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Are rash impulsive and reward sensitive traits distinguishable? A test in young adults

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Abstract

Adolescents and young adults are characterized as prone to risky behavior with a wide range of traits identified as predictors of individual differences in this behavior. Here we test a crucial difference between traits that reflect *rash impulsivity*, the tendency to engage in risky behavior without consideration of consequences, versus *reward sensitivity*, the tendency to be attracted to novel and rewarding experience. To test the validity of this distinction, we examined the factorial structure of eight risk-related traits in a sample of 899 18 to 22 year-olds. We predicted that rash impulsive traits would be separable in structure from reward sensitive traits and would uniquely predict relatively maladaptive risk-taking (e.g., drug use). In addition, we predicted that reward sensitive traits would be related to both adaptive (e.g., entering competitions) and maladaptive risk behaviors. Results revealed a factorial structure that distinguished these traits, with rash impulsive and reward sensitive traits uniquely predictive of different forms of risk-taking. The results suggest that it is possible to distinguish traits that reflect these two forms of risk-taking with implications for the measurement and interpretation of risk propensities in youth.

Keywords

Risk-taking; Rash impulsivity; Reward sensitivity; Adolescence and young adulthood

1. Introduction

Adolescence and young adulthood are transition periods characterized by elevated risk-taking behaviors relative to later adulthood (Arnett, 1992). One common neurobiological

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explanation for this increase in risk-taking is that the prefrontal cortex, which supports cognitive control, is underdeveloped in comparison to reward processing brain regions that motivate impulsive behavior (Galvan et al., 2006; Steinberg, 2008). Despite potential developmental differences between adolescents and adults, not all forms of reward-seeking are impulsive. A two-factor model posits that some forms may be better characterized as *reward sensitive*, which can be distinguished from *rash impulsiveness*, defined as the inability to control oneself when engaging in rewarding activities, despite potential negative consequences (Dawe, Gullo, and Loxton, 2004; Dawe and Loxton, 2004; Reyna et al., 2011). Reward sensitivity is defined as a more general tendency motivated by the dopamine reward system to seek novel and exciting experiences (Dawe and Loxton, 2004; Wahlstrom, Collins, White, and Luciana, 2010). However, the reward system is also a source of rash impulsiveness (Buckholtz et al., 2010; DeYoung, 2013), which makes it difficult to separate these two risk-taking tendencies.

Distinguishing these two tendencies has important implications for designing interventions (Reyna and Farley, 2006; Romer et al., 2011). Individuals guided by the prospect of achieving rewarding goals may weigh the benefits of risky behavior more heavily than the costs, making them more attracted to such behavior (Reyna and Farley, 2006). For others, heightened activation of the reward system may be accompanied by reduced ability to control risk-taking, and these individuals may be better characterized as exhibiting rash impulsive tendencies.

Consistent with the theoretical distinction between reward sensitive and rash impulsive personalities, one would expect differences in their typical forms of risk-taking behaviors. Although risk-taking can be mal-adaptive and lead to poor outcomes, some risk-taking can serve adaptive purposes (Pfeifer and Allen, 2012). For example, entering a competition can be considered a risky activity that could result in failure. Yet, such risk-taking is more adaptive than, for example, repeatedly engaging in unprotected sex or using drugs, and may be important for attaining achievement-oriented goals. Thus, the reward system can serve both as a vulnerability for maladaptive risk-taking outcomes (e.g., STD from unprotected sex) as well as an opportunity for adaptive outcomes (e.g., winning an award in a competition) (Telzer, 2016). What determines which of these goals individuals typically pursue may depend on their ability to regulate this system when faced with risks that may lead to poorer outcomes (Telzer, 2016; Wahlstrom et al., 2010).

Below we review eight reward-seeking traits that are hypothesized to reflect reward sensitivity or rash impulsiveness and their associations with different forms of youth risk-taking.

