. At the same time, individuals may adopt such behaviours, gradually becoming neurosocial participants within large platform-based ecosystems. An important question is whether non-platform websites will be able to compete with platforms that provide integrated services. The need to address this question, together with the challenges posed by artificial intelligence, encourages the development of realistic future scenarios (Seradzka et al., 2021). However, the digital world and the same metaverse are constantly updated in accordance with external signals. Moreover, this happens along with the renewal of our horizon of needs and opportunities. According to researchers, the mobility of the horizon of expectations helps to explain the ease with which our memories and contacts change (Shiner, 2019). Recent neuroscience studies suggest that the “mobility of expectations” may be related to the brain’s tendency to generate prediction errors.The brain appears to perceive the surrounding world as more predictable than it actually is (Lutsyuk, 2014). This conclusion is consistent with Popper’s view that “learning consists mainly of correcting errors” and adopting existing models of behaviour.

4. Ethical and Psychological Problems of Using Neurotechnologies

Modern neuroscience is engaged in a direct comparison of the brain correlates of conscious and unconscious information processing under the same conditions, thereby seeking to identify the brain mechanisms of the emergence of conscious experience.

Neuroscience is an interdisciplinary field that combines research activities related to the study of the nervous system, its development, structure, and functions. The normal functioning of the nervous system, as well as neurological and mental disorders, also constitutes an important subject of neuroscience research.

This field is concerned with the study and understanding of the mechanisms of the human brain. The central question in neuroscience is how the brain is related to the observed behaviour. Neuroscience includes neurobiology and encompasses theoretical models of neural coding, interactions with cognitive sciences (including psychology), the study of brain activity using instrumental methods, neural dynamics, and models of learning, perception, and behaviour. Neuroscience is a multidisciplinary framework that studies various aspects of brain and nervous system functioning. This combination of scientific disciplines allows researchers to explain how the brain functions in different areas of human life. Neurobiology and neuroscience are often used interchangeably in the literature (Nerubasska et al., 2020).

The development of neuroscience has also given rise to new areas in psychology and physiology - neuropsychology (understanding the psyche through the study of cognitive processes), neurophysiology (the study of the functions of the nervous system), neuroethology (understanding animal behaviour through the comparative study of the human nervous system), and neuroanatomy (the study of neural structures). New areas of research have emerged, such as social neuroscience (Mahfoud, 2021).

One of the actively developing areas of modern neuroscience is educational neurobiology. The idea of using the achievements of neurobiology and educational practice has become widespread in the last 10-15 years (especially in the last five years), and has been called neuroeducation. This branch of neuroscience combines the efforts of researchers in cognitive neurobiology, developmental neurobiology, educational psychology, pedagogy, and didactics in order to study the relationships between biological processes and educational activities (Niewiadomska, 2012). (Oliver et al., 2019).

Researchers in the field of educational neurobiology most frequently investigate the neurobiological mechanisms underlying reading, mathematical abilities, attention, and related difficulties (e.g., dyslexia and dyscalculia). According to proponents of educational neuroscience, the interdisciplinary findings obtained in this field may facilitate closer integration between neuroscience and educational technologies, improve learning outcomes in schools and universities, and promote direct collaboration between neuroscience researchers and educators (see the proposed Neurosocial Model in Figure 1). One of the widely used methods in neuroeducation is biofeedback (BOS), which allows the assessment and training of cognitive abilities, as well as the presentation of physiological indicators to both the researcher and the participant within a clinical protocol comprising two main groups:

- "neurofeedback" (neurotherapy), which is implemented on the basis of various parameters of the electroencephalogram (EEG) of the brain,

- biofeedback, which is based on physiological indicators such as electrocardiographic parameters, heart rate, and respiration(Picard, 2018).

Currently, the BOS method is used to study students' adaptation to the educational process, assess their psychological state under different learning conditions, evaluate and reduce stress during training and examinations, optimise physical and cognitive performance, promote relaxation and positive emotional states, and support speech rehabilitation, addiction treatment, and interventions for children and students with hyperactivity.

