Personality and Individual Differences 111 (2017) 58–64

Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

Understanding deviance through the dual systems model: Converging evidence for criminology and developmental sciences

Alexander T. Vazsonyi *, Albert J. Ksinan

Department of Family Sciences, University of Kentucky, 316 Funkhouser Building, Lexington, KY 40506, USA

ARTICLE INFO

Article history:
Received 25 October 2016
Received in revised form 22 January 2017
Accepted 23 January 2017
Available online 6 February 2017

Keywords:
Sensation seeking
Impulsivity
Impulse control
Adolescence
Discrepancy
Dual systems model
Problem behaviors

ABSTRACT

According to the dual systems model, adolescent risk-taking is related to asynchronous development of two distinct neurobiological subsystems; this difference leads to a discrepancy or gap that is responsible for an increased propensity for risky behaviors among youth. The current study a) replicated Steinberg et al.'s (2008) findings based on a large, cross-cultural sample; b) tested for potential sex differences in the development of sensation seeking and impulsivity over time; c) tested whether the discrepancy (or gap) between the two traits was associated with deviant behaviors. Based on 15,839 adolescents and young adults from eleven countries, findings largely support basic tenets of the model, among them (1) the sudden increase in sensation seeking, (2) important differences in the quasi-developmental course of risk seeking and impulsivity (impulse control) in male versus female youth, and (3) that the gap between the two is strongly associated with deviance. Findings are discussed in terms of their implications for the age-crime curve and associated conceptual work in criminology focused on maturational reform or crime desistance.

1. Introduction

From a health and well-being perspective, adolescence could be considered a paradoxical developmental period. On the one hand, adolescents' mental capacities become more powerful, effective, and flexible as compared to children, yet, they are also more vulnerable. This heightened vulnerability manifests itself through a surge in risky and health compromising behaviors. This change is particularly paradoxical as cognitive capacities greatly surpass the ones of children and nearly match the ones of adults (Dahl, 2004; Steinberg, 2007). The dual systems model was proposed as an explanation for these behaviors. The current study tested this model, namely whether impulsivity (impulse control) and sensation seeking levels differ during adolescence (also by sex) and whether this discrepancy (gap) was associated with deviance.

2. The dual systems model

Proposed by Steinberg and colleagues (Steinberg, 2007; Steinberg et al., 2008), the dual systems model identifies two distinct neurobiological subsystems as underlying the surge in risky behaviors during adolescence, the cognitive control and the socioemotional systems. The former includes the prefrontal cortex and connecting parts of anterior cingulate cortex (Casey & Jones, 2010; Steinberg, 2007) and is related to executive functioning (planning, decision making, impulse control). The latter refers to an ability to exert self-control to avoid engaging in risky behaviors. This is conceptually consistent with self-control theory, which has inspired a wealth of criminological and developmental research over the past two decades (e.g., Vazsonyi, Mikuska, & Kelley, 2016).

The socioemotional system responds to emotions, thrills, social cues, and seeks sensations (rewards) in the environment. During adolescence, the brain undertakes a process of remodeling, particularly its dopaminergic system related to reward seeking. This leads to a "dominance" of this system and creates a period of heightened risk/vulnerability as the cognitive control system develops more slowly and matures later (Casey, Jones, & Hare, 2008; Ernst, Romeo, & Andersen, 2009; Steinberg, 2007). Furthermore, adolescents are largely un-skilled in dividing attention to both systems which might give an advantage to the socioemotional one, but also creates a gap responsible for heightened risky behaviors (Casey & Jones, 2010; Casey, Jones, & Somerville, 2011). This gap serves as an explanatory framework and is the basic premise and focus of the dual systems model.

2.1. Empirical efforts testing the dual systems model

The dual systems model has been tested in several studies. Steinberg et al. (2008) used cross-sectional, self-reported measures of impulsivity as a trait representing the reverse of the cognitive control system and sensation seeking as a trait representing the socioemotional system to assess their relative levels in a large sample of participants between the ages of 10 and 30 years. Results showed that impulsivity declined

* Corresponding author.
E-mail addresses: vazsonyi@uky.edu (A.T. Vazsonyi), albert.ksinan@uky.edu (A.J. Ksinan).

http://dx.doi.org/10.1016/j.paid.2017.01.030
0191-8869/

linearly with age, whereas sensation seeking followed a quadratic function, steadily increasing from early adolescence to a peak around age 13, followed by a decline. Harden and Tucker-Drob's (2011) study used a longitudinal sample (ages 12 to 24) and found quadratic developmental changes for both constructs. Whereas impulsivity steadily declined into the early twenties, sensation seeking increased during early adolescence, peaking around age 16, followed by a decline. Quinn and Harden's (2013) study evaluated these changes and whether they explained increases in substance use. Slower decline of impulsivity from adolescence to early adulthood was related to increases in all types of substances while declines in sensation seeking were associated with increased alcohol use only.

2.2. Sex differences

Shulman, Harden, Chein, and Steinberg (2015) assessed sex differences in both subsystems, also documented elsewhere (Cross, Copping, & Campbell, 2011; Cross, Cyrenne, & Brown, 2013). Males reported higher levels of impulsivity and sensation seeking compared to females. For both, there was a sudden increase in sensation seeking during adolescence, followed by a decline, while impulsivity steadily and linearly declined. Based on the same sample, Shulman, Harden, Chein, and Steinberg (2016) longitudinally traced the developmental course of both subsystems from early adolescence into young adulthood (age 12–25) and found that the two appeared to develop independently, again supporting the dual systems model.

