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THE NEURAL ARCHITECTURE OF ORGANISED CRIME NETWORKS INVOLVED IN DRUG TRAFFICKING

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Abstract:

The phenomenon of organized crime constitutes an increasing threat to regional security in Europe, where criminal networks demonstrate a persistent capacity to overcome the efforts of authorities to counter its proliferation. The most profitable form of organised crime is cocaine trafficking from South America to European markets. The dynamism and fluidity of the criminal entities that orchestrate cocaine trafficking reflect their flexibility even in terms of how they are structured. Considering the need to understand the complexity and multidimensionality of cocaine trafficking, a neural network model will be proposed that encompasses the main characteristics of the criminal networks involved in this form of crime. The purpose of this research is to identify a new conceptual model for the structure of organised crime groups. This research aims to generate knowledge about operational reality of criminal groups by drawing an analogy between their structure and a neural network. The data analysed in this article were derived from reports issued by European and international authorities with institutional mandates in the field of monitoring, preventing and combating international cocaine trafficking, covering the period from 2021-2026, including news publications and academic literature in the field of sociology and neuroscience. The research finds that the neural network conceptual model integrates the main characteristics associated with organised crime networks into a unified framework: fluidity, decentralisation, (re)configurability and organisational flexibility.

Keywords*: organised crime groups, neural network, cocaine trafficking, decentralised structure.*

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Introduction

In the context of a highly dynamic and fluid international system, the phenomenon of organised crime has historically experienced structural and operational transformations, in response to economic, technological and geopolitical developments. These adaptations have served both to preserve the efficiency of illicit activities and to facilitate the sustained expansion of the phenomenon on a global scale. In this regard, the vectors of the threat, the organised crime groups, have demonstrated their acumen and agility in overcoming the challenges existing at the level of international ecosystem. Although countermeasures at the national and international levels have intensified, organised crime networks continue to exploit the systemic vulnerabilities, continuously seeking opportunities to expand their illicit operations. The transition from traditional hierarchical structures of criminal groups to fluid and decentralised structures has been a catalyst for the global expansion of organized crime (McCarthy-Jones et al., 2020). As a result, these groups have extended their influence beyond the geographical borders of their countries of origin, becoming non-state actors with a decisive role in international security and stability.

Over recent decades, the concept of "organised crime groups" has evolved substantially, reflecting both the progressive consolidation of expertise among competent authorities at global level and the increasing diversity, adaptability and structural complexity of these criminal entities (Williams and Godson, 2002). In the context, this research adopts the definition formulated by the United Nations Office on Drugs and Crime (UNODC, 2002), as follows: "An organised crime group is a structured group of three or more people, existing for a period of time and acting in concert with the aim of committing one or more serious crimes in order to obtain, directly or indirectly, a financial or other material benefit". Nonetheless, the definition proposed by the United Nations Office on Drugs and Crime does not expressly integrate the transnational operability and adaptability of organised crime groups but rather provides a starting point for understanding the structuring model proposed in this paper.

From a structural point of view, different patterns can be identified in terms of how criminal groups are organised and operate. In

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2002, the United Nations Office on Drugs and Crime published a report entitled. "Results of a pilot survey of forty selected organized crime groups in sixteen countries" with identified five patterns regarding the structure of criminal organisations: hierarchical organisations and their derivatives (grouped hierarchy and regional hierarchy), such as the Italian mafias in the 20th century, which operated both in their country of origin and in the United States of America; core group organisations (the power of these organizations lies in the hands of a small group of individuals), such as the McLean Syndicate; and network-type organisations that are decentralised, fluid and informal, such as the Sinaloa Cartel and the Albanian Syndicate. The applicability of these typologies to the operational dynamics of organised crime groups remains limited within the specialized literature (Le, 2012). Therefore, the Europol report "Serious and Organised Crime Threat Assessment" (2021) identified a distinction of organised crime groups from a structural perspective, limited to two categories: hierarchical and decentralised structures.

