16

Neuroethical Engagement on Interdisciplinary and International Scales

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Abstract

After a decade of growth and development, neuroethics as a defined discipline is establishing domains of inquiry and action, a defined canon, and set(s) of practices. Neuroethical address and discourse must engage the realities forged and fostered by brain science no matter where they emerge and deliberate upon neurotechnological applications on the international scale. The invention and application of neurotechnologies are raising questions of ethics, to be sure. Neuroscientific innovations are also altering and challenging how we regard ourselves as moral beings worthy of ethical standing. Neuroethical investigations, at the empirical levels of experimental research and clinical application or the philosophical levels of exploring moral capacities or ethical issues, concern ideas of what it means to be human and ideals of humanity-wide importance. As a discipline and in practice, neuroethics must heed the subjective realities of the people who take part in neuroscientific research and therapy. No single method could do justice to understanding ourselves as persons, nor could any single country monopolize the meaning of self-identity and self-worth. Therefore, neuroethics must become "disciplined" to be realized as genuinely intercultural, as well as thoroughly interconnected. We find that these goals and tasks are already being achieved through multidisciplinary and multinational networked teams that conduct collaborative inquiries in specific areas of both local and global concern. These teams deserve attention and appreciation as exemplars for future disciplinary progress in neuroethics.

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E. Racine, J. Aspler (eds.), *Debates About Neuroethics*, Advances in Neuroethics,
DOI 10.1007/978-3-319-54651-3_16

16.1 Neuroethics: Becoming a Discipline

The establishment of neuroethics as an emerging field initially suggested its categorization as yet another domain of applied bioethics. The fast growth of the field in recent years has involved extensive multidisciplinary enterprises. Neuroethics is developing foci that while based, at least in part, upon longstanding philosophical questions and issues important to bioethics at large takes something of a unique perspective, given the way that neuroethics is inextricable from the neural and cognitive sciences (Giordano 2010, 2014). Bioethics has struggled to transcend its American matrix, with much success. If bioethics will no longer be simply an "applied ethics," how could neuroethics be confined in that manner? Going further, we anticipate that neuroethics should become a disciplinary field in its own right.

We are observing, and describing in this chapter, the sorts of neuroethical research that relieve neuroethics from the status of an applied subfield. The only possible proof that neuroethics should prioritize interdisciplinary and international dimensions is to point out the demonstrably admirable research energizing much of neuroethics and guiding its development. Neuroethics was never going to be delimited by a few older disciplines, a couple of cultures, or any single country's ethics. There is no paradox inherent to the idea that the fulfillment of a multidisciplinary and multinational field of inquiry can eventually result in a new discipline. (Most other disciplines were birthed from that kind of heritage.) We have no deductive argument dictating that future. It is not inevitable. However, if our observations are sound, that disciplinary development and destiny for neuroethics seem probable.

The ethical centrality of the person serves as a primary illustration of this development. Bioethics had to presume much about the locus of moral value in the "person" and had to compare moral and legal views on personhood from established professions (e.g., medicine and law primarily), in order to manage conflicts among inflexible principles respecting persons. Neuroethics need not be so subordinate to such encumbrances. The biological, psychological, and anthropological nature of the individual, and the cognitive bases for the agency and responsibility that are expected of persons, are matters for ever-deepening study. How and why people become capable of moral judgment, and come to expect dignity and respect, are matters amenable to empirical inquiry in tandem with ethical insight.

Transcendent, trans-historical, and essentialist notions of personhood can retreat to their proper scale as important constructs that are embedded in socio-cultural contexts. That sort of context does not reduce those ideas to hollow words or superficial vanities. Understandings of persons, their moral features, and their ethical values are realizable in those instances in which they develop and establish their effectiveness in the world. In fact, they are so real that the social and life sciences can simultaneously investigate their many dimensions and implications. Neuroethical inquiry and discourse will not (and arguably should not) seek to duplicate the pursuits of other disciplines, but it will borrow investigational methods and background knowledge as needed for its more specific areas of concern. Along the way, neuroethical address must assume a responsible stance toward the ethical standards it will uphold. That responsibility cannot be left to any country's laws or one culture's traditions. As one of us (Giordano) has affirmed

> [R]esearch is being conducted—and highly scrutinized—in a number of developing and non-developed countries. Moreover the contexts of such research are changing. Thus, there is a need to address not only nations and cultures' needs, values and mores, but those ethical ideals and systems that are operative in the countries and cultures in which said research is being undertaken. So, while it is important to ensure that research is conducted ethically, an equally—if not more—important question is "by which ethical standards?" (Giordano 2013: 3).

To be sure, neuroethical discourse has never been bereft of ethical standards. As a field, neuroethics could easily become "disciplined" in a rigid manner, by incorporating mechanical application of self-standing ethical rules in relation to sterile clinical scenarios involving objective physiological interventions for measured therapeutic outcomes. Translatable neuroscience can take center stage, and neuroethical debates would shift from technique to technique as they are envisioned and put into practice. Hopefully, neuroscientific discoveries and neurotechnological inventions will "translate" in a practical sense into health-care diagnostics and treatments, and perhaps into consumer applications as well. But their ethical implications must "translate" in a second sense—an ethical sense. It is an ethical question to ask how those advances may be compatible (or not) with the values, self-conceptions, and life plans of intended recipients, and other members of society.

