HHS Public Access

Author manuscript

J Sex Res. Author manuscript; available in PMC 2015 July 30.

Published in final edited form as:

J Sex Res. 2013 ; 50(5): 480–488. doi:10.1080/00224499.2011.652264.

Sensation Seeking and Impulsivity: Combined Associations with Risky Sexual Behavior in a Large Sample of Young Adults

Richard Charnigo,
College of Public Health, University of Kentucky

Seth M. Noar,
School of Journalism and Mass Communication, University of North Carolina at Chapel Hill

Christopher Garnett,
College of Public Health, University of Kentucky

Richard Crosby,
College of Public Health, University of Kentucky

Philip Palmgreen, and
Department of Communication, University of Kentucky

Rick S. Zimmerman
Department of Global and Community Health, George Mason University

Abstract

Although prior studies have shown that sensation seeking and impulsive decision-making are related to sexual risk-taking, it is still unclear whether these personality traits operate independently or synergistically. The purpose of this study was to elucidate the joint contribution of these personality traits to HIV and sexually transmitted disease (STD) risk behaviors using data from a large sample of sexually active young adults (N = 2,386). Regression modeling indicated that both sensation seeking and impulsive decision-making were consistently associated with sexual risk behaviors across 11 risk-related outcomes. Results further indicated that sensation seeking and impulsive decision-making operated synergistically with respect to the outcome variables of sex acts using drugs, acts with a partner using alcohol, and acts with a partner using drugs. In contrast to this, sensation seeking and impulsive decision-making operated independently with respect to the other sexual risk outcomes. Theoretical implications, as well as implications for HIV/STD prevention among high sensation seekers and impulsive decision-makers, are discussed.

Each year, there are approximately 19 million new cases of sexually transmitted diseases (STDs). Nearly one-half of these cases occur in young adults and adolescents 15 to 24 years of age (Chesson, Blandford, Gift, Tao, & Irwin, 2004). Young adults are particularly

Correspondence should be addressed to Seth M. Noar, School of Journalism and Mass Communication, University of North Carolina at Chapel Hill, 363 Carroll Hall (CB 3365), Chapel Hill, NC 27599-3365. noar@email.unc.edu.

vulnerable to STDs for several reasons, including their tendency to have multiple sexual partners (concurrent or sequential) and because they often encounter problems accessing effective STD prevention services (Centers for Disease Control, 2006; Weinstock, Berman, & Cates, 2004).

Although much of the behavioral research on young adults has examined the impact of certain psychosocial variables (e.g., norms, attitudes, and self-efficacy) on risky sexual behaviors, personality traits may also be an important determinant of sexual behaviors (Noar, Zimmerman, Palmgreen, Lustria, & Horosewski, 2006). Specifically, sensation seeking and impulsive decision-making are two key personality traits often associated with high-risk sexual activities (Hoyle, Fejfar, & Miller, 2000). Both traits are typically measured on a continuum, with higher values indicating greater trait endorsement. Sensation seekers are characterized by a greater need for novelty, an exciting experience, and thrill seeking (Zuckerman, Buchsbaum, & Murphy, 1980). Impulsive decision-makers are individuals who tend to make decisions with little thought or planning (Donohew et al., 2000).

On a physiological level, sensation seeking is theorized to result from dopamine brain pathways responsible for interest in novel and rewarding behaviors (Panksepp, 1998; Zuckerman, 1994b). Interestingly, animal and human studies suggest that dopaminergic activity increases during adolescence, which is consistent with human studies showing that sensation-seeking behavior nears a lifetime peak during late adolescence and early adulthood (Romer & Hennessy, 2007; Zuckerman, 1994b). At the same time young adults experience this strong biological drive for novel activities, their capacity to rationally assess risks is still not fully developed, which may explain their impulsive behavior in high-risk situations (Nelson et al., 2002; Romer & Hennessy, 2007; Spear, 2000).

Although numerous studies in young people have looked separately at sensation seeking and impulsive decision-making as correlates of HIV/STD risk behaviors (Arnett, 1990; Kahn, Kaplowitz, Goodman, & Emans, 2002; Spitalnick et al., 2007), much less is known about the joint contribution of sensation seeking and impulsive decision-making to HIV/STD risk behaviors. For example, is sexual risk-taking among young people who are high sensation seekers *and* impulsive decision-makers greater than among young people who are high on only one of these traits? Prior studies using a range of sensation seeking and impulsive decision-making scales show that these traits are only modestly intercorrelated (Pearson's r between 0.2 and 0.4; Eysenck & Eysenck, 1977; Hur & Bouchard, 1997), suggesting the possibility that either of these traits may have an association with HIV/STD risk behaviors above and beyond the association induced by its correlation with the other trait. However, if this is so, what remains unclear is whether these traits operate independently or synergistically with respect to HIV/STD risk behaviors.

