



## **An Early – and Necessary – Flight of the Owl of Minerva: Neuroscience, Neurotechnology, Human Socio- cultural Boundaries, and the Importance of Neuroethics**

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### **Abstract**

Rapid neuroscientific advancement over the past 20 years has led to increased ethical, legal and social issues that are not confined to the academic world, but also are part of public discourse. There are questions on the use of neuroscientific techniques and novel neurotechnologies that are generated as we learn more about the brain and its relations to consciousness, emotion, behavior and the nature of self and relation to others. Should neuroscience and neurotechnology be used to advance humanity; or will it be engaged as demiurge and ultimately push humanity towards some new, and perhaps unanticipated reality? Irrespective of valence, the trajectory of neuroscience and

neurotechnology will lead to a more neurocentrically-dominated future. How will we address and navigate the possibilities and problems that this neurocentricism fosters? The emerging field of neuroethics may enable a more pragmatic understanding of these issues and perhaps lead to a more prudent resolution of the questions and problems that arise at the intersection of neuroscience, neurotechnology and society. The two traditions of neuroethics – the study of the neural mechanisms of moral cognition and actions (neuromorality), and addressing the ethical and legal issues instantiated by applications of neuroscience and technology in the social sphere, may afford a meta-ethics that will be of benefit at both individual and societal levels. Yet, we posit that in order to meet these challenges, neuroethics must be international, multi-cultural and multi-disciplinary, and not simply bound to philosophical dogma or defined by western ethical discourse. Moreover, neuroethics must be not be an “after-the-fact” reflection or analysis, but should be engaged while neuroscientific and neurotechnological advances are still relatively nascent in order to be ready for the reciprocal effects of neuroscience and neurotechnologies enacted, and as influenced by socio-culture on the world stages.

“When philosophy paints its grey in grey, one form of life has become old, and by means of grey cannot be rejuvenated, but only known. The owl of Minerva takes its flight only when the shades of night are gathering...” (GWF Hegel, *Elements of the Philosophy of Right*)

### **Neuroscience and neurotechnology: Trends, trajectories, and transitions**

The past 20 years have borne witness to broad and rapid neuroscientific advancement, both within its disciplines of anatomy, physiology, pharmacology, and through the engagement of new disciplines - within the natural and physical sciences (such as genetics, nanoscience, cyberscience), social sciences, and humanities. This growth is reflected in the gross fiscal investment in neuroscience and the neurotechnology that increased 25-30% annually from 2005 through 2010, and generated revenues of \$143 billion in 2010 (Lynch and Lynch 2009; Neuroinsights 2010). Such investment bespeaks the fact that neurological and psychiatric trauma, disease, and illness have become major medical markets, with total accrued costs of \$2 trillion (Lynch 2007a), incurred by a global patient population of approximately 2 billion individuals (Duncan 2008). With a projected growth of brain-research enterprises of up to 10-20% per year, the economic capital of the academic-industrial complex dedicated to neuroscientific and neurotechnological innovation could be as high as \$300 billion by 2015 (Lynch 2007b). Moreover, such innovation has also attracted the interest of the governmental sector(s) given the applicability of neuroscience and its technologies to national security and defense – inclusive of both public health and military operations.

This interest has been evidenced by a consistent investment of US Department of Defense and other national security agencies’ funding of neuroscientific and neurotechnological research and development (Kruse et al. 2010), which despite cutbacks, is expected to continue in coming years. The overall trend in neuroscientific advancement, and perhaps more specifically the potential use of neuroscience and neurotechnology for national security and defense agendas, have fostered concerns and debate within the academic/professional community, as well as the public. Indeed, neuroscience and neurotechnology are affecting public life through the iteratively more widespread – and accepted – use of neuroscience to define and explain various aspects of human experience and behavior. This new discourse is not limited to the scientific sphere or the proverbial “ivory tower” of academia; instead, neuroscience is extending effects deeper into the values, mores, norms and conduct of the modern social milieu in ways that are undeniable.

