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Introduction

Neuroscience, Law, and Ethics

In his influential *Hardwired Behavior: What Neuroscience Reveals about Morality* (2005), Laurence Tancredi combined neuroscience, psychology, philosophy, legal theory and clinical cases to insightfully examine the role of brain structure and function in moral behavior. Analyzing how neurobiology shapes reasoning and decision-making, he discussed questions such as whether or to what extent we have free will and can be morally and criminally responsible for our actions. Is our behavior hardwired and thus determined by the brain? Is free will an illusion? Can mental content be explained entirely in terms of neural content? If the brain influences but does not determine behavior, then how much of what we think and do is up to us? In his new book, *Decoding the Bad Brain*, Tancredi considers new developments in brain science with an eye to examining the relative effects of genetics, brain-mind interaction and the environment in forming the individual frameworks for a wide spectrum of destructive human behaviors. These reflect varying degrees of biological and environmental influences. He discusses potential approaches to permanently modifying such behaviors along with appropriate societal and legal responses.

Tancredi has made many original and significant contributions to debate on the ethical, legal and social implications of neuroscience. He has been an international leader in the field of law and psychiatry. The authors of the articles in this issue of the *International Journal of Law and Psychiatry* in honor of Professor Tancredi address many of the same empirical and normative issues that he has addressed in a thoughtful and nuanced way. They examine them further in considering emerging and potential future findings in neuroscience and how these findings influence assessment of our mental states and actions.

The most significant advance in neuroscience has been the ability of neuroimaging to identify the neural correlates of consciousness, reasoning and decision-making. Electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) have confirmed that some patients with brain injuries believed to be vegetative are covertly aware. (Owen et al., 2006; Owen & Coleman, 2008). This has opened the possibility of interventions that could restore some degree of functional independence for them. Brain-computer interfaces (BCIs) may enable locked-in and some minimally conscious patients to reliably communicate their wishes about life-sustaining care (Birbaumer, Gallegos-Ayala, Wildgruber, Silvoni, & Soekadar, 2014; Hochberg & Cudkowicz, 2014; Naci et al., 2012). Positron emission tomography (PET) and fMRI can record normal and abnormal activity in neural networks underlying the capacity to recognize and respond to reasons for respecting the rights, needs and interests of others. These techniques can influence assessments of whether individuals are responsible for their actions and omissions. Data from imaging can support judgments of responsibility, mitigation or excuse.

Some of these techniques have shaped the emergence of neurolaw. This is "a rapidly developing field of interdisciplinary research

concerning the relevance of neurosciences to the law, especially criminal law." (Meynen, 2016, p. 3, Meynen, 2014; Morse & Roskies, 2013; Glenn & Raine, 2014; Chandler, 2018). One example is the use of neuroimaging to support behavioral evidence in judging whether a person performing a criminal act met cognitive and volitional conditions necessary for criminal responsibility. Functional imaging recording abnormal activity in prefrontal-limbic pathways may indicate impaired cognitive and emotional processing and impaired capacity to deliberate and consider the consequences of what one does or fails to do. This and other forms of imaging may eventually offer a more fine-grained account of impaired inhibitory mechanisms in the brain. They may indicate that a person with this impairment lacked the capacity to restrain his impulses and control his actions. In addition, advanced fMRI and BCIs may accurately decode neural and mental states and become reliable forms of lie-detection (Meynen, 2017). Imaging detecting biomarkers in children's brains might predict who would be predisposed to criminal behavior. These and other techniques suggest that "In the near future, neuroscience may support forensic psychiatric diagnosis, prediction and intervention" (Meynen, 2016, p. 4). Intervention could involve not just treatment for but also, and more importantly, prevention of criminal behavior before the onset of neural and mental abnormalities associated with it.

