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NEUROTECHNOLOGIES IN LAW AND LAW ENFORCEMENT: PAST, PRESENT AND FUTURE**

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The scope of the research is the necessity for legal regulation of the use of neurotechnologies in various sectors of human activity and the possibility of their application in jurisprudence. Neurotechnology is based on advances in neuroscience that allow us to understand the structure of the brain. The advances in neuroscience are driving the rapid development of neurotechnologies and their spread in modern society. The special importance of neurotechnologies is explained by the fact that, on the one hand, they contribute to the enhancement of artificial intelligence, significantly increasing the amount of data necessary for artificial intelligence for learning, on the other hand, with the help of neurotechnologies, people can increase their capabilities, both physical and mental.

The purpose of the article is to analyze the development of the application of neurotechnologies in practical use and assess the degree of necessity for the right to respond to the use of various neurodevices by people, as well as to study the risks of using solutions based on neurotechnologies in law enforcement.

The methods of conducting this research include the formal logical method, historical and comparative legal methods, the method of systems analysis, the method of abstraction and the method of legal forecasting.

The main scientific results. Taking into consideration the available foreign experience, the history of the use of neurotechnologies in law enforcement to the present day is systematized, the origins of the formation of neuro-law are considered. The level of neurotechnologies achieved today is assessed, the main issues that the development of neurotechnologies pose to law, and the questions that arise in connection with the growing use of neurotechnologies in law enforcement in the world are listed. Analyzed the legal acts and international documents (soft law) aimed at the regulation of neurotechnology nowadays. The short-term prospects for the use of neurotechnologies in law enforcement are formulated and the related needs for changing legal regulation, in particular, the need to recognize a new group of neuro-rights for a person are highlighted.

Conclusions. The further development of neurotechnologies, declared as one of the state priorities in Russia, inevitably intensifies the penetration of neurotechnologies into various sectors of public and state life, including the activities of law enforcement agencies. Therefore, it is necessary to prepare the legal basis for this already today, implementing the relevant provisions into the Constitution of the Russian Federation, criminal, civil, administrative, labor and procedural legislation.

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1. Introduction

Neurotechnologies are a group of technologies that are becoming widespread in practice due to the development of neuroscience (neurophysiology, neurobiology, neuroengineering, neuroinformatics, etc.). Neuroscience allows you to understand the structure of the brain and get an idea of consciousness, thought processes, higher mental functions. Neuroscientists consider the brain as a collection of neurons – a neural network and offer solutions based on the principles of the nervous system. Neurotechnologies make it possible to improve the functioning of the human brain (biological neural network) and create artificial mathematical models built on the principle of biological neural networks capable of solving complex problems and self-learning. With the help of such technologies, neural interfaces are constructed for the exchange of information between the brain and the computer. Neurotechnologies have already reached a level that allows the spread of neurocommunications between humans and robots, in the next decade it will "completely change both the essence and the form of human communications and interactions."

Why will the importance of neurotechnologies grow? They are at the junction of digital and nature-like technologies. On the one hand, neurotechnologies make it possible to enhance artificial intelligence, the development of which depends on the amount of data it receives for analysis, and neurosensors supply this data. On the other hand, with the help of neurotechnologies, a person himself acquires new abilities. Neurotechnologies are aimed both at the development of artificial intelligence (neural networks, neurosensors), and at increasing human capabilities (neuroprostheses, neurochips, neuropharma), at creating hybrid (human-machine) intelligence. These technologies can be used to obtain personal data about the activity of the human brain and for external influence on it (Memory Engineering, etc.).

Due to the success of neuroscience, which makes it possible to talk about the "neurotechnological revolution" that has begun, neurotechnologies are included among the ten promising technologies for which the Decree of the Government of the Russian Federation No. 1750 of October 28, 2020 provides for the creation of experimental legal regimes, that is, the formation of a legal framework for accelerated implementation in practice. It is possible to predict a fairly rapid spread of neurotechnologies in the field of labor (through the use of neuroassistents, devices for monitoring the condition of a driver or employee at a dangerous object), in everyday life (the use of neurogajets for remote control of household appliances, online communication), in medicine (the development of neuropharma that allows the treatment and prevention of neurodegenerative diseases), in education, industry entertainment, etc.

The spread of neurotechnologies will not leave law without attention. We are talking not only about the creation of appropriate legal regulation, but also about the use of neurotechnologies in law enforcement. If the result of the development of neural networks in the field of law enforcement will be the introduction of artificial intelligence into law enforcement [1], then increasing the capabilities of people with the help of neurochips, neuroprostheses, neuropharma will require changes in the methods of work of law enforcement agencies, for which technologies can be used to carry out external effects on the human brain. It is necessary to prevent human rights violations and at the same time to maximize the use of new opportunities in order to solve the tasks facing law enforcement agencies.

