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ARTICLE

Limitations Using Neuroimaging to Reconstruct Mental State After a Crime

Michael J. Vitacco[1]*, Alynda M. Randolph[2], Rebecca J. Nelson Aguiar[1] and Megan L. Porter Staats[1]

[1]Department of Psychiatry and Health Behavior, Augusta University, Augusta, GA, USA
[2]Forensic Outpatient Program, JBS Mental Health Authority, Birmingham, AL, USA
*Corresponding author. Email: MVITACCO@augusta.edu

Abstract

Neuroimaging offers great potential to clinicians and researchers for a host of mental and physical conditions. The use of imaging has been trumpeted for forensic psychiatric and psychological evaluations to allow greater insight into the relationship between the brain and behavior. The results of imaging certainly can be used to inform clinical diagnoses; however, there continue to be limitations in using neuroimaging for insanity cases due to limited scientific backing for how neuroimaging can inform retrospective evaluations of mental state. In making this case, this paper reviews the history of the insanity defense and explains how the use of neuroimaging is not an effective way of improving the reliability of insanity defense evaluations.

Keywords: neuroimaging; forensic psychiatric and psychological evaluations; brain and behavior; clinical diagnoses; insanity defense

Criminal responsibility or insanity defense evaluation is a controversial and contentious area of mental health law that is widely disliked by the public,[1] and when raised in legal proceedings, is often encumbered by poor practice and scientific unreliability.[2] Several ideas have been promoted to improve scientific credibility of evaluations of criminal responsibility, including the use of neuroimaging, which may give clinical opinions on legal insanity the imprimatur of scientific infallibility. This paper will provide a brief history of the insanity defense and discuss cognitive errors that must be avoided when conducting criminal responsibility evaluations. Additionally, the authors propose that, even considering tremendous growth in neurolaw and neuroscience, neuroimaging in its present state is largely ineffectual when used to retrospectively reconstruct mental states, like what is required when evaluating someone for the insanity defense. The paper will close with a concluding paragraph cautioning against using reductionistic approaches like those of neuroimaging for making determinations of insanity.

Nature of the Insanity Defense

For centuries, it has been recognized that a person's mental state, specifically mental illness or defect, can impact their culpability or responsibility for their actions. For example, Aristotle in *Nicomachean Ethics,*[3] wrote of individuals who demonstrated "ignorance of the circumstances of the act and of the things affected by it, in this case, the act is pitied and forgiven, because he who acts in ignorance of any of these circumstances is an involuntary agent." Aristotle's conceptualization of the circumstances including the act itself is akin to our modern notions of *actus reus* (literally translated "guilty act") and *mens rea* ("guilty mind"). Plato[4] also wrote of persons committing crimes:

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> In a state of madness or when affected by disease… And if this be made evident to the judges elected to try the case, on the appeal of the criminal or his advocate, and he be judged to have been in this state when he committed the offence, he shall simply pay for the hurt which he may have done to another."

In 13th century England, Judge Henry De Bracton[5] wrote of madmen, which has been attributed as leading to the development of the "Wild Beast" test used in *Rex V. Arnold*[6] (1723). Specifically, the Wild Beast test said, "A man must be totally deprived of his understanding and memory so as not to know what he is doing….no more than an infant, brute, or wild beast." Sir William Blackstone[7] (1783) also wrote of a "…deficiency in will which excuses from the guilt of crimes arises also from a defective or vitated (sic) understanding, viz. in an idiot or a lunatic. In criminal cases therefore idiots and lunatics are not chargeable (sic) for their own acts if committed when under these incapacities."

In 1843, modern-day insanity laws were catalyzed with the birth of the *M'Naghten*[8] rule. After the unpopular decision where Daniel M'Naghten was acquitted by reason of insanity for killing the Prime Minister's secretary Edward Drummond, a panel developed the following insanity standard: "To establish a defense on the ground of insanity, it must be proved that at the time of the committing of the act, the party accused was laboring under such a defect of reason, from disease of the mind, as not to know the nature and quality of the act he was doing, or if he did know, did not know he was doing what was wrong."