Any neurological intervention, no matter how medically impressive, should also be ethically acceptable, especially to those who will be most deeply affected. Medical ethics, and bioethics more generally, have held biomedical advances to high ethical standards, and neuroethical analyses can do no less. All the same, such expectations remain external to the patient's own moral sensibilities, and indifferent to an individual's unique perspective on what it means to be that particular person. Ethical principles apply to persons, and should aim to protect persons, in a generic fashion; it suffices to be classified as a person in order to be covered by those principles. How any individual may happen to personally exemplify personhood and live one's life as a special self are just details, largely irrelevant to the universal rights and rules for all people. Human rights and fundamental laws should apply to all persons equally, without regard for individual differences.

As persons, however, we each discover and shape our individuality in our own ways, through the social and cultural resources accessible to us. No one tries to be an individual in the abstract; each person's own sense of individuality, along with one's sense of self and self-worth, is precious and irreplaceable. Bioethics need not deny these matters, but neuroethics has an extra responsibility to them. Neuroscience and neurotechnologies, by centering on neurological functions, more easily affect and potentially impact the ways people experience being themselves. There is no need to embrace a dualism of body and mind, or to reduce the 'self' or 'individuality' to the brain, in order to grasp how the brain is not just another organ of the body. A brain working better is not just a better-working brain. An individual's subjective world is also potentially at stake.

Walter Glannon of the University of Calgary and Nir Lipsman of Toronto Western Hospital have explored the medical case of an accountant receiving successful deep brain stimulation, illustrating the primacy of the subjective perspective:

> Any perceived threat the device poses to the accountant's experience of control is more acute than how people with cardiac arrhythmias such as atrial fibrillation might perceive implanted pacemakers or defibrillators. Unlike these other devices, DBS can directly modify mood and behaviour by directly altering the neural bases of unconscious and conscious mental states. The fact that a functioning DBS system modulates his brain and mind at the unconscious level, and that he becomes consciously aware of the system and its effects on his mood only when it malfunctions, reinforces the idea that he may have only limited ability to control his mental states and how they issue in his actions (Lipsman and Glannon 2013: 468).

Neuroethical inquiry must ask—and try to answer—questions of how experiments and treatments affecting the brain translate into that subjective world, a person's self-conception, and each individual's own values.

We propose that the future of neuroethical engagement on interdisciplinary and international scales will track and enhance the capacity to ensure than neurological advances can "translate" for all people. Only highly selective illustrations of this view can be gathered here, and we regret that citations are limited to English-language writings (but see Buniak et al. 2014; Darragh et al. 2015; Martin et al. 2016; Becker et al. 2017). Yet, we find that even this brief survey reveals a degree of useful subcategorization for areas of neuroethical investigation. Those subordinate areas, we believe, can help to integrate what may otherwise appear to be distantly related inquiries.

16.2 Persons as Research Participants and Individual Subjects

In 2002, the year that "neuroethics" was thrust into the academic spotlight, a special issue of the journal *Brain and Cognition* was devoted to this new discipline. The opening editorial by Judy Illes and Thomas Raffin (2002) surveyed the papers in this issue, noting how they cover ethical challenges in both basic and clinical research. Topics addressed included protecting human research subjects, patient privacy, communicating diagnostic findings, adequately interpreting findings from new brain imaging techniques, revising views of cognitive functioning as findings are interpreted, forming prognoses and predictions for patients, raising hopes about cognitive enhancements, and counseling patients about making meaningful and informed choices.

These and related topics still form much of the core of neuroethical focus, and rightly so. Like bioethics, neuroethics must support a robust and proactive stance toward safeguarding medical information, and minimizing risks of experimental research. Diagnostics about one's neurological and cognitive functioning are among the most sensitive and private types of medical information, perhaps only comparable to one's genetic information (Heinrichs 2012). Deep brain stimulation has rightly received intense ethical scrutiny. The emergence of transcranial stimulation deserves the same level of scrutiny (Rossi et al. 2009; Horvath et al. 2013). Research participants must receive due protection as subjects by the medical and legal fields. That proactivity must extend to the "subjective" realm of the first-person standpoint in lived experience, if there is to be a fully disciplinary neuroethics. The moral problems and questions of ethics that flow from the stages of cutting-edge research and clinical application amply illustrate central neuroethical concerns for the meaning and morality of neurotechnologies *as viewed by subjects themselves*.

After moving from Stanford to develop the National Core for Neuroethics at the University of British Columbia, Illes has continued to guide investigations into needed engagements between implementations of novel neurotechnologies and analyses of their ethical implications. These investigations can remedy the tendency to overlook the individuality of participants, and their subjectivity, while focusing on technical soundness. For example, Illes and coauthors have surveyed debates on neuroimaging, finding that those debates do not take much interest in individual subjects and their personal histories:

> As reviewers frequently note, fMRI studies in this area often include patients with different clinical symptoms, disease subtypes, ages of onset, illness duration, severity of symptoms, medication status (including dosage and side effects), comorbid conditions, and substance abuse histories. Since it has been shown that these factors are related to brain functioning, uncontrolled variation of these factors may well compromise the internal validity of studies. Sample heterogeneity, thus, constitutes a serious threat to the knowledge value of studies in this area (Anderson et al. 2012).

