Possibilities and Limitations of Neuroscience in the Legal Process

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Introduction

The neurosciences (broadly defined as comprising clinical and basic neuroscience and the science and clinical practice of mental health) are relevant to law and legal practice in two main ways. They contribute to jurisprudence by providing insight into the causes and mechanisms underlying human action (and people's perceptions about them) and they can contribute to individual cases with information about reliability of evidence, responsibility and dangerousness of the perpetrator (Jones et al., 2013). The first contribution has been discussed in detail by Greene and Cohen in an essay with the programmatic title "For the law, neuroscience changes nothing and everything"(Greene & Cohen, 2004). The authors argue that the current retributivist penal system, with the

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underlying assumption of free will, rests on dubious philosophical foundations. At least, it could be easily challenged by those who infer from the prevailing (largely) deterministic model of the universe that free will in the sense required for a strong concept of responsibility or blameworthiness is an illusion, in other words that free will is incompatible with the laws of physics (incompatibilism). They deny that abandoning classical concepts of blameworthiness would upend the penal system because all it would entail is to abandon retributivism and to base punishment completely on consequentialist goals (which already play a major role in the current system). They also point out that none of these considerations depend particularly on advances in neurosciences—natural and moral philosophy operate quite independently from them—but that these advances may influence folk psychology by providing more insight into the neurophysiological causal chains that led to the offensive action. Thus, the more people are informed about the incremental psychological stressors and resulting brain changes that preceded delinquency, the more they may be inclined to accept that a person is not to blame for his or her actions. In principle, though, it should not matter how much we find out about this causal chain because, ultimately, it exists for any human action, good or bad. Regardless of this increasing influence of neuroscience on folk psychology (and the resulting increasing willingness to exculpate perpetrators on the basis of the condition of their brains), it will still take some time and an extended debate until our legal systems will be aligned with the scientific quest for causal (mechanistic) explanation.

In the meantime, neuroscience can play a role in its second domain, supporting the legal process in the areas of evidence, assessment of the mental state of the offender at the time of the offence, disposal, and prognosis. In order to organize my discussion of these areas, I use the taxonomy of responsibility proposed by Vincent (Vincent, 2010). I first discuss the contribution of neuroscience to the gathering of evidence in the context of "action responsibility" (*actus reus*). I then consider the assessment of the offender's mental state under the headings of "intent" and "capacity". The contribution of neuroscience to the determination of disposal and prognosis will be discussed under the headings "liability responsibility" and "prevention of re-offending". Other authors of this book will expand on several of these topics, and I will provide

cross-references to the relevant chapters. The advances of neuroscience, particularly functional neuroimaging, in the last 25 years have given rise to hopes that many questions of criminal evidence could soon be resolved by brain scans, for example for lie detection, and that quantitative imaging would provide insights into a person's mind that could be used for assessment of capacity responsibility and prognosis. However, partly because of the difficulty of validating such predictive algorithms, this hope has so far not been fulfilled (and Chapters 5 and 6 of this volume discuss whether such a future would even be desirable and compatible with human rights concepts). Conversely, classical individual psychometric and psychopathological assessments (sometimes supported by clinical neuroimaging) are still very much needed in the criminal court, and I will argue that this will still be the case when (as I assume) the legal systems will move to more consequentialist frameworks as proposed by Green and Cohen over the coming decades.

Action Responsibility

A primary aim of criminal proceedings is to determine the circumstances of the action that led to the outcome in question, for example injury to someone's body. This determination, which includes the identification of the perpetrator or perpetrators of the action, concerns what in classical legal terminology is called *actus reus*, in distinction from the determination of the *mens rea*, which concerns intention and capacity of the perpetrator. The determination of the *actus reus* is the key component of the investigative part of criminal proceedings and includes weighing the evidence provided by witnesses, suspects, and victims. Neuroscience methods have been suggested to be potentially useful for the assessment of the reliability of a source of evidence. This could include techniques for lie detection (evaluating whether a particular statement is made with the intent to deceive), identifying perpetrator's knowledge or determining general unreliability of a witness. These techniques are essentially extensions of classical psychological or psychophysiological techniques. Lie detection uses presumed physiological signatures of deception (mainly altered arousal levels) to evaluate whether a particular

statement is likely to be true. Its reliability as an investigative method is a matter for ongoing debate. Theoretically, a lie detector could also be based on the recording of brain signatures of deception from EEG or functional MRI signals, but such attempts have to be regarded as premature given the current state of these fields (Rusconi & Mitchener-Nissen, 2013; Farah et al., 2014). The identification of perpetrator's (or "guilty") knowledge could use brain signature of familiarity, for example, with a crime scene. It is discussed further in Chapter 5 by Meijer and Van Toor. Finally, the general reliability of a witness depends on his or her cognitive abilities and personality profile. Its assessment is mainly within the domain of psychology (e.g. with tests of short- and long-term memory) or psychopathology (e.g. with regard to pathological lying), but brain imaging can help if there is a question of an identifiable brain disease (such as Alzheimer's dementia) that could make a witness unreliable.

