

On the Use and Misuse of Genomic and Neuroimaging Science in Forensic Psychiatry: Current Roles and Future Directions

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- Neuroimaging • Genetics • Law • Forensic assessment
- MAOA • Legally relevant psychopathology

With rapid advances having been made across multiple levels of genetic, molecular, and cognitive neuroscience, new questions arise as to when, whether, and how this enhanced knowledge of the neurobiological basis of human behavior will affect social institutions such as the criminal justice system. While some of these questions have focused on the potential uses of neuroimaging for lie detection and other forms of mind reading, an additional point of intersection between law and neuroscience resides in forensic psychiatry. As in other areas of psychiatry, the enhanced understanding of brain function offered by novel in vivo imaging technologies holds great promise for improved reliability and validity in diagnosis and assessment. Although we are cautiously optimistic about the longer-term benefits that may accrue from the introduction of neuroscience into the courtroom, the current tools have significant limitations. These caveats must be weighed heavily given the potential of neuroscientific data to

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hold significant prejudicial, and at times, dubious probative, value for addressing questions relevant to criminal responsibility and sentencing mitigation.^{1,2}

This article therefore summarizes, based on the current state of the science, the informational value provided to forensic psychiatry by two key neuroscientific domains with potential relevance to law: neuroimaging and genetics. This article is not intended to be comprehensive in terms of all possible uses of these technologies in any legal context, but rather limits its focus to forensic practice as it relates to the determination of insanity, diminished capacity, and mitigation. The first section reviews the current state of behavioral genetic research as it pertains to what is hereafter termed “legally relevant psychopathology” (LRP); that is, personality traits, behaviors, and diagnoses that may affect such forensic assessments (eg, impulsivity, substance abuse, antisocial personality disorder). The second section reviews basic principles of widely available neuroimaging tools and highlights some of the conceptual and analytical challenges of using these instruments to aid forensic assessment. Finally, in the third section, the authors look toward the future to identify certain trends that may overcome the limitations described in the preceding 2 sections.

FORENSIC GENETICS

On the occasion of the first draft release of the human genome, the full complement of inherited material possessed by the humans, Francis Collins (then the Head of the National Human Genome Research Institute) remarked, “What more powerful form of study of mankind could there be than to read our own instruction book.” Although Collins likely intended this as a general comment on the utility of genetic information for understanding our evolutionary history and shared biology, this statement perhaps encapsulates a sentiment (or hope) that is increasingly held by many in the field of law: that analyzing an individual’s DNA sequence can resolve the mystery of that individual’s past and future behavior. However, whereas technological innovations of the last quarter century have rendered the human genome accessible to scientific inquiry in ways never before thought possible, the ethical, legal, and social implications of the resulting flood of genetic information are far from settled. With respect to the law, interest in the use of genetic information in the courtroom is often centered on two components of forensic psychiatry. First, criminal responsibility, that is, whether or not the genetic makeup of an individual influenced their behavior in such a way as to diminish their level of moral responsibility for a given criminal act, thereby mitigating their criminal liability; and second, criminal prediction, the extent to which information about the genetic makeup of an individual can be useful for determining that individual’s future propensity toward criminality. Although a comprehensive and nuanced discussion of the implications of recent genetic discoveries for specific criminal contexts is beyond our expertise, we highlight several general issues pertaining to human behavioral genetics as a way of setting expectations for what is reasonable for legal thinkers to expect from genetics based on the state of the science.

In weighing the utility of genetic information for the determination of criminal responsibility and risk, it is instructive to contrast the goals of science with the goals of law. Scientific advances often proceed by use of inductive logic, whereby general conclusions are drawn from a collection of individual observations. For example, in genetic association studies, individuals with a certain genotype are grouped together and the frequency of a trait, behavior, or disorder is compared between the genotype groups. A statistically significant difference in the occurrence of that trait, behavior, or disorder between the two genotype groups is taken as an evidence of a positive genetic association. The strength of that association can be considered in terms of

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