The neuroethics team led by Eric Racine at the Institut de recherches cliniques de Montréal, associated with the Université de Montréal and McGill University, has raised similar concerns about neuroimaging practices in Canada (Deslauriers et al. 2010). Racine's team has also examined the procedures for obtaining and insuring informed consent for neuroimaging research in Canada. They reported:

> There appears to be significant variability and inconsistency in important areas in neuroimaging research such as risk reporting and the management of incidental findings. For example, we found evidence of substantial between-site and within-site variability in the strategies approved to handle incidental findings. There were also significant variations in the disclosure of risks associated with MRI and fMRI consent forms, especially with respect to psychological risks and risks associated with dizziness, discomfort, stress, and fatigue. We also encountered a few [consent] forms where the risks of MRI were downplayed (e.g., "no-risk" statements) and incidental findings were described as a benefit (Palmour et al. 2011: 5).

Downplaying risks, especially where no regard is shown for a participant's medical history or current state of health, must raise serious concerns in any country.

The matter of incidental findings is also concerning; the variability found within Canadian research is not uncommon. Divergent views among researchers are also found within the medical community in Japan, according to an investigation by Misao Fujita, of the Uehiro Research Division for iPS Cell Ethics at Kyoto University, and her colleagues at Kyoto, and the University of Tokyo (Fujita et al. 2014). Illes and colleagues at the University of British Columbia and the Stanford

Center for Biomedical Ethics agree that neuroimaging researchers themselves express concerns about adequate clarity and availability of ethical guidance about incidental findings (Borgelt et al. 2013; see also Kehagia et al. 2012; and Brosnan et al. 2013).

A survey of numerous countries, conducted by a team composed of specialists at various UK institutions such as the Royal Free Hospital NHS Trust, SFC Brain Imaging Research Centre at the University of Edinburgh, and Imperial College Healthcare NHS Trust, further confirmed this absence of standardization across all types of medical imaging. A key recommendation of their report was that “discourse of national and international practice is required in the light of existing legal and ethical frameworks to develop robust and practical guidelines for both research centres and ethics committees considering proposals for imaging research” (Booth and Boyd-Ellison 2015: 462). Members of that team, notably Thomas Booth and J. M. Wardlaw, have coauthored further work pursuing the ethical ramifications of discovering and reporting incidental neurological findings (Wardlaw et al. 2015; Ulmer et al. 2013).

16.3 Subjects as Relational

Due ethical concern for each subject’s individuality and personal values is entirely consistent with ample recognition of membership in a group category. Cordelia Fine, at the University of Melbourne in Australia, focuses on the dangers, and opportunities, of studies of neurological similarities and differences that are putatively relevant to gender (Fine 2013). Fine has also teamed with coauthors in the UK, USA, and Switzerland to formulate guidelines for conducting and interpreting neuroimaging relating to sex/gender studies (Rippon et al. 2014). Cultural and religious heritage are further contexts in which due sensitivity to an individual’s background and priorities is essential (e.g., Semrud-Clikeman and Bledsoe 2014). Wael Al-Delaimy, at the Division of Global Health of University of California, San Diego, sets out a valuable perspective for neuroethics:

> Western secular philosophy can direct ethical questions to standard ethical concepts of autonomy, beneficence, nonmaleficence, and justice, but other traditional non-Western populations may require evaluations of ethical questions from the specific contexts of their faith and culture. The religion of Islam with more than 1.3 billion followers worldwide is the second largest after Christianity and a unique global subpopulation. New intrusive technologies or instrumentation such as fMRI are likely to have ethical and religious implications for this large percentage of the world population because such technologies may also offer insight into the process of consciousness, spirituality and thought (Al-Delaimy 2012: 510).

An appreciation for the special circumstances and psychological consequences inherent to neuroimaging small children should also have an important place in research neuroethics (Shechner et al. 2013). Children are simultaneously neurological subjects and developing subjective mentalities. Ilina Singh, professor of neuroscience and society at the University of Oxford, has led interview sessions with these patients. She reports that

> [It] is not the case that encounters with neuroscience discourse or technologies necessarily lead children to construct neurological subjectivities. Rather, children are seen to be active and creative participants in discursive power negotiations among social, biological and technological forces. Throughout these negotiations many children sustain a resilient sense of self and agency, perhaps because the embodied experience of moral struggle over self-control outweighs reductive explanations for behaviour that they may hear from adults (Singh 2013: 825).

