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Cost-Benefit Analysis Mediation of the Relationship Between Sensation Seeking and Risk Behavior

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Abstract

Risk behavior during adolescence results in substantial morbidity and mortality. Sensation seeking consistently relates to engagement in risk behavior, but the psychological mediators of this relationship remain unclear. The current study demonstrates that adolescents' judgments of the costs versus benefits of risk behavior were a significant mediator of this relationship. Participants were 406 racially and ethnically diverse adolescents ages 12–17 ($M = 14.5$, $SD = 1.7$; 48.3% female) who participated in a larger multi-site investigation of personality and neurocognitive predictors of risk behavior. Data were collected via self-report in a single laboratory session. Mediation of the relationship of sensation seeking to risk behavior was tested using structural equation modeling. Results indicated that higher levels of sensation seeking predicted weighing the benefits of risk behavior higher than its costs, which in turn predicted higher levels of risk behavior. Implications of these findings for understanding mechanisms underlying adolescents' risk behavior and directions for future research are discussed.

1. Introduction

The leading causes of adolescent mortality in the United States are motor vehicle crashes, unintentional injuries, homicide, and suicide (Eaton et al., 2010), and adolescents' propensity for engaging in risk behavior are a direct antecedent of these fatal events (Feigelman & Gorman, 2010; Sells & Blum, 1996). Personality traits predict engagement in a number of risk behaviors in adolescence, including delinquency and substance use (Castellanos & Conrad, 2006; Williams et al., 2010). In order to prevent or mitigate the serious consequences of adolescents' elevated levels of risk behavior, it is important to understand the psychological mechanisms that underlie the associations between personality

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and risk behavior. The present study focused on sensation seeking, a trait that consistently predicts risk behavior. As is common in adolescent research (Jessor, 1991; Steinberg et al., 2008), we employ a broad definition of risk behavior as any behavior that jeopardizes the safety or well-being of oneself or others through immediate risk of harm or violation of societal rules and norms designed to prevent such harm. Sensation seeking was originally defined by Zuckerman (1979) as “the need for varied, novel, and complex sensations and experiences” (p.10). Developmentally, adolescence represents the period in which sensation seeking peaks (Steinberg et al., 2008; Zuckerman, Eysenck, & Eysenck, 1978). The high rates of both risk behavior and sensation seeking and their strong association during adolescence make this a key age group in which to test the mechanisms that may drive their association. For the purposes of the current study, adolescence refers to the age period beginning with the onset of puberty and ending when youth begin to transition into adult roles, around age 18.

Sensation seeking predicts adolescents’ risk behavior both cross-sectionally (e.g. Rolison & Scherman, 2002) and longitudinally. In one longitudinal study, sensation seeking predicted baseline levels of smoking, drinking alcohol, and using marijuana in middle school as well as the rate of increase in these behaviors through high school (Crawford, Pentz, Chou, Li, & Dwyer, 2003). In addition to its well-established relationship with substance use (Crawford et al., 2003; Zuckerman, 1994), sensation seeking relates to a variety of other risk behaviors by adolescents, including unprotected sex (Arnett, 1990) and delinquent behavior (Rolison & Scherman, 2002). Of course, not all risks are negative. Adolescents frequently take risks by trying new social roles, attempting to learn new skills, and participating in challenging activities. Sensation seeking also predicts engagement in such “positive risks” (Hansen & Breivik, 2001). While in the current paper we focus on potentially harmful risk behaviors, it is important to note that sensation seeking has been found to relate to a range of risk behaviors.

Sensation seeking, as we refer to it in the current study, is a distinct construct from impulsivity, although the two are often conflated in theory and in measurement. Sensation seeking refers to seeking thrilling experiences, while impulsivity refers to lack of inhibition. Recent research has revealed the distinct developmental trajectories of sensation seeking and impulsivity as well as their independent relationships to risk behavior (Smith et al., 2007; Steinberg et al., 2008). The current study focuses specifically on sensation seeking, using measures that capture thrill-seeking rather than lack of inhibition or other impulsivity-like characteristics.

The relationship of sensation seeking to risk behavior is well established. However, the psychological mediators of this relationship remain unclear. By what process does sensation seeking lead to increased risk behavior? Perhaps sensation seeking does not relate to blind engagement in any risk behavior, but rather to selective search for benefits from risk behavior and perceiving that those benefits outweigh the costs that may also be associated with the behavior.

