

**Abstracts**

# Selected Abstracts From the 2013 International Neuroethics Society Annual Meeting

The editorial team of *AJOB Neuroscience* blind-reviewed all abstracts from the INS meeting for merit based on novelty, relevance, and contribution to the field of neuroethics. The scores were tallied and the top abstracts appear below:

## **Animal Models of Pain and the Puzzle of Similarity**

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The Puzzle of Similarity is a problem for animal experimentation in general, but it is especially puzzling in neurobiological experiments involving animal models of pain. It can be stated as follows: If animal models (of pain) are valid, they are morally impermissible, and if they are morally permissible, they are useless. Either way, experiments involving animal models (of pain) should be abolished.

Animal models are a fundamental tool of experimental neurobiology. They are commonly used in experiments involving invasive interventions impermissible for human subjects. Nevertheless, some question their moral justification. For example, Regan and Singer hold that because animals are relevantly similar to humans they should not be subjected to suffering, which animal experimentation causes. LaFollette and Shanks, on the other hand, argue against animal experimentation because of its epistemological failures. They argue that animals are too dissimilar to humans to serve as valid models of human conditions.

The complication with animal models of pain is that they need to exhibit some similarity to the human experience of pain. However, if they did, this would confirm Regan's and Singer's worry that this kind of experiment causes animals to suffer. Defenders of animal experimentation may agree that animal models of pain subject animals to suffering but argue that the benefits from this practice are greater than the harm it produces. This position is reflected in the 3R policy, according to which experimental animals should be replaced with phylogenetically lower and presumably less sentient species whenever possible. However, adopting this position leaves the door open for questionable human experimentation in cases where the benefits could override the harm caused.

Defenders of animal experimentation may fare better if they can show that the animals involved in the study of pain are not capable of experiencing pain like humans. As an empirical question, this can be addressed in neurobiology. However, the animal experimentation supporter will have to find a way to show that animal models of pain are still valid even though the animals involved are relevantly dissimilar to the humans they represent.

A way to approach this problem is by adopting Bolker's notion of animal models as surrogate models as opposed to exemplary models. Exemplary models represent by example. They include animals as representatives of a broader class to which they belong, whereas surrogate models represent by substitution. Surrogate models are designed to study specific phenomena. The animals in these models serve as proxies for other species, most often humans. Assuming that animal models of pain are surrogate models, one could argue that the experimental system as a whole, rather than the organism it contains, models a given human condition, in this case pain. Therefore, the system will have to be evaluated for its representational validity and not the animals for their similarity to humans. Thus, animal models of pain may be valid even though the animals involved in them do not experience pain like humans.

## **The Ethical Challenges of the Novel, Non-Invasive Imaging of Amyloid-Beta Plaques in the Brain as a Predictive Biomarker of Alzheimer's Dementia**

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The difficulty of adequately treating Alzheimer's dementia once established and the cost of care have prompted both scientists and government agencies to raise as top priorities early detection and prevention. The most promising technology in that regard comes from the combination of positron emission tomography (PET) brain imaging with the injection of an amyloid-beta-binding small molecule

such as Pittsburg Compound B (PiB) or the newly FDA (and EU) approved florbetapir (Amyvid, from an Eli Lilly Subsidiary) (PiB-PET or florbetapir-PET). This novel imaging technique brings the ability to visualize in living people the amyloid plaques associated with Alzheimer's dementia that had previously required the slicing and staining of postmortem brain, and to use plaque burden to estimate the risk of future dementia in otherwise healthy or mildly cognitively impaired individuals. While there has been some discussion of the ethical issues raised by this amyloid imaging, little has considered Alzheimer's disease's uniquely socially embedded position. This technology falls at a time when governmental organizations argue in favor of prediction increasingly based upon the toll the disease takes not on the individual but on the rest of society. "Yes, the biggest driver of our long-term debt is the rising cost of health care for an aging population," said U.S. President Obama in his recent State of the Union Address. It is the costly spectre of Alzheimer's dementia—and what to do about it—that looms large within this statement and was specifically cited earlier in the same speech as a key reason to sustain funding in medical research. In the United Kingdom, moreover, the recent Foresight Report argued that prevention in areas like Alzheimer's disease is essential to guard and maximize the nation's "mental capital." How should we balance the interests of the individual (and who should determine those interests) with societal interests? Interestingly, studies of Alzheimer's risk genes suggests that individuals would like to know their risk in order to plan for the future or mitigate burden on loved ones should the condition develop. But against this, some critics argue against the acceptability of amyloid imaging, even if desired, citing concerns about needless worry, overtreatment, or harm from labeling those identified at risk. An ethical analysis of these tensions raised by using the amyloid-PET biomarker, which touch upon autonomy, privacy, and justice, is both urgent and largely underdiscussed. We appeal to relevantly similar cases, such as predictive genetic testing, to outline the key ethical issues raised by amyloid imaging, but we push the discussion further to consider where the moral landscape of imaging biomarkers diverges from that of genetic testing.

### Sources of Angst About Cognitive Enhancement: Changes to Core Features of Self and Perceptions of Success

Laura Y. Cabrera, Nicholas S. Fitz, and Peter B. Reiner, National Core for Neuroethics, University of British Columbia

Irrespective of whether one is enthusiastic or alarmed about the prospect of cognitive enhancement, it seems that most people feel at least some angst about the issue. There may be multiple sources of such worries, and we reasoned that empirical tools might be used to uncover the sources of this unease.

In practicing experimental neuroethics we employ the quantitative methods of cognitive science: systematic

experimentation and statistical analysis. Here, we used the contrastive vignette technique to explore public attitudes regarding sources of angst about cognitive enhancement. We used Mechanical Turk to recruit respondents ( $n = 1408$ ) from Canada and the United States: a data set more representative than typical undergraduate participants. Each individual was randomly assigned to read one (and only one) vignette describing the use of a pill to enhance one of 12 cognitive domains: alertness, attention, cooperation, creativity, empathy, mood, narrative memory, openness to experience, perseverance, self-control, sociability, or working memory.

The vignettes carefully described a situation in which a close friend was using a pill to enhance the relevant cognitive domain. Respondents were then asked how comfortable they were with their friend using the enhancement. Comfort with enhancement varied significantly depending upon the domain being enhanced: On a scale of 0 to 100, respondents rated their average comfort with the enhancement across the range from 34 to 55 ( $p < .001$ ). We then carried out two experiments that explored why such differences might exist. One hypothesis is that people feel more angst toward technological brain interventions that alter those traits perceived as fundamental to one's self-identity (Riis, Simmons, and Goodwin 2008). We found a modest negative correlation ( $r = .291$ ) between comfort level with the enhancement and the degree to which the enhancement was perceived as changing core features of the self. A second hypothesis is that people's comfort level with the enhancement depends on the benefit afforded to the individual. When comparing the 12 domains of enhancement, we found a modest correlation ( $r = .250$ ) between people's comfort level with a given enhancement and the degree to which an enhancement was perceived as improving success in life. These data offer support for both hypotheses and suggest that there are multiple sources of angst about cognitive enhancement.

### FUNDING

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### Frontotemporal Dementia Provides Evidence for a Revised Dual-Process Account of Moral Reasoning

Winston Chiong and Katherine Rankin, Memory and Aging Center, Department of Neurology, University of California San Francisco

Greene and colleagues (2001) reported distinct functional magnetic resonance imaging (fMRI) activation patterns during "personal" moral reasoning, as compared with "impersonal" moral reasoning and nonmoral practical reasoning.

They proposed that these findings lend support for a dual-process account of moral reasoning on which utilitarian judgments reflect controlled cognition while counterutilitarian judgments reflect prepotent emotional influences. However, subsequent research has shown that the network of brain regions recruited during personal moral reasoning is not specifically related to emotional processing. Instead, neural activity within this “default mode network” exhibits coordinated activity during a broad range of cognitive states, most unrelated to emotion.

These findings undermine the claim that personal moral reasoning and counterutilitarian judgment are specifically related to emotion; however, it remains notable that the default mode network is recruited during personal moral reasoning, while a reciprocally related “executive control network” is recruited during impersonal moral and non-moral practical reasoning. The differential recruitment of these two networks does suggest that two distinct cognitive processes may be engaged by moral reasoning; however, the nature and implications of this dissociation remain obscure.