Adults can be vulnerable subjects, no less than children. However, classifying "vulnerability" can obscure ethical problems. Eric Racine's team has called into question the usual attribution of vulnerability by biomedical ethics according to diagnosed condition. Such subjective vulnerability is largely due to a host of individual factors relevant to one's capacity to meaningfully participate in treatment decisions (Bracken-Roche et al. 2016). Joining in additional inquiry to the ethical issues of informed consent is a number of senior neuroethicists: Joseph Fins of Cornell University, Paul Ford of the Cleveland Clinic, and Walter Glannon at the University of Calgary in Canada. They rightly emphasize that subjectivity is relational and contextual as experienced and lived by the individual, and they propose that respecting patient vulnerability should share those features (Bell et al. 2014; see also Ford 2009). Fins has warned against a neuroethics that would be as static and flat as the fMRI scans driving so much of neuroscience toward depersonalized dogmas about brain functioning. His 2008 declaration still rings true: "Neuroimages are not in fact transparent, they are reflective" (Fins 2008: 50). How brain scans are interpreted says far more about what those who interpret scans are prepared to see, than what subjects' brains are actually doing. Fins's cautionary words continue:

> "I for one want to stay practical—as a physician and medical ethicist—and work in the service of patients who have been historically marginalized. I will leave the speculative work to the non-pragmatists. If we confine ourselves to the instrumentality of research or clinical applications of our work—avoiding the more speculative domains—I believe we will be better able to manage developments in our field and not be distracted by rhetoric and ideology, which can become powerful barriers to meeting a dire clinical need (Fins 2008: 50).

If neurological and psychiatric patients are to be regarded as subjects in the double sense as being subject to research and treatment agendas, while trying to live their subjective lives with meaning, then neuroethical analyses and guidance of this reality carry special ethical responsibility indeed. That responsibility is surely distributed everywhere that neurological research is fostered and applied. Herein, we suggest an initial division of labor into "research neuroethics" and "interrogative neuroethics." A third mode of neuroethics, "interoperable neuroethics," is then tasked in a later section with communicating with other areas of scientific and social knowledge and application.

16.4 Research Neuroethics

To analyze what is happening in exploratory and experimental research, where hopes for neuroscientifically based treatments are translated into therapeutic and rehabilitative regimens, it becomes important to understand the motivations and priorities of the people involved. Research neuroethics takes the research context and the methodical work of researchers as its field for targeted inquiries. For some novel application of neuroscience and its technologies (i.e., neuroS/T), the development and availability of neuroS/T research can be queried and assessed at many levels (Giordano 2015, 2016). These levels include a range of questions about research ethics:

How do people experience the neuroS/T research regimen as its subjects, from their personal perspective?

How do people assess this neuroS/T research for themselves, in terms of their medical needs and health priorities?

How do people express their disagreements among each other about prioritizing this, and similar types, of neuroS/T research, assemble into health-related interest groups, and justify their respective standpoints?

How do allied disciplines (e.g., medicine, psychiatry) assess the potential of this neuroS/T research for meeting therapeutic needs, with due regard for priorities expressed by interest groups, ethno-cultural populations, and (if any) broader social consensus?

How do other professions (e.g., law) and institutions (e.g., churches, government agencies) assess the conduct and implications of neuroS/T research in terms of the values and norms they presume and uphold?

How has the development of this neuroS/T research, and the brain science that undergirds it, been evaluated by standards of research risk assessment, responsible innovation, genuine social need, and justice for members of society?

How is society in general assessing the progress and impact of this neuroS/T research on people's lives, according to its customary values, cherished ideals, and established laws?

Research neuroethics must be entangled with intensely personal health needs in the context of individual life plans, on the one side, and with broadly social capacities for the public understanding and assessment of medical information on the other. It will share a great deal with the settled standard of research ethics in general and will encourage professional conduct in all research settings. Research neuroethics will also work closely with behavioral ethics on the more individual level and with social ethics on broad(er) levels. A second mode of neuroethics, interrogative neuroethics, more closely investigates what individuals presently think about new neuroS/T and the ways that such innovations can be clinically implemented.

16.5 Interrogative Neuroethics

To better anticipate what is happening in research laboratories and clinical settings as the need for neuroscientifically based treatments is translated into therapeutics, the experiences, motivations, values, and priorities of the people involved must be understood. Interrogative neuroethics takes the social context and peoples' settled views as its field for targeted inquiries. Here, for any novel neuroS/T development and availability, key questions include:

How do people experience the application of this neuroS/T, in the ongoing course of their lives?

How do people assess this neuroS/T's value for themselves, in terms of their health-care needs and their stable self-conceptions and values?

How do people express their disagreements among each other about this neuroS/T's value, form health-related interest groups, and justify their respective standpoints?

How do related disciplines (e.g., medicine, psychiatry) developing and utilizing this neuroS/T assess its capacity for respecting and supporting individuals as persons, with due regard for their membership in interest groups and/or social identity with an ethno-cultural population?

How do other professions (e.g., law) and institutions (e.g., churches, governments) assess neuroS/T's use in terms of the values and norms that those professions presume and uphold?

How has the application of this neuroS/T, and the brain science upon which it is based and derived, been evaluated by scientific and clinical participants for responsible innovation, genuine social need, and justice for members of society?

How is society, in general, assessing neuroS/T's impacts on people's lives, according to customary values, cherished ideals, and established laws?

Answers to these questions possess great significance and serve as a vital resource for more expansive deliberations about the potential and actual impact of neuroS/T on the needs and priorities of patients and their families, clinical care providers, health-care institutions and systems, public interest groups, and government agencies. In turn, well-informed and comprehensive policy formulations and implementations that guide and sustain support for research and use of neuroS/T should take these deliberations into careful consideration.