The use of artificial intelligence in law enforcement increases interest in neurotechnologies. Solutions based on neurotechnologies make it possible to multiply the amount of available data about a person, on the basis of which artificial intelligence will draw conclusions, prepare recommendations, etc. The more artificial intelligence is involved in law enforcement, the more neurotechnologies will be used to collect data about people and effectively control them. Neurotechnologies make it possible to realize the idea of human-machine communication,

and given that the range of tasks delegated to artificial intelligence in law will also grow, the importance of intermediary technologies between humans and artificial intelligence will increase.

More and more scientists have been studying the influence of neurotechnologies on the law and opportunities for the use of neurotechnologies in law enforcement in recent years. One of the first fundamental works can be called the work of Sh . Taylor's "Neuropsychological evidence on Appeal" [2] 1989. Today , the works of F. are devoted to this topic . Coppola (Columbia University), N. Farahani (Duke University), F.X. Shen (University of Minnesota), M.S. Pardo (Georgetown University), N.A. Vincent (University of Technology Sydney), R. Merkel (University of Hamburg), J. Riberg (Roskilde University, Denmark), etc. The research results are published in scientific journals, primarily in the "International Journal of Law and Psychiatry", "Criminal Law and Philosophy", "New Criminal Law Review", "Journal of Law and the Biosciences". Among Russian authors, researchers from the Institute of State and Law of the Russian Academy of Sciences S.V. Polubinskaya, A.B. Didikin, V.S. Gorban, M.A. Belyaev and a number of other authors touch on this topic in their works.

2. The use of neurotechnologies by jurisprudence: history to the present day

The prerequisite for the use of neurotechnologies in jurisprudence can be called the need to establish the truth. Attempts to find out whether a person is telling the truth or a lie have been made for thousands of years, in the Ancient world and in the Middle Ages various techniques were used for this – usually by the clergy – based on the observation of the physiological reactions of the subject, such as salivation, movements of body parts.

The founder of psychophysiology as a science can be called the German physiologist V. Wundt (1832-1920), one of whose students was academician I.P. Pavlov. In the XIX century, devices for measuring heart rate were invented, in 1881, a psychiatrist, professor of forensic medicine C. Lombroso already used a device recording changes in blood pressure during interrogations. In 1933 , a graduate of Stanford University , L. Keeler designed a device close to a modern polygraph and allows you to track the work of the heart, pressure changes, respiratory rate and galvanic skin reflex. Currently, a polygraph is a computer supplemented with a sensor unit and recording sensors. The use of a polygraph by law enforcement agencies is limited, and in some countries it is directly prohibited, since conclusions based on the physiological reactions of the body may be erroneous or biased.

In the last quarter of the XX century, the level of development of psychophysiology as a science has increased and from the science of physiological mechanisms of the psyche, it began to turn into the science of neural mechanisms of mental processes and states (neurophysiology). Neuroscience, aimed at studying the human brain, and cognitive psychology, which studies memory, attention, thinking and imagination, are closely related to neurophysiology.

The first official use of the term "neuroscience" can be dated back to 1962, when it appeared in the name of the research program of the Massachusetts Institute of Technology "Neurosciences Research Program" [3, p. 38]. In the early 1970s, expanded models of the economic order were developed, which used knowledge from other branches of science, as a result of which a new interdisciplinary approach was formed - the theory of studying human behavior in the decision–making process (neuroeconomics).

The successes of neuroscience also interested legal scholars, which led to the use of neurotechnologies in jurisprudence. For example, since the 90s of the XX century, neurotechnologies have been increasingly used in court proceedings in the United States, and case law in this area has gradually been formed. A special term "neuropsychology" appeared, it was first used in the article "Neuropsychologists and neuropsychologists" [4], published in the journal "Neuropsychology" in 1991. The authors of the article pointed to a head injury as a possible mitigating circumstance when deciding on legal liability in the case when neuropsychologists provided evidence of brain dysfunction due to such an injury. Neuro-law can be defined as an interdisciplinary field of knowledge linking the brain and law and leading to an understanding of human behavior in order to regulate it through the inclusion of neurotechnologies in legal research [5, p. 53].

In his article "The Forgotten History of

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Neurotravel" [6], F.H. Shen argues that the history of the use of neurotechnologies by jurisprudence began much earlier. He identifies four periods preceding the "modern history" of neuropraw:

1) fundamental medical and legal dialogue (XIX – early XX centuries);

2) the use of electroencephalography data in law (mid-XX century);

3) the use of psychosurgery to prevent violence (1960-1970s of the XX century);

4) the use of neurobiological evidence in lawsuits proving brain damage due to diseases or injuries that affected the behavior of a person (1980s - 1990s of the XX century).