Recently we have investigated the dynamic interrelationships of large-scale brain networks during moral reasoning in both patients and healthy subjects. Behavioral variant frontotemporal dementia (bvFTD) is a neurodegenerative illness marked by profound impairments in emotional and social function, and bvFTD patients give abnormally utilitarian responses to personal moral dilemmas. Notably, bvFTD is marked by atrophy and disrupted connectivity not within the default mode network, but in a more anterior “salience network” that is consistently linked to emotional cognition. Our research provides converging behavioral, univariate fMRI, and multivariate fMRI evidence for directed causal influences from the salience network to the default mode network during moral reasoning (Chiong et al. 2013).

Building on earlier work characterizing the salience network, we propose that it plays an alerting and switching role during moral reasoning, utilizing social and emotional resources to appropriately recruit either the default mode or executive control network depending on the dilemma under consideration. We further propose an account of the default mode network’s role in moral reasoning that appeals to recent work on this network’s role in the mental simulation of different perspectives. One feature of personal moral deliberation is that it often involves consideration of the subjective points of view of the agent and of other affected parties. This understanding of the default mode network may therefore provide a neuroscientific framework for the claim that counterutilitarian moral judgments are closely tied to a personal, rather than a fully objective, point of view (Nagel 1986).

Disclosures: None.

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## Ethical Challenges of Large-Scale Brain Simulations

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**Objective:** Large-scale brain simulations are an increasingly important tool in neuroscience (De Garis et al. 2010). This is exemplified by the selection of the Human Brain Project as one of the two scientific “flagships” of the European Union in January 2013. In my contribution, I discuss the ethical consequences when the brain is object of large-scale simulation approaches that intend to guide the research process in neuroscience. Referring to experiences made in climate modeling, I claim that the focus of an ethical assessment should not merely be output oriented, but should assess the (often hidden) normative decisions that model generation involves, may include the notion of value-sensitive design (Friedman 1997), and should be sensible to side effects of the research project, for example, with respect to differences in “working philosophies” of the involved disciplines.

**Methods:** I made a comparative assessment of recent examples of large-scale brain simulations with respect to the history of the brain–computer relation and to sociological and ethnographic research on climate modeling. The former is important because in neuroscience, the relation between the tool for simulation and the object of simulation is bidirectional. The latter is illustrative due to the long history and political importance of climate modeling, such that there is some ethnographic and sociological work available on the various social processes that accompany model generation.

**Results:** The historical analysis points to difficult epistemic problems that are related to the conceptualization of information in neuroscience (Garson 2003) and makes the attractiveness of brain simulations comprehensible, as they allow a reference to various deep philosophical problems. The comparison with experiences in climate modeling (Lahsen 2005) shows that collaboration between modelers and empirical scientists are tricky, that visualizations tend to blur important differences between the object of simulation and the simulations themselves, and that various psychological mechanisms are at work that may undermine the critical function of the knowledge base of the modeling process.

**Conclusions:** I conclude that several ethical challenges that large-scale simulations in neuroscience will have, are currently not sufficiently addressed in the neuroethics community. A reason for that may be that most neuroethicists have a background in medicine, such that issues that relate to medical problems like enhancement or incidental findings dominate. Furthermore, I predict that brain simulations will become equally politically influential as climate models, both with respect to guiding research investment

allocation with respect to informing political decision making.

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### Charting a Course for Mapping the Brain—The Noetics and Neuroethical Challenges of *Homo sapiens (Neuro)Technologicus*

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Since antiquity, the brain and its functions have been both enigmatic and a source of human inquiry, invention, and intervention. The newly proposed Brain Activity Map (BAM) and Brain Research through Advancing Innovative Neurotechnologies (BRAIN) initiative represent the most contemporary iteration of this pursuit. By employing knowledge and technical convergence that conjoins the physical, natural, social sciences, and humanities in tools-to-theory-to-tools (T-3) heuristics, the disciplines of neuroscience enable heretofore unparalleled knowledge, through techniques to assess, access, and target neural substrates of cognition, emotion, and behavior in ways that offer potential translation in medicine, public life, international relations, and national security and defense.

The technical capability and theoretical revision afforded by contemporary neuroscientific advances—inclusive of those leveraged in the BRAIN agenda—have potential to incur profound change in the sophic, empiric, and epistemic domains of human knowledge (i.e., the noetic contribution of neuroscience), and such change prompts questions about the boundaries of scientific intervention and effect, and the social implications and ramifications of each and any discovery.

Herein we offer that while history may provide salient object lessons against frank misuse of neuroscience and its technologies, the historical record also upholds the reality that “change happens” and is reflective of human progress. Simply put, the more that is known, the more that can be—and is—done with said knowledge, and the noetics of neuroscience are no different. But a map is of little value absent the means to travel and deal with exigencies and contingencies along each step of the route. In this light, we argue that agendas such as BAM and BRAIN must entail an equally strong substantiation of programs dedicated to (1) elucidating what the T-3 heuristics of neuroscience will be focused upon and most likely enable in the short and intermediate term (i.e., the “where are we going?” question); (2) depicting the realities of the situations that will be produced at these epistemological and technical waypoints (i.e., the “what will really happen when we get there?” question); and (3) elucidating the true benefits, burden, risks, harms—and controls that can and should be implemented upon arrival (i.e., the “what are we going to do with and about it?” question). Toward this end, we propose that any and all neuroethical focus should not be esoteric or agnostic, but rather should direct a realistic appraisal of the positive, neutral, and negative trajectories that viably result from specific undertakings of BRAIN.

Cognitive scientist Merlin Donald claims that the next phase of human cognitive evolution will be technological. We agree, and call for and outline a paradigm and program in the spirit of Arendt’s *homo faber*—the reflective, creative human—through which to develop and maintain *homo sapiens (neuro)technologicus*: humanity that employs knowledge and insight to the ways, ends, realistic products, outcomes, effects, guidance, and adjudication of the ways we use tools—of neuroscience, if not the brain itself—to shape our present and future world.

### Italian Neuroethics Society: History and Perspectives of a Research Program

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The Italian Neuroethics Society was founded in July 2013. The founding of the society is the culmination of a process that began in 2009, with the first national conference dedicated to this new field of research. The conference was held, as it is every year, at the University of Padua, one of the world’s oldest universities (where Galileo Galilei taught for 18 years).

The initial purpose of the conference (now an international meeting with scientists from many countries) was to bring together scholars from various different disciplines:

neuroscientists, cognitive scientists, philosophers, psychologists, legal scholars, economists, art experts, and theologians. The idea was to draw together, in addition to neuroscientists, all those scholars who explored the neurological aspects of their field: neurophilosophy, neuropsychology, neurolaw, neuroeconomics, neuroaesthetics, and neurotheology.

After this initial phase, the conference's promoters (Andrea Lavazza and Giuseppe Sartori) turned their efforts toward identifying the specifics of research in neuroethics, with regard to both the international debate and the Italian research tradition, especially in neuroscience, philosophy, and law, in an attempt to overcome A. Roskies's classic partition between the ethics of neuroscience and the neuroscience of ethics.

One possible approach to research sees the specific field of neuroethics as an exploration of what we learn about ourselves and our "functioning" thanks mainly (but not exclusively) to neuroscience. In other words, a metadiscipline that deals with the intersection of the various disciplines just cited is made pertinent by the strong naturalization of research on the human being. The subject of study—in light of its new and controversial character—would thus not be what we can do, but what we know or reliably think we know.

Indeed, unlike what happens with bioethics (which can aim to prescribe or ban certain medical practices), there is no possibility of limiting the diffusion or effects of our understanding regarding "how we are"; in other words, the availability of knowledge has philosophical consequences and leads to self-understanding of the human being, with more or less significant social, political, and legal implications.

The ideal goal is a comprehensive theory on the functioning of the mind/brain, but not in order to reduce all the explanations provided by the disciplines that contribute to neuroethics to a single neuroscientific explanation. The goal is to arrive at an explanation that begins from the functioning of the mind/brain—implied both subjectively in research activities and in the object of the research itself (namely, human beings in all their activities, from philosophy to economics)—while leaving some autonomous room for the "special sciences" of humans.