When ethical concerns need to be raised for consideration, interrogative neuroethical methods do not impose normative principles, for interrogative neuroethics wields none. Rather, familiarity with the moral values held by this or that sector of society, or society as a whole, allows an interrogative neuroethics to relay that further (and deeper) ethical dialogue is needed. Surveying attitudes and expectations about brain modifications can disclose both aversions and approvals toward neurotechnological advances.

Peter Reiner of the National Core for Neuroethics, at the University of British Columbia, and colleagues have sampled views among physicians and the public about brain stimulation, cognitive enhancement, and related neuroS/T (Fitz et al. 2014; Cabrera et al. 2015; see also Franke et al. 2014). Consumer demand for pharmaceuticals that supposedly enhance mental acuity and stamina is also worthy of close monitoring. Studies of college students around the world—typically conducted by teams comprised of experts in mental health, public health, pharmacology, and bioethics—are a notable category (Sattler et al. 2013; Singh et al. 2014; Maier et al. 2015; Schelle et al. 2015; Jensen et al. 2016). Elisabeth Hildt (then at the University of Mainz) worked with Andreas Günter Franke, of Mainz University Medical Center, on a qualitative study discerning why and how students seek academic advantage within the complex context of life's many pressures and challenges (Hildt et al. 2014). Interrogative neuroethics may even select an entire nation for study, as neuroethicist Arlene Salles undertook for Argentina (Salles 2014). How constituencies understand what neuroS/T can do, and how they evaluate any types of use by their own priorities, are the primary areas of interest for interrogative neuroethics.

A survey led by Jens Clausen (Institute for Ethics and History of Medicine, University of Tübingen) and Femke Nijboer (Human Media Interaction, University of Twente) further illustrates the interrogative approach. Clausen and Nijboer assessed answers from 145 respondents at an international Brain-Computer-Interface (BCI) conference, concerning terminology and definitions for BCI, marketability of BCI technologies, ethical aspects of BCI research and application, and perceived urgent matters about BCI (Nijboer et al. 2013).

Interrogative neuroethics easily integrates with issues of research neuroethics. Experimental diagnostic techniques may yield ambiguous gauges of neurological impairment, so estimates on degrees of cognitive functioning must be paired with clinical and family judgments about patient decision-making and quality of life. For example, a group of medical ethicists and physicians in Canada are pursuing projects to query the role of neuroimaging in determining awareness and sentience after severe brain injury, providing for patient participation in decisions, and explaining neurological prognostications to families (Weijer et al. 2014).

Perhaps the disciplinary extent of neuroethics could halt here, where research neuroethics and interrogative neuroethics are entwined. However, we envision additional territory to cover. That territory has been described by members of the Presidential Commission for the Study of Bioethical Issues, who in their 2014/15 *Gray Matters* reports, posited a greater ethical burden—and responsibility—evoked by the brain sciences. Summarizing those reports, neurologist and Commission member Stephen Hauser published a paper entitled *What ethics integration looks like in neuroscience research*. As might be anticipated given the growth of both neuroscience and neuroethics, Hauser's expectations for interdisciplinary collaboration on far-ranging neuroethical issues are even more comprehensive than the territory covered by the 2002 special issue of *Brain and Cognition* on neuroethics. Hauser states:

> Ethics integration entails collaboration between researchers and ethics professionals to acknowledge and understand the societal and ethical issues and implications of their work. Integration should equip scientists to recognize and address ethical issues as they arise, and ethicists to understand the science and technology with which they engage (Hauser 2014: 623).

These expectations are reasonable, in our view, but how should those more extensive collaborations proceed? The next section surveys some neuroethical inquiries offering answers to that question.

16.6 Neuroethics Operating Across Discourses

The targeted focus that is characteristic of both research neuroethics and interrogative neuroethics permits tremendous utility for near-term deliberations and planning. In the longer run, however, minds are gradually changed by intriguing news about the brain. Neither research neuroethics nor interrogative neuroethics are designed for anticipating or registering what happens when these factors become highly salient, such as when:

Fresh neuroscience findings call for altered conceptions of psychological matters.
People change how they regard psychological matters in light of news about neuroscientific findings.
Social subgroups and ethno-cultural populations compare their views on psychological matters with neuroscientific information.
Various related scientific and humanities fields assess and critique neuroscientific claims about the validity of findings and the relevance of clinical applications.
Different professions disagree about how to deal with drifting conceptions and evolving models of mental/psychological/behavioral matters.
Society's many reactions to emerging ways that conceptions of selves and persons are called into question.

How shall neuroscientists deliberate with ethicists, and how would both of these groups communicate with a wider public? That answer must start from the way that the new and unfamiliar must somehow be meaningfully linked with the comfortable and familiar. Neuroethical discourse must work with information provided by brain sciences, even as it addresses human matters in terms set by society. Martha Farah of the Center for Neuroscience and Society at the University of Pennsylvania has written

> [N]euroscience can now be brought to bear in many different spheres of human life, beyond the traditional application area for biological science, medicine. Any endeavor that depends on being able to understand, assess, predict, control, or improve human behavior is, in principle, a potential application area for neuroscience. This includes diverse sectors of society, for example, education, business, politics, law, entertainment, and warfare (Farah 2012: 573).