1.1. Reward sensitivity

The behavioral activation system (BAS) has been identified as the neurobiological system underlying reward sensitivity and activation of dopaminergic pathways (Carver and White, 1994; Gray, 1981). Three subscales assess subtraits within the BAS: *reward responsiveness* (“positive responses to the occurrence or anticipation of reward”); *drive* (“persistent pursuit of desired goals”); and *fun-seeking* (“desire for new rewards and a willingness to approach a potentially rewarding event on the spur of the moment”). Similarly, sensation seeking (SS),

the tendency to seek out novel and exciting experiences, is another trait reflecting reward sensitivity (Chambers, Taylor, and Potenza, 2003; Zuckerman, 1994), although it may reflect rash impulsiveness too (Dawe and Loxton, 2004). BAS and SS have been linked to potentially harmful risk-taking, such as drug and alcohol abuse, dangerous driving, smoking, and risky sex (Franken and Muris, 2006; Hoyle, Fejfar, and Miller, 2000; Reyna et al., 2011; Zuckerman, 1994). However, BAS also has been related to adaptive risk-taking associated with goal-striving (Alloy et al., 2012) and adaptive psychological outcomes such as greater hope (Harnett, Loxton, and Jackson, 2013) and less loneliness (Clark, Loxton, and Tobin, 2015). Similarly, SS may be related to increased working memory, IQ, and cognitive control (Dawe and Loxton, 2004; Romer et al., 2011; Zuckerman, 1994).

1.2. Rash impulsiveness

Drawing from animal research (Winstanley, Olausson, Taylor, and Jentsch, 2010), two kinds of rash impulsivity are distinguishable: impulsive action and impulsive choice. *Impulsive action* is assessed with trait batteries that focus on tendencies to act without thinking (Patton, Stanford, and Barratt, 1995). Given its high reliability, we used three subscales from Whiteside and Lynam's (2001) Urgency Premeditation Perseverance Sensation Seeking (UPPS) scale to assess different facets of impulsive action: urgency, (lack of) premeditation, and (lack of) perseverance. *Urgency* reflects acting on strong impulses often under conditions of negative affect. *Lack of premeditation* reflects acting without thinking. *Lack of perseverance* reflects the inability to stay focused on boring or difficult tasks. Alternatively, *impulsive choice* is assessed with delay discounting tasks that present choices between immediate versus delayed rewards (Kirby, Petry, and Bickel, 1999).

Both impulsive action and impulsive choice have been associated with weak executive function (Horn, Dolan, Elliott, Deakin, and Woodruff, 2003; Shamosh et al., 2008) and maladaptive risk-taking behavior, such as addiction (Magid, MacLean, and Colder, 2007; Smith et al., 2007), gambling, and drug use (Reynolds, 2006; Verdejo-Garcia, Lawrence, and Clark, 2008). Each trait has been shown to predict unique variance in alcohol use (Cyders, Flory, Rainer, and Smith, 2009; Khurana et al., 2013) and sexual initiation during early adolescence (Khurana et al., 2012).

1.3. The current study

The purpose of this study was two-fold: 1) to determine whether personality traits associated with risk-taking in young people are separable into reward sensitive and rash impulsive tendencies; and 2) to test whether reward sensitive and rash impulsive traits differentially predict adaptive versus maladaptive risk behaviors. To address these goals, we used structural equation modeling (SEM) to determine the factorial structure of the eight traits described above and their unique associations with risk-taking behaviors in a young adult sample, when many risk behaviors emerge (Willoughby, Good, Adachi, Hamza, and Tavernier, 2013).

2. Materials and methods

2.1. Participants

Eight hundred ninety-nine (28% male) students (ages 18–22, $M = 19.5$, $SD = 1.02$) at X University (temporarily blinded for review) participated in an online survey for course credit: 60% non-Hispanic white, 22.2% Asian, 6.1% African-American, 3.7% Hispanic, and 7.6% other. This study was approved by X University's Institutional Review Board (temporarily blinded for review).

2.2. Materials

2.2.1. Self-report questionnaires—Eight impulsivity-related traits were assessed with the UPPS, Brief Sensation Seeking Scale (BSSS), and Behavioral Activation Scale (BAS) (see Supplemental Table 1 for questionnaire descriptions). SS was measured using the 8-item BSSS (Hoyle, Stephenson, Palmgreen, Pugzles Lorch, and Donohew, 2002) instead of the SS subscale of the UPPS because of its ability to assess all four components of SS with a validated and shorter version of Zuckerman's (1994) scale.

2.2.2. Behavioral task—Participants also completed a behavioral delay-discounting task that measured their ability to delay gratification. Participants decided whether to choose a smaller amount of hypothetical money now or a larger amount later. The monetary amounts and delay intervals varied across items. We estimated a “discount rate” that describes a threshold at which respondents are unwilling to wait for a delayed reward. Three discount rates for small, medium, and large monetary values are defined, which were averaged to create a discount rate for each participant (Kirby et al., 1999). Kirby (2009) showed that these discount rates remained relatively stable after one year, at levels comparable to those obtained for other personality traits.

