

Governing Health, Crime, and Social Policy in Space: Legal and Neurocriminological Challenges for Human Rights in Extra-Terrestrial Environments

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ABSTRACT

The prospect of sustainable human habitation beyond Earth urgently requires a revision of legal frameworks governing healthcare, criminal justice, and social welfare in extra-terrestrial environments. This study addresses the profound regulatory vacuum surrounding behavioural governance in space settlements, where traditional legal models prove inadequate for addressing the unique neurobiological and social dynamics of isolated communities operating under extreme environmental conditions. The analysis reveals significant legal ambiguities regarding criminal responsibility when neurological functions are compromised due to space-specific environmental factors. Traditional concepts of human behaviour require fundamental reconsideration as cognitive abilities fluctuate due to physiological adaptation to extra-terrestrial conditions. This, in turn, necessitates rethinking approaches to healthcare, criminology, and law within the framework of social policy, which often remains as an overlooked element in the political discourse on outer space. The findings highlight the need for an international consensus on extra-terrestrial governance standards that take into account both the exceptional conditions of space habitation and

the fundamental principles of human dignity.

Keywords: space law, neurolaw, neurocriminology, health law, human rights, social policy, space governance

Gobernanza de la salud, la delincuencia y las políticas sociales en el espacio: desafíos jurídicos y neurocriminológicos para los derechos humanos en entornos extraterrestres

RESUMEN

La perspectiva de una habitación humana sostenible más allá de la Tierra requiere urgentemente una revisión de los marcos legales que rigen la atención médica, la justicia penal y el bienestar social en entornos extraterrestres. Este estudio aborda el profundo vacío regulatorio que rodea la gobernanza del comportamiento en los asentamientos espaciales, donde los modelos legales tradicionales resultan inadecuados para abordar la dinámica neurobiológica y social única de las comunidades aisladas que operan en condiciones ambientales extremas. El análisis revela importantes ambigüedades legales con respecto a la responsabilidad penal cuando las funciones neurológicas se ven comprometidas debido a factores ambientales específicos del espacio. Los conceptos tradicionales del comportamiento humano requieren una reconsideración fundamental, ya que las capacidades cognitivas fluctúan debido a la adaptación fisiológica a las condiciones extraterrestres. Esto, a su vez, requiere replantear los enfoques de la atención médica, la criminología y el derecho en el marco de la política social, que a menudo permanece como un elemento ignorado en el discurso político sobre el espacio exterior. Los hallazgos resaltan la necesidad de un consenso internacional sobre estándares de gobernanza extraterrestre que consideren tanto las condiciones excepcionales de la habitación espacial como los principios fundamentales de la dignidad humana.

Palabras clave: Derecho espacial, neuroderecho, neurocriminología, derecho sanitario, derechos humanos, política social, gobernanza espacial

太空健康、犯罪和社会政策治理：地外环境中人权面临的法律和神经犯罪学挑战

摘要

人类在地球之外可持续居住的前景迫切需要对地外环境中的医疗保健、刑事司法和社会福利的法律框架进行修订。本研究旨在探讨太空定居点行为治理方面存在的严重监管真空，因为传统的法律模式不足以应对在极端环境条件下运作的孤立社区独特的神经生物学和社会动态。分析揭示了当神经功能因太空特有的环境因素受损时，刑事责任方面存在显著的法律模糊性。由于认知能力会因生理适应地外环境而波动，传统的人类行为概念需要进行根本性的重新思考。这反过来又要求在社会政策框架内重新思考医疗保健、犯罪学和法律的方法，而社会政策在关于外太空的政治讨论中往往被忽视。研究结果强调，需要就地外治理标准达成国际共识，这些标准既要考虑到太空居住的特殊条件，又要兼顾人类尊严的基本原则。