These far-reaching prospects for neuroscience all have one thing in common: they are premised on the ability of those social sectors to appreciate and utilize neuroscience's discoveries for their own specialized work. Explaining the intricate implications of neuroscience could be avoided of course, by taking the easy road of depicting science as the supreme truth and chief debunker. Formulaic headlines in this tenor seem so familiar by now. Statements such as "Brain science says X, so widely-held views about Y are wrong" presume that a conception of Y (e.g., feeling love or some moral judgment) must be vulnerable to a hypothesis about X (e.g., oxytocin levels or prefrontal cortical activity). Assertions like "Neuroscience cannot find X in the brain, so X is a myth" presume that the only reality X could have (e.g., deeply loving or freely choosing) is a neurological reality. Neuroethics need not be reduced to crude myth-busting, if it first investigates and revises any presumptions.

Domains of knowledge are ontologies in their identification and categorization of known matters, and their interrelationships, in turn permitting information storage, efficient retrieval, and responsive querying. Any area of human knowledge displays an ontology, usually in a poorly organized and less-than-logical way. Disciplinary fields attempt to improve their ontologies for better methodological utility. Life sciences and health sciences put vast efforts into regimenting and coordinating their ontologies—medical informatics is a prominent example among many kinds of biomedical ontologies.

But no matter how regimented and logical a domain's ontology may be, a neighboring discipline probably has a somewhat different ontology—because different things matter in differing ways to different groups. Even if two related subfields both use the same term for an entity or process, those subfields may not mean precisely the same thing, even in those situations in which all may agree that only one subject matter is involved. Informatics ontology can advise fields on improved precision for theoretical terms and their relations and operational definitions of as many significant concepts as possible. That precision and operationality in turn permits better mutual comprehension between neighboring fields. Ideally, even where two fields do not have closely similar ontologies, they would be able to understand and use scientific information from each other, thanks to a degree of terminological and ontological interoperability. Neuroscience's accounts about neural systems and functions will be fairly closely aligned with behavioral and cognitive psychology. At their intersection, the emerging field of cognitive neuroinformatics is an example of interoperable ontology at work (Poldrack and Yarkoni 2016). Neuroethics must itself become more interoperable, so that it may meaningfully engage with many other fields.

This interoperability can extend to any aspect of psychology and mentality, if (and perhaps, only if) neuroethics does not deviate from the interrogative mode. An example involving neurological adjustments to reduce compulsive behaviors will serve. Grant Gillett of the University of Otago, New Zealand, and Berthold Langguth of the University of Regensburg, Germany, collaborated with medical and neuroscience colleagues to explore the psychological ramifications of neuromodulating cortical regions associated with predicting, considering, and choosing among optional actions (De Ridder et al. 2016). Because patients undergoing successful treatment typically report greater freedom to choose actions and deny compulsions, these individuals can be said to be acquiring "freer wills." On the ethical level, neuroethicists are invited to conclude that such a psychological outcome is rightly regarded as a morally positive result.

Law, political science, and economics are further examples of fields of knowledge, and beyond all disciplinary ontologies lies the vaster realm of socially accepted ontologies (in a loose sense) that encompass what people typically take to be real. These discordant and even conflicting ontologies, whether disciplinary or popular, provoke deep puzzlement and philosophical inquiry. Knowledge about brain structures and processes cannot dictate how people must understand their ordinary, and extraordinary, behaviors and projects of daily life. However, when the brain sciences are asked to craft questions about causes of behavior in order to apply social categorizations to a person's conduct (as willful, deliberate, autonomous, negligent, compulsive, and so on), the scientific answers are under no obligation to conform to those categorizations. Nicole Vincent rightfully notes that neuroscientific evidence about a specific type of poor brain function cannot, by itself, indicate whether a person suffers from a blameless incapacity or exhibits an immoral character. Vincent calls into question that false dichotomy:

> [I]n my view the capacity-character problem … reflects a need for theories of moral and legal responsibility to recognize a broader and more finer-grained taxonomy of the different kinds of moral appraisal, and to take these different kinds of moral appraisal into account in the right way (Vincent 2015: 494).

Neuroethics can become fully interoperable, helping to sustain mutual comprehension between advances in brain research, multiple disciplinary fields, and sectors of the public trying to keep pace with such developments. It must prepare for conversing with the polysemous discourses already heard today and with the emerging discourse(s) of tomorrow.

16.7 Interoperable Neuroethics

Communication about science must understand society just as carefully as society should try to understand science. Brain science is no exception. Neuroethicists often pronounce that some domain of social discourse is predicated on a certain conception of mental events and then warn that nothing in the brain indicates that such mental events really occur. Yet that discourse may be misleading. What we like to say about ourselves need not match our actual expectations, and what we like to say about our social institutions need not be accurate about how they actually work. Stephen Morse, citing extensive legal scholarship, points to the realm of legal proceedings:

> Contrary to what many people believe, and what judges and others sometimes say, free will is not a legal criterion that is part of any doctrine, and it is not even foundational for criminal responsibility. … when adopting a compatibilist metaphysics about responsibility, criminal law doctrines are fully consistent with the truth of determinism or universal causation that allegedly undermines the foundations of responsibility (Morse 2015: 54).

According to Morse, and we agree, jurisprudence and legal philosophy should be closely consulted before any neuroethical verdict is summarily rendered.