The author of the article "The Forgotten History of Neuro-law" notes the progressively expanding use of neurotechnologies in lawsuits in the United States, for example, if only eight cases were registered before 1950 in which electroencephalography was mentioned, then in 2016 alone there were almost 2000 cases. The third of the periods indicated by the author of the article covers the time of application of such a medical procedure as lobotomy in order to "correct" repeat offenders recognized as mentally ill [7]. Modern researchers call this time the "dark prehistory" and continue to ask the question: can the use of neurotechnologies to influence the work of the brain as a means of preventing offenses in the future be justified? [8]

F.H. Shen calls the most important factor that distinguishes neuro-law, the acceleration of the development of neurotechnologies, which is reflected in law enforcement. Thus, a study by American neurophysiologists, the results of which were published in the journal "Nature Neuroscience" in 2003, proved that the formation of various parts of the cerebral cortex occurs unevenly throughout a person's life [9]. This led to a ban on the death penalty of minors, established two years later by the US Supreme Court.

To date, there are two main ways of using neurotechnologies in the judicial process in the United States. In the first case, neurotechnologies are used to reinforce the validity of the statement about the influence of a certain state of the brain on human behavior (the verdict in a particular case depends on this), and in the second, "neurobiological data and theories provide basic knowledge to support broad regulatory requirements concerning general classes of people" [10, p. 2]. As for legal regulation, in 2008 the first bill on the national neurotechnological initiative was introduced in the US Congress, in 2009 another bill with the same name was introduced, none of them was approved by Congress.

Over the past two decades, the number of studies in the field of neuro-law has increased. One of the largest charitable foundations in the USA, the MacArthur Foundation, supported the initiative "The Law and Neuroscience Project", within which research groups of lawyers, neuroscientists and philosophers were created to study conceptual issues and conduct empirical research, the results of which, published in 2013, were supposed to demonstrate the importance of neuroscience for law [11].

In addition to American researchers, European, Asian and Australian authors are engaged in this topic. For example, N.A. Vincent has published a number of articles and books on this topic. The author studies the possibilities of restoring mental abilities based on direct intervention in the brain using neuropharma. Such means are "sometimes used in criminal cases to achieve the goals of justice" [12, p. 21], allowing to assess the degree of responsibility of a person for the committed act. This, in turn, raised the question of the correlation of the capabilities of neuroscience with human rights. An overview of the positions of various researchers on this issue is presented, in particular, in the article by M.N. Mora "How law and neuroscience have become a new field of research" [13].

In 2012, the Center for Strategic Analysis under the Government of France published the report "Brain and Law: analysis of the emergence of neuro-law". The report, prepared by experts in law, philosophy, cognitive neurology and psychology, examines in detail the ethical and legal issues related to the spread of neurotechnologies. One of the authors of the report emphasized that when collecting and analyzing personal data, it turns out that people differ greatly from each other in the level of empathy, intelligence, impulsivity and aggression. The existing differences between people contribute to the development of society, but present a puzzle for the judicial system, built on the principle of equality of all before the law. "The myth of equality of people assumes that all people have the ability to control their motives, make decisions

and understand the consequences," however, the statement about equality in relation to nervous systems is false [14, p. 49]. The achievements of neuroscience make it possible to understand the behavior of people in a long continuum, and not through simplified categories that are used to date. Researchers who published an article in the Stanford Law Review a little earlier disagree with this position, insisting that brain neuroimaging (in particular magnetic resonance imaging), introduced at various stages of the criminal process as evidence of a person's mental state in the past, should not be accepted by the court, as it may mislead him [15]. Several special issues of international scientific journals are devoted entirely to discussions in this area. Examples are issue #65 "Neuroscience, Law, and Ethics" ("International Journal of Law and Psychiatry", 2019) and issue # 21 "The Neurolaw Issue" ("New Criminal Law Review", 2018).

Russian researchers also discuss the impact of neurotechnologies on law, the need for their regulation and the possibility of using them in law enforcement. In September 2018, the Department of Philosophy of Law, History and Theory of State and Law of the Institute of State and Law of the Russian Academy of Sciences organized a seminar "Law and Neuroscience". The seminar participants focused on the differences between the term "neuro-law" and the names of branches of law ("civil law", "constitutional law", "labor law", etc.), which outline the sphere regulated by the norms of these branches. Neuro-law does not regulate nervous processes, so it is impossible to talk about a separate set of norms, while law and neurology really have in common – human consciousness [16, p. 3].