3. Current study

The current study sought to partially replicate some of the original findings from Steinberg et al.'s (2008) work on the developmental course of the associations between impulse control and sensation seeking. Secondly, like Shulman et al. (2015), it examined whether developmental changes were similar or different by sex. Third, it examined the extent to which the discrepancy score (or gap) predicted deviant behaviors, ranging from vandalism to interpersonal violence. With some exceptions (e.g., Quinn & Harden, 2013), few studies have examined the importance of the dual systems model for explaining variability in problem behaviors and deviance. Since the main contribution of the current study is the focus on predictive utility of the dual systems model, we tested both impulsivity, consistent with the original work by Steinberg and colleagues, as well as impulse control (simply the reverse), in line with an operationalization of the developing cognitive control system.

It was hypothesized that an increase in sensation seeking during middle adolescence would be observed, followed by a decline in both female and male youth. On the other hand, it was expected that impulsivity would decline, but not in a simple linear fashion. Harden and Tucker-Drob (2011) observed a quadratic effect for both variables, while Shulman et al. (2015) found significant cubic terms. Thus, in contrast to Steinberg et al.'s (2008) original proposition, it was expected that both sensation seeking and impulsivity would decline quadratically, with the possibility of significant cubic effects. We also hypothesized that male youth would report higher levels of both sensation seeking and impulsivity in comparison to female adolescents across age groups. Lastly, we hypothesized that the gap would be predictive of deviant behaviors; more specifically, the "dominance" of sensation seeking over impulse control would be positively associated with deviance.

4. Method

4.1. Sample

The data were collected as part of the International Study of Adolescent Development and Problem Behaviors (ISAD). More information about this study and data collection process can be found in Vazsonyi, Pickering, Junger, and Hessing (2001). The current study includes cross-sectional data from 16,266 participants from 11 countries, namely China ($n = 1350$), Czech Republic ($n = 1222$), Hungary ($n = 871$), Japan ($n = 355$), the Netherlands ($n = 1315$), Slovenia ($n = 1422$), Spain ($n = 1030$), Switzerland ($n = 4018$), Taiwan ($n = 1443$), Turkey ($n = 1027$), and United States ($n = 2213$). For the current analyses, a decision was made to limit the age to 28 years or younger, which resulted in dropping 177 cases. A total of 250 participants did not report their sex and thus were removed from further analyses. This resulted in a final study sample of 15,839 participants (mean age = 17.66, $SD = 2.41$) which included 8034 male (50.7%) and 7805 female adolescents and young adults (49.3%; see Table 1).

4.2. Measures

4.2.1. Background and control variables

Analyses included a number of background variables, namely age, sex, family structure (0 = two-parent family, 1 = other), SES (standardized index of highest attained maternal education, paternal education, and annual family income; see Table 1), and nationality (individual countries were dummy-coded with US as the reference).

4.2.2. Impulsivity

Impulsivity was measured by five items part of the impulse control subscale from Weinberger's Adjustment Inventory (Weinberger & Schwartz, 1990); to distinguish impulse control and sensation seeking, we followed a similar method as described by Steinberg et al. (2008) and carefully evaluated the face validity of items to distinguish ones that clearly measured impulse control. The following five were included: "I do things without giving them enough thought," "I become 'wild and crazy' and do things other people might not like," "When I'm doing something for fun (for example, partying, acting silly), I tend to get carried and go too far," "I say the first thing that comes into my mind without thinking enough about it," and "I stop and think things through before I act" (reverse coded). All items were rated on a 5-point Likert-type scale, ranging from *strongly disagree* (1) to *strongly agree* (5). The average score was 2.48 ($SD = 0.69$, range 1–5), and the reliability was $\alpha = 0.67$ (range: 0.56 to 0.72). Again, in some analyses

Table 1
Descriptive statistics of demographic variables by sample.

Mean age (*SD*)	17.66 (2.41)
Sex	
Males	8034 (50.7%)
Females	7805 (49.3%)
Family structure	
Two biological parents	13,147 (83.6%)
Other	2573 (16.4%)
Father's education[a]	
Elementary school	3396 (21.7%)
High school	5095 (32.6%)
Some college	2003 (12.8%)
Undergraduate degree	2310 (14.8%)
Graduate degree	1992 (12.7%)
Mother's education[a]	
Elementary school	4162 (26.7%)
High school	5608 (35.9%)
Some college	2004 (12.8%)
Undergraduate degree	2085 (13.4%)
Graduate degree	1075 (6.9%)
Family income[a]	
20 K or less	2258 (15.2%)
20 K to 35 K	4301 (28.9%)
35 K to 60 K	4081 (27.4%)
65 K to 100 K	2578 (17.3%)
100 K or more	1669 (11.2%)

The percentage is of valid responses until otherwise noted (see below).
[a] Father's education: the response "does not apply" selected by 812 respondents (5.2%), missing 231 cases (1.4%); Mother's education: the response "does not apply" selected by 673 respondents (4.3%), missing 232 cases (1.4%); Family income: missing 1377 cases (8.5%).