The intersection of legal justice, social values, and personal ethics is particularly fraught with confusions and tensions across discourses. The area of forensic psychology is displaying the transformative effects of neuroscience in the courtroom, which in turn invites unexpected social intrusions into the realm of law. Georgia Gkotsi of the Institute of Legal Psychiatry, Switzerland, has surveyed a variety of civic priorities, such as public safety and the medicalization of violence, pondering how that consequentialism may diminish offenders' autonomy and rights (Gkotsi and Gasser 2016). Farah Focquaert of Ghent University, Belgium, assessed a similar civic overlap, where interests of public welfare may shift the purpose of punishment over to a lifetime of mandatory neurological "correction" (Focquaert 2014).

Jennifer Chandler of the University of Ottawa Law Faculty, working together with Eric Racine and colleagues provided another illustration by considering the legal implications of a victim of violent crime who undergoes therapy to reduce memory trauma prior to the criminal trial. Are legal proceedings that rely heavily on evidence of reliable memory and emotional distress going to be compromised (Chandler et al. 2013)? As legal systems begin to grapple with such novel questions, neuroethics can monitor discourses from many countries around the world, observing how novel neuroS/T impact the practice of law and how legal climates are shaping neuroscientific research (Farahany 2009; Spranger 2012; Pardo and Patterson 2013). Neuroethics can also monitor international concerns about mental health and human rights (Stein and Giordano 2015).

A highly conversant neuroethics will be an interoperable neuroethics, grounded in perceptive attention to nuanced discourses occurring in diverse domains. In this way, we could pose the following questions about novel neuroS/T, building from simpler questions posed in prior sections:

How might people understand this neuroS/T, as applied to their own mental lives, and think about potentially altering their notions of mental/psychological matters or even modifying their entire self-conceptions?

How might people express their disagreements with others over this neuroS/T's seeming revision of mental/psychological matters, align together in interest groups, and justify their disagreements about each other's self-conceptions?

How might brain-related disciplines agree or disagree about the potential for this neuroS/T to require revisions to scientific conceptions of mental/psychological matters?

How may philosophical analyses and assessments of disciplinary views on this neuroS/T expose fallacious, confused, or biased thinking and moderate excessive claims about drastic revisions to conceptions of mental/psychological matters?

How may brain-related disciplines disseminating neuroS/T's revision of certain mental/psychological matters assess implications for respecting and supporting individuals, as those individuals conceive of themselves, with due regard for their membership in interest groups and/or social identity with an ethno-cultural population?

How might other professions and institutions assess disciplinary claims made about this neuroS/T's revision of mental/psychological matters and judge resulting effects on individuals' self-conceptions, in terms of the values and norms that those professions exemplify and uphold?

How may society in general assess neuroS/T's revision of mental/psychological matters and effects on individuals' self-conceptions, according to its customary values, cherished ideals, and established laws?

Gaining answers to these questions would allow neuroethical inquiries to diagnose and help alleviate conflicting views over the import and worth of neuroS/T innovation and advances. What appear to be sharply dissenting viewpoints may only require some careful translation to help parties understand that and how their differences are not so great. On the other hand, parties using the same terms may be camouflaging quite discrepant views, which need to be elucidated and made plain for critique.

Translation can be done both well and poorly, but it is surely unavoidable regardless. Neither neuroscience nor neuroethics should imagine that scientific knowledge or technological prowess is straightforwardly conveyed to the public. Racine, Illes, and DuRousseau investigated the media coverage of a widely-reported scientific achievement in 2002: “Rat navigation guided by remote control” as published in *Nature*. They noted how value-laden phrases such as “remote-controlled rats,” “mind control,” and “threat to autonomy” proliferated throughout the ensuing reactions in the press.

> Our study supported a broadened, multidirectional approach to the understanding and practice of science communication … We found that when research moved from the bench to headline, findings were not simply transmitted but instead were *translated*. Language literally changed, and with it changed the meanings ascribed to both the study and the fundamental goals of science communication (Racine et al. 2012: 186).

Neuroethics cannot forestall this kind of fast-paced process of dissemination and digestion. However, versatile and fluent neuroethicists could lend a conversant academic voice to ensuing public debates.

Interoperable neuroethics has a much-needed role at the intersection of medicine, government regulation, and social welfare. One example is the question whether professionals such as pilots or doctors should be permitted—or even encouraged—to seek off-label use of certain drugs for their alleged ability to promote alertness, concentration, memory, sharpness, and so on (Franke et al. 2013).

Another opportunity for interoperable neuroethics is provided by the growing availability of cognitive enhancement devices (CEDs). Thomas Douglas and Julian Savulescu of the Uehiro Centre for Practical Ethics at the University of Oxford, along with Oxford colleagues and Neil Levy of the University of Melbourne, argued that CEDs should be classified with medical devices and regulated accordingly, per the EU’s Medical Devices Directive (MDD). They forcefully claim:

> CEDs are not categorically different from medical devices; in fact, the very same device may be used both for therapeutic and enhancement purposes, in some cases using similar parameters. CEDs, as devices that modify brain function to improve cognitive performance are, in important respects, the same *sorts* of devices that the MDD covers: they intervene to modify physiological processes and present varying degrees of physiological risks and side effects (Maslen et al. 2014: 79).