Mens Rea

Determining a person's intention on the basis of brain imaging signals or other neural measures could be useful both for the evaluation of the truthfulness of a statement (in the context of "lie detection", as outlined in the previous section) and for the determination of the *mens rea*. Although it is possible to map correlates of people's mental states with functional imaging, for example detect brain activation patterns associated with auditory hallucinations (Linden, 2012), the reverse inference (from a brain state onto a mental state) is very difficult to make on the basis of brain imaging data (Poldrack, 2006). Many external stimuli, cognitive tasks, and presumably also mental states can be associated with similar or highly overlapping brain activation patterns. Thus, although we can predict reasonably well which brain areas will be involved in the processing of a particular stimulus, for example a face, we cannot infer from activation of the corresponding brain area (the fusiform face area) that the person was actually seeing a face—they could also have imagined or hallucinated a face or been exposed to visual stimuli that had some face-like features. More fine-grained inferences from brain states onto mental states may be possible through multivariate pattern analysis.

Here the general procedure entails training an algorithm on the brain activation patterns associated with events from two different categories (e.g. pictures of appetizing and non-appetizing food) and then testing how well it predicts what type of food a person was seeing during a new instance of presentation of food pictures (Franssen et al., 2020). An interesting attempt in this respect was an experiment modelling the culpable states "knowing" and "reckless" in the meaning of the American Model Penal Code, which provided preliminary evidence for the possibility of differentiating such states at the neural level (Vilares et al., 2017). This approach can be extended to more than two categories. One example is the differentiation of brain activation patterns associated with six basic emotions (disgust, fear, happiness, sadness, anger, and surprise) (Saarimäki et al., 2016). Such fMRI-based mapping of neural patterns associated with specific mental states relies heavily on the cooperation of the participant and although significant accuracy rates have been reported in many studies these are often just above chance level and thus not in the range needed for criminal evidence (Uncapher et al., 2015). At present, the associations between neuroimaging or psychophysiological markers and specific patterns of thought or behaviour are not yet stable enough for any prospect of replacing the classical clinical and personality assessments used to determine intent (and capacity responsibility, see the following section) in forensic psychology and psychiatry.

Capacity Responsibility

A person who committed a violent offence might have the defence of insanity available to them, if, in general, at the time of the offence they were suffering from a mental illness that precluded them from understanding the nature or wrongfulness of their action or, if they had such understanding, from acting upon it (Simon & Ahn-Redding, 2006). The first scenario, also called "cognitive insanity" may occur, for example, in patients with dementia or delusions and is available in most jurisdictions; the latter, also called "volitional insanity" and more controversial and less widely used, would apply in severe cases of impulse control disorders or command hallucinations.

In such cases, the expert witness would have to establish a diagnosis of a recognized mental (e.g. schizophrenia) or neurological (e.g. brain tumour) disorder and then show that this disorder led to a functional impairment resulting in "cognitive insanity". If neuroimaging comes into play such as in the case of a brain tumour, the challenge is not so much to prove the abnormality of the imaging finding (which is generally defined by widely accepted clinical criteria), but its contribution to the act in question (for example, using the counterfactual thought experiment whether someone, given their primary character, would have been likely to commit such an act before the disease in question developed). A more difficult situation from the neuroimaging perspective arises when a defendant does not present with a qualitative and clinically recognized abnormality but an expert would like to argue that he or she was incapable of moral reasoning because of a quantitative abnormality, for example reduced perfusion in prefrontal areas that are crucial for this type of reasoning. This type of reasoning, which has been applied in a number of criminal cases (Werner et al., 2019), faces major methodological challenges (including determining normative values, and accounting for the plastic nature of the human brain) (Jones et al., 2013). Although it has so far had limited use in actual legal practice this move to more quantitative measures that might be able to place people on a spectrum of criminal responsibility, rather than using the classical dichotomy of sanity vs. insanity, is interesting from a theoretical perspective. It can be seen as part of a move to deconstruct the multifactorial causation of delinquent behaviour that incorporates both biological and psychosocial vulnerabilities. The argument could go like this—why should a perpetrator whose act was "caused" by a brain tumour receive more leniency from a court that the perpetrator whose act was "caused" by a concatenation of psychosocial adversity, early drug abuse, resulting brain damage and lack of access to support services? Ultimately, a causal chain of physical events exists for any human action. Whether or not this basic fact of physical causation of human action is relevant for their praise- or blameworthiness is a matter of intense philosophical debate (Greene & Cohen, 2004), but whatever one's position in this debate, it should not matter what kind of brain process caused a criminal offence. Either everyone is capacity responsible for their actions whatever their brain scan reveals