2.2.3. Self-reported risk-taking—The frequency of various types of risk-taking was assessed with the Adolescent Risk Questionnaire (ARQ) (Gullone, Moore, Moss, and Boyd, 2000). Based on a principal axis factor analysis with promax rotation (Supplemental Table 2), an alcohol use factor score including the items “underage drinking,” “getting drunk,” and “staying out late” was created as an alcohol-related risk measure. The items “taking drugs,” “smoking tobacco,” “drinking and driving,” and “unprotected sex” also formed a factor of riskier substance use and sexual behavior. The remaining ARQ items did not load on meaningful factors. However, we created a composite of the items, “parachuting,” “roller blading,” “taekwondo,” and “snow skiing” as a measure of engagement in risky sports, and “entering a competition” was used as an achievement-oriented risk-taking measure. We used these four behavior scores as measures of maladaptive (alcohol use, drugs and risky sex) versus more adaptive (sports and entering competitions) risk behaviors.

2.3. Structural equation modeling analyses

Preliminary data analysis was conducted using IBM SPSS version 21. Principal axis factor analyses with promax rotation were conducted separately with the UPPS, BSSS, and BAS scales to validate their structure as defined. Each of the scales in those batteries closely corresponded to the composition of the scales as defined in the literature (Carver and White,

1994; Hoyle et al., 2002; Whiteside and Lynam, 2001). Therefore, standard scales for the UPPS and BAS were used. The only difference between the factor structures of our scales versus the original scales was that BSSS and BAS fun-seeking items loaded together on one factor, also found by Reyna et al. (2011), which we henceforth refer to as SS.

We used MPlus (Muthén and Muthén, 1998 Muthén and Muthén, 2010) with robust standard errors to define a measurement model for the risk-related traits and to conduct the main analysis. Standard methods for assessing goodness of fit were used, including the maximum likelihood goodness-of-fit chi-square test ($p > 0.05$), the comparative fit index (CFI > 0.95), and the root mean square error of approximation (RMSEA <0.08) (Kline, 2011). SEM analyses were conducted with multi-group models, one for each gender. Young men can engage in riskier behavior than young women (Harris, Jenkins, and Glaser, 2006), so we tested relations between traits and behaviors separately by gender to determine the generalizability of the distinction between reward sensitivity and rash impulsiveness and relations with risk behaviors.

3. Results

3.1. Means and correlations

Descriptive statistics for measures are displayed in Supplemental Table 3 separately for males and females. Supplemental Table 4 presents inter-correlations among the personality scales and ARQ risk behaviors for males and females. Consistent with our classification of sports and entering competitions as more adaptive forms of risk-taking, rash impulsive traits tended to be exclusively related to maladaptive risk behaviors. SS was positively related to all forms of risk-taking except for sports in males, suggesting that this form of reward sensitivity may underlie many forms of risk behavior. For both genders, BAS drive and reward responsiveness were positively related to a variety of risk behaviors. With the exception of delay discounting, all risk-related traits were significantly inter-correlated. These patterns underscore the importance of identifying unique relations between traits and risk behaviors.

3.2. Measurement model test

We tested the fit of a measurement model for the traits based on distinguishing rash impulsive and reward sensitive traits, assuming similar factor structure for males and females. The correlations in Supplemental Table 4 showed little difference between genders in the associations between the traits. Thus, we tested a measurement model with model parameters treated as equivalent for males and females. However, this model did not produce a good fit to the data. Consistent with Duckworth and Kern (2011), examination of residuals indicated that lack of perseverance should be removed from the Impulsive Action factor. In addition, BAS drive was uniquely correlated with urgency, and BAS reward responsiveness was uniquely correlated with lack of premeditation. Thus, we included these unique correlations in a revised model. Although factor loadings and residual variances were not equivalent across genders, a model assuming equivalent inter-factor covariances fit the data as well as one with unique parameters, ^{2} (10) = 9.80, $p > 0.25$.

The final model (Table 1) with the following five potentially interrelated dimensions provided an adequate fit to the data: SS, BAS sensitivity (with drive and reward responsiveness as indicators), impulsive action (with urgency and lack of premeditation as indicators), lack of perseverance, and impulsive choice (delay discounting), χ^2 (23) = 62.39, $p < 0.001$; RMSEA =0.062, CFI = 0.967.