Before continuing, we briefly clarify the terms *independently* and *synergistically*. When one trait's association with an HIV/STD risk behavior does not depend on the level of the other trait, we say that the traits operate independently or, synonymously, that the traits do not interact; when one trait's association with a behavior does depend on the level of the other trait, we say that the traits operate synergistically or, synonymously, that the traits do interact. To illustrate, consider four prototypical individuals named "A," "B," "C," and "D,"

who are “high/high,” “high/low,” “low/high,” and “low/low” on sensation seeking and impulsive decision-making, respectively. If the difference between individuals A and B in the propensity for engaging in an HIV/STD risk behavior is similar to the difference between individuals C and D, then the two traits are operating independently because the strength of impulsive decision-making’s association with the behavior does not depend on whether sensation seeking is high (as in the comparison of individuals A and B) or low (as in the comparison of individuals C and D). However, if the difference between individuals A and B in the propensity for engaging in an HIV/STD risk behavior is either greater than or less than the difference between individuals C and D, then the two traits are operating synergistically; in the former case (“greater than”), the nature of the synergy is that impulsive decision-making is more influential when sensation seeking is high, whereas in the latter case (“less than”), impulsive decision-making is more influential when sensation seeking is low.

The results from one prior study among adolescents (Donohew et al., 2000) suggest that these traits may largely operate independently. However, that study dichotomized the traits, which may have reduced statistical power, and did not explicitly quantify any interactions that might exist between sensation seeking and impulsive decision-making.

Therefore, the purpose of this study was to elucidate the joint contribution of sensation seeking and impulsive decision-making, treated as continuous variables, to HIV/STD risk behaviors among young adults. In particular, we sought to quantify any interactions that might exist between sensation seeking and impulsive decision-making. We hypothesized that young adults high on sensation seeking or impulsive decision-making would engage in higher risk behaviors than those low on such traits, and also that those high on both traits would engage in the most high-risk behaviors. The ultimate goal was to better understand whether these traits operate independently or synergistically with respect to HIV/STD risk behaviors; as such, an understanding may inform future interventions.

Method

Participants

This study utilized data from a larger study of a safer sex mass media campaign targeting young adults from two cities: Lexington, Kentucky and Knoxville, Tennessee (Zimmerman et al., 2007). Pre-campaign data were examined to avoid contamination from the safer sex campaign. These data were collected between May and December 2002 in City 1 (eight months of data) and between May 2002 and December 2003 in City 2 (20 months of data). The two cities were in different states in the Southeast United States, each with similar demographics and population sizes.

Two university research centers recruited participants using random digit-dialing (RDD). Telephone numbers for the RDD originated from multiple sources, including commercial firms, college registrar lists, and standard RDD. During the 28-month data collection period for this study, 103,931 numbers were dialed. The RDD procedure accounted for 84% of dialed numbers. Ninety-three percent of calls resulted in non-participation, mostly due to wrong numbers (e.g., out of service, business, or no answer).

A total of 6,826 people completed the required screening interview. Of these, 3,199 (47%) did not meet study inclusion criteria (i.e., sexually active with an opposite sex partner, age 18–26, and a current U.S. citizen). Of the 3,627 (53%) eligible for the study, N = 2,386 (66% out of 3,627) completed a self-administered survey for the project.

The mean age of participants was 21.70 years (SD = 2.09). The sample was 56.8% female, 86.1% White, 10.9% African American, and 3.0% "other" or multiracial. A majority, 74%, was enrolled in college. Of those not enrolled in college, nearly all (90.9%) reported completing high school or having their general equivalency diploma. A majority of respondents were in a relationship (79.5%), with 48% of these relationships lasting more than one year. The mean age at first sexual intercourse was 16.6 (SD = 2.08).