The present scientific approach focuses on organised crime groups involved in the international cocaine trafficking from the countries of origin, Colombia, Bolivia, and Peru, towards European markets, particularly Albanian groups, as these groups have demonstrated notable resilience in the face of law enforcement interventions. The illegal cocaine trade in Europe is defined by increasing availability and purity, with cocaine being the second most consumed narcotic on the European continent (EUDA, 2024). This market stability ensures the profitability of illicit trade, making it attractive to criminal networks. Moreover, this phenomenon is inherently multifaceted, generating significant social, economic, and political distortions while simultaneously perpetuating a climate of violence and reinforcing patterns of corruption.

This research adopts a qualitative research design, emphasizing in-depth analytical examinations of data from reports issued by European and international authorities with institutional mandates in the field of monitoring, preventing and combating international cocaine trafficking, covering the period from 2021-2026, including news publications and academic literature in the field of sociology and

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neuroscience. These sources were selected in order to obtain a comprehensive understanding of the dynamics of criminal networks and their structural and operational developments.

The methodological approach involves a comparative analysis between the decentralised structure of criminal networks and the neuronal structure. Following the data analysis process, an examination of the convergences between the decentralised structure of Albanian networks and the neuronal structure will be carried out, with an emphasis on the characteristics that facilitate adaptability, resilience, and optimisation of operational flows.

The specialized literature employs various terminologies to characterise the structure and operation of criminal networks, including "fluid", "decentralised", "reconfigurable", and "flexible". Collectively, these attributes can be synthesized into a unifying conceptual framework, referred to in this study as a neural model. The proposed neural model seeks to consolidate the defining characteristics of this structural configuration of organised crime groups into a single conceptual framework, while also providing an accurate representation of the contemporary dynamism of organized crime, which is characterised by operational flexibility, high interconnectivity, and systemic adaptability.

The progressive transition of organised crime groups—from hierarchical structures to decentralised models.

Groups with a history of violence and a large number of members, operating at international level, tend to have hierarchical structure, with a clear division of tasks and multiple levels of power and authority (EUROPOL, 2024). However, in the context of the fluidisation and decentralisation of organised crime, Albanian groups have undergone structural and functional developments, evolving from a strict hierarchical structure based on family connections to a more operationally efficient structure (Rama, 2021) characterised by decentralised distribution of power and responsibilities (Times, 2026).

The Albanian Mafia is a syndicate—a large number of groups of the same ethnic origin—that operates across Europe and maintains

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direct cooperation with criminal groups in both Latin America and Europe in the trafficking of cocaine (GIATOC, 2021). According to Europol, Albanian organised crime groups initially emerged as service providers for other criminal entities (EUROPOL, 2004). These groups had a hierarchical, homogenous structure based on family relationships and the "Besa" code, defined by the phrase "oath of honour" (Albanian Studies). This code was adopted to protect group members by strengthening internal cohesion and limiting the incursion of law enforcement into the hierarchical structure of the groups.

Since 2010, the Albanian groups have no longer relied exclusively on family or social ties, but have expanded their networks through cooperation with members outside the community and with foreign citizens (Fabian Zhilla, 2015). This has led to these organisations becoming more diverse, with both Albanians and people from other countries, especially from places along the main heroin and cocaine trafficking routes, like Ecuador, Mexico, the UK, Germany, Greece, Italy, Spain, Turkey and Kosovo (VoxNews, 2024). By 2015, more than 40 organised crime groups were operating in Albania, engaging in illicit activities originating from Tirana, Shkodra, Durrës, Vlorë, Fier, Berat, and Elbasan, exhibited more fluid organisational structures compared to the initial mafia families that emerged at the end of the twentieth century (Zhilla et al., 2016). Fabian Zhilla and Besfort Lamallari, in their 2015 paper entitled "Albanian Criminal Groups", consider that the current organisational structure of Albanian criminal groups is significantly more efficient than in the initial stages of their formation. In terms of cocaine trafficking, members of these groups are present in European Union countries and in the countries of origin of cocaine, in order to facilitate trafficking across the ocean and to maximize their profits.