These developments generate real issues, questions and dilemmas for contemporary society (Giordano and Gordijn 2010). For example, should we view neuroscience and neurotechnology as the latest iteration of demiurge through which humanity seeks to understand and manipulate nature? Are neuroscience and

neurotechnologies forms of “liberation technologies” that are expressions of a “natural” human tendency toward machine-use? Or, are these advancements moving us ever farther along a trajectory that is not only representative of the “human in transition” – what some have termed the “transhuman” - but toward engineering a being that is novel to our current constructs of humanity? Could neuroscience foster a new world society, enabled by an inclusive ideal of the human being that transcends biological (e.g. gender, ethnic) and cultural – if not species’ distinctions, that is devoid of anthropocentric bias, and united by an understanding of consciousness and experience? Could this reconcile humanity and nature, organic and inorganic beings, and in some way reveal the nature of life? And what outcomes might these trajectories of neuroscience and neurotechnology evoke for the open societies of the coming century? Perhaps most significant is the proverbial “hard question” of how “mind” occurs in brain; it may be that this remains both an unresolved question and an un-knowable reality, and therefore any and all conceptualizations of the neural bases of consciousness, self, free will, and morality must be regarded as speculative, and we must be savvy to the ways (if not tendencies) for neuroscientific information to be mis-communicated and/or misconstrued, and neurotechnological tools to be used inaptly – if not frankly misused (Giordano and Olds 2010).

The questions and issues that arise at the intersection of neuroscience, neurotechnology and society reveal the reciprocity of effects: Neuroscience may offer insight to our social cognitions and actions, and at the same time, neuroscience – as a field and a set of practices, outcomes and products – is nested within and influenced by the economic and political domains of society. These latter domains can be disconnected from – if not discordant with – considerations for employing science and technology in ways that best meet humanitarian needs. Given these tensions, the task at hand is to recognize the capacity and limitations of both neuroscience and the socio-economic and socio-political settings in which it may be employed.

### **Technological trends and social transition**

The problems of both brain science and society can be seen as a reason and motivation for ongoing neuroscientific research to study and further define the relationship of brain and mind, the bases of consciousness, and the human as a social creature. But while such information is important, it is equally important to note that most scientific and technological advancement exceeds progress of social responsibility. It is crucial to appreciate the social implications and manifestations incurred by neuroscientific discoveries and the potential uses of neurotechnology, and assess if current methods of social responsibility can capably address and resolve the questions and dilemmas fostered by such implications. It may be that given the scope and pace of change(s) evoked by neuroscience and technology, new(er) constructs, systems, and approaches might need to be developed, at least to some extent, or in certain circumstances.

The speed and breadth of neuroscientific discovery has generated public anticipation and anxiety about potential the ethical, legal and social issues incurred by such developments. These expectations and apprehensions are not unrealistic, as neuroscience and neurotechnology have already been shown to prompt numerous challenges (Giordano and Gordijn 2010; Racine 2010; Glannon 2011) Yet only a fraction of the US federal scientific budget is explicitly dedicated to the ethical and socio-legal issues manifested by neuroscientific research and the translation of its outcomes and products into healthcare and public life (AAAS 2010). Given the pace and possible directions of neuroscientific advancement, we believe there is a need for a pragmatic, finely-grained, but nonetheless encompassing view of the actual capabilities, limitations and implications of neuroscientific and neurotechnological progress, and in light of such assessment(s), develop an ethics that reflects the rapid growth of neuroscience, and responds to the social repercussions resulting from the new knowledge and capabilities that neuroscientific progress affords.

## **Neuroethics: Bridging scientific, technological and social domains**

We opine that the field of neuroethics may meet this challenge by studying the putative neurological substrates and mechanisms of interpersonal and social relations and conduct (i.e. neuroethics in the “first tradition,” viz. – neuromorality), and addressing the ethical, legal and social issues fostered by neuroscientific research and its uses and misuses in the social sphere (i.e.- neuroethics in the “second tradition”) (Roskies 2002; Racine 2010). We have argued that when these two “traditions” of neuroethics taken together, may afford a form of meta-ethics that enables both insight to nature of individual and socio-cultural moral decision-making, and guidance of neuroscience as a societal influence (Giordano 2011a). We believe that the value of neuroethics is derived from its wider vision of the human and humanity – if not all sentient – beings in general, as both reflecting advancements and effects of neuroscience, and in acknowledgment of the bio-psychosocial view of organisms’ reciprocal interactions with their environments.