Since neuroscience, as a rule, refers to the natural-scientific field of knowledge based on the laws of nature, and jurisprudence is a social science, because law is a product of society, this leads to difficulties in the formation of an interdisciplinary neuro–law. Nevertheless, it can be argued that by now legal scholars specializing in various branches and institutions of law (constitutional law, criminal law, labor law, intellectual property law, tort law, medical law, etc.) are interested in achievements in the field of neuroscience [17]. Such interest will lead to the emergence of a community of neuro-jurists who, relying on neuroscience to help understand human behavior, will shape many aspects of legal activity in the future [5, p. 54]. In the meantime, the achievements of neuroscience are most actively used by criminology, according to some authors, as a fait accompli, we can talk about the formation of neurocriminology [18], based on the connection of legal responsibility with the work of the brain, visualized with the help of neurotechnologies [19].

3. Possibilities of modern neurotechnologies and regulation of their use by law

Currently, technologies for processing and interpreting human condition data using neurophysiology are rapidly developing, the market for wearable biometrics is expanding, including various devices: fitness trackers, smart watches and other gadgets using sensors. Technologies for creating brain–computer neural interfaces are being improved, allowing people to control a computer with the power of thought. Systems are being developed that decrypt brain signals and turn them into speech. Communication systems are being tested that provide an opportunity to communicate to people deprived of speech and motor functions due to cerebral palsy, strokes, injuries [20]. The combination of technologies that blurs the boundaries between the physical, digital and biological spheres is becoming a distinctive feature of the information society [21].

The integration of the achievements of neuroscience, neuropsychology and neuroengineering brings us closer to understanding the activity of the human brain. Neuropsychologists are beginning to play an increasingly important role in the consideration of cases by the courts, especially those related to bodily injuries, compensation for harm caused [22]. Neuroimaging of the brain is used to reinforce evidence of guilt or innocence of the accused. In courts of different countries, neurobiological evidence is provided when considering both criminal and civil cases (Russian courts are no exception). In this regard, questions are raised:

- can a decision on criminal prosecution be made on the basis of brain neuroimaging? [23, p. 29]

- is it possible to reconsider the attitude to the actions of violators if the neural activity of the

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brain is programmed and a person is not free in his aspirations? [24, p. 19]

- who is allowed to transfer such evidence to the court and for what purposes it can be used (for example, by the prosecution to establish guilt or only by the defense to refute the charges)?

- what role should expert testimony play, which is often necessary for the interpretation of such evidence, and what principles should judges take into account when experts disagree about the value of specific evidence? [25]

- what significance should high-tech evidence have in relation to other types of evidence, for example, to the testimony of witnesses?

– can the use of such methods to collect evidence violate existing rights, for example, the use of neurotechnologies for mind reading - the right to remain silent? [26]

- is it possible to predict the probability of correcting a criminal by studying and visualizing brain activity during a person's intellectual activity? [27, p. 32]

From a practical point of view, lie detectors based on neurotechnologies represent a new problem, "opening the way to the development of a new paradigm in legal science" [28]. The lie neurodetector is more reliable and therefore has prospects in law enforcement practice. Nevertheless, some researchers are skeptical about its use, so, according to S.V. Polubinskaya, the creators of the lie neurodetector did not take into account "the complexity and interconnectedness of the human brain and the inability to localize human actions in a specific area of the brain" [29, p. 7], which does not allow us to recommend a lie neurodetector for use in real trials.

Researchers from different countries note the lack of clear standards, the lack of regulatory regulation of neurotechnologies and indicate that ethical and legal issues related to interference in the human brain, in the cognitive sphere, are waiting for solutions [30, p. 979]. This is especially true for regulating the use of neurotechnologies simultaneously with artificial intelligence. Together, these technologies are becoming the most significant technologies of the Fourth Industrial Revolution. Firstly, neurotechnologies make it possible to obtain previously inaccessible data about a person, thereby increasing the opportunities for artificial intelligence training. Secondly, in the era of artificial intelligence development, neurotechnologies make it possible to strengthen natural intelligence, as well as combine it with artificial intelligence into one system, leading to the creation of hybrid (human-machine) intelligence.

The first country to have a special section of legislation dedicated to the regulation of neurotechnologies was France, which restricted the commercial use of neuroimaging technologies. In 2011, Chapter IV was included in Book I "On Persons" of the French Civil Code, containing one article 16-14 "Use of brain imaging methods", which states that "brain imaging methods can only be used for medical or scientific purposes, or as part of a forensic examination."