They go on to point out the heavy (and unjustifiable, in their view) burdens upon device manufacturers and the public wanting those devices if new regulations are imposed. Arguing on behalf of medicine's contribution to social welfare rightly carries great weight in these sorts of debates.

However, an interoperable neuroethics can also ponder how medicine and the public may be poorly informed about the real-world effects of such devices. CEDs do objectively modulate neurophysiological functions, but the subjective results will surely vary from individual to individual, in various contexts, and across cultures. What does "cognitive" normality or improvement really mean? The contrary position against lightly regulating CEDs has been taken by James Giordano of Georgetown University and John Shook of the University at Buffalo.

> Neuroethical analyses and explorations into cognitive enhancement must keep abreast of relevant findings from many fields, such as personal genomics, developmental psychology, social neuroscience, cultural neuroscience, cross-cultural psychology, and cultural anthropology. As any of these fields can indicate, there will always be debate as to what constitutes the "cognitively normal" human brain, and rightly so. What exactly counts as constituting a cognitive deficit, disorder, distortion, or bias will not converge across cultures or even within societies. It is naïve to suppose that a compensatory adjustment, much less an enhancing adjustment, could be generically assigned any validity across all of humanity (Shook and Giordano 2016: 84).

Interoperable neuroethics, as this debate exemplifies, points the way toward deep philosophical issues, while displaying interoperability's inherent limitations.

16.8 Disciplined Neuroethics

Sensitivity to the diverse interpretations of neuroS/T that people and institutions will form for themselves, and their divergent views of mental and personal matters that result, establishes that interoperable neuroethics should remain acutely aware of tectonic shifts in conceptions of mentality, agency, the self, the person, and so on. But interoperable neuroethics is powerless, by itself, to do anything about those shifts. Adjudicating matters concerning the right or best views on those core psychological and ethical matters falls outside its competence.

In this regard, interoperable neuroethics is *not* designed for resolving issues such as:

Neuropsychological revisions to folk psychological conceptions that in turn alter people's sense of their values, their moral capacities, and their self-identities
Revisions to people's values, morals, and self-valuations happening in different ways across populations, producing sharp disagreements on fundamental matters
Social subgroups and ethno-cultural populations that adopt highly variable stances toward putative revisions by neuroscience to communal values, morals, and identities
Professions committed to visions of the self, the bases of self-worth, and the dignity of personhood that cease assuming that these should be univocal matters
Societies relying on stable institutions and resolute professions (e.g., education, law) that may find those foundations eroding and fragmenting

Neuroethics becomes deeply philosophical as these kinds of issues arise. However, its interdisciplinary and culturally fluent inquiries from the foundational stages of research, interrogative, and interoperable neuroethics will serve it well. Two more examples from recent neuroethical literature serve to justify this hope.

A team of Japanese researchers, led by Eisuke Nakazawa of the University of Tokyo and Keiichiro Yamamoto of the National Center for Global Health and Medicine, is acquiring impressive expertise with real-time fMRI-based neurofeedback techniques for modifying both behaviors and mental judgments (Nakazawa et al. 2016). They are also exploring considerable neuroethical territory, as they ponder the workability and ethicality of modifying moral judgment through the use of this approach. Beyond questions of research neuroethics (e.g., about the safety, efficacy, reversibility of the techniques, etc.) and interrogative neuroethics (e.g., about subjects' compliance, goals, and self-transformation), interoperable neuroethics poses additional questions, such as:

How authentic could these moral modifications become?
Who will approve this technique as therapeutic or possibly as enhancing?
By what standard could neuroscience affirm that moral improvement is achievable?
Who will receive society's encouragement (or coercion) to undergo this moral modification?

John Trimper, Paul Root Wolpe, and Karen Rommelfanger of Emory University are addressing "brain-to-brain interfacing" technologies (Trimper et al. 2014). Again, concerns at the stages of research and interrogative neuroethics are accompanied by ethical quandaries calling for interoperable neuroethics. Here, questions include:

In what sense could two brains be mentally connected?
How would that mental connection constitute a psychological overlap or continuity?
Does that relationship amount to a diminishment of subjectivity or an enlargement?
Would a subject's autonomy be diminished or possibly enhanced?
Where does any boundary to the "self" have to be re-situated, or is it blurred entirely?

These matters in turn inspire more difficult questions, indeed, fully philosophical questions, about the opportunities and risks for individuality and personhood that are incurred when neuroS/T is employed to manipulate psychological capacities.

We have stated before, and re-iterate here, that neuroethics, as a discipline and a set of practices, has come of age and must now face the future of rapidly developing brain science, ever more diverse applications and effects of the knowledge and capabilities that brain science affords, and last, but certainly not least, of its own viability, engagement, and value, to the foci and scope of brain science and its translation, and to society, writ-large (Giordano 2010, 2014). While coming of age, it is our view that neuroethics will mature as a discipline, developing a robust portfolio of tools and principles having proven value in global contexts (Shook and Giordano 2014; Lanzilao et al. 2013), and, in these ways, fully contribute to philosophical debates in the modes of research, interrogative, and interoperable neuroethics. That maturation is evidently well underway, and its impressive growth is measured by the ample neuroethical collaborations having both multidisciplinary and multinational dimensions.

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