### **Neuroscience and Technology (NeuroS/T) as the New Dual-Use Frontier: Importance and Necessity of Neuroethical Guidance and Articulation**

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Dual-use research in the life sciences has long been recognized as uniquely distinct from nuclear or other defense-adapted technologies, due to its intrinsic inseparability from human health needs within the context of dynamically changing ecosystems. Since the historic Asilomar Conference convened with the advent of recombinant DNA,

there has been a "ground up," intensely ethical dialogue involving academia, federal agencies, and the medical, health, and lay communities, to determine how to ethically guide the use of emerging biological technologies, particularly revolving around infectious disease organisms or organisms that produce life-threatening illness. Indeed, the Fink report outlined the "seven deadly sins," or those experiments that represent the most ethically questionable scientific endeavors in microbiological disciplines (Committee on Research Standards 2004), and following the anthrax attacks of 2011, the "select agent list" further circumscribed the field. The debate continues today at the highest levels of government (National Institutes of Health n.d.).

We propose that neuroscientific and neurotechnological (neuroS/T) advancements represent new, unique frontiers in the dual use dilemma, which require similar—but we posit perhaps more specifically focused—(neuro)ethical discourse on potential use and misuse that is apace with, realistically analytic toward, and thereby appropriate to current and near-future scientific and technological advances. As a traditional life science, neurobiology in and of itself does not connote immediate dual-use concerns within the academic community. However, with convergence of genetic, cellular, and molecular techniques, advances in imaging, computation, and various interventional techniques (e.g., trans- and intracranial stimulation, neuropharmacologicals, nanomaterials, etc.), neuroS/T enables strong pillars of both civilian and military applications, and currently these pillars exist as primarily distinct silos. NeuroS/T affords clear benefits to both civilian and military medicine, in areas such as neural prosthetics, therapeutic chemical neuromodulation, promotion of psychological "hardiness," and others, any of which can be purposefully utilized for nefarious dual-use application. Importantly, by advancing understanding of cognition, behavior, and decision making, neuroS/T offers unique dual-use potential to assess, access, and target/manipulate the "essence" of human thought and action.

In this context, we have developed the term "neurodeterrence," a merging of cognitive neuroS/T to deterrence theory. We view this as a novel tool that can be applied to a traditional philosophy of defense and security actions and decision making, and hope to mature this potential with the full input of each discipline. However, dual-use neuroS/T and agendas and programs of neurodeterrence each and all foster neuroethical, legal, and social issues (NELSI) and concerns. Recognizing this, we propose that the responsibility to begin, direct, and sustain pragmatic, genuine dialogue between the neuroscience and defense communities be borne by neuroethics as a field, and be engaged on several levels. We offer a tentative infrastructure of personnel, process(es), protocols, and policies with which to articulate address, and potential resolution of dual-use and neurodeterrence NELSI, and discuss the potential strength, limitations, and delimitations of this model, advocating the importance and need for such NELS guidance and governance before, during, and

sustainably through current and new neuroS/T development and application(s).

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## Pedophilia and Hemodynamic Brain Response: Is Arousal Guilt?

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Until recently, the most common method of determining the sexual preferences of pedophiles has been the use of penile plethysmography or "phallometry," an invasive procedure that measures blood flow to the penis when the subject is exposed to sexually suggestive materials. Phallometry is notoriously unreliable insofar as little testing has been conducted on non-sexual offenders, and because it tells us little about the origin of the sexual arousal (e.g., perhaps the subject was a victim of sexual abuse and is responding to his or her own victimization). More recently, studies have suggested that functional magnetic resonance imaging could be used to achieve more accurate (insofar as the testing has also been conducted on non-sex offenders) and less invasive results.

The argument for hemodynamic brain scanning is that it could be used not merely to test arousal, but to identify known brain structures that contribute to abnormal sexual desires; thus, such information could be employed to develop effective treatment strategies. However, there are obvious ethical issues at stake in this testing. One might ask, for example, how should such testing be used and in what contexts? Phallometry has been used as evidence to deny inmates parole, and to maintain the civil incarcerations of so-called "sexually violent predators." Early proponents of phallometry also argued that it could be used to develop therapies or treatments for pedophiles; however, these tests have not lived up to these promises and pedophilia remains nearly impossible to treat. Should brain scans be substituted in similar contexts and be used for the same purposes? Would such scans be more compelling to the general public than phallometry, such that there could be a call to use such testing as a screening device for non-offenders applying for jobs that require subjects to care for and/or supervise children? And finally, what do such tests tell us, if anything, about whether the subject is going to act on his or her desires?

## Neuroethics of Pain and Suffering in Disorders of Consciousness

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The intriguing issue of pain and suffering in patients with disorders of consciousness (DOCs), particularly in unresponsive wakefulness syndrome/vegetative state (UWS/VS) and minimally conscious state (MCS), needs empirical and theoretical assessment. We present an overview of recent neuroscientific literature to sketch an ethical analysis, given that the issue is very problematic and potentially innovative in neuroscientific as well as in neuroethical literature (Demertzi et al. 2013; Farisco 2013).

To date, not many studies have been dedicated to pain perception and suffering in patients with DOCs and, despite a progress in our knowledge, a critical uncertainty remains (Schnakers, Laureys, and Faymonville 2009). Additionally, only acute pain has been well investigated; our understanding of possible chronic pain in these patients is insufficient, particularly on the presence of baseline pain or suffering and whether it interferes with the ability to perceive a particular noxious stimulus (Laureys et al. 2002). Further investigation is certainly useful since the issue of pain and suffering in patients with DOCs raises not only scientific but also ethical questions.

In particular, our work investigates the possibility of pain perception by patients with DOCs, not to assign them a moral status (in relation to the so-called "end-of-life decisions"), but only to determine whether it is ethically right, due, or optional to treat them with analgesics. Notwithstanding the relevance of both issues, the latter is surely an ethical and legal problem affecting the everyday practice of a greater number of people.

Given this state of art, what degree of uncertainty is acceptable at a legal and ethical level? We believe that from a social and public point of view, in order to make decisions regarding the management of patients with DOCs, the best strategy would be to connect neuroscience with other fields, especially law and ethics; we do not have to wait for neuroscience to clarify all its doubts, but we have to deal exactly with this uncertainty. If we were not uncertain, we would not need juridical and ethical principles to assess our actions.

As a tentative conclusion we suggest formal guidelines and a situationist ethics in order to best manage the critical scientific uncertainty about pain and suffering in DOCs and to ensure the best possible care for such patients.

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### Sources of Angst About Cognitive Enhancement: Hard Work, Authenticity, Worth, and Success

Nicholas S. Fitz and Peter B. Reiner, National Core for Neuroethics, University of British Columbia

Imagine that a friend of yours has been assigned a new project at work and decides to take a safe and effective cognitive-enhancing pill to improve her working memory. Is her performance authentic? Is she worthy of promotion? Despite well-reasoned refutations of the authenticity concern, questions concerning authenticity and the value of hard work touch on deep cultural motifs surrounding the use of technological tools writ large. The essence of the issue is not whether enhancement is a shortcut to success—it is—but rather whether such shortcuts are problematic (Parens 2005; Schermer 2008).

We practiced experimental neuroethics: exploiting the traditional methods of cognitive science—systematic experimentation and statistical analysis—to gain insight into the way people make judgments about neuroethical issues. Here, we employed the contrastive vignette technique to probe public attitudes about authenticity of performance and worthiness of achievement when using a cognitive enhancer. Respondents recruited from Mechanical Turk ( $n = 698$ ) were randomly assigned to one—and only one—vignette that described an individual who enhances to improve performance in the workplace. In the realm of cognitive enhancement, shortcuts to success might be achieved in two ways: Technology might improve productivity, allowing one to work more efficiently per unit time, or technology might facilitate cognitive perseverance, allowing one to work longer without mental effort. For these reasons, the vignettes systematically differed by virtue of the presence or absence of enhancement, the effort expended, and time invested in performing the task.

Members of the public view enhanced performance as less authentic than unenhanced performance. Irrespective of whether the hypothetical individual in the vignette succeeded or failed at the task, the individual's performance was viewed as significantly more authentic when that person did not use a cognitive enhancer ( $p < .001$ ). Diminished authenticity did not translate into diminished worthiness: Respondents felt that enhanced individuals who succeeded at the task were rated as significantly more worthy of promotion than those who did not enhance and failed ( $p < .001$ ).