On June 29, 2021, the French National Assembly approved a bill amending the law on bioethics. This law concerns a wide range of issues, including the use of neurotechnologies. According to articles 12 and 13 of the bill approved by Parliament, amendments are being made to a number of French laws, including:

- to the French Civil Code, article 16-14 of which now regulates not only the use of brain imaging methods, but also other methods of recording brain activity;

- to the French Criminal Code, article 225-3 of which is supplemented with the wording on "data obtained as a result of registration of brain activity";

- to the Code of Public Health, the title of paragraph V of Book I of Part One of which is supplemented with the word "neuromodulation", and Chapter 1 is supplemented with Article L 1151-4: "Actions, procedures, techniques, methods and equipment designed to change brain activity that pose a serious danger or an alleged serious danger to human health may be prohibited by decree after the conclusion of the Supreme Health Authority."

The next State following the path of legislative regulation of issues related to neurotechnologies has become Chile, whose parliament is considering a bill on the inclusion of a new group of human rights in the Constitution of Chile. These are rights aimed at protecting the mental integrity and integrity of the individual – neuro-law. The problem of protecting the brain from the risks posed by the spread of neurotechnologies requires the formation of a legal framework that can reduce risks and prevent possible future damage

[31]. The bill, submitted for consideration in the fall of 2020 and already approved by the Senate, calls fundamental rights in this area: the right to personal identity, freedom of will, privacy, equal access to technologies that expand human potential, as well as the right to protection from bias and discrimination.

The first document of an international legal nature that formulates standards for the development of neurotechnologies is the Recommendation of the Council for Responsible Innovations in Neurotechnologies of the Organization for Economic Cooperation and Development (hereinafter referred to as the OECD Recommendation), approved on December 11, 2019. The text of the OECD Recommendation recognizes that neurotechnologies:

- open up great prospects for human health and innovation;

- they are developing rapidly and require flexible forms of management;

- provoke the emergence of ethical and legal issues, given the supposed central role of the brain and cognitive functions in the concepts of human identity, freedom of thought and autonomy;

- can be used not only for health purposes and potentially establish social inequality;

- require the highest level of security, etc.

The OECD Recommendation calls the principles of the development of neurotechnologies:

1) Promoting responsible innovations in neurotechnologies to solve health problems (avoiding harm, paying due attention to human rights and public values, especially privacy, cognitive freedom, human autonomy and preventing innovations in neurotechnologies that seek to affect freedom and self-determination, especially in cases where this will contribute to bias and discrimination);

2) Priority of safety in the development and use of neurotechnologies (taking into account potential unforeseen side effects in the research and development of neurotechnologies, creating mechanisms for short- and long-term supervision and monitoring of product safety);

3) Promoting the inclusion of neurotechnologies for health (striving to ensure that neurotechnologies are developed and accessible to those who need them);

4) Promotion of scientific cooperation;

5) Encouraging public discussion.

Paragraphs 6 and 7 of the OECD Recommendation state that it is necessary:

- to respond to opportunities arising from neurotechnologies and legal issues arising in this regard in order to ensure supervision and problem solving;

- to develop institutional capacity, mechanisms for forecasting and evaluating potential results and ways of developing neurotechnologies;

- protect personal data related to the brain and other information obtained with the help of neurotechnologies by resolving issues of collection, storage, processing and potential use of data collected for medical purposes;

- to promote opportunities for people to choose how to use and share their data, including options for accessing, changing and deleting personal data, to promote policies that protect personal brain data from being used for discrimination;

- promote privacy and security, including by implementing strict security standards.

Paragraph 9 of the OECD Recommendation is devoted to the prevention of inappropriate use of neurotechnologies, it includes provisions on the need to take measures to protect against potential abuse of neurotechnologies, to create guarantees for the protection of privacy, the dignity of an individual or groups of people both in the short and long term, the need to anticipate and prevent actions that can affect the decision-making process by individuals or groups, deliberately influencing freedom and self-determination, for example through intrusive observation, unreasonable assessment, manipulation of brain states and (or) human behavior.

The following international documents were adopted in 2020 Recommendation No. 2184 and Resolution No. 2344 of the Parliamentary Assembly of the Council of Europe with the same name "Brain-computer interface: new rights or new threats to fundamental freedoms?" . Resolution No. 2344 notes the rapid progress of neurotechnologies in recent years, including the ability to register and directly stimulate neural activity, which accelerates the creation of increasingly effective neural interfaces. It is indicated that this progress is due to a

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combination of a deeper understanding of the functioning of the brain, an increase in the level of technological developments and the development of artificial intelligence systems. Although the ability to create a complete symbiotic connection between the human brain and artificial intelligence seems to be a distant prospect, nevertheless, this goal has already been set by developers and is likely to be achieved eventually. Paragraph 4 of Resolution No. 2344 emphasizes that the successes already achieved and the resources allocated for further research state the need to immediately begin to predict the situation and regulate it based on the precautionary principle. The huge potential advantages of neurotechnologies, especially in the field of medicine, are such that innovations should not be held back, at the same time research should be directed away from predictably harmful or dangerous moments that threaten the dignity, equality and freedom of the individual.

