#138

THE MORAL IMPLICATIONS OF CONSCIOUSNESS IN HUMAN NEURAL ASSEMBLOIDS

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INTRODUCTION

- In the field of consciousness science, an increasing concern has arisen regarding **synthetic biological systems**, like human brain organoids (HBOs), because of their potential to be conscious.
- **HBOs** are human-induced pluripotent stem cells-derived (hiPSCs) entities, reproducing a **broad variety of brain structures**, differing in functional and neurophysiological complexity, according to their specific synthetic origin.
- While **simpler types of organoids** have received good attention from the philosophical community, neuroethical reflection on more complex types of HBOs, like **assembloids**, has been quite disregarded to date.

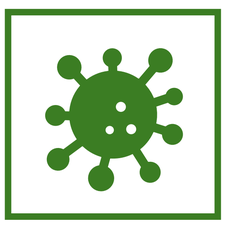
This work aims at highlighting the **ethical issues** elicited by complex assembloids in an attempt to provide a **comprehensive framework** for philosophical inquiry.

SCIENTIFIC CONTEXT

According to their synthetic process, HBOs can be distinguished in at least three fundamental categories (Pașca et al., 2022):

- **Regionalized neural organoids** are obtained from hiPSCs 3D cultures by guiding their development through the addition of small molecules or factors to reproduce a determinate brain region, with regionally specific cell types (i.e., cortical, spinal or striatum organoids).
- **Unguided neural organoids** are obtained from self-development and differentiation of hiPSCs 3D cultures, leading to systems with a high diversity of neural cell types, as well as non neural derivatives.
- **Neural assembloids** are obtained from self-organization of cellular systems resulting from the combination of one type of organoids with another type of organoids (i.e., dorsal forebrain with ventral forebrain) or with different types of specialized cells.

While regionalized neural organoids lack a vascular system and neither can receive sensory inputs nor can send motor outputs to the external environment**, neural assembloids can be equipped with an ascending sensory pathway** (i.e., the spino-thalamic pathway with pain-sensitive receptors) **and a descending motor pathway** (i.e., the cortico-spinal motor pathway)**, thus enabling a form of embodiment and connection** with the surrounding environment**.**



Disconnected Organoid



Connected Assembloid

ETHICAL FRAMEWORK

- With regards to HBOs, most neuroethicists have called for a **precautionary approach**, that is the opportunity to take moral precautions, based on the organoids potential to develop consciousness, starting from a minimal form of sentience (Birch, 2024; Lavazza, 2021).
- Conversely, some scholars have disregarded the possibility of consciousness in simple HBOs, given their **lack of both embodiment and representationalist constraints,** thus justifying the employment of regionalized organoids in biomedical research, supported by a **consequentialist perspective** (Croxford & Bayne, 2024; Koplin & Savulescu, 2019).

MORAL IMPLICATIONS

- In the case of human neural assembloids, a **precautionary approach** is needed, given their capacity to establish sensorimotor interactions with the surrounding environment and to become potentially sensitive to pain, instantiating at least a minimal form of valenced sentience.
- Additionally, given the possibility to develop conscious contents of a higher phenomenological complexity, a consequentialist position should be carefully weighed with the **Kantian prescription** of treating such entities as pure ends, and not mere means.
- Based on the previous consideration, and echoing the analysis by Lavazza (2021), it also seems **highly unethical** to synthesize assembloids with the **sole purpose of studying the emergence of human consciousness**, as this would not produce direct benefits for human well-being, thus ruling out the consequentialist justification.

LEGAL CONSEQUENCES

- Based on a precautionary view, the synthesis of human neural assembloids should be **limited**, according to a **careful evaluation** of their actual capacity of interacting with the surrounding environment.
- Given their potential to develop complex contents of consciousness, their **employment as scientific models for the study of human consciousness** should be likely **banned.**
- Conversely, **the synthesis of regionalized organoids**, unable to establish a sensory-motor connection **should be allowed and promoted**, given their promising role in the study of neuropathologies and the development of related treatments.

FUTURE PERSPECTIVES

Future research in neuroethics should extend its target from HBOs to other types of **synthetic biological systems**, such as **Xenobots and DishBrain**, eliciting different, but equally relevant, concerns for their possibility to become conscious.

References:

Birch, J. (2024). When is a brain organoid a sentience candidate?. *Molecular Psychology: Brain, Behavior, and Society*, *2*(22), 22.

Croxford, J., & Bayne, T. (2024). The case against organoid consciousness. *Neuroethics*, *17*(1), 13.

Koplin, J. J., & Savulescu, J. (2019). Moral limits of brain organoid research. *The Journal of Law, Medicine & Ethics*, *47*(4), 760-767.

Lavazza, A. (2021). 'Consciousnessoids': clues and insights from human cerebral organoids for the study of consciousness. *Neuroscience of Consciousness*, *2021*(2), niab029.

Pașca, S. P., Arlotta, P., Bateup, H. S., Camp, J. G., Cappello, S., Gage, F. H., ... & Vaccarino, F. M. (2022). A nomenclature consensus for nervous system organoids and assembloids. *Nature*, *609*(7929), 907-910.

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