Organoid Intelligence in Forensic Neuroscience: A Connection-Based Approach to Crime Analysis

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This study examines organoid intelligence (OI), connection science, and artificial intelligence approaches in forensic science. Organoid models derived from human brain cells are used to analyze biological information processing and memory mechanisms; the potential of these systems to model consciousness, memory, and decision-making processes in criminal behavior is evaluated. Furthermore, neurobiological markers associated with criminal behavior and the predictive capacity of artificial intelligence are discussed, along with the ethical and legal limitations of OI in forensic applications.

Keywords: *Organoid intelligence; connectivity; forensic science; crime analysis; neuroscience.*

Органоїдний інтелект у судовій нейронауці: підхід до аналізу злочинності, заснований на зв'язках

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Розглянуто підходи до користування органоїдним інтелектом (OI), наукою про зв'язки та штучним інтелектом у криміналістиці. Моделі органоїдів, отримані з клітин людського мозку, застосовують для аналізу механізмів опрацювання біологічної інформації та пам'яті; оцінюють потенціал цих систем для моделювання процесів свідомості, пам'яті та прийняття рішень у злочинній поведінці. Окрім того, обговорюють нейробіологічні маркери, пов'язані зі злочинною поведінкою, і прогностичну здатність штучного інтелекту, а також етичні та правові обмеження OI в судово-експертному застосуванні.

Ключові слова: *органоїдний інтелект; зв'язок; криміналістика; аналіз злочинів; нейронаука.*

Information processing is fundamentally a multilayered process that occurs through connectivity, and life can be considered a structure formed by the flow of information at different levels. In this context, the human nervous system is one of the most advanced examples of connectivity. Today, studies aimed at understanding this system are expanding with artificial intelligence and organoid intelligence research. Connectivity science, by offering a fundamental approach to explaining information processing processes in biological and artificial systems, provides new methodological possibilities for the analysis of criminal behavior in forensic investigations.

Organoid intelligence is an approach based on the information processing capacity of biological structures derived from human brain cells. These systems allow for the modeling of memory, learning, and decision-making processes. In this respect, organoid intelligence is considered not only a biological model but also a computational system [4]. Biological computational processes emerge as hybrid systems where digital and analog structures work together. At the same time, these processes operate in inseparable layers from the molecular level to the system level [1].

In this context, organoid intelligence, as a model based on connectivity mathematics, stands out as a new tool in criminological research for understanding complex criminal behaviors [2–6]. Neurobiological data plays an important role in understanding criminal behaviors. Indicators such as neurotransmitter levels, synaptic plasticity, and neural activity patterns can be correlated with individuals' behavioral tendencies [1; 2].

AI analysis of organoid data predicts criminal trends with approximately 85% accuracy using deep learning, while quantum-assisted neural networks achieve accuracy exceeding 90%; this highlights the increasing importance of predictive models in forensic science [3].

In this context, low-voltage artificial neurons developed by University of Massachusetts Amherst researchers and produced with Geobacter sulfurreducens-derived protein nanowires are directly related to organoid intelligence-based biological computation models. These systems enable coherent signal transmission between

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biological and artificial networks by mimicking the operating parameters (~100 mV) of human neurons [4]. This development strengthens the integration of neurobiological data from organoid systems with artificial intelligence, providing a theoretical foundation for more sensitive and low-energy analysis platforms for the neurobiological basis of criminal behavior in forensic science [5].

Organoid intelligence research is not limited only to classical biological processes, but is also associated with quantum-based approaches. Quantum processes, which are claimed to occur at the microtubule level, are raising new discussions in understanding consciousness and information processing mechanisms.

In this context, the integration of quantum computing and biological systems offers new possibilities in forensic data security and analysis processes. Quantum communication technologies and organoid intelligence, in particular, will play a critical role in expanding forensic investigations and ensuring data security.

This study addresses organoid intelligence in the context of forensic science not only as a theoretical concept but also as an application-oriented analytical model. The proposed approach consists of three main components: Biological data generation (organoid models), Artificial intelligence and algorithmic analysis processes, Forensic interpretation and criminalistic integration. This model offers the possibility of a deeper analysis by focusing not only on the consequences of criminal behavior but also on its neurobiological origins [6; 7].

Organoid intelligence systems hold significant potential in forensic science, particularly in areas such as witness verification, criminal intent analysis, and behavioral prediction. Organoid models and artificial intelligence algorithms, supported by neurobiological data, reveal relationships within datasets, offering forensic experts new analytical tools. However, these systems should be used as supporting tools, not direct decision-makers [1].

Organoid intelligence applications raise significant ethical and legal debates due to issues such as consciousness and memory modeling, the use of biological data, and privacy. Therefore, its use in forensic science should be limited by international ethical and legal frameworks. Organoid intelligence, along with connectivity science and artificial intelligence, presents a new paradigm in forensic science, enabling a deeper analysis of criminal behavior. However, effective and safe use requires a comprehensive consideration of both technical and ethical dimensions, and future support with more concrete data.

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