Paragraph 8 of Resolution No. 2344 contains an appeal from the Parliamentary Assembly of the Council of Europe to the member States of the Council of Europe:

- establish an ethical framework for research, development and application of neurotechnologies;
- clearly define the limits of research by creating specific legal mechanisms that ensure effective observance and protection of human rights;
- ensure the existence of bodies to oversee research, development and application of neurotechnologies and their regulation;
- to consider the establishment of a new group of rights – neuro-rights as the most effective means of protection against possible risks associated with the spread of neurotechnologies in practice.

As we can see, international documents concerning the regulation of neurotechnologies belong to the so-called "soft law", which, unlike international treaties, is not binding, but pushes for the creation of national and international legal regulation based on the proposed model. If the OECD Recommendation contains proposals to regulate the use of neurotechnologies in practice, which is supported by the majority of theoretical researchers, then Resolution No. 2344 proposes more serious restrictions - to regulate not only the use of neurotechnologies, but their very development.

4. Prospects for the use of neurotechnologies in law enforcement and the need for regulation

The spread of neurotechnologies in practice continues. In 2021, the regulatory state body – the US Food and Drug Administration – approved testing on volunteers of the Synchron brain neuroimplant, implanted into the brain through the jugular vein and used as an invasive, that is, implanted into the body, brain–computer interface to influence external devices.

As for the spread of neurotechnologies in law enforcement, there are currently relatively few achievements of neuroscience that are recognized as sufficiently reliable for the court, but there is reason to believe that the situation will change here as well. This is indicated by "the dizzyingly rapid progress of cognitive neuroscience, which provides evidence of how the brain processes information over the past decade" [32, p. 184]. The development of neurotechnologies will change people and society: "the architecture and functioning of our brain become a matter of choice" [33, p. 1], understanding the consequences of this choice will help to avoid the destructive use of neurotechnologies. The management of cognitive improvement, the spread of neurointerfaces and neuroimaging will entail a shift in the boundaries of state control over the individual and society, creating new opportunities for the state.

In order to avoid the negative consequences of the development and spread of neurotechnologies, a number of legal categories will need to be revised. A. Colbert, in his article "Will there be a neuro-legal revolution?" published in 2014 in the Indiana Law Journal, emphasizes: "The revolution in the field of neuro-law will not necessarily be the result of radical changes in our ideas about criminal responsibility" [34, p. 807], and will be the result of a wave of new technologies that will change society. It will happen because new brain imaging methods will eventually allow us to measure suffering, which will clarify the assessment of moral harm and the amount of compensation, and recognize people's thoughts, which will require the creation of legal norms to protect confidentiality, but will inevitably reduce actual confidentiality.

In addition, the development of artificial intelligence will change the way laws are written and interpreted. We are talking about the implementation of machine-readable and machine-executable law in practice. Projects aimed at automating the law are already being implemented in many countries. In Russia , at the initiative of the Ministry of Economic Development of the Russian Federation , a concept for the development of machine - readable law technologies has been developed . The results of the implementation of this concept will be:

- selection and testing of machine-readable law technologies, creation of machine-readable reference books of legal terms, development of document designers for the implementation of the powers of state bodies (2021-2024);

- replication of successful experience in the use of machine-readable regulation and automated law enforcement (2024-2028);

- reform of the system of preparation and decision-making on changes in regulation and law enforcement practice (2028-2035).

Thus, the planned automation of law enforcement through the involvement of artificial intelligence will undoubtedly be complemented by the opportunities provided by neurotechnologies. For example, wearing a non-invasive neurointerface will become mandatory for persons who have committed certain types of crimes, as a sanction that ensures control over their behavior.

On the other hand, the development of neurotechnologies will add lawyers to discuss issues other than those voiced earlier. For example, suppose complex brain-reading devices have been created to detect information stored in a person's memory, but these will be subjective experiences, not objective truths. In addition, obtaining such information requires the use of machine learning algorithms, which may be opaque or even inexplicable to the court, which will prevent assessing the reliability of evidence [35, p. 58].

It cannot be denied that the development of neuroscience contributes to understanding the connection between the brain and human behavior and can influence the doctrinal rethinking and practical application of such categories of criminal law as guilt, sanity and age of criminal responsibility [36, p. 10]. In his article "Nine Predictions of Neuropraw", published in 2018 in the journal "New Criminal Law Review", M.B. Hoffman suggested that in the next ten years it will be possible to diagnose many legally significant mental disorders and conditions. Nevertheless, according to M.B. This will not have a big impact on legal practice: diagnosis by clinical methods will remain, and neurobiological data will be able to help with expert discrepancies in assessments. At the same time, if we predict the use of neurotechnologies for a longer period from 10 to 50 years, neurotechnologies will allow us to determine how "adult" the brain of a particular person is, which may lead to changes in the norms on the age of criminal responsibility and differentiate in more detail the measures of criminal legal impact [37, p. 213].