because physical causation is irrelevant for the question of responsibility, or nobody is (this is the position advocated by Greene and Cohen). The latter case does not remove the rationale for punishment (only for its retributivist aspect), nor does it remove the need to differentiate between offenders on the basis of their brain state (see next sections), but it moves these considerations into the domain of liability responsibility.

Liability and Responsibility

In Vincent's taxonomy, "liability (responsibility)" refers to the way in which an offender will be treated by society, what liability will be imposed on them. In the criminal context, this is mainly about the justification for and determination of the right level of punishment. Of the five purposes of punishment identified by Vincent, all but the first (retribution) can still very much apply even in a model that denies everyone capacity responsibility. These are "general and specific deterrence", "reform and education of the offender", "quarantine of dangerous people to protect society", and "expression of society's solidarity with victims by publicly condemning offenders' actions" (Vincent, 2010). Deterrence, reform and education and protection of society from dangerous individuals often require close liaison between legal practitioners and clinical experts from psychiatry, psychology and neuroscience. Contributions of neuroscience to considerations of deterrence and education and reform will be discussed in this section, whereas the rationale for the quarantining of dangerous individuals will be discussed in the subsequent section on prevention of re-offending.

Let us consider the justification of punishment by its deterrent properties through a few examples. The patient who committed an offence because a frontal brain tumour interfered with the normal functioning of areas that are essential for moral reasoning and/or impulse control, does not need to be punished (at least not under the auspices of deterrence) after a successful operation of the brain tumour and restitution of his or her previous level of functioning. Specific deterrence does not apply because the patient's risk of re-offending is not conceivably higher than that of the general population, and general deterrence does not

apply either, because it is reasonable to assume that it will not be possible to deter someone (a hypothetical other patient) with this kind of brain tumour with the prospect of a jail term. The patient simply will not have the ability to judge the outcomes of his or her action, and whether there is a chance that he or she might go to jail for it does not enter into his or her considerations. Conversely, the person who committed a similar offence because of the chain of adverse upbringing and circumstances outlined in the previous section might be punished by a jail sentence because it is reasonable to assume that his or her brain (and that of others in a similar situation) is capable of processing information about reward and punishment and make this a guiding principle of the person's decision-making. Finally, a perpetrator who, like the patient with the brain tumour, is not able to take potential future punishment into consideration when planning and performing certain actions, but who does not have the prospect of a definitive cure, for example a patient suffering from severe learning disability, would not be punished on grounds of deterrence, but may still need to be committed to an institution for the protection of the public.

The question of educational prospects and reform of the perpetrator is closely coupled to that of deterrence. Most people for whom deterrence does not work because of severe learning disability or another severe and enduring mental and/or neurological disorder will also show limited if any responsiveness to attempts at education and reform. Because they were driven in their actions by simple stimulus–response mechanisms uncontrolled by higher-order planning mechanisms the main educational strategy will generally be one of behaviour analysis and modification, rather than one that employs more complex cognitive strategies. The scientific understanding of the brain and behaviour, both in general and in relation to the individual perpetrator, can help formulate the appropriate strategy for education and reform although the advice from educational and behavioural psychologists will generally be more relevant than that from neuroscientists. The situation changes if there is a treatable underlying condition that would transform the perpetrator's understanding of and ability to follow moral norms and legal rules. For example, in the aforementioned case of the perpetrator with the frontal brain tumour, removal of the brain tumour will be the key

step to reform, so much so that very little if any additional education is needed in order to reintegrate him or her into normal societal processes. Similar, for a perpetrator with a chronic delusional disorder, successful psychiatric treatment of this disorder may be the key to reformability. In such cases, the advice of a clinical neuroscientist or psychiatrist may be sought to determine the best disposal and determine the risk of re-offending.

