Developmental Cognitive Neuroscience 19 (2016) 1–18

Contents lists available at ScienceDirect

Developmental Cognitive Neuroscience

journal homepage: http://www.elsevier.com/locate/dcn

Adolescent neurobiological susceptibility to social context

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ARTICLE INFO

Article history:
Received 16 November 2014
Received in revised form
18 November 2015
Accepted 19 December 2015
Available online 25 December 2015

Keywords:
Adolescence
Brain development
Social environment
Neuroimaging
Individual differences

ABSTRACT

Adolescence has been characterized as a period of heightened sensitivity to social contexts. However, adolescents vary in how their social contexts affect them. According to neurobiological susceptibility models, endogenous, biological factors confer some individuals, relative to others, with greater susceptibility to environmental influences, whereby more susceptible individuals fare the best or worst of all individuals, depending on the environment encountered (e.g., high vs. low parental warmth). Until recently, research guided by these theoretical frameworks has not incorporated direct measures of brain structure or function to index this sensitivity. Drawing on prevailing models of adolescent neurodevelopment and a growing number of neuroimaging studies on the interrelations among social contexts, the brain, and developmental outcomes, we review research that supports the idea of adolescent neurobiological susceptibility to social context for understanding why and how adolescents differ in development and well-being. We propose that adolescent development is shaped by brain-based individual differences in sensitivity to social contexts – be they positive or negative – such as those created through relationships with parents/caregivers and peers. Ultimately, we recommend that future research measure brain function and structure to operationalize susceptibility factors that moderate the influence of social contexts on developmental outcomes.

Contents

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http://dx.doi.org/10.1016/j.dcn.2015.12.009

1. Introduction

Development proceeds through an intricate weaving of inherent, biologically-guided mechanisms and one's experiences, good and bad. While much behavioral research shows that adolescence is a developmental period characterized by heightened sensitivity to social experiences in particular (e.g., peer interactions), recent reviews of neuroimaging-based evidence corroborate this characteristic of adolescence (Blakemore and Mills, 2014; Burnett et al., 2011; Crone and Dahl, 2012; Nelson and Guyer, 2011; Nelson et al., 2005; Pfeifer and Allen, 2012; Somerville, 2013). Among the behavioral changes unique to adolescence relative to childhood or adulthood are increased self-consciousness, greater orientation away from parents and toward peers, heightened sensitivity to social acceptance, increased risk-taking especially in the presence of peers, and greater emergence of mental health problems that hinder social functioning. These characteristics may partially reflect maturational changes in how the adolescent brain codes and generates responses to social information (Nelson and Guyer, 2011; Steinberg, 2008). Therefore, individual differences in the structural growth and functional fine-tuning of neural circuitry that underpins social-cognitive and affective processing may relate to adolescents' increased and differential sensitivity to social influences (Davey et al., 2008; Nelson and Guyer, 2011). Indeed, highly salient and impactful social contexts in adolescence, such as being embedded in hostile parent-child interactions or in exciting, accepting peer environments, likely interact with neurobiologically-based individual differences in shaping subsequent outcomes.

Theoretical frameworks concerning neurobiological susceptibility (Ellis et al., 2011), also known as biological sensitivity to context (Boyce and Ellis, 2005), differential susceptibility to environmental influences (Belsky et al., 2007; Belsky and Pluess, 2009), and sensory processing sensitivity (Aron and Aron, 1997), provide a valuable model for considering how an adolescent's level of neurobiological sensitivity might moderate the influence of social contexts on development. These models suggest that individuals vary in their sensitivity to their environments, with some more affected than others. An implication of this is that individuals who are particularly sensitive to adverse social environments are also those that are most responsive to supportive social environments. At the same time, several models of adolescent brain development have suggested that changes in brain-based social sensitivity during adolescence promote developmental trajectories that range from a successful transition to adulthood to those culminating in psychopathology or maladaptation. We propose that considering an adolescent neurobiological susceptibility to social context framework (Figs. 1 and 2), derived from extant models of neurobiological susceptibility and adolescent neurodevelopment, will yield a fuller characterization of biological susceptibility. By incorporating brain function and structure parameters that might reflect the neural instantiation of this sensitivity, future work can characterize not only those individuals at greatest risk for negative outcomes but also those most likely to benefit from supportive social contexts.