Neuroimaging of the brain can help to make more informed decisions when assessing the risks of relapse [38, p. 79]. According to R. Merkel, the need to predict the future danger of criminal defendants with the help of neurotechnologies and artificial intelligence arises at least when assessing the potential danger of persons previously convicted of sexual violence. At the same time, it is necessary to realize that the state has the opportunity to impose sanctions on someone for what they have not done, only there is a danger that they will do it in the future. This practice becomes "a borderline case for any law and order committed to the principle of justice" [39, p. 1358].

The State is obliged to use all available scientifically acceptable methods to determine the forecast of the future danger of the offender. Can magnetic resonance imaging (hereinafter referred to as MRI) R. Merkel, referring to the work of a number of researchers [40, 41, 42], argues that there are at least two mental predispositions to reoffending that allow to establish the results of MRI – pedophilia and psychopathy. As a consequence, concludes R. Merkel, states not only have the right, but are also obliged to use neurotechnologies to predict a person's behavior in the future and, if necessary, apply preventive detention measures based on them. To do this, it will be necessary to clearly state in the law what can be done with the help of MRI, and what is not, because the presence of a tendency to pedophilia does not necessarily mean encroachments on the sexual integrity of children. According to empirical studies, many more men and women have this tendency than the number of people who have ever committed such crimes, many

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avoid it because of the threat of criminal punishment [43].

Since advances in brain-reading technologies are changing traditional epistemological boundaries, the sustainability of the existing human rights framework is being questioned. Shouldn't the constitutional right to freedom of thought be reformulated in order to ensure adequate protection of the human right from "reading" the brain without its consent? According to European researchers, the right to freedom of thought in accordance with its current understanding will not cover the use of most neural devices for "reading" the brain in relation to criminal justice, it would be more logical to enshrine in law the right to freedom of (non-) expression of opinion with a number of exceptions [44, p. 1]. Nevertheless, the problem of correlation the possibilities of neuroscience with human rights will increase, because access to neurobiological data using brain scans poses a threat to the right to privacy [5, p. 56]. Analyzing the achievements of neuroscience, more and more researchers insist on securing guarantees of privacy in the law, including the right not to be subjected to illegal supervision by public authorities or private corporations. Such guarantees will include a new group of rights and freedoms – neuro-law, covering cognitive freedom, the right to mental integrity, the right to mental integrity and the right to psychological continuity [45, p. 9].

The need for legislative consolidation of a whole group of new rights is due to the fact that the possibilities of neurotechnologies are not limited to neuroimaging of the brain, there are other areas, such as neuropharma, neuroprosthetics, etc. In a relatively short time, the use of neuropharma in the form of drugs that enhance memory, attention and cognitive functions will become quite common, and this will also require consideration law. Recent advances in neuroscience offer parents new opportunities in parenting – changing brain activation to improve cognitive functions. "Parents' use and government regulation of cognitive improvements will inevitably cause tension between parent, child and the state. These contradictions stem from three different but fundamentally related reasons, namely the incompetence of minors in making decisions concerning their own well-being, parental autonomy in making decisions about the upbringing of their minor children and the interests of the state in protecting the well-being of minors" [46, p. 1].

Neuropharma can also be used in law enforcement activities. For example, a "digital tablet" with a built-in sensor can monitor the condition of a person and their intake of necessary medications [47]. By the way, "digital tablets" are already a reality, in particular, the first such "tablet" was approved several years ago by the US Food and Drug Administration, already mentioned above.

In addition to neuropharma, in a few years, the spread of neuroimplants with artificial intelligence is predicted, not only restoring lost functions, but also enhancing human capabilities. This will stimulate an increase in the number of people with improved physical and mental abilities that exceed the capabilities of an ordinary person. There is a need to regulate the rights of people who do not use such neuroimplants, and the rights of persons with neuroimplants [48]. It is not yet clear exactly how to regulate their rights, but at the international level, the formation of the principle can be traced: people who need neural devices for medical reasons should be recognized the right to use them [49]. It will also be necessary to formulate the principles of access to cognitive improvement. Will everyone be guaranteed the right to cognitive improvement? Some researchers are of the opinion that fixing this right in the law will only increase social inequality, fair access to technology should be limited to therapeutic purposes [50].