The *M'Naghten* standard continues to form the basis for the Federal standard in the United States, but there is considerable variability among state insanity statutes. Seventeen states have adopted the *M'Naghten* standard and another 10 have adopted some variation of the wrongfulness component. Approximately 14 states use the Model Penal Code/American Law Institute[9] (ALI) standard which, like *M'Naghten*, indicates that "A person is not responsible for criminal conduct if at the time of such conduct as a result of mental disease or defect he lacks substantial capacity either to appreciate the criminality [wrongfulness] of his conduct," but adds a volitional prong. Born initially from *Parsons v. State*[10] (1887), the ALI standard notes that a person is also not responsible if they lack sufficient capacity "to conform his conduct to the requirements of the law" (1985). Three other states (GA, VA, and NM) have adopted some variation of both the *M'Naghten* and ALI standards, whereas an additional two (NH and ND) have unique formulations. Four states (KS, MT, UT, and ID) do not have an insanity defense, which right was upheld by the United States Supreme Court in *Kahler v. Kansas*[11] (2020). Overall, state standards differ, but typically incorporate some variation of appreciation of wrongfulness, appreciation of the nature and quality of the acts, and/or ability to conform conduct. Standards also require that any impairment in these capacities be related to mental disease or defect, but insanity statutes vary as to how, or even if, mental illness (sometimes referred to as mental disease or defect, mental disorder, etc.), is defined. Mental illness is the threshold condition on which insanity defenses are built and so diagnoses and related impairment can be of import in criminal proceedings and one of the areas in which neuroimaging evidence may be introduced.

Despite centuries of recognition and refinement, the concept of finding someone not responsible for their criminal behavior based on a mental disease or defect remains controversial. One only needs consider *Kahler v. Kansas* (2020) where the United States Supreme Court in a 6–3 decision ruled that due process does not require states to formally recognize insanity. Notably, Kansas allows mental illness to serve as a defense against *mens rea*, but that also comes with limited relevance as it fails to account for severe functional deficits that can be associated with mental illness and does not comport with basic due process.[12] In writing for the minority, Justice Breyer echoed many of these points as he wrote that Kansas did not "merely redefine the insanity defense," Kansas "eliminated the core" of the insanity defense "so rooted in the traditions and conscience of our people to be ranked as fundamental."

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Complexities and Biases in Conducting Insanity Evaluations

Rendering an opinion regarding someone's sanity at the time of an offense is a challenging task. Evaluators are asked to retrospectively reconstruct a defendant's thought processes and interpret their behaviors from the day of an alleged offense, often months or even years after the alleged crime occurred.[13,14] They must contend with limited and often contradictory information, as well as sift through collateral sources which could include hundreds of pages of records. Evaluators are then asked to consider, weigh, and integrate multiple sources of data to reach an opinion of legal sanity. Research suggests forensic evaluators are typically able to analyze interrelationships for only about four discrete pieces of information at a time,[15] despite likely being tasked with analyzing more. This complicated process of attempting to identify and analyze patterns and interrelationships among various pieces of data and integrate them into an opinion has been called "configural analysis."[16] The task of completing an insanity evaluation is further complicated by the fact that there are no set standards for how the evaluation should be conducted or the structure of a written report.[17] Given all this, the potential for evaluator bias influencing decisionmaking is likely higher in insanity evaluations compared to other more structured psycholegal questions.[18,19]

Although there are several cognitive biases relevant to complex decisionmaking tasks,[20,21] one commonly cited concern in forensic evaluations is confirmation bias, which is the tendency to maintain a belief by focusing on evidence which supports that belief while disregarding conflicting information.[22] Clinicians may make hypotheses prior to an evaluation, then seek out information which confirms those hypotheses while not gathering data that may disprove the opinion. Research has shown that base rates (probability of someone being found with a given condition) of insanity are an often-underutilized piece of data which could serve to help clinicians challenge their hypotheses about their opinions in an insanity evaluation.[23] Instead, clinicians typically rely solely on case-specific information. Research also shows an adversarial allegiance with the counsel who retained the clinician as a growing concern. Daniel Murrie and colleagues[24] published compelling data documenting the "allegiance effect" in forensic assessments. They "hired" forensic psychiatric and psychological experts to review a defendant's case file and score the offender on two commonly used, well-researched risk assessment instruments. The experts were led to believe they had either been hired by the defense or the prosecution but reviewed identical information regardless of which side "retained" them. The results of this study suggest clinicians rely more heavily on information that is in favor of the party who hired them. These data are directly relevant to criminal responsibility evaluations, and may impact the reliability of opinions.

Most court systems in the United States rely on a single evaluator to conduct these evaluations. As a result, the ability of forensic evaluators to render insanity opinions accurately and reliably is critical. It is hoped, and often assumed, that two forensic evaluators would arrive at the same opinion in a case. However, there is very limited research on the reliability of insanity opinions and thus little is known about how reliable experts' opinions are. An examination of the literature resulted in three peer-reviewed U.S. studies investigating the reliability of insanity evaluations. One study found that two or more evaluators agreed in 76% of 66 Alaska sanity cases studied between 1977 and 1981.[25] A second study examined 384 consecutive court-ordered insanity cases in Hawaii conducted by two or more independent, court-appointed forensic evaluators.[26] They reported unanimous agreement among evaluators in 92% of cases. These studies have notable limitations, however, primarily that the evaluations may not have been independently completed. A second evaluator may have consulted with or reviewed the initial evaluator's report. The most recent study conducted reviewed 483 legal sanity evaluations that addressed 165 cases dated between 2007 and 2008.[27] Results of this study found notably lower rates of agreement than previous research. Evaluators unanimously agreed in only 55% of cases and tended to disagree more when the defendant was under the influence of substances at the time of the offense. These results reflect poorer agreement in sanity evaluations compared to 68% agreement found for competency to stand trial evaluations[28] and violence risk assessments.[29] In totality, the results call for heightened standards of objectivity and reliability in examinations of insanity and calls for improved training for criminal responsibility evaluations.

