Developmental Cognitive Neuroscience 25 (2017) 260–271

Contents lists available at ScienceDirect

Developmental Cognitive Neuroscience

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

# But is helping you worth the risk? Defining Prosocial Risk Taking in adolescence

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ARTICLE INFO

*Article history:*
Received 16 April 2016
Received in revised form
28 November 2016
Accepted 30 November 2016
Available online 6 December 2016

*Keywords:*
Prosocial risk taking
Prosocial
Risk taking
Social sensitivity
Adolescence
Social brain

ABSTRACT

Recent work has shown that the same neural circuitry that typically underlies risky behaviors also contributes to prosocial behaviors. Despite the striking overlap between two seemingly distinct behavioral patterns, little is known about how risk taking and prosociality interact and inform adolescent decision making. We review literature on adolescent brain development as it pertains to risk taking and prosociality and propose a new area of study, Prosocial Risk Taking, which suggests that adolescents can make risky decisions with the intention of helping other individuals. Given key socialization processes and ongoing neurodevelopmental changes during this time, adolescence may represent a sensitive period for the emergence of Prosocial Risk Taking, especially within a wide variety of social contexts when youth's increased sensitivity to social evaluation and belonging impacts their behaviors. Prosocial Risk Taking in adolescence is an area of study that has been overlooked in the literature, but could help explain how ontogenetic changes in the adolescent brain may create not only vulnerabilities, but also opportunities for healthy prosocial development.



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http://dx.doi.org/10.1016/j.dcn.2016.11.008

## 1. Introduction

For decades, adolescence has been characterized as a time of "storm and stress" that is often associated with a heightened risk of engaging in negative, health-compromising behaviors (Arnett, 1999; Hall, 1904). However, researchers have recently shifted their attention towards investigating the positive aspects of adolescent development in order to better understand the factors promoting well-being (Lerner et al., 2005; Telzer et al., 2014). This latter focus underscores adolescence as not only a period of vulnerability for negative behaviors, but also a period of opportunity for healthy development (Dahl, 2004). Recent work combining theoretical and methodological approaches from developmental science, cognitive neuroscience, and social psychology illustrate that negative, risk-taking behaviors and positive, prosocial behaviors rely on overlapping neural circuitry (Telzer, 2016) and that these behaviors increase in adolescence, in part, due to changes in neural circuitry around the time of puberty. In fact, while theory and research on risk taking and prosocial behavior have been extensively discussed and well defined in the literature, the intersection of these two constructs has not been introduced to the field. This gap in the literature highlights the complexity of studying brain and behavior relationships during adolescence, whereby simpler models of adolescent brain development may fail to capture important interactions between affective, cognitive, and social processes that affect developmental outcomes (Crone and Dahl, 2012; Pfeifer and Allen, 2012).

To contribute to this increasingly interdisciplinary research on adolescent neurodevelopment, the current review proposes a new area of study called Prosocial Risk Taking, which emerges at the intersection of risk taking and prosociality. Prosocial Risk Taking considers how these two well-defined adolescent behaviors overlap to address an intriguing possibility: do adolescents *take risks to benefit others*? By moving beyond traditional methods examining risk taking and prosociality separately and focusing instead on how these behaviors interact and vary across social contexts, we may gain a more nuanced understanding of the complex psychosocial and neurobiological factors that influence adolescent decision-making. Prosocial Risk Taking challenges the widely-supported model of adolescence as a period of heightened vulnerability by suggesting that traditionally negative behaviors, like risk taking, could foster positive social development if those risks are taken to benefit others. Indeed, exciting advances in the field of developmental cognitive neuroscience often emerge from studying the cognitive, social, *and* neurodevelopmental processes by which they occur, highlighting the need to integrate multiple behavioral constructs to gain a more comprehensive understanding of adolescent development.

Before expanding on our definition of Prosocial Risk Taking, it is important to review the existing adolescent literature guiding the development and framework of the proposed area of study. First, we discuss prominent neurodevelopmental and social changes in adolescence, rendering it a sensitive period for cognitive, social, and affective processing. Second, we review the literature on adolescent risk taking and prosocial behavior, highlighting similarities in their developmental trajectories, underlying neural systems, and socialization processes. While prior reviews have summarized the risk taking literature (e.g., Crone et al., 2016), our review on prosocial development will be the first to synthesize behavioral and neuroimaging evidence in support of the emerging model of adolescence as a period of opportunity for positive, healthy behaviors. Third, we integrate these literatures to describe our proposed area of study, with a particular emphasis on its possible neural underpinnings. Finally, we discuss prospective methods of measuring Prosocial Risk Taking and its implications on developmental outcomes during adolescence..

## 2. Neurodevelopment and social sensitivity during adolescence

Adolescence is marked by complex biological and psychological transformations that underlie a wide range of behaviors (Nelson et al., 2005, 2016; Spear 2011). Specifically, adolescent neurodevelopment is characterized by a rapid maturation and hyperreactivity of the ventral affective system, which includes the ventral striatum (VS) and amygdala (Hare et al., 2008; Monk et al., 2003; Galván et al., 2006). Activation in the VS is implicated in motivation and reward processing (Somerville et al., 2010; Casey, 2015), shows developmental peaks in activation during adolescence (Galván et al., 2006), and is thought to underlie adolescent-specific increases in novelty seeking and approach behaviors (Telzer, 2016; Silverman et al., 2015). The amygdala plays a role in the detection of meaningful and salient stimuli, especially socioemotional ones (e.g., Guyer et al., 2008a,b; van Bavel et al., 2008), and shows adolescent-specific peaks in response to negatively-valenced stimuli (Hare et al., 2008) but hypoactivation in response to the omission of rewarding stimuli (Ernst et al., 2005).

In contrast to the ventral affective system, the prefrontal cortex (PFC), which is involved in cognitive control, shows protracted development into the second decade of life (Spear 2000, 2011; Lebel et al., 2008; Tamnes et al., 2010). As a result, relatively hypersensitive affective systems in conjunction with a still maturing cognitive control system may render adolescents susceptible to poor behavioral and emotional regulation (Steinberg, 2010; Strang et al., 2013; Silvers et al., 2012). Indeed, extant literature demonstrates that these neurodevelopmental processes in adolescence contribute to greater rates of health compromising behaviors in humans (Somerville et al., 2010; Casey et al., 2011), as well as non-human primates (Fairbanks, 1993) and rodents (Spear, 2000, 2011).

In addition to changes in affective and inhibitory control systems, adolescence is a sensitive developmental phase for social cognitive processing (Blakemore and Mills, 2014). Significant structural and functional changes occur in the social brain network during adolescence (Mills et al., 2014a; Blakemore and Mills, 2014), which is comprised of the temporoparietal junction (TPJ), posterior superior temporal sulcus (pSTS), dorsomedial and medial prefrontal cortices (dmPFC, mPFC), and other cortical midline structures such as the medial posterior parietal cortex (mPPC; see Pfeifer and Peake, 2012 for an expanded characterization of the social brain). Numerous studies have found that teenagers exhibit increased activation in social brain circuitry relative to adults or children when processing social cognitive information, which may differ across social contexts (e.g., peers, parents) (Blakemore and Mills, 2014; Somerville et al., 2013). For example, the mere thought of being watched by peers uniquely induces self-conscious emo-