Despite potential benefit, recording and intervening in the brain involve potential harm. Children deemed at risk of having a behavioral disorder based on a neural biomarker may not develop it and unnecessarily be exposed to psychotropic drugs or neuromodulation that could have deleterious effects in their developing brains. Third-party access to this information could also make children and adolescents susceptible to bias and discrimination. "Biomarker information might reshape the beliefs, practices and decision-making of the people in a child's environment, including parents, teachers and health providers" (Singh & Rose, 2009, p. 204). This could affect how they interpret the child's behavior and their interactions with him. The predictive value of biomarkers for criminal behavior is questionable because it is based on the uncertain enterprise of probabilistic risk assessment. They are only one component among other biological, psychological and environmental components influencing human behavior. In fMRI- or BCI-based lie detection, a defendant could anticipate what she would be asked, rehearse responses and game the system. More fundamentally, a defendant could not be forced to undergo lie detection against her will. Implantable BCIs would be vulnerable to hacking, or brainjacking, which could disrupt electrical signals in the brain and the translation of intentions into actions (Pugh, Pycroft, Sandberg, Aziz, & Savulescu, 2018; Pycroft et al., 2016). This unauthorized interference with information contained in the implant and computer would violate neural and mental privacy as well as the person's freedom to act.

Images from PET and fMRI can have a seductive allure and an

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outsized impact on a jury's assessment of a defendant's behavior. They may unduly influence judgments about control and criminal responsibility. In one capital case where data from fMRI of a defendant's brain was presented to a jury, a juror stated: "It turned my decision all the way around. The technology really swayed me. After seeing the brain scans, I was convinced this guy had some sort of brain problem" (cited by Jones, Wagner, Faigman, & Raichle, 2013, p. 734). Just because a person has a "brain problem" does not imply that he cannot control his behavior. Unless brain dysfunction is severe, neuroimaging alone cannot determine that he lacked the capacity to refrain from performing a criminal act or had this capacity but failed to exercise it. Mental disorders associated with brain abnormalities do not always constitute mitigating or excusing conditions. "Simply because mental disorder played a role in explaining [the defendant's] behavior does not mean the behavior could not be controlled" (Morse & Newsome, 2013, p. 166). In cases where a brain or mental disorder caused one to lose behavior control, future neurointerventions may be able to restore it. But forcing these interventions against one's will could undermine one's cognitive liberty.

Even if the risks in neurotechnologies could be minimized or avoided, they could add levels of complexity to legal assessments of behavior. Specifically, they may require revision of *mens rea* and *actus reus* requirements for holding persons criminally responsible for their actions and omissions. As part of a BCI system, people with brain implants can use them to activate neural signals and move prosthetic limbs. Consider a hypothetical case of an individual who assaults another person through this action. The intention to move the prosthetic correlates with activity in motor cortices, and the BCI enables him to translate the intention into the act of moving it. This act involves more planning and conscious effort and attention in executing the intention than the ordinary act of voluntarily moving one's hand or arm. The mental act of translating the intention into moving the limb is as significant as the mental act of forming and the mental state of holding the intention. In assessing the agent's responsibility in such a case, it is not clear whether the mental act of executing the intention to assault a person with the limb should be categorized as *mens rea* or *actus reus*. Should it be categorized as a second *mens rea,* a second *actus reus*, or as a separate condition? Nor is it clear whether the challenges in moving a prosthetic limb would be a mitigating factor in judging criminal responsibility. There is the more general question of whether people who need implants to modulate neural and mental activity, or enable physical activity, have an obligation to use them in accord with social and legal norms. It raises the question of fairness in expecting some people to operate these devices in a certain way when others do not need them to regulate their behavior through no effort of their own.