The Albanian syndicate has now extended its influence over the production-trafficking-distribution process, following the model of the Italian Mafia in the 20th century (the two groups began collaborating in the 1990s), by organising air, land, and transports through maritime ports in Ecuador (GIATOC, 2021), exploiting the infrastructure and connections of the 'Ndrangheta Mafia (the 'Ndrangheta is an organized crime group in Italy that reached its peak in the early 21st century through cocaine trafficking from South America (Mistler-Ferguson,

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2022). According to Kevin Mills, the Albanian Mafia is well positioned in the illicit cocaine trade to Europe: "he Albanians have had a meteoric rise in the cocaine trade, operating in many parts of Europe, particularly the UK and the Netherlands. If anyone is going to have an advantage in the container trade, it will be the Albanian Mafia. They have a footprint in Latin America and at many exit points. They still hold face-to-face meetings with people here in the region". This transnational expansion functions to mitigate the risk inherent in intermediation, optimise profits, and enhance the autonomy of criminal groups within the international trafficking process.

In this context, by adopting a decentralised structure, organised crime groups gain the capacity continuously reorganise themselves, thus limiting attempts to suspend their activities by law enforcement. This capacity for structural adjustment proliferates the threat posed by organised crime groups and allows them to exploit different environments to ensure the success of their criminal activities.

An overview of cocaine trafficking from South America to Europe

Within the context of international cocaine trafficking, organised crime groups exploit critical infrastructure—particularly European seaports—by corrupting customs and law enforcement officials, infiltrating logistics chains, and diversifying trafficking routes and methods of insertion, thereby limiting the capacity of competent authorities to contain the spread of this phenomenon (EUROPOL, 2022). The instrumentalization of corruption constitutes a core component of the operational DNA of criminal groups, acting as a catalyst both for infiltrating in the logistics of seaports (EUROPOL, 2023) and state institutions, and for circumventing law enforcement, thereby expanding their influence across political, economic, and social spheres (EUROPOL, 2025). Moreover, corruption is directly correlated with violence, with approximately 25% of organised crime groups frequently using both physical and psychological violence in a planned and premeditated manner (EUROPOL, 2021) to ensure compliance with the rules imposed by previously corrupt actors.

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The diversity of methods of insertion and transport routes underscore the high adaptability of these groups to the measures implemented by institutions responsible for combating and preventing the illicit international trafficking. In Latin American, cocaine shipping points are frequently changed by criminal organisations to avoid controls by authorities in the region (EUROPOL, 2025). In the case of European port terminals, there has been a shift in trafficking flows from the ports of the Iberian Peninsula, with in the 1980s were the epicentres of cocaine trafficking by Medellin and Cali cartels (Fernández, 2024; Resa-Nestares, 1999), to those in Western Europe notably in Belgium (Antwerp), the Netherlands (Rotterdam), and Germany (Hamburg) (Kundu, 2021; EUDA, 2022). Currently, organised crime groups tend to reuse Iberian ports (Saiz, 2025). The fundamental element underlying the transition is defined by operational flexibility in relation to the direction measures implemented in European ports, particularly those implemented in the port of Antwerp (Belga News Agency, 2024; Magli, 2023), as a result of the quantities of cocaine seized in 2022 (110.9 tons).

At the territorial and local level, criminal entities involved in cocaine distribution across Europe have both proliferated and diversified (EUDA, 2022). This fragmentation of the distribution market facilitates control of purity by criminal actors in order to maximize profits. Moreover, groups use minors to distribute cocaine in European markets in the interest of evading the authorities. This modus operandi reflects their flexibility in exploiting legislative loopholes and the protection of minors stipulated in national legislation, with the aim of reducing the risk of criminal sanctions for committing crimes (EUROPOL, 2025).

Due to the adaptability of these groups, technological challenges have not impeded their operational progress, as they have taken advantage of the benefits associated with the use of technology. Groups have resorted to encrypted means of communication such as EncroChat (EUROPOL, 2023), Sky ECC, and Anom (EUROPOL, 2024; EUROPOL, 2025), as well as the use of submarines or semi-submersible vessels to facilitate the flow of illegal shipments despite the tightening of interception measures by law enforcement agencies in European ports.