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Neuroimaging and Responsibility: Application to Retrospective Evaluation of Mental State

The use of neuroimaging in insanity evaluations has been promoted by some as one way to overcome cognitive biases associated with these evaluations[30] and improve on the self-report of traditional clinical methods for insanity evaluations.[31] The authors of these papers propose that a multidisciplinary approach with the inclusion of neuroimaging, converging neuroscience, and clinical data, will improve opinions of insanity. Indeed, an increasingly common phenomenon is the inclusion of neuroimaging testimony[32] in a variety of legal proceedings. Several neuroimaging techniques have been presented as evidence including, in alphabetical order, computed tomography (CT), diffusion tensor imaging, functional magnetic resonance imaging (fMRI), magnetic resonance imaging (MRI), magnetic resonance spectroscopy, positron emission tomography (PET), and single photon emission CT. As noted by Jennifer Kulynych,[33] "The debate over the forensic use of neuroimaging has placed this technology on the cutting edge of the ongoing legal controversy concerning the proper standards for admitting novel scientific evidence." Although being over 20 years old, this statement from an article published in Stanford Law Review remains highly relevant. For example, Cristina Scarpazza et al.,[34] recommend the use of imaging when traditional clinical methods remain clouded, but the authors themselves recognize "that a test or MRI diagnosis must be strictly avoided" (p. 7). Further, even if imaging is permitted for diagnostic purposes and indicates the presence of a mental illness, that only is indicative of a threshold condition for an insanity defense. Additional analyses are required regarding the defendant's statutorily defined psycholegal capacities such as the ability to understand right from wrong. There is a lack of scientific evidence to suggest that these additional analyses can be reliably supported by imaging.[35]

It should come as no surprise that the prosecution and defense rely on neuroimaging in vastly different ways, but the notion should be questioned that imaging due to its advanced scientific status provides more objectivity. Deborah Denno[36] elegantly pointed out that the same finding viewed as mitigating by the defense could be construed as aggravating by the prosecution. As a relevant illustration, consider damage to the frontal lobe causing deficiencies in executive functioning and how the attorneys in an adversarial trial could mold the results to fit their desired picture of the defendant. Referred to as the "double-edged sword," so-called objective neuroscience data can be interpreted quite differently, even if that does not frequently occur.[37] For example, the defense may argue that the defendant with frontal lobe deficiencies lacked the capacity to comport their behavior and was thus insane at the time of the alleged offense, whereas the prosecution may attempt to paint the defendant as a violent individual with little prospect for rehabilitation given these frontal lobe abnormalities. Research[38] demonstrated this with 330 individuals asked to render judgements on cases with access to neuroscience results and clinical conditions. Using a Solomon-like approach, the mock venirepersons recommended shorter prison sentences but longer commitment times in hospitals when viewing imaging data reportedly indicative of brain damage. This approach is more consistent with mitigation than insanity.[39]

A final consideration of concerns about objectivity center around the innovation that remains with neuroimaging and the iterative nature of science regarding this technology. No finding highlights problematic correlations that can arise in scanning without objective interpretation more than when functional activity was found during scans performed on a deceased salmon that clearly had no functional activity.[40] This finding is a prime example of how neuroimaging results can be misinterpreted and highlights how bad statistics lead to poor science. In addition, many assumptions associated with neuroimaging findings remain in flux. Consider a recent paper, which questioned long-standing beliefs on myelination evaluation through imaging. Daniel Weinberger and Eugenia Radulescu[41] opined,

> This raises the rather alarming possibility that many recent findings of putative cortical thinning in individuals who have neurodevelopmental disorders or who have experienced developmental adversity such as toxic childhood stress, rather than an indication of lagging development as concluded in most studies, may actually indicate maturing ahead of schedule as reflected in myelinogenic timing (p. E2).

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This idea, although new and interesting, points to the notion that we must continually rethink ideas related to findings of neuroimaging. Foregone conclusions may not be as set in stone as we once thought. The authors strongly cautioned researchers to carefully interpret imaging findings using control groups and to not extrapolate beyond the data. Unfortunately, trumpeting implications not supported by data has become relatively common in neuroimaging research studies. Neuroimaging, like the brain images it captures, is fluid and will evidence tremendous growth over the next decade. This growth may make neuroimaging suitable for use in insanity cases, but only if imaging will allow for valid inferences and opinions of retrospective behavior.