The limitations of imaging should make us circumspect in appealing to it to explain brain function. The blood-oxygenation level-dependent (BOLD) signal in fMRI measures hemodynamic changes, not changes in neural activity. Changes in blood flow lag several seconds behind the neural activity that produces them and thus are not a direct measure of it (Roskies, 2013, p. 50). There is an inferential distance between brain imaging and actual brain activity (Roskies, 2008). There are also problems with the signal-to-noise ratio in fMRI. This is a measure of how much relevant information (signal) is corrupted by junk information (noise). The ratio is too low in a single scan for it to have any neurophysiological value. Data from fMRI must be averaged over many brains from many studies to have any statistical significance. Yet for imaging to have a role in forensic psychiatry and criminal law, data must be translated from a group level to an individual level to influence judgments about whether individuals could be criminally responsible for what they do or fail to do (Meynen, 2016, p. 4). Moreover, brain activity recorded in a scan may be very different from brain activity when one performed a criminal act. There is an additional problem with functional neuroimaging. A recent meta-analysis of fMRI studies showed a false positive rate of up to 70% among researchers interpreting data from fMRI results (Eklund, Nichols, & Knutsson, 2016).

The authors point out that spatial autocorrelation in statistical analyses of imaging data can lead investigators to "find" brain activity where it does not exist.

These limitations reinforce the inferential distance between brain function and behavior. Brain function and dysfunction may correlate with normal and impaired reasoning and decision-making. But correlation is not causation, and thus appeal to the brain alone cannot provide a satisfactory explanation of our actions. The neural circuits mediating reasoning and decision-making are domain-general rather than domain-specific (Decety & Wheatley, 2015; Liao, 2016). This complicates attempts to associate a structural or functional feature in a specific brain region with a specific action. Even if there were a strong correlation between hyperactivity in the brain's reward circuitry and impulsivity, this by itself would not completely explain why an individual acted impulsively at a certain time. The connections between brain activity, mental states and actions are not fixed. Just as there is no conclusive evidence that genetics determines behavior, there is no conclusive evidence that the brain determines behavior. Brain structure and function, and the mental states it mediates, are not immutable but adaptable and susceptible to change (Tancredi, 2005, p. 43).

Because of epistemic gaps between brain function, brain imaging and behavior, images showing abnormalities in brain regions associated with cognitive and emotional processing cannot prove that a person could not control her actions and be morally or criminally responsible for them. Neuroimaging cannot and likely will not be able to completely decode and "read" the mind in any substantive sense. These gaps raise questions about the probative value of neuroimaging and other applications of neuroscience in the criminal law. They may account for why the evolution of neuroscience has not resulted in a rejection of the psychological model of criminal responsibility based on how mental states manifest in behavior. Neuroimaging displaying anatomical or physiological abnormalities in brain regions mediating motivation and inhibition may clarify questions about impulsivity, for example, when behavioral criteria are ambiguous or inconclusive. Nevertheless, neuroimaging will likely continue to supplement rather than supplant behavioral evidence of the mental capacities that are the basis of moral and legal judgments of our actions.

Normative questions about how persons should or are expected to act are conceptually different from empirical questions about how the brain functions (Schauer, 2009). What *ought* to be the case regarding human behavior cannot be directly inferred from, reduced to, or explained away by what *is* the case regarding neuroanatomy and neurophysiology. Normative questions about whether a person could control her actions will continue to be based primarily on assessments of mental capacities manifesting in behavior and only secondarily on structural and functional features of the brain (Morse, 2005, 2014). "Neuroscience cannot tell us where the brain thinks, believes, knows, intends or makes decisions. People (not brains) think, believe, know, intend and make decisions" (Pardo & Patterson, 2013, p. 46). Although the brain generates and sustains the mind, neuroscience has not yet solved the problem of *how* the brain does this (Adolphs, 2015). The brain enables a person to form and execute action plans. Yet neural states and events are not the only components of this process. An explanation of action requires not only the brain but also the person's attention to the plan, his effort and his response to the environment in executing it.

More advanced neuroimaging with improved spatial and temporal resolution may show stronger correlations between brain processes and mental content. It may also show stronger correlations between brain abnormalities and harmful behavior. Combined with genetic analysis, imaging might be able to predict who would engage in this behavior. This could make it more influential and give it more probative value in forensic psychiatry and criminal law (Roskies & Morse, 2013). Still, these advances may not provide a conclusive answer to the question of how localized areas of brain dysfunction affect the distributed neural networks that enable rational and moral agency. What matters for judgments of responsibility, mitigation and excuse is not brain

processes as such. Rather, what matters is whether or to what extent these processes enable or disable the mental and physical capacities necessary to control one's thoughts and actions.