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In addition, organised crime groups use online markets (Darknet markets) to sell cocaine, taking advantage of anonymity of the Darknet and payment methods with low traceability (payments made in cryptocurrencies) (EUDA, 2022). This method catalyses the expansion of distribution networks by minimizing the risks associated with physical contact, which can compromise the smooth running of criminal activities.

The high profitability associated with cocaine trafficking provides considerable financial rewards (EUROPOL, 2021), generating interest from numerous criminal networks, which are often in direct competition with each other. Competition within the illicit cocaine market not only fosters illegal practices but also encourages a significant predisposition for violence and corruption, as criminal networks-including Albanian groups, Latin American Cartels, and Moroccan organisations (EUROPOL, 2021), and for control over lucrative trafficking routes and market domination (EUROPOL, 2025). The proliferation of criminal groups involved in cocaine trafficking creates opacity in the process by which competent authorities establish the structural configuration of these organisations.

Organised crime networks through the lens of the neural model: A structural and functional equivalence

The neural model of organised crime group structuring suggests that decentralised criminal networks exhibit structural and functional characteristics comparable to those of biological neural systems. Within this framework, organised crime groups are conceptualized as interconnected operational units whose efficiency derives from decentralised coordination, rapid information transmission, adaptive resilience, and continuous structural reorganisation. Consequently, the functioning of transnational criminal networks may be interpreted through principles analogous to those underlying neuronal architectures.

Rather than replacing hierarchical or network-based paradigms, the neural model expands their explanatory capacity by emphasizing the adaptive and decentralised properties of organised crime structures operating within fluid transnational environments. Thus, the neural model contributes to a more nuanced understanding of informal coordination mechanisms and structural adaptation processes,

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providing an innovative conceptual framework that complements and enriches existing models of the organisation and functioning of organised crime groups.

Within this structural-functional model, the transnational criminal network is conceptualised as a decentralised adaptive system structurally comparable to a neuronal network. Its architecture consists of geographically distributed yet operationally interconnected groups functioning as specialised nodes within the criminal structure. Similar to neurons within biological neural systems, each operational unit performs specific functions whose efficiency derives from interdependence, synchronization, and continuous information exchange.

Analogous to neuronal networks in the human brain, composed of neurons interconnected by synapses and organised into intricate functional structures (Kandel et al., 2013), organised crime groups operate within complex networks that are difficult for authorities to map. These networks are characterised by an internal distribution of roles among members, efficient communication mechanism, and a high capacity to adapt to the dynamic and fluid nature of the international ecosystem. In both types of previously presented structures, the network architecture is not randomly designed but is the result of an organisation geared towards efficiency and optimal functioning in relation to the established objectives. Within neuronal systems, these objectives involve the rapid processing and transmission of information necessary for cognitive and physiological functioning, whereas within organised crime structures they involve the coordination and protection of illicit activities intended to maximize operational efficiency and profit generation.

Within the neuronal networks, each neuron plays a key role in receiving, processing, and transmitting electrical signals, contributing to the coherence of the nervous system's functioning (Hăulică, 2000). These signals are transmitted using the action potentials of neurons, which, through their speed and accuracy, allow the body to respond immediately to internal and/or external stimuli. Functionally comparable mechanisms can be identified within transnational organised crime networks, where operational groups facilitate the rapid circulation of strategic information related to trafficking routes, financial transfers, corruption networks,

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and law enforcement activity. Each group has a well-defined function, and the success of an action lies in the complementarity of their synchronization and systematic collaboration within the network.

Throughout neural architectures, myelin facilitates the accelerated and protected transmission of electrical signals by insulating axonal fibres and minimizing signal dissipation (Moșanu-Șupac and Coșcodan, 2024). A functionally equivalent mechanism may be observed within organised crime networks through the use of corruption, intimidation, and encrypted communication technologies, all of which reduce operational exposure while facilitating rapid and secure information circulation throughout the network. Similar to myelinated neural pathways, these protective mechanisms contribute to the operational continuity and resilience of decentralized criminal structures, minimizing the risk of intervention by the authorities.

