

Using Big-Data and Artificial Intelligence in Brain and Mental Health: Promises and Challenges

Marcello Ienca (ETH Zurich)

Emerging trends in pervasive computing and medical informatics are creating the possibility for large-scale collection, sharing, aggregation and analysis of unprecedented volumes and variety of data, a phenomenon commonly known as *big data*. The application of big data approaches to clinical neuroscience, together with the development of artificial intelligence (AI) techniques for multimodal and multiscalar data analysis, is opening new promising opportunities for brain and mental health. The use of single molecular biomarkers in isolation has so far not successfully predicted the functional and cognitive outcomes of dementia (Geerts et al., 2016). Acquiring data from heterogeneous data sources (including genetic, neuroimaging and mobile health data) and at various scales (from the molecular to the behavioural and population scale) could help in cracking the pathological conundrum of several poorly understood brain disorders (e.g. Alzheimer's disease) by shedding new light on its aetiology and enabling more precise therapeutic solutions. These big brain data (Landhuis, 2017) trends hold great promise. Nonetheless, their full deployment is still hindered by technical, methodological and regulatory challenges. Furthermore, they raise ethical controversy.

In this contribution, we review the existing scientific literature on big data and AI approaches to brain and mental health, with special focus on dementia. Our analysis suggests that big data approaches to brain research and mental health hold promise for improving current preventive and predictive models, casting light on the aetiology of disease, enabling earlier diagnosis, optimizing resource allocation, and delivering more tailored treatments to patients with specific disease trajectories. At the same time, our results show that major ethical and methodological disagreements arise in relation to five major issues: data protection and security (Ienca & Haselager, 2016), data control, risk of algorithmic discrimination (Monteith & Glenn, 2016), ethical guidelines for big data research (Vayena & Blasimme, 2017) and cognitive enhancement (Maslen, Douglas, Cohen Kadosh, Levy, & Savulescu, 2014). This paper provides an early assessment of these challenges and charts the route ahead for research, ethics, and policy.

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