Perhaps most important was the observation that respondents felt that the agent was significantly more worthy still when that agent was successful without the use of cognitive enhancers ( $p < .001$ ).

Our results suggest that members of the public endorse success while also placing value on how that success is obtained—supporting both meritocratic and character values. Despite entreaties by philosophers to dismiss the authenticity concern, members of the public appear to attach substantial value to the issue. Concerns about authenticity may represent a continuing source of angst about cognitive enhancement. (Fitz et al. submitted).

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### Diagnosing Mental Disorders, Psychiatric Metaphysics, and the Neuroethics of Mental Health and Psychiatry

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The American Psychiatric Association's *Diagnostic and Statistical Manual* (DSM) is a knowledge tool influenced by technological advances and philosophical theories, as well as the sociocultural environment in which it has been developed and used. The 2013 fifth edition (DSM-5) will be employed in an American population in which the lifetime incidence of mental disorders renders these conditions statistically "normal." In international terms, the World Health Organization's International Classification of Disease (ICD) may soon constrict the DSM's influence. Thus, the presumed medical model that theoretically supports some form of universal psychiatric classification system may conflict with the present diagnostic paradigm, which relies on culturally variable phenomenological and social experiences. This raises questions about the scientific validity of globalizing nonobjective diagnostic and treatment standards and fosters ethical dilemmas regarding what type(s), extent, and system(s) of resources are needed to address international mental illness.

A number of factors affect the scope and conduct of psychiatry, including: (1) expectations of a self-medicalized society; (2) public health conceptualizations of psychiatric normality and related public policy agendas; (3) clinical ambiguities of attempting to discern “disorder” from ordinary troubles; (4) clinical utility in selecting and implementing effective treatment and prognosis; and (5) the need for research to demonstrate biological etiologies of mental disorders able to support the development and use of biomedical interventions (inclusive of pharmacologicals and neurotechnologies). The tools of neuroscience, and reductive, physicalist theories of mind, support a medical model of mental illness, and its values. However, overreliance on these tools and theories can narrow the scope of psychiatric research and treatment by disregarding the viability of a broader metaphysics of mentality and ontology of mental disorders, and the alternative treatment options that more existential (i.e., biological as well as psychosocial) theories of mind would allow.

We posit that DSM diagnostic categories are medicocultural constructs that reflect and support social concepts of health. These constructs affect the treatment of disorders as natural facts in research or clinical contexts, and can influence the profession and practices of psychiatry. The ethical and practical implications of psychiatric nosology extend beyond the medical milieu, to affect the social, economic, and even political realm; this incurs neuroethical, legal, and social concerns.

Herein, we argue that a contemporary “neuroethics of/for mental health and psychiatry” must embrace the core domains of philosophy, and address the issues generated by tensions fostered by (1) metaphysical and methodological naturalism as relate to knowledge of the brain–mind; (2) the as-yet contingent understanding of the brain–mind relationship; (3) limits conferred by this contingency upon knowledge and technical tools and their use; and (4) the responsibilities to engage such pragmatic evaluation(s) in the anthropological domains in which psychiatry is enacted as a medical discipline and public practice.

### **Sensorimotor Neural Prosthetics and the Relevance of Disability Perspectives**

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Sensorimotor neural prosthetics—devices that are implanted in or interact with the brain to help replace functions of the human body—aim at improving the lives of individuals with sensorimotor disabilities. As an example, Braingate2, a brain–computer interface that involves an electrode array implanted in the motor cortex, allows a paralyzed individual to control an external device, such as a computer cursor or robotic arm. After training, the device is able to interpret the individual’s motor

intentions, and translates them into control of the cursor or robotic arm. Although the current device is fully wired and not easily portable, engineers hope to develop wireless implants that offer the individual significantly greater freedom.

Neural technologies offer significant promise, but they also raise concerns. Our group is charged with identifying and exploring ethical questions related to neural devices (including neural prosthetics) for an engineering research center focused on sensorimotor neural engineering. Our project maps out a set of ethical concerns to consider midstream, during the development of sensorimotor neural prosthetics, including issues of identity, privacy, control and authority, responsibility, and neurodiversity. Crucial to our approach to these issues is recognition of the need to attend to concerns from potential end users—people with sensorimotor disabilities—even in the early stages of device development.

Consider, for instance, the capacity to lift a coffee cup for a drink without spilling the contents. Braingate2 and its technological offspring may return this capacity to a person with quadriplegia through the use of a robotic arm wirelessly controlled by the person’s motor intention. This technology would allow an individual local control, in a social setting, in a way that approximates normal functioning. Yet normality is a deeply contested notion. Must we assume that drinking through a straw, perhaps with the assistance of a personal aide, is necessarily problematic functioning? To some it seems obviously true that these different ways of life are mere deficiencies, yet disability rights activists have fought hard to have alternative modes of functioning recognized as acceptable, and insisted that reasonable accommodations be made to ensure that disabled individuals have access to full participation in social life. They have rejected the idea that individual bodies must always be fixed, focusing instead on ways to make the social environment more accommodating. While neural prosthetics offer one way of achieving functioning, their risks—for example, concerns about hacking, access to private neural events, confusions about moral and legal responsibility for accidents, and so on—require careful attention prior to implementation. Indeed, we recommend attention to these issues from the perspective of people with disabilities in the early stages of technology development, and we suggest that some of the most significant concerns could be tempered through design choices that recognize their salience.

### **Revising Weakness of Will**

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**Background:** Weakness of will refers to the phenomenon of acting against one’s better judgment. Philosophical examinations of weakness of will typically focus on two main issues: (1) whether instances of weakness of will genuinely exist (i.e., is it actually possible to choose what one



knows to be the worse option); and (2) if they do, what mental or physiological entities and mechanism(s) underlie them.

**Problem statement:** Recently, it has been argued that weakness of will should be understood in terms of the psychological phenomenon of ego depletion, or the depletion of energy resources preferentially drawn on by mechanisms of self-control (Baumeister et al. 1998; Holton 2009; Levy 2011). This position assumes that ego depletion is the sole underlying cause of all substantive cases of weakness of will. However, we bring together evidence from psychology and neuroscience to suggest that, in point of fact, multiple, discrete causes are involved in generating what are commonly recognized as instances of weakness of will.

**Methods:** We describe the commonsense and theoretical components of weak-willed behavior. We then analyze and interpret two sets of psychological and neuroscientific studies as evidence that weakness of will is elicited using factors other than ego depletion. First, situational circumstances such as social status and physical position predictably elicit weak-willed behavior, as when participants in the Milgram experiments condemn the theoretical harming of innocent strangers, but immediately engage in blatant harming behaviors (Merritt, Doris, and Harman 2010). Second, damage to the orbital and lower mesial frontal cortices, as in the famous case of patient EVR, leaves individuals able to make complex social judgments in theory, while rendering them incapable of making sound personal and social decisions in real life (Eslinger and Damasio 1985). We argue that both of these behavioral patterns correspond to weakness of will.

**Results and conclusion:** Ego depletion is not the sole underlying cause of weakness of will. The task of future research will be to explore whether a coherent neuroscientific theory can succeed in unifying and explaining these various, intersecting causes of weakness of will. It is proposed that computational valuation may be able to achieve this goal, allowing us to seek out and formulate practical remedies for addressing weakness of will.

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## The Ethics of Molecular Memory Modification

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Research into the neuroscience of memory is beginning to uncover molecular-level targets for memory modification. Specifically, interventions that target molecules involved in the memory reconsolidation process have recently shown the ability to erase, enhance, and alter long-term memories. There is therefore a need to consider the possible applications of molecular memory modification (MMM). The example of this technology may present a more ethical form of memory modification and also helps to clarify broader issues regarding the ethics of memory enhancement, such as safety, the duty to remember, and selfhood.

Most memory-related “enhancement” discussed in the ethics literature refers to pharmacologic interventions that improve a relatively circumscribed set of cognitive abilities, such as putatively enhancing attention and short-term memory with stimulants such as Ritalin. There has also been some attention to what has been called “therapeutic forgetting”: using medications to dampen the intensity of traumatic memories (Kolber 2006). While there have been many speculations about “memory editing,” these hypothetical scenarios are generally not well grounded in the empirical literature.