Cost-benefit judgment consists of rating whether the potential benefits of a behavior outweigh its potential costs. Adolescence is marked by major developments in abstract thinking and logical reasoning (Keating, 2004), abilities that enable adolescents to engage in cost versus benefit deliberations. Like sensation seeking, perceptions of costs and benefits have also been found to predict adolescents’ engagement in risk behavior (e.g. Fromme, Katz, & Rivet, 1997; Parsons, Siegl, & Cousins, 1997), though whether perceived costs or benefits are most predictive of risk behavior is a matter of some debate.

Some authors have suggested that adolescents tend to engage in more risk behavior than adults because they underestimate the amount of risk they truly face (Arnett, 2000; Romer & Jamieson, 2001). However, research has demonstrated that adolescents rate the risks of their own behavior quite accurately in comparison to objective standards (Johnson, McCaul, & Klein, 2002; Parsons, Halkitis, Bimbi, & Borkowski, 2000). Rather than an under-appreciation of risks, adolescents appear to engage in an over-appreciation of the perceived benefits of risk behavior (Millstein & Halpern-Felsher, 2002).

While cost-benefit analysis certainly occurs in adults as well as adolescents, adolescents are particularly attuned to benefits in the case of risk behavior. This likely reflects several developmental phenomena of adolescence. First, risk behavior is likely to yield social rewards such as peer approval, which are particularly salient to adolescents versus adults (Millstein & Halpern-Felsher, 2002; O'Brien, Albert, Chein, & Steinberg, 2011). Second, neurobiological evidence suggests that the development of rewards systems outpaces that of inhibitory systems during adolescence, leading to an overprioritization of rewards during this period (Galvan et al., 2007). Third, contrary to previous beliefs that adolescent risk behavior is purely impulsive, several theoretical and empirical pieces suggest that much of adolescent risk behavior is planned and results from deliberative process focused on achieving benefits from risk behavior (Gibbons, Houlihan, & Gerrard, 2009; Maslowsky, Keating, Monk, & Schulenberg, 2011; Reyna & Farley, 2006).

Accordingly, empirical evidence regarding the role of benefits in adolescents' risk behavior demonstrates that adolescents do indeed report that they are more likely to engage in a risk behavior if they believe it will lead to benefits (Moore & Gullone, 1996). Expectations of positive outcomes predict higher levels of risk behaviors such as substance use (Urbán, Kökönyei, & Demetrovics, 2008) and sexual risk behavior (Ott, Millstein, Ofner, & Halpern-Felsher, 2006). Although expectations of negative outcomes also play a role in predicting less risk behavior by adolescents (Urbán et al., 2008), the literature indicates that perceived benefits are more strongly associated with engagement in risk behavior than are perceived costs (e.g. Cauffman et al., 2010).

Perceived benefits of engaging in risk behaviors such as substance use, aggression, illegal activities, and risky sex, are more predictive of engagement in those behaviors than are perceived costs (Fromme et al., 1997). In a short-term longitudinal study, college students' perceived benefits of risk behavior predicted frequency of engaging in those behaviors three months later, controlling for past levels of those behaviors (Parsons et al., 1997). In a second study, perceived benefits of unprotected sex were more strongly related to college students' engagement in that behavior than were perceived costs (Parsons, Halkitis, Bimbi, & Borkowski, 2000).

Expecting high levels of benefits to result from risk behavior is also predicted by higher levels of sensation seeking (Katz, Fromme, & D'Amico, 2000). Given this association and the well-known association of sensation seeking to risk behavior, several studies have tested whether positive expectations of risk behavior mediate this relationship. These studies, focused specifically on alcohol use, demonstrated that positive outcome expectancies predict increased alcohol use and mediate the relationship of sensation seeking to alcohol use (Darkes, Greenbaum, & Goldman, 2004; Urbán, Kökönyei, & Demetrovics, 2008). Because risk behaviors tend to cluster during adolescence (Jessor, 1991), this mediation could be expected to extend beyond substance use to risk behavior in general.