A defining characteristic shared by both neuronal and organised crime systems is decentralization. Within neural architectures, cognitive functionality emerges through the interaction of heterogeneously distributed neurons rather than through the existence of a singular coordinating core (Sapolsky, 2018). This principle of decentralization is likewise reflected in the structures of criminal groups, where criminal cells are capable of operating independently while remaining integrated within the broader criminal network through stable communication pathways and shared strategic objectives.

Another point of convergence between the two types of networks is the efficiency of internal communication. In the nervous system, as mentioned above, communication is ensured by action potentials, a process characterized by rapid execution (Blooijs et al., 2023). The same holds for organised crime networks engaged in global cocaine trafficking, which employ advanced encryption technologies, including secure messaging applications, to circumvent law enforcement possible detection.

Last but not least, the strongest structural-functional correspondence between neural and criminal systems lies in their adaptive capacity. Within biological neural networks, neuroplasticity enables the continuous reorganisation of synaptic structures in response to environmental stimuli and external pressures through the formation of new neural pathways and the modulation of synaptic connection strength (Kandel et al., 2013; Pop, 2024). A comparable phenomenon can

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be identified within decentralised organised crime groups, where neuroplasticity manifests through capacity for structural reorganization following a breakdown caused by law enforcement intervention, as well as through the diversification of trafficking routes and transportation methods. A conclusive demonstration of this capacity for operational adjustment is the reorientation of cocaine flows from South America to alternative European ports (Dunkerque, Helsingborg, and Nynashamn) in response to tighter security measures at established port hubs (Rotterdam, Hamburg, Antwerp).

Under this framework, transnational organised crime networks may also be understood as systems capable of generating operational intelligence through decentralised interaction. Similar to cognitive processes emerging from neuronal connectivity rather than centralized command, strategic adaption within criminal structures arises from the cumulative interaction of semi-autonomous operational units distributed throughout the network. Consequently, the operational behaviour of the network exceeds the capabilities of individual groups, reflecting a form of collective adaptive intelligence.

While this conceptual model captures the structural and functional complexity of organised crime networks involved in cocaine trafficking, several limitations should be acknowledged that may restrict its applicability and universality. Firstly, the analogy with the structure of neural networks may simplify the social and cultural dynamics of organised crime groups, neglecting the economic, political, and contextual factors that influence the behaviour of members and strategic decisions. Secondly, unlike organised crime groups, there are no power relations or divergent interests between the neurons of a network that could lead to internal conflicts or competition for resources. Finally, the neuronal structuring model was developed primarily with reference to Albanian organised crime groups involved in cocaine trafficking, which may limit the broader applicability of the framework across other forms of organised crime. Consequently, further comparative research is necessary to evaluate the applicability of the model to criminal structures operating within different geographical, cultural, and operational environments.

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Conclusion

The neural network proposed in this paper represents an innovative framework for interpreting the structure and functioning of Albanian organised crime groups involved in cocaine trafficking from South America to European Markets. This conceptual model synthesizes the main characteristics associated with the network-type structures—namely fluidity, decentralisation, (re)configurability, and organisational flexibility—into a unified analytical framework. Concurrently, it provides an accurate representation of the contemporary dynamism of organised crime, characterized by operational flexibility, high interconnectivity, and systemic adaptability.

The neural model is grounded in empirical data on Albanian organised crime networks, which reveal a transnational structure fragmented into a semi-autonomous group that are functionally interconnected both in key European market countries and in cocaine production regions in South America. These networks operate through distinct operational nodes, each specialised in segments of the production-trafficking-distribution chain, while remaining integral components of the same criminal system, similar to neurons within a neuronal network.

The research findings underscore the relevance of the neural model as a tool for interpreting and enhancing understanding of the multifaceted phenomenon of contemporary organised crime. In parallel, its application must be integrated with universally accepted theoretical paradigms to address the limitations inherent in biological analogies and challenges of empirical validations. Consequently, a coordinated, synergistic approach by competent European authorities is essential to curb the proliferation of this phenomenon. Effective control over cocaine trafficking is crucial for safeguarding the political, social, and economic stability of Europe, particularly in the context of the unprecedented rise in global cocaine availability and purity.

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