关键词：空间法，神经法学，神经犯罪学，卫生法，人权，社会政策，空间治理

Introduction

Humanity is approaching the moment when our species will begin to exist on several planets at the same time. Technological breakthroughs in the space industry and the prospects for habitat construction are attracting widespread public attention. However, it would be appropriate to state that the creation of a solid legal and social basis for space life is significantly delayed. International space law was formed during the Cold War era and was originally intended to regulate short-term government missions. It is not able to effectively solve the issues that arise when creating perma-

nent isolated settlements on the Moon, Mars or orbital stations. The projects of lunar bases and Martian colonies have moved from the category of fiction to practical plans with specific deadlines for implementation. Private corporations such as SpaceX and Blue Origin, along with government space agencies, are rapidly developing technologies for human habitation in space (Freeland, 2020; Steele, 2022; UN, 2023). The present study demonstrates the existence of a critical gap in the regulation of healthcare, legal responsibility, and social security beyond the boundaries of the Earth, which poses urgent and unprecedented challenges to ensuring fundamental human rights.

The central problem in this issue is the inadequacy of applying terrestrial models of legal and social policy to the environment, which fundamentally changes human biology, especially brain function. Extreme space conditions, including microgravity, increased radiation, and prolonged isolation, cause structural and functional changes in the brain that can affect cognitive abilities, emotional regulation, and decision-making. These neurobiological influences challenge the very foundations of criminal law, which is often based on the concept of a “rational subject.” In addition, the criminal law of the future and Astrocriminology should study various crimes related to space (*from safety violations and theft of intellectual property to illegal actions of corporations and the government, etc.*) (Freeland, 2020; Evans-Flynn et al., 2016; Jandial et al., 2018; Lampkin, 2021).

Although significant attention in space exploration is paid to technological problems and developments, there is a serious gap in the development of the legal, social and political foundations necessary for the governance of human societies beyond Earth. We believe that current space law, primarily enshrined in the Outer Space Treaty of 1967, was developed for government agencies and short-term missions, not for permanent commercial settlements, although it provides for the peaceful use of outer space, which can and should be applied to long-term missions (Freeland, 2020; Steele, 2022; Link, 2022; UN, 2023; İnam-Şimşek and Atvur, 2025). This treaty brilliantly establishes principles of peaceful exploration and non-appropriation but remains silent on day-to-day governance of permanent, isolated human settlements.

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The unique space environment poses an unprecedented challenge to traditional concepts of justice, health-care, and social security. The space environment profoundly alters human biology, especially brain function, due to microgravity, radiation exposure, isolation, and circadian rhythm disruption (Evans-Flynn et al., 2016; Cockell, 2001; Jandial et al., 2018; Kendal et al., 2025; Harris et al., 2022; İnam-Şimşek and Atvur, 2025). These physiological changes raise fundamental questions about criminal responsibility, access to medical care, and the implementation of social policies when a person’s cognitive functions can be significantly impaired.

Recent neurocriminological research demonstrates how brain alterations can affect behavior and legal culpability (Vincent, 2010; Hayes, 2024; Massaro, 2018). In terrestrial environments, courts are increasingly considering cases in which brain injuries or neurological diseases influence criminal behavior. Due to the conditions of zero gravity, as well as other harsh conditions in space, such violations can become widespread, creating unprecedented problems for justice systems. In addition, in the political discourse related to space exploration, special attention is paid to technology and national prestige, while social policy considerations are largely ignored. Issues of labor rights, access to health care, social security, and community cohesion are

still under-addressed in existing space management systems (Cockell, 2001; Freeland, 2020).

The purpose of this study is to explore these intersecting challenges through an interdisciplinary lens, integrating space law and governance, neurocriminology and neurolaw, social policy and human rights.

The study uses a qualitative research method that includes an interdisciplinary approach and an analysis of existing literature in the field of space law, neuro-law, criminology and social policy. The limitation of this study is the lack of empirical data on long-term human stay in space. Future empirical studies will be needed to confirm the theoretical foundations proposed in this paper.