In sum, the extant literature indicates that sensation seeking and cost-benefit judgment each predict risk behavior during adolescence, and that perceived benefits of risk behavior mediate the relationship of sensation seeking to at least one form of risk behavior, alcohol

use. This paper builds upon these results by using a measure of a variety of risk behaviors to test whether this mediation applies to risk behavior as a more general construct. We also measure cost-benefit judgment to test the role of relative benefits versus costs, rather than benefits in general, in predicting adolescents' risk behavior. We address these questions in a large, racially and ethnically diverse sample of adolescents.

We hypothesized that cost-benefit judgment would mediate the relationship between sensation seeking and risk behavior, with higher levels of sensation seeking predicting rating benefits of risk behavior higher than costs, which would predict more frequent engagement in risk behavior. This hypothesis was based on previous literature, reviewed above, demonstrating the positive relationships of both sensation seeking and cost-benefit judgment to risk behavior and offering some evidence for the role of perceived benefits of risk behavior as a mediator of the relationship of sensation seeking to risk behavior.

2. Method

2.1 Participants

This study was part of a larger study conducted by the MacArthur Foundation Research Network on Adolescent Development and Juvenile Justice. Participants were recruited from five data collection sites: Denver, Irvine (California), Los Angeles, Philadelphia, and Washington, D.C. For additional information on study design, see Steinberg et al. (2008) and Cauffman et al. (2010). The total sample included 935 individuals aged 10–30 years. Of these, the adolescent participants were included in the present study ($n = 406$, ages 12–17, mean age 14.5 $\pm$ 1.7 years, 48.3% female). Participants were racially and ethnically diverse (34.2% Black, 22.2% Latino/a, 21.9% White, 11.1% Asian, 10.1% mixed or other race). The genders were approximately evenly represented within each race/ethnicity subgroup with the exception of White (68.5% male) and Asian (63.0% female).

2.2 Procedure

Participants were recruited via newspaper advertisements and flyers posted at community organizations, Boys and Girls clubs, churches, community colleges, and local places of business in neighborhoods targeted to have an average household education level of “some college” according to 2000 U.S. Census data. Members of the research team described the nature of the study to the participant over the telephone and invited those who were able to read and understand English to participate. Data collection took place either at one of the participating universities' offices or at a convenient location in the community. Before beginning, participants were provided verbal and written explanations of the study, their confidentiality was assured, and their written consent or assent was obtained. For participants who were under the age of 18, informed consent was obtained from a parent or guardian.

Participants completed a 2-hour assessment composed of self-report measures and computer-based tasks to assess cognitive, personality, and neurocognitive predictors of risk behavior from adolescence through adulthood. Research assistants monitored each participant's progress, reading aloud the instructions as each new task was presented and providing assistance as needed. All procedures were approved by the IRB of the university associated with each data collection site.

2.3 Measures

2.3.1 Risk Behavior—Frequency of risk behavior was measured using an abbreviated version of the Risk Behavior subscale of the Benthin Risk Perception Measure (Benthin, Slovic & Severson, 1993; $\alpha = .73$, $\mu = 1.47$, $SD = 0.49$). The abbreviated measure was

chosen for the sake of time needed to complete this and other measures during the laboratory session. This scale measured the frequency of risk behaviors over the past six months. Response options ranged from 1 (*none*) to 4 (*>5 times*). Risk behaviors included alcohol use, vandalism, riding with a drunk driver, smoking cigarettes, unprotected sex, stealing, fighting, going into a dangerous part of town, and threatening someone. The internal consistency reliability was calculated for this sample. Validity of the Benthin measure has demonstrated via significant correlations with parental estimates of their adolescents' risk behavior, (Gerrard, Gibbons, Benthin & Hessling, 1996) and statistically significant relationships to risky choices in laboratory tasks (Rao, Sidhartha, Harker, Bidesi, et al., 2011). For this and all other scales, we randomly grouped the large number of individual items into a small number of parcels, which acted as indicators for the latent variable; see Analysis section for additional detail.

