Brain Scans: Valid Legal Evidence for Criminals?

Christie Ciarlo

In 1966, Charles Whitman, a student at the University of Texas at Austin, climbed to the top of an observation tower and murdered 14 people before being killed by the police. Shortly before the incident, Whitman wrote, "lately (I can't recall when it started) I have been a victim of many unusual and irrational thoughts. These thoughts constantly recur and it requires a tremendous mental effort to concentrate on useful and progressive tasks" [1]. Later, when doctors performed an autopsy on Whitman, they found that he had a malignant brain tumor compressing his amygdala, an area of the brain involved in the regulation of fear and emotional responses.

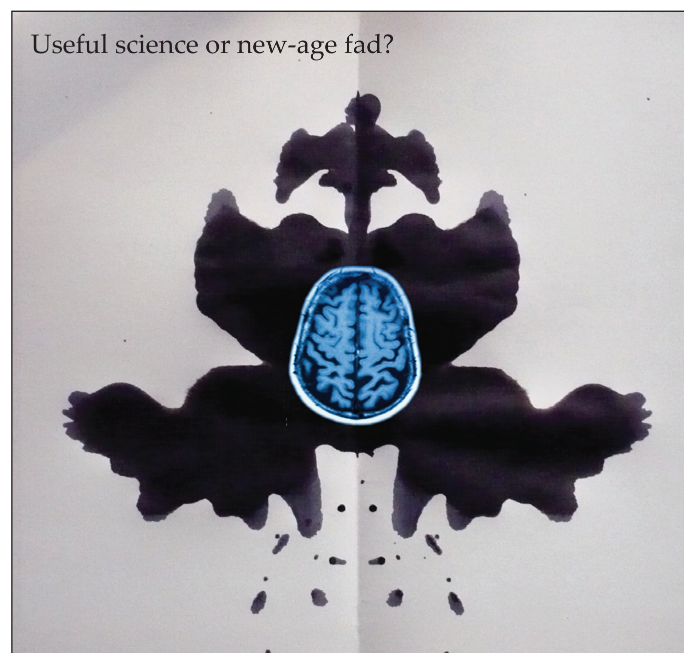
It is easy to jump to the conclusion that the tumor must have caused Whitman's actions, especially considering his writings. Yet experts still disagree as to whether the tumor could have been the cause of Whitman's actions, or if it was even related. If different medical experts interpret the results of a neuroimaging test very differently, is it legitimate to allow them to be presented as evidence to a jury? Even what seems to be a clearly relevant piece of evidence can be denied admittance based on legal standards that require the general acceptance of scientific evidence in its field.

In terms of criminal defense, neuroimaging results have found erratic success and ubiquitous controversy in the United States for the past 25 years. Two relevant legal defenses are the diminished responsibility on the part of the defendant and the excuse of insanity; the validity of each depends upon the definition of pathology, which can be highly variable. Other issues include reproducibility of results and the distinction between association and causality. More fundamentally, brain imaging studies are statistical analyses of groups of people and cannot be directly applied to an individual with certainty. In light of these difficulties, current standards for the admissibility of scientific evidence are insufficient for evaluating the appropriateness of neuroimaging results as evidence in criminal defense.

Diminished Responsibility vs. Insanity

Neuroimaging results have been presented as evidence in both determination of guilt and imposition of punishment. A defense that has been supported by neuroimaging evidence is that of mental impairment as a mitigating circumstance. At least two cases have occurred in the United States in which positron emission tomography (PET) scans have been introduced as evidence of mental impairment and secured a life sentence in place of the death penalty [2]. There have been numerous other cases in which neuroimaging evidence was successfully introduced but failed to sway the jury in favor of the defendant.

A second defense is the excuse of insanity, which has had several notable and somewhat surprising successes involving the use of neuroimaging evidence. The federal test for insanity requires determination of whether "at the time of commission of the acts constituting the offense, the defendant, as a result of severe mental disease or defect, was unable to appreciate the nature and quality of the wrongfulness of his acts" [3]. Most state legislatures have adopted similar rules. The federal test for insanity was implemented as the Insanity Defense Reform Act after the acquittal of John Hinckley, Jr. in 1982. Hinckley shot Ronald Reagan, attempting to assassinate him, and was acquitted based on evidence of brain atrophy. A CT scan indicated that Hinckley had enlarged sulci, or brain grooves, contributing to the suggestion that he was schizophrenic: as Dr. David Bear testified, one-third of schizophrenics have enlarged sulci,



Useful science or new-age fad?

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as compared to 1 in 50 non-schizophrenics [4]. Hinckley was found not guilty by reason of insanity, and after the trial several jurors acknowledged the importance that the psychiatric testimony played in their decision [5]. It seems that in the case of the Hinckley trial the ability for evidence to mislead was commensurate with its usefulness as an indicator of disease.