Prevention of Re-offending

This brings us to the last major section of the legal process to which neuroscience could make a meaningful contribution, prognosis, and prevention. The assessment of re-offending risk is generally a complex and multifactorial procedure, but in some cases, such as that of the perpetrator with the brain tumour mentioned above who committed an illegal act that was completely out of character, a close causality between a treatable disease and the act can be determined, resulting in a positive prognostic assessment after successful treatment. At the other end of the spectrum of treatability, it is also conceivable that the expert would conclude, for example in a case of an incurable brain tumour or a progressive neurodegenerative disease, that a patient remains permanently dangerous until he or she is physically or cognitively so impaired as to become incapable of any independent action. Mental disorders sit between these two extremes because they are generally neither completely curable nor incurable, and thus, any remaining risk owed to a treated but not completely cured illness would be matter of degree. Beyond categorical diagnoses one can also consider neuroscience-based quantitative parameters such as local brain volume or metabolism as potential predictors of recidivism (Delfin et al., 2019). However, the required longitudinal studies are very difficult to conduct, and the necessary independent validation of predictive models in new cohorts poses considerable logistic and ethical challenges.

In public and legal debate the issue of preventive detention, that is, the confinement of a person beyond the term of their sentence for public protection, often arises in the context of sexual offending but also in

other cases of violent crimes. Sexual offenders pose a considerable risk of re-offending, current treatments are not particularly effective in reducing this risk, and risk predictions in individual cases have a large margin of error (Dennis et al., 2012). The question for legislators is then whether sexual offenders should be released from prison when they have served their term and be a risk to the community or whether they should be detained as long as they pose a risk—and thus potentially indefinitely? Over the last 30 years legislatures and law courts, for example in many States of the USA, several Australian provinces, New Zealand, Germany, Scotland and England have increasingly favoured the second option (Janus, 2013, McSherry & Keyzer, 2009). In the USA, all State laws providing for confinement of sexually violent predators follow the criteria set out by the Supreme Court in the case *Kansas v. Hendricks* (1997). In order to be legally detained in a special facility beyond the term of the original conviction the offender needs to have.

"(1) a history of sexually harmful behavior; (2) a mental abnormality that produces an impairment of control over sexually harmful behavior; (3) a prediction of future sexually dangerous behavior" (Janus, 2013).

Clinical neuroscience as such rarely comes into the determination of these criteria because the "abnormality" concerned is generally not of an identifiable neurological nature (and it if it, the question of treatability becomes paramount). However, criteria 2 and 3 are within the purview of the forensic psychiatrist or psychologist. Some sexually violent predators fulfil diagnostic criteria for an identified mental disorder from the group of paraphilias such as paedophilia or sexual sadism disorder (Linden, 2019). However, the criteria are not confined to these patients with a classical psychiatric diagnosis because they use the broader (and controversial) term of "mental abnormality"(McSherry & Keyzer, 2009) which may be a universal category for those assessed as posing a risk of future sexually dangerous behaviour (and it is not automatically the case that those with a diagnosis are more dangerous than those without). In many cases, the application of these criteria by courts (and the legislation they have to follow) thus becomes more of a politico-legal than a purely medical-scientific matter. In addition to the contribution to diagnosis and risk assessment, neuroscience and psychiatry might also have

a role in the future development of treatments that might reduce re-offending rate. A classical debate concerns the use of brain surgery for sexual offenders (Linden, 2014), which is becoming a topical issue again because of the advances of deep brain stimulation (Fuss et al., 2015) but still far away from practical implementation. However, if patients are detained preventively on the basis of a medical model that assigns them an abnormality that leads to them posing a risk to the community they should also have access to any treatment that might cure or mitigate their condition (Merkel, 2007). Thus, it would be desirable to have a debate about new treatments enabled by recent advances in clinical and basic neuroscience that could potentially reduce the risk of sexual violence or other types of violent offending.

Summary and Conclusions

Whereas the role of neuroimaging and other neurotechnologies for determining the *actus reus* is currently very limited, neuroscience (in its broad definition that includes mental health) has considerable relevance for the evaluation of the *mens rea* and insanity as well as for questions of disposal and prognosis. Most of the questions that are currently posed to a forensic psychiatrist will still be relevant if legal systems abandon the classical intuitions of blameworthiness and retribution and move to a purely consequentialist system of punishment (Greene & Cohen, 2004). After all, questions of capacity responsibility and liability (sensu Vincent) are closely entwined, and although retribution would disappear from the scope of the latter in a consequentialist system, the other aspects of punishment would remain. Practical differences would probably be limited: In a consequentialist system, most offenders found to have diminished responsibility in the current system would be punished under the auspices of education and reform and protection of the public, rather than deterrence. As argued above, proper assessment of these categories frequently involves the evaluation of neural and psychological criteria for reformability and re-offending, which will be relevant to any society whatever its philosophical views on moral responsibility. Individual assessments of capacity for moral reasoning and impulse control as

well as the investigation of the underlying neural mechanisms will most probably still play a major role in both retributivist and consequentialist legal systems.

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