2.3.2 Sensation seeking—Sensation seeking was measured using a subset of 6 items from the Sensation Seeking Scale (SSS-V; Zuckerman, 1994; $\alpha = .69$, $\mu = 0.67$, $SD = 0.26$). True/false items (0 = *false*, 1 = *true*) were presented in this scale, with items such as “I like doing things just for the thrill of it” and “I’ll try anything once”. Following Steinberg et al. (2008), the 6 items used here were selected because they clearly represent thrill-seeking rather than impulsivity, as some items in the larger scale represent. In the Steinberg et al. (2008) study, this 6-item scale showed good internal consistency ($\alpha = .70$) and correlated significantly with behavioral measures of thrill-seeking, indicating that it is both a reliable and valid measure of the thrill-seeking component of sensation seeking.

2.3.3 Cost-benefit judgment of risk—Cost-benefit judgment was measured using the Risk Assessment Subscale ($\alpha = .79$, $\mu = 1.61$, $SD = 0.49$) of the Benthin Risk Perception Measure (Benthin et al., 1993). For each of the nine risk behaviors, participants were asked, “How much do the benefits or pleasures of [behavior] outweigh the risks of doing it?” Response options ranged from 1 (“*benefits are much greater than risks*”) to 4 (“*risks are much greater than benefits*”). This scale was reverse coded such that higher ratings represented rating benefits greater than costs.

3. Results

3.1 Data analytic strategy

The mediation model was tested using confirmatory latent variable structural equation analysis in EQS software (Bentler, 1995). Parceling was used to group the large number of items on each scale into a smaller number of indicators of a latent variable for each construct. Parceling is common practice in structural equation models in which unidimensional constructs are measured by one scale with many items (Coffman & MacCallum, 2005; Sass & Smith, 2006). Parcels are more reliable than individual items as latent variable indicators and are more likely to satisfy assumptions of multivariate normality (Sass & Smith, 2006). Specifying many indicators of a factor can lead to poor model fit due to unreliability individual items introduce into the model. Parceling is recommended because it produces a sufficient number of indicators of a latent construct without introducing artifactual variability from individual items into the parameter estimates (Coffman & MacCallum, 2005). Parcels therefore produce more accurate and precise solutions than models using many single-item indicators (Marsh, Hau, Balla, & Grayson 1998). In the current study, parcels were formed according to the guidelines of Coffman and MacCallum (2005). Items were randomly assigned to form three parcels per construct. The mean of the items in each parcel was computed, and this variable was an indicator of the latent variable.

Missing data were minimal (less than 2% of cases); therefore, the EQS default of listwise deletion was used. Following Kline's (2005) guidelines, we report the following indices of model fit: chi-square, comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). CFI values greater than .95 and RMSEA and SRMR values below .06 indicate an excellent fit (Hu & Bentler, 1999). Preacher and Leonardelli's (2006) online calculation tool was used to test the significance of all mediation effects.

3.2 Mediation model

The mediation model is presented in Figure 1. This model was an excellent fit for the data ($\chi^2(24) = 44.9$, CFI = .98, RMSEA = .05, SRMR = .04). As hypothesized, sensation seeking was a positive predictor of cost-benefit judgment of risk behavior, such that higher sensation seeking predicted rating benefits of risk behavior higher than its costs. Cost-benefit judgment was a positive predictor of risk behavior, such that rating the benefits of risk behavior higher than its costs predicted engaging in more risk behavior. Cost-benefit judgment was a significant mediator of the relationship between sensation seeking and risk behavior ($Z = 3.11$, $p < .01$), accounting for 20.5% of the variance in this effect. This was a partial mediation; sensation seeking remained a significant predictor of risk behavior after including cost-benefit judgment as a mediator.

In supplementary analyses, we tested a multiple group model in which the structural model was fit separately and simultaneously for male and female adolescents. This model revealed no significant gender differences in any of the structural relationships. Cost-benefit judgment was a significant mediator of the relationship between sensation seeking and risk behavior among both males and females. We also tested the total-sample model while controlling for the effect of adolescents' age on each of the latent constructs, and the pattern of results did not change, indicating that controlling for age-related variance in these constructs does not affect the significance of the mediation relationship. Based on these results, we chose to leave out age as a control variable for the sake of parsimony of the final model.