Interpreting Abnormality

The defenses supported by neuroimaging evidence depend on determining the point at which a neurological abnormality becomes pathological. Without the distinction between abnormality and pathological abnormality (e.g. insanity), one could imagine that the predisposition to violence could be used to argue reduced responsibility on the part of the defendant. The logical end of such reasoning implies a complete overturn of the current standard on which legal punishment is based: the premise of free will. If the distinction between conscious action and mental predisposition is

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neglected, the notion of a fair punishment collapses. Though recent research suggests that the brain may begin to produce actions before intention becomes conscious, the exoneration of criminals based on a predisposition to violent or antisocial behavior would be detrimental to public safety [6, 7].

Determining the boundary of mental pathology has remained a difficult problem faced by psychologists, even with the advent of functional neuroimaging techniques. Computed tomography (CT), a structural neuroimaging technique, is used to produce images similar to traditional x-ray images, which show differential tissue density. Magnetic resonance imaging (MRI) can distinguish tissue types by analyzing the relaxation times of protons in a magnetic field. More recently developed functional neuroimaging techniques such as functional MRI (fMRI), PET, and single photon emission computed tomography (SPECT) produce images indicating metabolic activity in different brain regions based on glucose or oxygen consumption. These images provide a wealth of information not only on the functions of different brain areas but also on time dependent patterns, the significance of which is only beginning to be discovered. However, in terms of identifying disease, neuroimaging has not advanced past the point of association, an issue that played a central role in the Hinckley trial. Certain patterns of brain activity are *associated* with certain diseases, but the associations are not exclusive: healthy individuals may demonstrate these patterns as well.

Diseases whose existence in individuals has been supported by neuroimaging evidence include schizophrenia, bipolar disorder, and obsessive-compulsive disorder. Others have produced evidence of decreased activity or size in an area of the brain, often in the frontal lobe. The frontal lobe includes the prefrontal cortex, an area of the brain that, along with the temporo-limbic region, has been shown to function abnormally in individuals with psychopathic disorders. A main theory of psychopathic disorders points to deficits in anticipation of rewards and punishments, which has been shown to correlate with abnormal prefrontal activity [9]. Studies such as these point to a physical basis for criminal behavior, but neuroscience has no way of determining causality—whether abnormal brain activity can be said to cause violent or anti-social behavior or if the two are inextricably tied.

Admissibility of Scientific Evidence

Standards regarding the admissibility of scientific evidence are referred to in terms of the cases in which they were established: the Frye approach and the Daubert approach [10]. The Frye approach, established in 1923, states that the science upon which evidence is based should have "gained acceptance in the particular field in which it belongs," while the Daubert approach, established in 1993, puts forth four criteria under which the judge should determine admissibility: general acceptance in the relevant scientific community, testability, subjection to peer review and publication, and known or potential error rate. Neuroimaging results have been both admitted and rejected under these rules. For example, in the 2001 case of People v. Protsman, the defense attempted to admit a PET scan demonstrating decreased frontal lobe activity due to traumatic brain injury, but the scan was denied admittance under Frye due to lack of "general acceptance" of the method [2, 10]. On the other hand, in People v. Weinstein (1992), PET scan images, which showed reduced brain function in and around a cyst in the defendant's frontal lobe, were successfully introduced under Frye as evidence that he was not responsible for his actions: Weinstein was charged with manslaughter rather than murder [11, 12].

The fact that the same analytical method was determined to be "generally accepted" by one court and not by another points to the insufficiency of such a standard in determining the appropriateness of neuroimaging in criminal trials. Neuroimaging confounds the idea of general acceptability by prompting the question: the general acceptability of what? It is generally accepted that functional neuroimaging can display levels of metabolic activity, but what those patterns of metabolic activity mean is still largely unverified. It is generally accepted that certain metabolic patterns correlate statistically with disease states, but correlation is not causation, and the consistency of the correlations themselves is far from ideal. This is not to say that neuroimaging should be completely excluded from evidence in criminal trials, for it has the potential to offer valuable insight, especially in the cases of defendants with traumatic brain injuries. Practical rules for the admittance of neuroimaging evidence should include well-demonstrated correlations of results identifying brain structure or activity with brain disease or damage, as well as verification of the significance of these results by multiple unbiased experts.

Science, aided by large data sets, aims to understand by constantly questioning its own theories, which evolve over long periods of time. Law, on the other hand, holds standards based on traditional precedents and aims to judge individuals in a limited time span. These fundamental differences make the introduction of neuroimaging results as legal evidence uniquely challenging. ■

Christie Ciarlo is a senior studying Physics at Brown University.

Join in the debate with our expert panel on Tuesday 21st October, as we discuss:

"Can We Blame Our Brains? Neuroscience in the Courtroom"

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