MMM works by manipulating gene expression that affects neuronal connections, thereby improving the acquisition or retention of information. For example, overexpression of protein kinase M-zeta (PKM $\zeta$ ), an enzyme involved in memory maintenance, has been shown to enhance long-term memory in rodents, even well after memories are initially formed (Shema et al. 2011). Researchers hypothesize that this particular type of MMM can act on discrete memories while leaving other memories intact, because it relies on recall, which isolates a single memory trace for modification. This intervention could prove a more powerful method for memory enhancement compared to existing neurotechnologies because of its specificity, low side-effect profile, and distinct action on long-term memory.

However, questions remain about the method of action of molecularly based technologies and their purported specificity. There may be challenges regarding safety and efficacy for use in humans; for example, could modifying memory of autobiographical events produce unintended changes in behavior, emotion, and sense of self? There also remains the risk of unanticipated long-term side effects.

MMM may also illustrate broader ethical perspectives on what we now call “memory enhancement.” If successful, molecularly based techniques could also cause memory errors. Under reconsolidation theory, the memory recall

necessary for this procedure also induces memory lability. “Enhancing” or updating a memory by incorporating new information ipso facto comprises the integrity of the original memory. This consideration has important implications for certain applications; for instance, in law, neurotechnologies intended to improve eyewitness testimony may actually leave memories more vulnerable to inaccuracy and biases. Ultimately, MMM helps illustrate that there is a need to be more rigorous about the word “enhancement”; this umbrella term will have to be differentiated as new technologies are applied to a widening array of purposes.

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## A Meta-Analysis of Psychostimulants’ Cognitive Enhancing Effects

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The use of psychostimulants, such as amphetamine and methylphenidate (brand names Adderall and Ritalin), to enhance healthy cognition is an expanding, well-documented phenomenon. The large number of non-attention deficit hyperactivity disorder (ADHD) users across various ages and occupations emphasizes the importance of examining these drugs’ efficacy in a healthy sample. The present meta-analysis was conducted (1) to estimate the magnitude of the effects of methylphenidate and amphetamine on cognitive functions central to academic and occupational functioning, including inhibitory control, working memory, and immediate and delayed declarative memory; (2) to examine the evidence for publication bias; and (3) to test for heterogeneity and moderation. We found that stimulants’ effects on inhibitory control, working memory, and immediate episodic memory were significant but small. Although the influence on delayed episodic memory appeared more sizeable, ranging from small to medium (by Cohen’s classification) depending on retention interval, the effect was qualified by evidence for publication bias. The data were suggestive of publication bias in research on working memory and immediate episodic memory, as well. We conclude that the effect of amphetamine and methylphenidate on the examined facets of healthy cognition is small at best. In some situations a small advantage may be valuable, although it is also possible that healthy users resort to stimulants to enhance their energy and motivation more than their cognition.

## Is Transcranial Direct Current Stimulation an Effective Tool for Enhancing Working Memory? A Meta-Analytic Review

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Numerous publications suggest that transcranial direct current stimulation (tDCS), a noninvasive brain stimulation technique involving the application of a weak electrical current to the head via electrodes, can alter brain function in cognitively normal individuals. Due to its simple setup and minimal side effects, the technology has attracted the attention of do-it-yourself enthusiasts, interested in building and marketing their own rigs, and ethicists, concerned with the moral and social issues surrounding cognitive enhancement, alike. Despite this early excitement over the technology’s presumed brain boosting abilities, the reliability and extent of effects shown in healthy subjects remain variable and poorly understood.

This review evaluated the current tDCS literature on working memory (WM) in cognitively normal adults. WM, the ability to maintain and manipulate information in active awareness, is essential for flexible, intelligent behavior. Two hundred and fifty articles were screened and 11 were included in a meta-analysis reviewing the effects of anodal stimulation of the left dorsolateral prefrontal cortex (DLPFC) on WM.

Analyses are continuing, but preliminary results found that the small but significant effect on WM after stimulation is qualified by evidence of publication bias. Our provisional conclusion is that more studies with larger sample sizes need to be conducted before we can have confidence that tDCS can effectively enhance the healthy brain. Our results extend ethical concerns about safety and unintended consequences by questioning the “benefit” side of the risk/benefit ratio. Additionally, they spark bigger ethical questions regarding publication bias and “cherry picking” positive results. There’s a need both to replicate and publish all existing tDCS experiments and to be critical in interpreting the effects of new technologies that have the potential to alter the healthy brain.

## Political Encounters of the Neuroethical Kind: Projections and Recommendations

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As the cognitive sciences continue to surge in prominence, and as their intellectual uptake into disciplines like neuroethics broadens apace, so too will their political implications. The science of the brain has the potential to reshape society’s conception of what humans are like; this is a politically fraught prospect. Here I offer projections and recommendations at the intersection of neuroscience

(or other cognitive sciences), neuroethics (or related fields), and North American politics.

I argue that—contrary to the trend observed so far—neuroscience/neuroethics could conceivably clash as extensively with the social justice instincts of the left as with the principles of conservatism. The view from neuroscience tends to envision human behavior as causal, atomized, essentialist, and imperfectly rational, a view that will prove at least partly unpalatable to both sides of the political aisle. Scholars writing in neuroethics have noted (though not in explicitly political terms) that the view of human nature embraced by many varieties of conservatism—a view that deals in terms of moral choice and individual responsibility—is threatened by the causal-reductionist explanatory pattern of scientific naturalism (Reiner 2011). Similarly, the economic philosophy favored by conservatives and libertarians has come under siege from research in the behavioral sciences (Reiner 2011). Yet that same causal-reductionist explanatory pattern may appear equally threatening to left-progressives, who tend to organize around a minimalist view of human nature favoring social-historical understanding. And when the behavioral sciences address politically charged dimensions of human difference (e.g., race, sex, class), the accounts they produce may appear to normalize or naturalize oppression in ways the left would decry as essentialist, even fatalistic. As one recent example among many, when a professional football player killed his partner and then himself, the popular media's rush to speculate that his crime may have stemmed from sports-related brain injury drew condemnation from feminist critics, who insisted that a causal, neuroscientific level of explanation was both factually and morally the wrong choice for covering an act of gendered violence (Marcotte 2012).

I conclude with some recommendations for researchers and commentators whose writing in this arena may have political implications. I advocate striving for political awareness—considering, prior to making a given point, who might take exception to it and why. I recommend practicing a doctrine of political avoidance—avoiding unnecessarily politicized provocation where the underlying science does not absolutely necessitate it. Finally, as a counterbalancing corollary to that doctrine, I reaffirm the importance of scientific integrity—backed by preparedness to hold one's ground in those truly rare instances where science does unavoidably clash with preconceived notions of human nature embedded in ideology.

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## A Proposed Ethical and Policy Framework to Evaluate Neural Interface Systems in the U.S. National Security Context

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The use of neuroscience and neurotechnology for national security purposes is a timely concern. A 2012 Royal Society report indicates that multiple nations are interested in neuroscience-based national security applications for performance enhancement and degradation. We focus here on enhancement via what the Royal Society calls “neural interface systems” (NIS). The United States is interested in monitoring or influencing brain function to enhance cognition (Board on Army Science and Technology 2009; The Royal Society 2012). Despite this clear interest in NIS, there is no policy framework for determining whether, why, and how particular NIS should be developed or deployed in the national security context.

Two existing policy frameworks are inadequate to the task. The policy framework for “dual use research of concern” (DURC) primarily focuses on pathogen-based threats to public health (U.S. Government Policy 2013). Pathogens pose threats to public health when they act on populations; NIS are implemented at the individual level and pose no comparable threat to public health. The DURC framework addresses considerations particular to pathogens; NIS pose distinctive concerns. The policy framework for human subjects research applies to participants in government-funded studies, but the extent and adequacy of its application to particular NIS in the national security context is uncertain (Code of Federal Regulations n.d.).