4. Discussion

Personality traits play an important role in adolescents' overall well-being (Garcia, 2011). Sensation seeking in particular has been consistently linked to adolescents' engagement in risk behavior (Horvath & Zuckerman, 1993; Rolison & Scherman, 2002). This study builds upon that literature by demonstrating that cost-benefit judgment partially mediates the relationship between sensation seeking and risk behavior. Specifically, higher levels of sensation seeking predicted rating the benefits of risk behavior higher than its costs, and rating benefits of risk behavior higher than its costs predicted greater engagement in risk behavior. This is consistent with past studies showing that ratings of benefits of risk behavior are more predictive of that behavior than subjective ratings of the risks involved (Fromme et al., 1997; Parsons et al. 1997, 2000). It is also consistent with research demonstrating significant increases in adolescents' risk behavior in the presence of peers, presumably due to the impact of peers on adolescents' sensitivity to rewards (Chein et al., 2010; O'Brien et al., in press).

Mediation of the relationship of sensation seeking to risk behavior by cost-benefit judgment is consistent with previous studies demonstrating that expected benefits of risk behavior mediate the relationship between risk-associated personality characteristics, such as high sensation seeking, and substance use (Greenbaum, Brown, & Friedman, 1995; Urbán et al., 2008). Our study expands on this result to show that this mediation applies to a wide variety of risk behaviors. We also demonstrated that relative benefits versus costs of risk behavior,

not just benefits themselves, mediate the relationship of sensation seeking to risk behavior. As such, cost-benefit judgment may be one mechanism via which sensation seeking relates to health and antisocial risk behavior by adolescents. High sensation seekers search for thrills from their experiences, and they rate the thrills of risk behavior as highly beneficial. Although we did not employ a discrimination between physical and social thrill seeking (Reio, Petrosko, Wiswell, & Thongsukmag, 2006), whether this distinction would reveal more or less mediation may be of interest in future studies.

This study had several limitations. First, the data are self reports and thus susceptible to self-report biases and method covariance. Second, for future research, it will be important to identify additional mediators of the sensation seeking/risk behavior relationship, as cost-benefit judgment was only a partial mediator, and also to include additional assessment methods beyond self-report. Longitudinal studies would also help to establish the direction of causality among the factors, which cannot be ascertained in these cross-sectional data.

Despite these limitations, this study revealed one mediator of the relationship between sensation seeking and risk behavior, individuals' assessment of the relative costs and benefits of risky activity. Given the strong association of sensation seeking with risk behavior, understanding one mechanism underlying this behavior is an important contribution to this field of research. Considered together with recent findings that a substantial portion of adolescent risk behavior is likely planned rather than impulsive (Maslowsky, et al., 2011), addressing the sources of adolescent risk behavior may entail greater attention to adolescents' active preferences in addition to impulsively reactive behaviors. Additionally, cost-benefit judgment may be a more proximal process to the actual risk behavior and thus a higher-yield target for intervention and prevention programs seeking to decrease risk behavior. While sensation seeking is a fairly stable individual trait, cost-benefit analysis may be more amenable to intervention. In their review of adolescent decision making and risk behavior, Reyna and Farley (2006) conclude that interventions aimed at changing adolescents' risk perceptions are likely to fail because adolescents already accurately judge their risks of experiencing harmful outcomes. Instead, they recommend interventions that accelerate the shift from adolescent-style quantitative weighing of benefits versus costs to a more intuitive, "all or none" categorical avoidance of risks more characteristic of adult decision-making. The results of the current study support this recommendation. One further implication is that encouraging such a shift may have reciprocal benefits, given the evidence of mutually reinforcing longitudinal connections between risk cognition and risk behavior (Gerrard et al., 1996).

We have demonstrated that adolescents with high levels of sensation seeking are likely to weigh the benefits of risk behavior greater than its risk. They will benefit from preventive interventions that discourage such quantitative reasoning, as well as those that offer safe and socially acceptable opportunities for positive risk-taking and exploration.

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Highlights

- Cost-benefit judgment mediates sensation seeking/adolescent risk behavior relation
- Sensation seeking relates to rating benefits of risk behavior as greater than costs
- Weighing benefits greater than costs predicts higher rates of risk behavior
- Cost-benefit judgment is suggested as a target for intervention

Figure 1.

Summary of the standardized path coefficients representing the effects of sensation seeking and cost-benefit rating on risk behavior. Coefficient in parentheses represents the direct effect of sensation seeking on risk behavior without the mediator; coefficient outside the parentheses represents the effect after the mediator was entered. Benefits>Costs: The benefits of a behavior outweigh its costs. * $p < .05$.