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Understanding youth antisocial behavior using neuroscience through a developmental psychopathology lens: Review, integration, and directions for research

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ABSTRACT

Youth antisocial behavior (AB) is an important public health concern impacting perpetrators, victims, and society. Functional neuroimaging is becoming a more common and useful modality for understanding neural correlates of youth AB. Although there has been a recent increase in neuroimaging studies of youth AB and corresponding theoretical articles on the neurobiology of AB, there has been little work critically examining the strengths and weaknesses of individual studies and using this knowledge to inform the design of future studies. Additionally, research on neuroimaging and youth AB has not been integrated within the broader framework of developmental psychopathology. Thus, this paper provides an in-depth review of the youth AB functional neuroimaging literature with the following goals: (1) to evaluate how this literature has informed our understanding of youth AB, (2) to evaluate current neuroimaging studies of youth AB from a developmental psychopathology perspective with a focus on integrating research from neuroscience and developmental psychopathology, as well as placing this research in the context of other related areas (e.g., psychopathy, molecular genetics), and (3) to examine strengths and weaknesses of neuroimaging and behavioral studies of youth AB to suggest how future studies can develop a more informed and integrated understanding of youth AB.

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Introduction

A long history of research on children and adolescents has emphasized multiple pathways in the development and maintenance of antisocial behavior (AB) (e.g., Frick & White, 2008; Loeber & Dishion, 1983; Loeber & Stouthamer-Loeber, 1998; Moffitt, Caspi, Dickson, Silva, & Stanton, 1996; Moffitt et al., 2008). This heterogeneous group of behaviors, including physical and sexual aggression, destruction of property, theft, and violation of serious societal rules, has been of particular interest to researchers and the general public because of the large cost to society through their negative impact on perpetrators and victims, the chronic nature and trajectory of AB, and the difficulty in preventing and treating AB (Colman et al., 2009; Odgers et al., 2007; Scott, Knapp, Henderson, & Maughan, 2001). Theories on the etiology of AB from a wide array of disciplines have emphasized the contributions of biological (e.g., neural, hormonal, genetic) and/or environmental (e.g., parenting, poverty, peers) mechanisms, with recent nuanced views emphasizing the complex interplay between these domains of influence (e.g., D'Onofrio, Rathouz, & Lahey, 2011; Guo, 2011; Kendler, 2011b; Reiss, 2005; Rutter, 1997; Sameroff, 2010).

In the past two decades, advances in neuroscience and related biological sciences (e.g., molecular genetics) have furthered our ability to measure specific biological processes involved in psychopathology (e.g., Bogdan, Hyde, & Hariri, 2012; Cole, 2009; Rutter & Dodge, 2011; Stoltenberg & Burmeister, 2000). Improvements in, and greater accessibility of, neuroimaging techniques such as functional magnetic resonance imaging (fMRI) have made studies incorporating these techniques more practical in larger samples, which have increased our understanding of the brain's role in psychopathology (e.g., Dolan, 2008; Hariri, 2009). Recently, research has been initiated that applies functional neuroimaging to the study of AB in both adults and children that can directly address biological theories of AB. For example, studies have linked dysfunction in several brain areas to adult psychopathy (e.g., Yang & Raine, 2008) using a variety of different fMRI paradigms to probe the neural correlates of specific behaviors implicated in psychopathy. Recent studies involving adolescents (Jones, Laurens, Herba, Gareth, & Viding, 2009; Marsh et al., 2008) have linked callous–unemotional (CU) traits (a downward extension of the interpersonal and affective components of the adult psychopathy construct) and AB to specific brain mechanisms, and have integrated these findings within the context of both developmental psychology and neuroscience. The existing studies of neural functioning in youth with AB share several important strengths that can inform our understanding of the neural correlates of AB, but also limitations that could be improved upon in future work. In this vein, the current paper seeks to integrate theory and research from basic neuroscience and developmental psychopathology and suggest future directions for studying the neurobiological mechanisms involved in the development of youth AB. Relevant work from forensic psychology, biological psychiatry, and genetics is incorporated with the goal of integrating converging findings across disciplines so that each area can inform the other.

While several authors have written recent reviews on similar topics (e.g., the neurobiology of psychopathy, the neurobiology of aggression in children: Blair, Peschardt, Budhani, & Pine, 2006a, 2006b; Glenn & Raine, 2008; Kiehl, 2006; Sterzer & Stadler, 2009; Yang & Raine, 2008), most of these reviews have been written more narrowly with the primary goal of describing an author's theory of neural mechanisms involved in AB, with less emphasis on a critical examination of the reviewed studies' methods and results. In contrast, the goals of the current review are as follows: (1) to provide a broad and in-depth literature review of the functional neuroimaging literature as it relates to youth AB with the goal of *evaluating* how this literature has informed our understanding of youth AB at the neural and behavioral level; (2) to evaluate the current neuroimaging studies of youth AB from a developmental perspective with an eye towards integrating research from neuroscience and concepts from developmental psychopathology, as little work has examined how behavioral and neuroimaging studies inform each other and how the integration of these studies may highlight areas for future research; (3) to examine strengths and weaknesses of neuroimaging *and* behavioral studies of youth AB to suggest how future studies can develop a more informed and integrated understanding of youth AB; and (4) to examine how other relevant literatures (i.e., structural MRI of youth AB, neuroimaging in