The international group of authors of the articles in this issue discuss a broad range of theoretical and practical topics at the intersection of neuroscience, law and ethics. Many of them are distinguished researchers who have already made significant contributions to debate on these issues. Their articles, and those by the authors who are emerging researchers, offer valuable insights into the normative implications of different neurotechnologies. They also offer prudent recommendations for anticipating potential future applications of these technologies to map, monitor and modify the neurobiological underpinning of human behavior.

The issue begins with Gerben Meynen's discussion of the three main research areas in neurolaw–revision, assessment and intervention—and their relevance for forensic psychiatry. The first area focuses on whether findings in neuroscience should lead to revision of the law and legal practices. The second area focuses on assessing the mental states of defendants and prisoners in the criminal law. The third area focuses on brain-based interventions that could result in treatment options to reduce the risk of recidivism. While emphasizing the need for caution in making claims about the legal implications of neuroscience, Meynen points out that forensic psychiatrists have a professional and ethical duty to stay up to date with new neuroscience developments as potentially useful tools in psychiatric diagnosis, prediction and intervention.

In a systematic review of recent literature on issues in law and neuroscience. Jennifer Chandler, Neil Harrel and Tijana Potkonjak note that criminal law, public health law and legal theory and decision-making are the dominant themes. The literature displays considerable interest among researchers in the ethical and legal implications of the brain sciences. One particularly interesting finding is the connection between law and cultural neuroscience. The authors underscore the need of the law and other social institutions to consider future developments in theoretical and applied neuroscience and how these institutions may be affected by them.

David Freedman and Simona Zaami analyze and discuss the influence of neuroscience on forensic assessment of the mental conditions pertinent to criminal culpability. They show how neuroscience has led to a better understanding of a person's neurodevelopmental trajectory and the mental states that underlie criminal behavior. At the same time, they point out that uncritical acceptance of neuroscience can result in the view that it could "uncover the criminal brain." Lack of scientific rigor and selection bias in many neuroimaging studies may lead many to fail to appreciate the extent to which a person's thought and action occur in a social context. Freedman and Zaami offer a balanced view of the potential of neuroscientific evidence to improve forensic assessment, as well as the limits of this evidence in explaining and predicting behavior.

Andrew Dawson and co-authors discuss how dopamine replacement therapy for patients with Parkinson's disease can result in impulse control disorders (ICDs). They cite differences between neurologists, geriatricians and psychiatrists regarding how ICDs compromise patients' decision-making capacities, and how these differences influence judgments of control of and responsibility for their behavior. The divergence between the authors' findings and expert testimony from past cases highlights the need for prosecution teams to include clinical neuroscience experts in future judgments of offenders with ICDs.

Georgia Martha Gkotsi, Jacques Gasser and Valerie Moulin discuss the critical role of experts in presenting, interpreting and communicating findings from neuroscientific techniques to judges and juries in criminal cases. Conflicting testimony of the same empirical evidence from different parties generates uncertainty about the interpretation of neuroimaging data. This raises questions about the presumed objectivity of this data in helping us to understand criminal behavior. Because of this uncertainty, the authors emphasize that legal

professionals need to train themselves to be capable of interpreting information from new developments in neuroscience.

Allan McCay and Christopher James Ryan discuss an Australian sentencing appeal based on neuroimaging and neuropsychological testing that resulted in a less severe sentence on the offender than what was originally imposed. Analyzing evidence of the offender's mental condition, they argue that inferences from frontal lobe damage to impaired cognitive function are contestable. This raises questions about reasons for mitigation of punishment based on these inferences. McCay and Ryan's conclusion has broader implications for the use of neuroimaging to support claims of mitigation in criminal law.