We propose a two-level policy framework to evaluate whether, why, and how particular NIS should be developed or deployed in the national security context. An initial screen for likelihood of deployment would evaluate immediacy, feasibility, and potential impact. Immediacy refers to the time until a technology is fully deployable. Feasibility encompasses environmental and technological constraints, such as the expertise required to implement a technology. Potential impact addresses the strategic advantage a technology may confer. This initial screen ensures that all and only those NIS that are sufficiently likely to be deployed will then proceed to a second-level evaluation of the ethical and policy implications for the enhanced individual, military operations, and society. Concerns surrounding the individual include the implications of particular NIS for autonomy, identity, privacy, beneficence, and nonmaleficence. Operational concerns include the implications for inter- and intra-unit engagement as well as military engagement and

the “rules of war.” NIS may eventually be used in clinical, end-consumer, and commercial marketing; it is therefore important to evaluate not only the dual-use implications but also the multiuse implications for society.

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### Neurobiological Paradigm of Memory Formation and Its Theoretical and Ethical Implications

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In the past, researchers claimed that memory consolidation, the process of memory stabilization, takes place only once. It was believed that, after consolidation, memories are stable and resilient to disruption. However, recently, neuroscientists who focus on neural processes and mechanisms of memory persistence have shown that consolidation takes place not only after new learning but also after every recall (memory retrieval). During retrieval, consolidated memories enter a transient state where they become labile once again, and require another phase of consolidation to persist. Current hypotheses assume that the labile phase of reconsolidation allows new information to be associated with established and reactivated memories. Memory traces are modified and reconstructed to update and adjust them to new circumstances. Every time we recall, new perceptions, expectations, attitudes, perspectives are fused into the original memory trace, thereby constructing a new memory, a new meaning. Thus, reconsolidation theory claims that a memory is not a literal reproduction of the past, but instead an ongoing constructive process. Reconsolidation is a natural process where the memory trace of an event undergoes various modifications.

Thus, the conception of memory as a reliable source of the past is challenged, resulting in both theoretical and ethical implications. For example, these findings may change our self-perception and raise questions regarding our illusion of constant memories and persistent sense of self. Autobiographical memories function to form personal identity and concept of self. It is the only type of memory that

provides an epistemic authority on our own past. Yet do neuroscientific theories of memory challenge this authority? Neuronal processes in the present modify memories of the past over and over again without us being aware that our memories differ from real past occurrences. Memories persist over time but become different from the way they originally were when first generated.

The importance of the neurobiological theory of memory is not limited to the already-mentioned theoretical implications. This paradigm of memory formation also guides the development of new drugs and behavioral methods that alter specific autobiographical memories. These treatments might be used to erase unwanted memories or to enhance desired ones. Therefore, understanding the neurobiological paradigm of memory formation will enable us to consider how and in what way memory manipulations extend or may disturb natural memory processes.

Thus, reviewing how neuroscientific theories of memory describe the way in which memories are established and maintained in the brain will help us to consider whether these theories challenge the authority of memory as a reliable source of our past knowledge and our sense of personal identity. It will also enable us to examine and determine whether interventions and memory manipulations are of the same neuronal nature as natural unconscious modifications that take place constantly, or whether they interrupt the natural processes.

### “My Spirit Does Not Depend on Genes”: Public Perceptions of the Ethics of Gene Therapy for Brain-Related Conditions

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Gene therapy research moves at a rapid pace, and speculative hopes of treating a large number of brain disorders exist alongside the potential for ethical issues. Most surveys of public attitudes toward those ethical issues date back to the 1990s and their content has been researcher driven. To examine the current state of public perceptions of ethical issues in gene therapy, we developed an online instrument that is responsive and relevant to the prevailing discourse around gene therapy and the brain. The survey was developed around themes uncovered in a recent study looking at the discussions around gene therapy for the brain in online social media. The 16-question survey was launched using the platform Amazon Mechanical Turk and was made available to residents of Canada and the United States. The survey was divided into six sections: (1) demographic information; (2) general opinions about gene therapy; (3) medical applications of gene therapy; (4) identity and moral/belief systems; (5) enhancement; and (6) risks. We received and analyzed responses from a total of 467 participants. Our results show that a majority of respondents (>90%) accept gene therapy as a treatment for severe brain disorders such

as Alzheimer's disease, but this receptivity decreases for conditions such as attention deficit hyperactivity disorder (79%) and for enhancement (47%). Main ethical concerns with enhancement were the potential for disparities in resource allocation, access to treatment, and discrimination. The greatest area of concern for the application of gene therapy to brain conditions is the fear of not receiving sufficient information prior to undergoing the treatment. When comparing our data to those from the 1990s, our findings suggest that the acceptability of gene therapy is increasing, and this trend is occurring despite concerns over ethical issues. Providing the public and patients with adequate up-to-date information and opportunities to engage in the discourse are priorities.

Disclosures: None.

### What We Can, and Cannot, Learn from a Neural Signature of Pain

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A recent study by Wager and colleagues (2013) is a landmark in the quest to discover a "neural signature of pain" and provides an impetus to reexamine recent discussions on the neuroethics of this issue. Wager's group used machine learning to analyze data from functional magnetic resonance imaging (fMRI) scans of people who self-reported pain or other, nonpainful conditions, then used these results to correctly assess, 93% of the time, whether people in a new task were feeling pain or not.

Though these results are impressive, they also raise questions about the possible uses of a neural signature of pain. One feature crucial to understanding pain experience is the dissociation between the sensory and affective dimensions of pain. In various paradigms, the sensory features of pain (its intensity, location, and modality) can be manipulated independently from the affective component of pain (how unpleasant a subject finds the pain). In cases where patients have been given analgesics or have lesions in parts of the anterior cingulate cortex or insula cortex, patients will often report that the pain is still present but no longer bothers them as much (Price 2000).

This dissociation is relevant to previous discussions on using a neural signature of pain as evidence in cases where the severity of a patient's long-term injury is questioned. Consider an example from a *Science* opinion piece (Miller 2009) that describes a man asking for compensation from his employer for chronic pain caused by a workplace accident. Wager's technique specifically finds a neural signature for "physical pain." Physical pain, based on the regions of activation cited by Wager's group, includes aspects of both the sensory and the affective dimensions of pain. However, chronic pain is extremely difficult to treat, and one of the reasons for this is that it often does not manifest many of the conditions typically associated with the sensory dimension of pain. A recent study by Hashi et al. (2013) found

that as acute pains transitioned into chronic pains, the relevant brain activation patterns shifted away from the sensory regions of the brain and toward emotion-related centers of the brain. Thus, a neural signature of pain that includes sensory brain areas might mistakenly rule out legitimate cases of chronic pain, and, if so, should not be used for detection of chronic pain.

On the other hand, the affective dimension of pain and the brain activation patterns associated with it have been shown to vary with conditions such as depression, high anxiety, and fearfulness. This means patients in a scanner could possibly mimic activation associated with the affective component of pain by thinking negative thoughts that increase their anxiety, thus reducing one of the most important advantages of using fMRI to detect pain (Kolber 2007). If the affective component of pain can be faked, then a neural signature of pain offers little advantage over subjective reports. As such, neural signatures of pain might not be useful in legal disputes over whether someone has chronic pain. However, barring other complications, it still would be a useful way to obtain information in cases where subjective reports are not available.

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### The Use of Brain Images When Evaluating Religious and Non-Religious Media Reports

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The presence of brain images in mainstream media reports has been reported to affect perception of scientific credibility. What is interesting about these studies is that they have focused on how advances in neurobiology have changed the way we view the nature of human psychological experience and agency, and the weight that a neurological understanding of psychological experience and scientific technology carry in current culture. While there has been an increase in the use of brain imaging data to influence opinion and perception of issues ranging from medical diagnosis to marketing and parenting, little research has been conducted examining the effects that brain imaging has had on issues related to religion. The appeal to neurobiological explanations offers a more tangible and credible form of evidence from which opinions about our psychological experience are derived. It may also be the case that

religious convictions may influence the ease with which brain images may influence opinion. Of particular interest is whether or not the neuroscientific report being presented challenges or confirms existing religious beliefs. Core religious convictions that are rooted in a different worldview may be resistant to appeals to epistemological methods (i.e., scientific research) that challenge these convictions. While it is clear that appeals to brain imaging may influence opinion on matters that have little to do with religion, such as whether video games increase math skills, this effect may be less severe when there is religious investment in the matter in question (such as the moral agency of a murderer). And the impact may be further clouded if the nature of the neurological evidence is confirming rather than disproving of a religious conviction. In this project we examined the effectiveness of media usage of brain imaging technologies and influence opinion of religious and nonreligious topics. After a survey of the prevalence of functional magnetic resonance imaging (fMRI) image use in media reports, we examined the persuasiveness of fictional media reports utilizing brain images on religious and nonreligious topics in both religious and nonreligious populations. Similar to previous studies, the reports use color fMRI brain images, bar graphs of the data, or no visual aids. The topics of the reports included religious visions, criminal standing, and spiritual formation. Perceptions of scientific credibility, persuasiveness, and whether their opinion changed were measured, as well as religious conviction and sentiment as moderating factors. No significant difference between fMRI, bar graph, and text controls on credibility, persuasiveness, or change of opinion scores was observed; however, religious topics were viewed with greater skepticism (reduced credibility and persuasiveness) when compared to nonreligious control topics. This effect was negatively correlated to religious orientation measures. Our results failed to replicate earlier studies showing increased credibility ratings when media reports were accompanied with fMRI images. We did find that there was considerable resistance/skepticism with respect to credibility and persuasiveness scores in religious individuals when the topic was religious compared to non-religious topics.

