Neuroscience, crime and criminal responsibility: Opportunities and challenges for forensic psychiatry

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Dear Editor,

Contemporary neuroscience has significantly expanded the debate on public safety and the possibility of crime prevention through the identification of neurobiological factors associated with antisocial behavior and violence. Structural and functional neuroimaging studies have demonstrated that alterations in frontolimbic circuits—particularly involving the dorsolateral and ventromedial prefrontal cortex, the amygdala, and reward-processing systems—are associated with deficits in inhibitory control, impulsivity, risky decision-making, and reduced sensitivity to punishment, factors frequently related to criminal behavior (Blair, 2013; Raine, 2013).

Nevertheless, caution is warranted to avoid reductionist interpretations. Crime cannot be understood solely as a consequence of brain functioning. Human behavior results from a complex interaction among biological, psychological, social, and environmental factors. Life history, adverse childhood experiences, family dynamics, substance use, socioeconomic adversity, cultural influences, and personality traits all contribute substantially to behavioral outcomes (Rosell & Siever, 2015; van der Gronde et al., 2014). Therefore, neuroscientific evidence should be integrated into a broader biopsychosocial framework rather than interpreted as a deterministic explanation of criminal conduct.

Adolescence and early adulthood represent critical periods of neurodevelopment. The delayed maturation of the prefrontal cortex, responsible for executive functions and self-regulation, contrasts with the earlier activation of subcortical reward and emotional systems. This developmental imbalance contributes to increased impulsivity and risk-taking behavior during youth (Blair, 2013). Such findings are consistent with criminological evidence demonstrating the well-established age–crime curve, according to which criminal behavior peaks during adolescence and early adulthood before declining with age (Farrington, 2003).

General criminal prevention in this context requires evidence-based approaches capable of identifying individuals or groups at elevated risk without resorting to stigmatization or biological determinism. Contemporary risk assessment models, widely employed in forensic psychiatry and criminology, integrate historical, clinical, and contextual variables to estimate the likelihood of future violence or recidivism (Fazel et al., 2012). Neuroscientific findings may contribute to understanding mechanisms underlying impulsivity and aggression; however, they cannot replace comprehensive psychosocial assessment.

Recent contributions published in Psychiatria Danubina reinforce the importance of integrating neuroscientific findings with comprehensive forensic psychiatric assessment. Žarković Palijan et al. (2010) reviewed the relationship between neuroimaging findings, psychiatric comorbidity, and violence risk assessment, emphasizing that neurobiological abnormalities may contribute to violent behavior but should always be interpreted within a broader clinical and social context. Similarly, studies in forensic psychiatry have highlighted the relevance of psychiatric comorbidity, particularly substance-use disorders, in understanding violent offending and recidivism risk (Žarković Palijan et al., 2009). Klopf (2005) discussed psychophysiological and neuropsychological correlates of dangerousness in personality disorders, supporting the view that biological markers may provide complementary information for risk assessment while remaining insufficient as isolated predictors of criminal behavior. More recently, Perito et al. (2024) reported associations between cognitive impairment, impulsivity, and emotional dysregulation among psychiatric patients, including individuals involved in violent offenses, reinforcing the relevance of neuropsychological factors in understanding criminal behavior. Together, these findings support an integrative biopsychosocial model in which neuroscience contributes valuable evidence to forensic evaluation without replacing traditional clinical, psychological, and social analyses.

It is equally important to emphasize that the use of neurobiological markers for preventive purposes must respect strict ethical and legal boundaries. The risks of premature labeling, discrimination, violations of fundamental rights, and reinforcement of existing social inequalities remain significant concerns (Farrington, 2003). Effective prevention should therefore prioritize primary and secondary interventions, including early childhood programs, promotion of socioemotional competencies, social inclusion policies, and adequate treatment of mental and substance-use disorders.

Recent developments in forensic neuroscience and neurolaw have further emphasized that neurobiological evidence may inform, but not determine, legal judgments regarding criminal responsibility and competence. Advances in neuroscience, psychiatry, and legal research may help forensic experts refine their understanding of the relationship between mental disorders,

antisocial behavior, and criminal responsibility. Nevertheless, forensic opinions should continue to rely on comprehensive assessments that include dimensional personality characteristics, psychiatric symptoms, psychosocial functioning, developmental history, family context, educational background, and sociocultural influences. Neuroscience offers valuable insights into the mechanisms underlying human behavior, but criminal responsibility remains a legal and moral construct that cannot be determined by neurobiological findings alone.

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