Focusing on conduct problems in youth, Andrea Glenn cites evidence of multiple biological and environmental factors in the development and trajectory of these problems. She argues that information about these factors may enable health professionals to identify individuals at an early age who would respond to interventions targeted to them. This could maximize effective outcomes in reducing the incidence of problematic behavior. In addition to the potential benefit, Glenn discusses some of the potential harm in assessing biological risk. This includes inequality in access to services and discrimination or labeling based on this information.

Katherine Flannigan and co-authors examine the vulnerability and overrepresentation of adolescents and adults with Fetal Alcohol Spectrum Disorder (FASD) in the criminal justice system. Young offenders with FASD have significant cognitive, social and behavioral impairments that are often compounded by environmental adversity. Flannigan et al. argue that assessment of neurocognitive strengths and weaknesses in individuals with this disorder can effectively guide screening and sentencing and contribute to programs that will promote positive outcomes for them.

The next three articles discuss ethical and legal issues associated with different uses of psychopharmacology and neurotechnology to modify the brain, mind and body. Thomas Sobirk Petersen analyzes two arguments against removing prohibitions on pharmacological cognitive enhancers (PCEs) for healthy people. He explains that legalizing PCEs would not imply that people would be coerced into taking these drugs. In addition, he explains that increased use of these drugs would not necessarily medicalize problems of work-related stress and burnout. Noting that these are sociopolitical problems without a foreseeable solution, he points out that taking PCEs as a form of individual problem-solving may be preferable to doing nothing.

Elizabeth Shaw explores new approaches to offender rehabilitation given the high rate of criminal recidivism. She discusses the use of biomedical interventions in criminal rehabilitation and the connection of this idea with the literature on moral bio-enhancement. Shaw focuses mainly on the preconditions that would have to be met before cognitive enhancement could be withheld from an offender who requested and would benefit from it. She also considers preconditions that would have to be met before the effects of enhancement could be reversed.

Christoph Bublitz and co-authors examine legal liability for harms caused by users of BCIs. They argue that the law should view some BCI-mediated movements as actions, even if they are not willed bodily movements. They distinguish criminal from civil issues arising from this technology. Regarding the first, there should be some latitude for permissible risk negating criminal negligence. Regarding the second, users should be subject to strict liability. At a more theoretical level, the authors show that interaction between minds and machines involves epistemic gaps that may cause problems for ascribing criminal responsibility to those who use them.

The last three articles of the issue focus more on conceptual issues at the intersection of neuroscience, law and ethics. Following the work of Jean Decety and Philip Jackson, Gerrit Glas analyzes different aspects of the neuroscience of empathy. Addressing some of the difficulties in trying to bridge empirical and normative interpretations of empathy, he rejects reductionist and mentalistic explanations of this disposition. Instead, Glas builds on Decety and Jackson's developmental and

interactionist approach to empathy. He shows how adopting this approach within a framework of social neuroscience can have important clinical, legal and ethical consequences.

Paul Nestor rejects the claim that recent findings in neuroscience demonstrate that belief in free will is an illusion. He argues that neural and perceptual machinery can explain how we can have free will and be responsible for our actions. Nestor cites neuroimaging evidence of activity in frontal, parietal and motor cortices that enables the experience of intentionality and agency. He explains how pathologies in this cortical network can impair agency and influence judgments of criminal responsibility as a practice grounded in fairness and cooperation.

Stephen Napier discusses some of the ethical issues surrounding patients in a minimally conscious state (MCS) dependent on artificial nutrition and hydration (ANH). He exposes flaws in the argument that an advance directive to refuse ANH in such a case should always be respected. Napier presents empirical evidence challenging the assumption that a person who expressed an earlier interest in refusing ANH would refuse it at the time when it was medically indicated. He points out that adherence to an advance directive against life-sustaining care may reflect a disability bias of third-person judgments about the patient's quality of life that may be incongruent with his first-person experience.

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