### **Neuroscience Fiction as Eidóla: On the Neuroethical Role and Responsibilities in Representation of Neuroscience**

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Neuroscience and neurotechnology are increasingly being employed to assess and alter cognition, emotions, and behaviors, and the knowledge and implications of neuroscience have the potential to radically affect, if not redefine, notions of what constitutes humanity, the human condition, and the “self.” Such capability renders neuroscience as a compelling theme that is becoming ubiquitous in literary and cinematic fiction. This preponderance of neu-

roscientific references and portrayals in popular entertainment media (what we refer to as so-called neuroscience-fiction, or “neuro-SciFi”/neuroS/F) gives rise to a growing, but not yet explicitly articulated, public awareness of and sensitivity to the issues, questions, and problems that are intrinsic to, defined by, and the focus of neuroethics.

In this way, neuroS/F may be seen as *eidóla*: a created likeness that can either accurately—or superficially, in a limited way—represent that which it depicts. Such representations of neuroscience in the entertainment media can orient and influence public disposition toward neuroscience and the potential benefits, burdens and risks generated by its advances, and these representations—while fictional—can also exacerbate public misperceptions of the capacities and uses (and/or misuses) of neuroscientific tools and techniques. Because neuroS/F blurs the line between hard (neuroscientific) facts, soft (neuroscientific) oversimplifications, and outright fantasy, we argue that it is—and will be ever more—necessary to be mindful of the effects of accurate and inaccurate portrayals of neuroscience and neurotechnology in popular media. However, distinguishing “neurofact” from “neurofiction” is particularly challenging, given the contingent understanding of brains, minds, and consciousness.

Furthermore, works of neuroS/F often constitute self-contained neuroethical discourses in which the effects of technological advances are considered from a variety of perspectives. Thus, popular entertainment media have great power to affect realistic views, as well as both utopian and dystopian visions of the ways that the brain sciences may be employed in society. In light of this, we posit that there is a reciprocal relationship between neuroscience, neuroethics, and neuroS/F that reflects, and is based upon, relevance, importance, and responsibility.

Toward these ends we propose two different ways that neuroethics can engage neuroS/F:

Reflectively: as a diagnostic and/or predictive vehicle for inquiry (e.g., the plot/scenario as a thought experiment).  
Reflexively: as a meta-framework to afford understanding of the neuroscience of fiction and inform interpretations of neuroscience in fiction.

Inasmuch as neuroS/F can serve both as a vehicle and means for neuroethical contemplation, it can be regarded as a Foucauldian discourse in which scientists, neuroethicists, creative artists (in various media), and their audiences all participate as “discourse actors” that can contest, resist, and/or transform popular neuroscientific and neuroethical understanding. Our ongoing work is focused upon critical neuroethical consideration of neuroS/F that problematizes public perceptions and misperceptions of neuroscience, in an attempt to (1) establish the mutual empowerment gained by distinguishing of “neurofact” from “neurofiction,” and (2) parse realistic public hopes and fears from sheer phantasma.

## Objects of Subjects: Evaluation the Moral Status of Neural Bioart

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We use “neural bioart” to refer to new media artworks that incorporate living neural tissue in culture—preparations that are generally confined to the laboratory or clinical setting. Neural bioart offers audiences a culturally embedded, subjectively rich experience to generate new value frameworks surrounding the often ignored ethical relationships between humans and neural tissue culture. Examples of such works include *Force and Intelligence on Plastic*, where live neurons and muscle cells were cultured in scaffolds shaped like Stone-Age tools, as well as later works such as *Fish and Chips*, *MEArt*, *Silent Barrage*, and *In Potentia*, where living neural tissue cultures were given control of robotic bodies using electrical interfaces. While *Force and Intelligence on Plastic* used live neurons for their symbolic value, these later works allowed audiences to observe neural tissue cultures “behaving” with artificial bodies, and in the case of *MEArt* and *Silent Barrage* to in turn be “observed” by neural tissue cultures. We use neural bioart as a case study to investigate the question: Under what conditions might these neural tissue cultures be capable of subjective, affective states (such as suffering) that burden the artists and scientists who created these works with moral obligations toward them?

We evaluate this question from the perspective of animal ethics (Singer 1975), a mathematical view of subjectivity (Tononi 2004), and a view of subjectivity that focuses on the significance of social context (Gillett 2009). Starting from animal ethics, we view the neural tissue cultures contained in these pieces as “partial” or “former” animals; however, this perspective has limited utility for this case, as behavior is morally arbitrary in these pieces. We then look to direct, mathematical descriptions of neural network activity to describe possible subjective states. These tools help us explore the structure of possible subjective states in these systems without commenting on their moral value. Finally, we shift our focus from the internal dynamics of these neural tissue cultures to the social and cultural context that these entities exist within. We conclude by discussing the potential value of neural bioart to neuroethics, as a resource for examining new ways of culturally and subjectively engaging with neurotechnology. Discussions of these novel uses of neurotech-

nologies may provide relevant frameworks for addressing ethical issues related to humans who have suffered from injured brains, as well as nonhuman animals and artificial intelligences.

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## Oral Presenters

### Print Media Coverage of Brain Imaging Studies Addressing Medically Unexplained Symptoms

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Physicians have the ethical responsibility to provide patients with explanations for their symptoms and illnesses that are both satisfactory to the patient and congruent with scientific thought. This is particularly challenging for so-called medically unexplained symptoms for which no medical cause is known at present. These include pain associated with fibromyalgia or irritable bowel syndrome that occurs without identified tissue lesions, as well as tinnitus, the perception of sound within the ear in the absence of a sound-emitting source outside the ear. People with these symptoms report significant suffering and often face resistance from those, including physicians, who may not believe their symptom reports. Consequently, they often turn to media coverage of scientific findings to provide validation for the existence of or potential explanations for these symptoms. Brain imaging has been employed to study medically unexplained symptoms. However, analysis of media coverage of brain imaging studies of other phenomena has shown that newspaper articles often describe these phenomena as uncritically real or objective to the public (Racine, Bar-Ilan, and Illes 2005). This tendency, termed neurorealism, in particular does not relate the complexities of data acquisition and image processing.

Thus, on the one hand, the medically unexplained symptoms pain and tinnitus involve by definition subjective experience and perception, but require third persons and parties for their recognition and explanation. On the other hand, media have a tendency to adopt a neurorealistic interpretation of brain imaging studies. In the present work, we therefore addressed the hypothesis that print media covering brain imaging studies on medically unexplained

symptoms have a strong tendency to present these studies uncritically as showing the objective existence of these symptoms.

We identified print media articles covering scientific brain imaging studies on medically unexplained symptoms using Factiva. The majority of the print media articles covering brain imaging studies on fibromyalgia or tinnitus were optimistic in tone. The former, in particular, often related the idea that brain imaging provides evidence that these symptoms objectively exist. Media covering imaging studies on irritable bowel syndrome offered a more balanced view in the sense that they often stressed that brain imaging revealed the existence of increase visceral sensitivity rather than pain or indicated that the link observed between differences in brain structure or activation and symptoms was not necessarily a causal one. We are now comparing the print media articles to the brain imaging scientific studies they cover to identify the origin of the optimistic and uncritical tone as well as of the more balanced view concerning the objective existence of medically unexplained symptoms.

