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The triadic systems model perspective and adolescent risk taking

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ABSTRACT

In this special issue, Ernst (2014) outlines the triadic systems model, which focuses on the balanced interaction among three functional neural systems: the prefrontal cortex (regulation/control), striatum (motivation/approach), and amygdala (emotion/avoidance). Asynchrony in maturation timelines, coupled with less mature connectivity across brain regions, is thought to result in unique vulnerabilities for risk taking during the adolescent age period. Yet, the research evidence linking the triadic systems model to differences in risk taking across adolescence and adulthood is equivocal, and few studies have examined how neural development is associated with real-world behavior. In this commentary, we outline research on adolescent risk taking which highlights the importance of considering trait level and situational conditions when examining associations between neural systems and behavior, as well as the need to adopt a lifespan perspective.

1. Introduction

Recent research indicates that brain maturation and the strengthening of neural connections among brain regions continues throughout adolescence and into young adulthood (Dosenbach, Petersen, & Schlaggar, 2013; Geier & Luna, 2009). These findings have sparked renewed interest in the adolescent age period and have led neuroscientists to explore how neural development might be linked to adolescent motivated behavior (e.g., risk taking; Ernst, Pine, & Hardin, 2006). In this issue, Ernst (2014) outlines the triadic systems model (TSM), which focuses on the balanced interaction among three neural systems: the prefrontal cortex (regulation/control), striatum (motivation/approach), and amygdala (emotion/avoidance). Ernst suggests that these systems mature along different timelines, and that this asynchrony, coupled with less mature connectivity across brain regions, may be implicated in adolescent risk taking.

Ernst (2014) acknowledges that research linking the TSM to differences in risk taking behavior across adolescence and adulthood is inconsistent, and suggests that researchers focus on the interactions between neural systems and trait level or situational conditions (e.g., social context). We agree, and in this commentary we introduce four questions (which are outlined in depth in our full article in this issue) that elucidate why, from a social developmental perspective, it is important to consider trait level and situational factors.

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Question 1: Are the increases in mortality and morbidity from childhood to adolescence as dire as often implied?

Many researchers (e.g., Dahl, 2004) underscore concerns about adolescent risk taking by highlighting the significant increases in morbidity and mortality rates from childhood to adolescence (e.g., National Vital Statistics Report, 2012). It is important to note, however, that the survival rate of high school students in North America is 99.96%. Furthermore, rates of unintentional injuries and inpatient hospital visits during adolescence are relatively low, and can be partially accounted for by adolescents' increased involvement in organized sports (Cheng et al., 2000). Overall, the increases in mortality and morbidity from childhood to adolescence are very small. Furthermore, mortality rates continue to rise from adolescence to young adulthood, which casts doubt on the claim that adolescents might be particularly vulnerable.

Question 2: Does the peak age of involvement in real-world risk taking correspond to predictions based on the triadic systems model of brain development?

The asynchrony in maturity between the striatum/amygdala and regulatory systems is most pronounced in middle adolescence, and leads to the hypothesis that risk taking also should peak in middle adolescence (Steinberg, 2008). This hypothesis has not been empirically supported by longitudinal data examining real-world risk taking. Adolescents, on average, engage in low levels of risk taking behaviors (e.g., alcohol consumption, marijuana use), and involvement in these behaviors tends to increase linearly over time rather than peaking in middle adolescence (Hooshmand, Willoughby, & Good, 2012). Instead, the peak of risk-taking involvement occurs when individuals are in their early 20s (O'Malley and Johnston, 2002). These results call into question the specificity of adolescence as an age period when risk behaviors are typical, and highlight the importance of understanding how the social context (e.g., social norms and opportunities supporting risk taking in university/college versus high school) may constrain and/or facilitate risk behavior across the lifespan.

Furthermore, Ernst (2014) states that adolescence represents an age period of "unique vulnerability to mental problems" (pg 1). Yet, although adolescence may represent a period of increased risk for the onset of mental disorders (Costello et al., 2002), the lifetime prevalence of many mental disorders continues to increase into adulthood (Kessler et al., 2005). Adults have higher rates of many psychiatric disorders than adolescents, including mood disorders, (Statistics Canada, 2013), schizophrenia (Goeree et al., 2005), and deaths by suicide (Nock et al., 2008). Thus, the hypothesis based on the TSM that adolescents may have *unique* vulnerability to risk taking and mental problems needs to be reconciled with the frequency of these problems across the lifespan.

Question 3: Is risk taking necessarily unregulated?

The TSM assumes that risk taking in adolescence is often impulsive. We contend, however, that risk taking is not always unregulated or impulsive, but might be *planned* in certain contexts (see Reyna & Farley, 2006). Adolescents may even deliberately engage in risk behaviors in order to gain social rewards in spite of aversions to risk. For example, alcohol consumption may result in strong social rewards for adolescents (e.g., easing social inhibitions, encouraging acceptance from peers), and individuals may enact self-control in order to "overcome" a distaste for alcoholic beverages so that they can gain such rewards (Rawn & Vohs, 2011). Thus, adolescents may deliberately take risks to gain benefits.

Question 4: What differs between adolescent and adult risk taking?

Adults, like adolescents, engage in risk behaviors (e.g., gambling, infidelity, binge drinking, overeating, Cano & O'Leary, 2000; Foster, Clark, Holstad, & Burgess, 2012). The assumption of the TSM that approach/avoidance and control systems govern motivated behavior is consistent with dual process models of adult decision making (e.g., Hofmann, Friese, & Strack, 2009; Kahneman, 2011), which posit that there is a fast, intuitive, automatic system ("system 1"), and a slow, controlled, reflective system ("system 2") that direct behaviors to varying degrees depending on trait-level characteristics (e.g., whether the individual has high trait self-control) and situational conditions. Friese, Hofmann, and Wanke (2008) suggest, for example, that system 1 tends to control behavior under conditions when willpower or self-control resources have been recently depleted. It is likely, however, that the situational factors that affect whether self-control is depleted may differ for adolescents as compared to adults. For example, the presence of peers may deplete adolescents' willpower more than adults (Gardner & Steinberg, 2005), but there might be other situations that deplete adults' willpower more than adolescents. Indeed, age differences in risk taking may be due less to asynchrony in brain development timelines than to differences between adolescents and adults in the situational factors that they find tempting or rewarding.

In conclusion, we agree with Ernst (2014) that it is critical that future studies examine how associations between configurations of the neural systems and behavior are moderated by situational conditions (e.g., task demands, goals) and trait-level characteristics. Ideally, this research needs to be embedded in long-term longitudinal studies which include diverse samples across the lifespan.

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