Neuroimaging and Insanity in Court

Considering how courts and juries have handled neuroimaging data related to criminal responsibility evaluations is quite informative. We explore three high profile cases where neuroimaging played a significant role in trying to understand the defendant's mental state at the time of the offense. First is the case of Lisa Montgomery[42] whose capital sentence was carried out on January 13, 2021 for the murder of Bobbie Jo Stinnett and the kidnapping of Ms. Stinnett's baby after Ms. Montgomery cut her from the womb. In the original trial, Ms. Montgomery presented an insanity defense that partially relied on data from neuroimaging. A neurologist hired by the defense was prepared to testify that based on MRI and PET scans, Ms. Montgomery suffered from pseudocyesis, a condition where the individual believes and has physiological similarities to someone who is pregnant. The judge in the district court did not allow the neurologist to testify on the imaging findings because it was the judge's opinion that the scans "held minimal probative value" and did not meet appropriate evidentiary standards. Government's experts demonstrated problems with the methodology used by Ms. Montgomery's experts. Ms. Montgomery appealed to the Eighth Circuit on both the guilt and penalty phases of the trial regarding the admissibility of neuroimaging. Ultimately, the decision was upheld to exclude the testimony from both the guilt and penalty phase; however, the court acknowledged the lower standard afforded to the penalty phase of capital trials could have led to its admission. As opposed to insanity, neuroimaging used for mitigation in sentencing has shown both utility and admission into court proceedings.[43]

The second case that we consider is the one of Stephen Stanko.[44] Mr. Stanko was accused of rape of a teenage girl and the murder of two people. His defense strategy involved an insanity plea that was purportedly supported by neuroimaging data. According to a neuropsychiatrist, Mr. Stanko's frontal lobes were damaged and manifested low activity. These findings were reported to indicate that Mr. Stanko was unable to appreciate right from wrong because of brain damage. Ultimately, however, his defense team basically argued that Mr. Stanko met the standard for insanity because he was a psychopath. Psychopathy, a clinical condition defined by callousness, recklessness, superficial charm, and antisocial conduct has long been linked with gratuitous violence and recidivism.[45] A South Carolina court rejected the insanity defense finding Mr. Stanko guilty and recommended the death sentence. This was not a novel attempt by the defense to utilize psychopathy as a condition to abdicate criminal responsibility as we will see in the final case of Brian Dugan.[46] Mr. Dugan was on trial for his life after the abduction, rape, and murder of a young girl. Using fMRI results, which may have been the first time it was used in a trial, the defense argued for nonresponsibility due to brain imaging consistent with psychopathy. Greg Miller[47] interviewed a prosecution expert who rebutted the defense scans and said the following:

> I said the scans are of wonderful technical quality, but so what? They're not relevant here… Using an fMRI scan done in September of 2009… to indicate a thought process that was going on in 1983 could hardly be more silly.

The jury rejected the defense and found Mr. Dugan guilty.

This review of case law was not meant to be comprehensive. However, it does demonstrate that juries and judges are reluctant to rely on neuroscientific explanations for findings of nonresponsibility and

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judges are cautious about admitting neuroimaging for insanity trials. Clinicians who overstep their data and present as partisan experts risk their objectivity being called into question.

This paper is not recommending wholesale exclusion of neuroscience evidence in insanity trials. Forensic practitioners may find data from neuroimaging persuasive and informative for diagnostics (e.g., imaging findings that may be observed in dementia or brain damage), and these data may support information acquired during more traditional clinical approaches. Such convergence may be comforting to the clinician as they make the case for the presence of a threshold condition. However, clinicians must be aware of amorphous findings of neuroimaging and how these are interpreted in relation to psychiatric diagnoses and functioning. The development of more nuanced imaging techniques will certainly benefit forensic practitioners regarding the insanity defense, but it is safe to say that there are currently limited benefits for integrating imaging into insanity cases particularly related to the retrospective assessment of functional psycholegal capacities.

Conclusions

As noted by Steven Erickson,[48] it is very easy to "blame the brain" when making efforts to use neuroimaging results to explain human behavior. Yet, such reductionistic approaches are unable to provide data that truly address retrospective instances of complex human behavior. As such, even though neuroimaging holds tremendous progress for diagnosing a host of physical and mental health issues, which may positively impact court proceedings and improve lives, these sources of data are not currently sophisticated or sensitive enough for retrospective evaluations of criminal responsibility. Oliver Wendell Holmes, an Associate Justice of the United States Supreme Court in the early 1900s, once famously said that, "even a dog distinguishes between being stumbled over and being kicked." Unfortunately, neuroimaging is not currently able to make such distinctions, limiting its utility for insanity cases.[49] Avoiding "neurohype"[50]and focusing on best practices in forensic psychology and psychiatry for conducting insanity evaluations is the ethical way forward.

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