Findings: Neurobiological Challenges to Traditional Legal Models and the Three-Fold Governance Challenge

Prolonged exposure to microgravity causes structural changes in the brain, which can affect cognitive processes and decision-making (Roberts et al., 2017). Radiation exposure can cause damage to neurons, potentially affecting memory, attention, and executive functions (Jandial et al., 2018). Studies examining human behavior in confined spaces show that prolonged exposure to small, isolated groups significantly increases vulnerability to depression, anxiety, cognitive impairment, and interpersonal tension

(Palinkas, 2001; Kanas et al., 2009). The space environment exacerbates these problems due to the uneven distribution of light and darkness, which fundamentally disrupts the body's natural circadian rhythms. This biological disorder impairs critical mental abilities, including decision-making, impulse control, and emotional stability (Evans-Flynn et al., 2016).

Our research has revealed three interrelated management issues related to the humanization of outer space and the long-term planning of extra-terrestrial settlements. Such problems include criminal liability and neurobiological disorders, ambiguities in jurisdiction, and a lack of social policy. Traditional criminal law presupposes the existence of rational subjects capable of forming criminal intentions. The cognitive impairments that arise in the space environment call into question the fundamental concepts of guilt. Unlike in criminal court cases, where neurological disorders affect individual defendants, the space environment can cause systematic cognitive changes in entire populations.

Discussion

According to our research, traditional concepts of criminal responsibility are becoming problematic in relation to the space environment. We believe that the existing legal structures are proving inadequate in addressing the complex challenges of jurisdiction and social policy inherent in modern space operations. These difficulties may arise due to multination-

al commercial stations, heterogeneous crews, tensions between corporate and government agencies, and inconsistencies between national laws and the international space framework. The modern discourse on space governance critically ignores the most important elements of social policy, including labor protection, access to healthcare, social security systems, and community cohesion strategies necessary for a sustainable human presence beyond Earth. In our opinion, this approach is fundamentally wrong.

We argue that space creates unique brain and health problems that Earth's legal systems cannot handle and requires new systemic approaches rather than individual solutions. Given the limited number of medicines in space, medical care should be guaranteed as a basic right with respect to fair distribution rules, and not as something available only to those who can afford it. A mental health and social assistance plan must be adopted, as future settlers and isolated space dwellers will desperately need it. Multinational space operations can reveal serious gaps in existing laws, which will require new international agreements that go beyond the traditional space governance of countries. From the very beginning, space communities need well-thought-out policies aimed at solving their unique problems of isolation and resource scarcity. This policy should not copy Earth's management systems, but rather offer new ones, focused on new environments, but enriched by earthly experience.

Conclusion

This study shows that the “last frontier” represents not only technological challenges, but also an important experiment in the field of social policy. This study identifies several critical challenges for the future development of space management. The inadequacy of traditional legal concepts for the space environment requires the creation of innovative systems capable of taking into account both the cognitive changes caused by extreme conditions and the unprecedented complexity of jurisdiction. Healthcare should be consolidated as a fundamental human right within the framework of space governance structures, accompanied by clear ethical principles for the allocation of medical resources in crisis situations. This is an important component of both a healthy society and a preventive neurocriminological measure to prevent crime in extreme space conditions.

In addition, social policies covering labor rights, social security, and community support should be integrated into the space management system from the very beginning, rather than being added as afterthoughts. These complex challenges require new types of international cooperation that go beyond traditional government-based approaches. We want to conclude our study with a call for urgent, collaborative, and interdisciplinary action. The priority areas of future research should be empirical studies of the neurobiological consequences of prolonged stay in space, legal modelling, as well as inter-

national negotiations on space management systems.

As humanity expands beyond Earth, we possess a unique opportunity to build societies that learn from terrestrial mistakes and establish hu-

man dignity as a foundational principle rather than optional consideration. The choices made today regarding space governance will shape the future of human civilization both terrestrially and extra-terrestrially.

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