In this review, we examine evidence from the neuroimaging literature that supports the ideas that adolescence is a period of heightened neurobiological sensitivity to social context and that

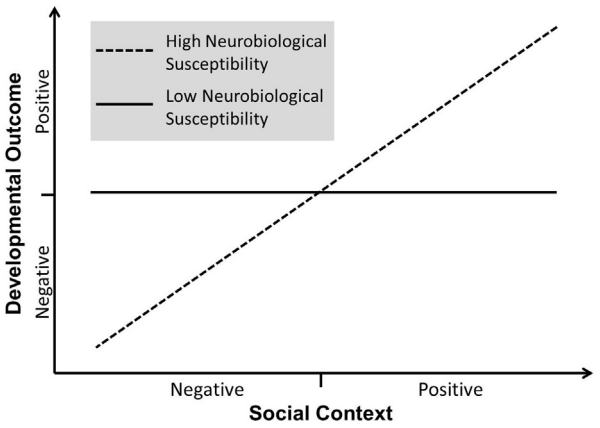

Fig. 2. Graphical representation of the moderated effect of social context on developmental outcomes in accordance with adolescent neurobiological susceptibility. The x-axis represents variation in social contextual factors from negative to positive (e.g., harsh vs. supportive parenting; peer victimization vs. support); the y-axis represents variation in developmental outcomes from negative to positive (e.g., high vs. low or absent depressive symptoms); and the two lines represent groups differing on adolescent neurobiological susceptibility, high vs. low. Moderation by adolescent neurobiological susceptibility is shown in that the relation between susceptibility and developmental outcomes is significant at both ends of the social-contextual influence.

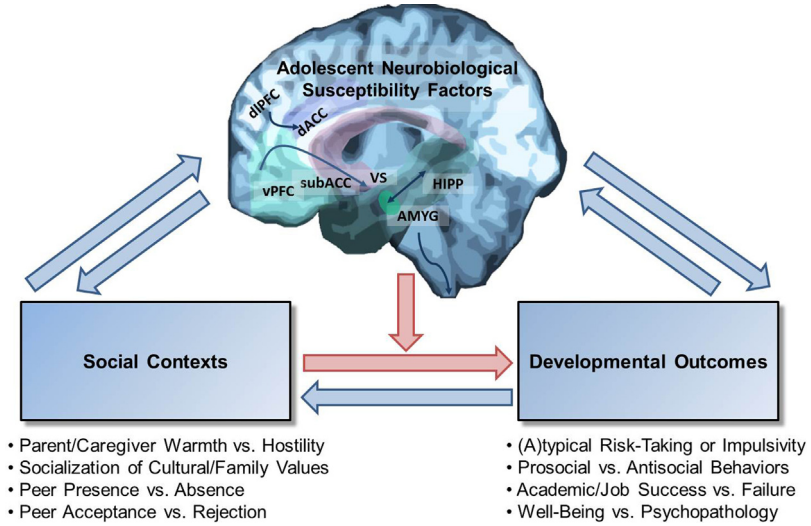

Fig. 1. Conceptual model depicting our proposed adolescent neurobiological susceptibility to social context framework, whereby the manner and extent to which social contexts shape developmental outcomes is moderated by adolescents' susceptibility to social context as indexed by brain characteristics (e.g., function, structure). The pink arrows represent the moderated link from social context to developmental outcomes. The blue arrows represent additional bidirectional links among components of the model, which, although important, are not the focus of the proposed framework. Amygdala = AMYG; dorsal anterior cingulate cortex = dACC; dorsolateral prefrontal cortex = dlPFC; hippocampus = HIPP; subgenual anterior cingulate cortex = subACC; ventral prefrontal cortex = vPFC; ventral striatum = VS.