In any case, it is necessary to formulate general rules for safe and fair access to neural devices [51]. In addition, the philosophical concept of transhumanism, which is gaining more and more supporters, challenges the established paradigm of human rights protection: it becomes difficult to delineate cognitive boundaries between people and machines, and those who want to actively use neurotechnologies (up to the creation of hybrid intelligence) reject the idea that privacy and mental integrity should be protected. In this regard, ethical and legal issues arise related to the protection of persons entering into relationships with people who have taken advantage of new opportunities of neurotechnologies and changed their nature [52, p. 1].

The consequence of the spread of neurotechnologies in practice will also be the

problem of ensuring the safety of persons using neurotechnologies, especially brain implants (neurochips). Cyberattacks will become a threat to their security, from which the state will be obliged to protect its citizens. Cyber attacks can be carried out in order to obtain information about bank accounts, manipulate a neuroprosthesis to harm a third party, etc. How in this case will it be necessary to qualify the disabling of the neuroprosthesis: as damage to a person's property or as a threat to his life and health? The severity of the punishment will depend on this. Apparently, in some cases, the commission of a crime by a person with a neuroprosthesis will be qualified differently, because the neuroprosthesis can be used as a weapon. The administrative legislation is likely to have regulations governing the creation of special databases for the accounting of complex neuroprostheses and the issuance of licenses for their installation.

If the number of people using neuroprostheses is likely to remain limited in the next decade, since people without medical indications are unlikely to massively want to install neuroimplants at the achieved level of neuroprosthesis development, then the extreme prevalence of neurogajets aimed at healthy users and having various non-medical applications (for example, educational or work-related) will become another challenge for jurisprudence in the coming years [53]. Such neural gadgets do not require invasive intervention in the human body and the demand for them will grow rapidly. However, neuroscientists and neuroengineers claim that the main medical and technological obstacles to neuroprosthetics will be eliminated over the next two decades, which will stimulate the spread of neuroimplants [54].

5. Conclusion

The introduction of neurotechnologies in all areas of human activity will expand, since "the main customer in the development of neurotechnoscience is no longer so much medicine, as areas and practices in which human intelligence is either controlled, or improved, or imitated" [55, p. 50]. The development of artificial intelligence requires the constant help of neurotechnologies. The next stage of the technological revolution is associated with neurotechnologies, as their use allows expanding human capabilities, integrating a person into the emerging "smart" digital environment and connecting natural intelligence with artificial intelligence. The law will be forced to respond to the changes taking place in society by embedding provisions into the system of regulatory regulation that take into account the growing level of development of neurotechnologies.

At the constitutional level, we are talking about the inclusion in the texts of constitutions of a new group of rights (neuro–rights) that protect against unauthorized "reading" of the brain - the creation of elements of constitutional protection in the new era of direct access to the human mind [56]. In criminal, criminal procedure and penal enforcement legislation, there will be norms regulating the use of brain neuroimaging (as has already been done in part in the French Criminal Code) and neural interfaces, other neural devices for monitoring persons who have committed a crime. Civil legislation will have to solve, among other things, the issue of the distribution of civil liability for harm caused by a neuroprosthesis with artificial intelligence [57]. The possibilities of neurotechnologies will make it possible to more accurately assess moral harm in order to establish the amount of fair compensation. The administrative legislation is likely to have norms regulating the maintenance of databases on the accounting of complex neuroprostheses and the legality of the use of neuropharma. Labor legislation will limit the ability of employers to use neurotechnologies in the process of work, otherwise employees will be forced to constantly wear neural gadgets that allow them to monitor in detail the performance of their work duties, effectively depriving them of the right to privacy, etc.

The use of neurotechnologies in the activities of law enforcement agencies will grow, although it is worth agreeing with S.V. Polubinskaya, who notes that courts are careful to decide on the admissibility of neuroimaging evidence due to doubts about their scientific reliability, reliability and relevance to the case, so far "the very practice of the presence of such evidence in courts is evaluated very ambiguously" [37, p. 10]. Nevertheless, the vector of development of such a direction as the use of the achievements of neuroscience in law enforcement (together with the rapid increase in the level of

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neurotechnologies) suggests a tendency to expand their further use. An indirect confirmation of this is the creation of the Roadmap of the National Technological Initiative "Neuronet" in 2021, according to which the improvement of legal regulation in the Russian Federation is planned for the further development of neurotechnologies. Paragraph 1.5.2 of this Roadmap for the period up to 2025 provides for "Gradual improvement of the regulatory framework in order to eliminate barriers to the use of advanced technological solutions and create a system of incentives for their implementation." If solutions based on neurotechnologies will be widespread in business, in everyday life, in education, then their widespread use by law enforcement agencies is a matter of the near future, which means that legal restrictions and assumptions on the use of various neurotechnologies in law enforcement should be developed now.

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