3.3. Prediction of risk-taking

Using the structure identified in the trait measurement model, we conducted an analysis allowing paths from the five risk-related factors (Impulsive Action, BAS sensitivity, SS, Impulsive Choice, Lack of Perseverance) to each risk behavior (Alcohol Use, Drug/Sex, Sports, Entering Competitions). In addition, we allowed the risk behaviors to be correlated. Table 2 presents the standardized robust estimates of path coefficients and tests of significance after dropping paths that were not significant for both genders. Goodness of fit comparisons between the models for males and females indicated that a model with different path weights by gender did not provide a better fit than a model with equal weights, χ^2 (8) = 9.52, $p > 0.25$. Hence, we focus on the model with equal weights. This partially unrestricted model provided a good fit to the data, considering the sample size: χ^2 (61) = 131.19, $p < 0.001$; RMSEA = 0.051, CFI = 0.963.

The two traits indicative of reward sensitivity (SS and BAS sensitivity) were uniquely related to adaptive risk behaviors as well as other risks. SS was related to drug use and risky sex, as well as playing sports. BAS sensitivity predicted entering competitions and alcohol use. Impulsive action traits (urgency and lack of premeditation) only were predictive of maladaptive risk behaviors, such as alcohol/drug use and risky sex. Delay discounting, as a measure of Impulsive Choice, marginally predicted alcohol use and was inversely related to sports. Lack of perseverance, although related to impulsive action traits, did not independently predict any of the risk behaviors. Although not shown in Table 2, many of the risk behaviors were positively inter-correlated (Supplemental Table 4). However, the SEM analysis took these associations into account when identifying unique relations between the traits and risk behaviors.

4. Discussion

This study examined a wide variety of associations among risk-related traits and with different forms of risk-taking in young adults. Aside from delay discounting, all of the traits were inter-correlated, which confirms the difficulty of distinguishing them. Further analysis identified five correlated factors: impulsive action, discounting, SS, BAS, and lack of perseverance. Once we controlled for overlap among these factors, all of them except lack of perseverance uniquely predicted risky behavior. In support of our hypotheses, reward-sensitive traits (SS and BAS) predicted both adaptive and maladaptive risk-taking, suggesting that this motivation underlies a wide range of risky behavior in young people. Alternatively, rash impulsive traits (impulsive action and discounting) were exclusively related to maladaptive risk behaviors (drug use and sex). Although males tended to engage in risk behaviors more than females, the factorial structure of these traits did not vary by

gender, suggesting that the distinction between rash impulsiveness and reward sensitivity is similar in males and females.

Among reward-sensitive traits, BAS sensitivity was predictive of entering competitions and alcohol use, whereas SS was predictive of sports, drug use, and risky sex engagement. These patterns are consistent with prior research suggesting that greater BAS sensitivity is associated with ambitious goal-striving and achievement motivation (Alloy et al., 2012) as well as alcohol use (Franken and Muris, 2006). Alternatively, SS seems unrelated to achievement-oriented risk-taking. Alcohol use in undergraduates is prevalent (Hingson, Heeren, Zakocs, Kopstein, and Weschler, 2005; Reyna et al., 2013) (68% of our sample reported drinking alcohol). Students with greater BAS sensitivity may drink alcohol to gain social acceptance (e.g. Franken and Muris, 2006, O'Connor and Colder, 2005).

BAS drive and reward responsiveness contained unique associations with rash impulsive components of the UPPS. We accounted for these unique relations in the model, thus enabling a cleaner examination of BAS sensitivity. However, researchers using the BAS should recognize that drive and reward responsiveness subscales are not pure measures of BAS sensitivity, and will likely display relations with maladaptive risk-taking because of their associations with rash impulsiveness. This could be one reason that the BAS has been related to serious maladaptive behaviors, such as substance abuse (Franken and Muris, 2006).

Lack of perseverance was not uniquely related to any of the risk behaviors. However, it was strongly correlated with impulsive action and discounting, suggesting that it is related to both forms of rash impulsiveness (Zayas, Mischel, and Pandey, 2014). This pattern is consistent with the trait inasmuch as lack of perseverance should be related to preference for shorter- versus longer-term commitment, which is also a sign of less adaptive risk-taking. Thus, although lack of perseverance did not uniquely predict any of the risk behaviors, its effects were encompassed by the other rash impulsive traits.