Certainly, neuroethics must be built upon a foundation of ethical analytic and executive methods, and given the naturalistic orientation, and basic and clinical applicability fostered by the neurosciences, the focus and interdisciplinary nature of bioethics are therefore equally important (Racine 2010; Levy 2011). But, we maintain that in order to recognize and guide how neuroscience and neurotechnology affect the human being, human condition, and concept of the human-in-society, neuroethics cannot be yoked to dogmatic ideas. Rather, we call for neuroethics to both regard the value of both traditional ethical views and be open to, and incorporate new knowledge so as to develop more epistemologically current ethical constructs that reflect and are relevant to the effect(s) of neuroscience upon the human and society (Giordano 2011b). Thus, neuroethics can remain well positioned to engage contemporary issues ranging from the philosophical to the juridical, and the individual to the socio-political.

The social dimension is crucial, because scientific and technological advancement are often responses to socio-cultural needs and/or demands, and new scientific information and technologies evoke societal change (Lowrance 1985). Socio-cultural values and contexts must be taken into consideration if scientific and technological development is to be oriented and guided to effect public good. This reaffirms the value of neuroethics: First, as neuromorality to develop an understanding of 1) the interactive nature of neurobehavioral function and socio-cultural environments; 2) the mechanisms and multi-dimensionality of these effects; and 3) how particular neural, and cultural-environmental variables may be engaged to mediate, modify or mitigate certain cognitive-emotional constructs and behavioral effects. Second, such knowledge of moral cognition and decision-making is vital to developing a fuller and deeper insight to both ethics, in general, and those specific ethical analyses and articulations that could be instrumental to discerning and guiding how extant or novel technologies could – and perhaps should – be developed and used to change social thought, ideals and ontologies, and improve the human condition, and society.

A neurocentric future portends possibilities for great insight and access to cognition, emotion, behavior and being, as well as equal potential for misconception, misappropriation, and misuse of information, knowledge and the power these confer. Hence, we assert the need to refrain from premature or ampliative claims about the benefits – or possible harms – of neuroscience and neurotechnologies, and instead address the actual capability and limitations of these approaches, and the benefits, burdens, and risks incurred by their use or non-use. It is unwise to wait until the “...shades of night are gathering” to take stock of what is old, what is new, and the benefits, burdens and harms that might be respectively possible or preventable (Hegel 1991). Indeed, it is not enough simply to know what possibilities exist; instead knowledge prompts action – both before and during each and any engagement of neuroscience and neurotechnology. Thus, we argue that it will be necessary for an early flight of Hegel’s “owl of Minerva,” so as to gain prescience of what the present and future can be, and in so doing foster insight into what practical and ethical actions should be developed and articulated. Such pragmatism may insure against

harms of commission or omission, and enable a more meaningful view of the ways that neuroscience affects society, and socio-cultural diversity, and economic and political forces affect neuroscientific and neurotechnological development and utilization on an increasingly pluralized world-stage.

## Summary

In this essay we have provided a view of neuroscience and neurotechnology as both forces that shape current and future socio-cultural conditions and that are influenced by socio-cultural forces. Given the provocative and often contentious nature of effects incurred through the employment of neuroscience and neurotechnology in the social milieu, we call for the relatively new field of neuroethics to define and guide the ways that neuroscientific and technological developments can and should be pursued and applied. However, we argue that to do so in a meaningful way will mandate pragmatism, reflection, and freedom from an exclusively Western orientation. To meet this challenge, we posit that programs of neuroethics education and practice must be international, multi-cultural and multi-disciplinary. It is our hope that neuroethics will provide a system and method(s) for analysis of, and preparedness for an imminent neurocentric future. To be sure, it is a field that is gaining intellectual and practical maturity; and we opine, none too soon, as neuroscience and neurotechnology proverbially “push the envelope” of knowledge and possibility that will be leveraged upon the social stage. So, if neuroethics is to “...come of age and face the future” with any real sense of value (Giordano 2010), it cannot be an after-the-fact endeavor, but must be proactive and grounded to the realities and exigencies of the present. It must be collaborative and innovative in its approach, and remain rigorous in its scrutiny, guidance and governance of neuroscientific and neurotechnological invention, intervention and social effect.

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