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### **Opposition to the Misuse of Neuroscience for “National Security”: The Neuroscientist Pledge and Other Approaches**

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The interest and excitement that we feel about new discoveries in neuroscience is sometimes shadowed by fear of the unethical uses that can flow from the same discoveries. The danger is acute in the area of “national security.” Our conflict-laden world has many state and nonstate actors who seem ready to use whatever technology is available, including neurotechnology, to maintain or gain power. As responsible human beings we must oppose immoral and illegal uses of our science. But how?

One approach is through a pledge that is circulating internationally. In signing the pledge, neuroscientists commit to (a) making themselves aware of the potential applications of their work and that of others to applications that violate basic human rights or international law such as torture and aggressive war; and (b) refusing to participate knowingly in the application of neuroscience to violations of basic human rights or international law. In essence, the pledge calls on neuroscientists to recognize the consequences of their actions, take responsibility for those consequences, and obey the law (Bell 2010; Bell 2014). Neuroscientists in 17 different countries have signed the pledge. The pledge may be read and signed online at [tinyurl.com/neuroscientistpledge](http://tinyurl.com/neuroscientistpledge).

The pledge complements other actions that neuroscientists can take to counter the misuse of neuroscience for “National Security” purposes, including:

- a. *Development of awareness through education and discussion.* This is a necessary but insufficient first step. Action is also required.
- b. *Development of committees or working groups to examine the issue and consider ethical and legal parameters to guide work on “national security” and legislation.* A committee of the British Royal Society has, for example, already examined already some of the issues (The Royal Society 2012).
- c. *Strengthening and updating international law as embodied in the Geneva Conventions, the Chemical Weapons Convention, the Biological and Toxin Weapons Convention, and the Convention Against Torture and Other Cruel, Inhuman and Degrading Treatment or Punishment.* Malcolm Dando has written extensively on this approach to the misuse of neuroscience for “National Security” (Dando 2009).
- d. *Including the proscription of work on applications that violate fundamental human rights or international law in the ethical statements of neuroscience societies.* The neuroscience society of one country, Uruguay, has already made such a declaration (personal communication to C. Bell).

Neither the pledge nor these other actions will prevent the misuse of neuroscience. Together, however, these actions can nurture a scientific culture that is focused on enhancing human well-being, but that also faces the danger of applications that damage such well-being. In taking these actions, neuroscientists join other professional and civil society organizations in moving the world toward peace and respect for international law.

### **Gender, Justice, and the Conceptual Structure of Moral Agency**

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Through a series of studies and experiments, I developed a moderated mediation model (Baron and Kenny 1986) to explain why and for whom physically deterministic explanations, including neuroscientific reduction, influence judgments of free will, moral responsibility, and appropriate punishment. My findings support three conclusions. First, several distinct and anomalous findings can be unified and explained if attributions of free will are in part caused by attributions of moral responsibility, rather than the other way around. Second, the general class of anomalous effects in compatibilist attributions of moral agency may only manifest significantly among men. And third, these differences suggest that the increasing use of neuroscience testimony raises new and unique legal, ethical, and logical issues regarding gender inequality on the bench.



In Study 1 (Holtzman 2013), I found that compatibilism was the most common view among professional philosophers (53.9%, SE = .051) and undergraduate women (63.4%, SE = .058), but undergraduate men were significantly less likely than professional philosophers ( $\chi^2_{315} = 11.405, p < .001$ ) or undergraduate women to be compatibilists (34.1%, SE = .054). Study 2 found that the widely discussed correlation between the level of abstraction with which a crime is described, and subjective judgments of its perpetrator's free will (Feltz and Cokely 2008; Nichols and Knobe 2007), was medium-sized and significant for men ( $r_{93} = .371, p < .001$ ), but not significant for women ( $r_{132} = .123, p = .159$ ). Conditional process analyses revealed that although experimental condition had a significant indirect effect on judgments of free will, there was no significant direct effect of experimental condition on judgments of free will for participants of either gender, other than the effects mediated by judgments of moral responsibility.

Finally, Study 3 involved testing the hypothesis that gender moderates the effect of biomechanical explanation on judges' sentencing of psychopaths on the data from Aspinwall, Brown, and Tabery (2012), which was first reported in *Science*. They found state trial judges to mitigate sentencing of psychopathic assailants more when given supplementary neuroscientific evidence of the psychopathy than when provided only with psychiatric evidence. I confirmed that the neuroscience testimony only had a selectively greater significant impact on the sentences rendered by male judges, not those rendered female judges. Furthermore, the data fit the model's prediction that mitigated sentencing occurred even though judgments of free will and moral responsibility were not affected.

The findings as a whole raise important questions about the sociological causes of these intuitional differences, the validity and implications of assertions about "folk intuitions" made without attention to individual differences, and the potential usefulness of structural equation modeling to parse concepts in neuroethics that are all too often conflated, including the concepts of free will, moral responsibility, and appropriate punishment. Most importantly, the results highlight the importance of increasing gender equality in public neuroscience decision making, in order to maintain a fair and representative legal system.

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- End the End-of-Life Decision Debate: Why Discussion of End-of-Life Decisions Through Brain–Computer Interfaces Starts the Ethical Debate Off on the Wrong Foot**
- C. Weijer<sup>1,2</sup>, A. Peterson<sup>1,2</sup>, L. Naci<sup>2</sup>, M. Graham<sup>1</sup>, D. Cruse<sup>2</sup>, D. Fernández- Espejo<sup>2</sup>, A. Lazosky<sup>3</sup>, and A. M. Owen<sup>1,2</sup>, <sup>1</sup>Rotman Institute of Philosophy, Western University, London, Ontario, Canada, <sup>2</sup>Brain and Mind Institute, Western University, London, Ontario, Canada, <sup>3</sup>London Health Sciences Center, London, Ontario, Canada
- Recent investigations (Monti et al., 2010) suggest that brain–computer interfaces (BCIs) are a viable means for detecting covert awareness in patients diagnosed with disorders of consciousness (DOC). Additionally, in at least three reported cases, investigators have utilized BCIs for communication with this patient group, thereby raising the possibility of integrating these patients into the decision making process related to their own medical care (Bardin et al. 2012; Monti et al. 2010; Naci and Owen 2013).
- Indeed, the clinical application of this technology may open a promising new avenue for improving diagnostic accuracy and quality of life for DOC patients. However, utilizing BCIs in medical practice poses to bioethicists several difficult questions, which extend beyond standard concerns related to the use of new technologies in the clinic. Not only are there difficult ethical concerns regarding the fair treatment of vulnerable patients, there are also exceedingly difficult epistemic problems regarding the very possibility of knowing whether another human is, in fact, conscious.
- To date, the neuroethics literature has focused significant energy on the ethical permissibility of utilizing BCIs in end-of-life decision making (Bendsten 2013; Fins and Schiff 2010). Much of this literature has presented a cautious tone when contemplating the use of BCIs in this context. This position is derived from the fact that assessment of decision-making competency, a necessary condition for allowing a patient to make such a decision autonomously, is currently precluded by technical limitations in BCI application.
- We believe the ethics literature has wrongly advanced this position by conflating the ethical problems relevant to acute DOC patients ( $n < 3$  months post injury) with those relevant to chronic DOC patients ( $n > 1$  year post injury). As it is argued, BCIs have no place in clinical decision making because they are insufficient for satisfying ethical conditions of high-stakes decisions in the acute context (Fins and Schiff 2010). However, successful instances of BCI

communication have only been documented in chronic DOC patients. High-stakes decisions, such as removal of artificial ventilation, are common in acute DOC patients but relatively unusual in chronic DOC patients. Indeed, most decisions involving chronic DOC patients are low or medium stakes. Thus, narrowly focusing on the use of BCIs for end-of-life decisions in chronic DOC patients misconstrues how these techniques might reasonably be utilized to improve patient well-being.

Identifying and clarifying this conflation draws into doubt a central assumption regarding the clinical utility of BCIs. We aim to address this problem by distinguishing which ethical issues are, in fact, relevant to acute versus chronic DOC patients, and parsing out how BCIs might be realistically applied in each of these patient groups.

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