In total, our results are consistent with the characterization of reward sensitivity as a more general approach tendency towards novel and exciting experiences (Dawe and Loxton, 2004; Telzer, 2016; Wahlstrom et al., 2010). Alternatively, once the overlap between reward sensitivity and rash impulsiveness is removed, rash impulsive traits only predicted more maladaptive behavior. Thus, researchers studying risk propensities in youth should distinguish between traits that reflect more reward-sensitive forms of risk-taking, such as SS and BAS, versus those more clearly indicative of rash impulsivity, such as urgency and lack of premeditation. Youth high in reward-sensitive traits may require interventions that channel exploratory behavior into more adaptive forms of risk-taking, whereas those high in rash-impulsive traits may require interventions to enhance self-control.

Despite strengths, several limitations should be noted. First, we used self-report measures to assess risk behaviors. However, these measures were obtained anonymously (reducing reporting biases) and have been validated with measures of behavior in previous work (Berns, Moore, and Capra, 2009). Second, we used a student sample, which may not necessarily generalize to the larger population of young adults; however, there was clearly

sufficient range in both risk behavior and personality to detect relationships. Also, undergraduates engage in considerable risk behavior, making them an important population to study. Third, our study was cross-sectional; thus, we are unable to draw causal conclusions about the relationships between traits and risk behaviors. However, our main goal was to disentangle the relationships between different personality traits and forms of risk-taking. Indeed, longitudinal research has shown that these traits prospectively predict risk behavior controlling for prior behavior (Cyders et al., 2009; Quinn and Harden, 2013). Fourth, the ARQ cannot distinguish between frequency of participation in risk behaviors and degree of engagement. Reward sensitivity, although related to many forms of risk-taking, may be more related to frequency than problematic engagement in such behaviors (Cyders et al., 2009; Magid et al., 2007; Smith et al., 2007). Future research should aim to use risk measures that are able to assess this distinction.

In conclusion, this research provides support for a two-factor framework (Dawe et al., 2004) for understanding the relationships among reward sensitive and rash impulsive traits and their associations with different forms of risk-taking in young people. Reward sensitive traits (SS and BAS) confer risk for engaging in a wide range of risk behaviors, whereas rash impulsive traits (urgency, lack of premeditation, and discounting) are specifically related to problematic risk-taking, underscoring the importance of distinguishing these traits in young people.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Inter-correlations between factors in the measurement model

	Impulsive action	BAS	SS	Discounting	Lack of perseverance
Impulsive action	1	0.153	0.489	0.195	0.619
BAS	0.137	1	0.619	−0.047	−0.408
SS	0.468	0.656	1	0.016	0.113
Discounting	0.163	−0.044	0.016	1	0.126
Lack of perseverance	0.607	−0.443	0.131	0.127	1

Note. Females are shown above the diagonal and males below. Correlations with $p < 0.05$ uncorrected for multiple comparisons are shown in bold. Impulsive action=Urgency and Lack of Premeditation; SS = Sensation Seeking; BAS = Behavioral Activation System (Reward Responsiveness and Drive).

Table 2

Goodness of fit indices and statistically significant standardized weights in relations between risk-related factors and risk behaviors in structural equation model

Path/goodness of fit	Males			Females		
Estimate	**S.E.**	**C.R.**	**Estimate**	**S.E.**	**C.R.**	
IA →						
Drugs/sex	0.270	0.047	5.79	0.239	0.039	6.09
Alcohol use	0.262	0.047	5.59	0.209	0.036	5.77
SS →						
Drugs/sex	0.204	0.034	5.98	0.233	0.036	6.40
Sports	0.187	0.030	6.27	0.217	0.033	6.52
BAS →						
Alcohol use	0.384	0.043	9.00	0.395	0.035	11.34
Competitions	0.272	0.042	6.45	0.298	0.038	7.94
Discount →						
Alcohol use	0.056+	0.032	1.73	0.052+	0.030	1.73
Sports	−0.081	0.032	−2.58	−0.084	0.032	−2.61
χ^2/df	131.19/61					
CFI	0.963					
RMSEA (90% CI)	0.051 (0.039, 0.063)					

Note. Only statistically significant ($p < 0.05$) standardized paths are shown. +$p < 0.1$. IA = Impulsive Action; SS = Sensation Seeking; BAS = Behavioral Activation System.