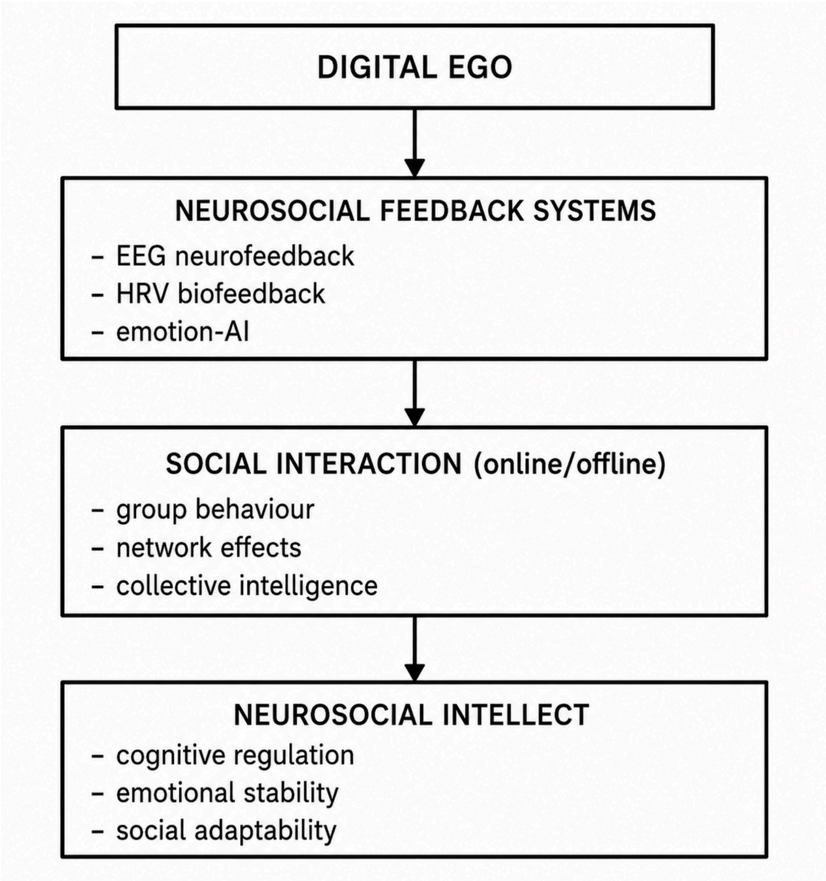

Figure 1. Neurosocial Model

The study used the psychophysiological BOS methodology CMS (Current Mental State), which is based on the assessment of psychological state parameters derived from cardiorhythmogram data and allows rapid evaluation of the current psychological state, as well as monitoring of changes over time and assessment of the effects of various intervention(Maklyuyen, 2003).

5. Conclusions

1. Neurotechnologies currently being developed and technologies that, according to experts, will appear in the foreseeable future, will help compensate for damage to motor and sensory organs, train cognitive functions, develop the ability to enter mental states necessary for the performance of professional functions.

2. The use of neurotechnologies may be beneficial at different stages of professional development and may also influence the content and duration of the following stages:

- career choice (neurotechnologies may help reduce certain professional limitations and contraindications, shifting the focus from strict compliance with occupational requirements towards individual preferences and interests);

- professional training (intensification of training and reduction of its duration, the emergence of the opportunity to master additional professions or change several main professions during life);

- professionalisation and professional excellence (facilitating the achievement of peak professional performance and extending professional longevity).

3. The use of neurotechnologies, in addition to positive effects, may be associated with a number of undesirable consequences and difficulties in adapting a person to these technologies. The use of neurotechnologies, especially invasive ones, will require a certain period of medical rehabilitation and psychological support.

Thus, it may be concluded that trust in artificial intelligence can be supported through active human oversight combined with well-developed neurosocial intelligence. Predicting the future requires a detailed description of such concepts as: “digital needs”, “corridor of unmet needs” and “platform man”. The security of global digital networks may be related to collective forms of neurosocial behaviour, their investigation, and the further development of the concept of the “Digital EGO”. The personal neurosocial unconscious and the personal code of neurosocial intelligence expand their influence on social online and offline interactions and the “Internet of Things”.

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