Measures

Sensation seeking and impulsive decision-making—Both multi-item scales utilized a five-point, Likert-style response format. Items were recoded so that higher scale scores reflected greater sensation seeking or impulsive decision-making. Although some previous research (Donohew et al., 2000; Zimmerman et al., 2007) has dichotomized sensation seeking and decision-making based on median splits stratified by race and gender, for these analyses, we maintained sensation seeking and decision-making as continuous variables to provide greater statistical power for detecting their associations with the outcome variables. Also, for ease of interpretation, we have used the average, rather than the summation, of the item scores constituting each scale. In other words, both sensation seeking and decision-making have been calibrated to range from one to five for these analyses.

Sensation seeking was assessed using the Brief Sensation Seeking Scale (BSSS), a validated, eight-item measure (Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002). Respondents indicated their agreement with items such as, "I would like to explore strange places," and "I get restless when I spend too much time at home." Inter-item reliability for this measure was satisfactory (α = .74).

Impulsive decision-making was measured using the Decision-Making Style Scale, a validated, 12-item scale (Zimmerman & Donohew, 1996). Respondents were asked how often they engage in certain behaviors when making decisions. Specific questions included, "I think about all of my choices very carefully," and "I consider the effect it will have on my health." Inter-item reliability for this measure was satisfactory (α = .85).

Risky sex outcome variables—Four domains of risky sexual behavior were assessed using 11 outcome variables (described later).

Personal outcome variables—The first behavioral domain was number of sexual partners, measured in the last year and over a lifetime. The second behavioral domain was number of unprotected sex acts in the past 30 days. The third behavioral domain measured respondent alcohol use and drug use before or during sex in the past three months. Both alcohol use and drug use were measured on 5-point scales ranging from 1 (*never*) to 5 (*every time*).

Partner-related outcome variables—The fourth behavioral domain measured self-perceived exposure to sex partners at high risk for HIV/STDs in the past three months. This domain included six variables measured on 4-point scales ranging from 1 (*definitely no*) to 4 (*definitely yes*). Four variables included having a sex partner who had an STD, injected drugs, was non-monogamous, or had sex with both men and women. Two additional variables assessed partner alcohol use and drug use before/during sex.

Procedure

Eligible individuals expressing interest over the telephone were invited to complete a survey assessing several sexual risk-taking behaviors. Participants had several choices for completing surveys, including administration at home or at the research center. Surveys were private and anonymous, and all participants gave informed consent. Prior to administering surveys, interviewers asked a small number of demographic questions. Afterward, participants completed a 40- to 45-min, self-administered survey using a laptop computer. Laptops provided greater privacy and allowed for item randomization. Participants received $30 after survey completion. Institutional review boards at both universities approved study recruitment and interviewing procedures.

Data Analyses

For each of the three outcome variables that were counts (number of partners last year, number of partners in lifetime, and number of unprotected acts in the last 30 days), we fit a negative binomial regression model relating the outcome variable to sensation seeking, impulsive decision-making, and a term representing their interaction. A negative binomial regression model is like a Poisson regression model in that non-normally distributed count outcomes can be accommodated. However, a negative binomial regression model includes an extra parameter that allows the outcome variable to have larger variance than is compatible with a Poisson distribution. Using a negative binomial regression model, thus, helps to circumvent the overdispersion phenomenon, which can potentially undermine one's inferences from a Poisson regression model (Hilbe, 2007).

For readers new to negative binomial regression, we provide the following guide to our models. Let x_1 denote sensation seeking, x_2 denote impulsive decision-making, and μ denote the mean score on the outcome variable. A negative binomial regression model has the following structure:

$$\mu = exp\left[b_0 + b_1 (x_1 - 3) + b_2 (x_2 - 3) + b_3 (x_1 - 3)(x_2 - 3)\right], \quad (1)$$

where exp is the exponential function and b_0, b_1, b_2, b_3 are regression coefficients. The exponentiated regression coefficients are loosely analogous to odds ratios but, more precisely, have the following interpretations:

- $\exp[b_1]$ is the ratio of mean scores comparing individuals who are one unit apart on sensation seeking, but who both have the (intermediate) score of 3 on impulsive decision-making. A value of 1.0 for $\exp[b_1]$, thus, corresponds to a null hypothesis

of no association between sensation seeking and the outcome variable among those with a score of 3 on impulsive decision-making.

- exp[b_2] is interpreted like exp[b_1], but reverses the roles of sensation seeking and impulsive decision-making.
- exp[b_3], representing interaction between sensation seeking and impulsive decision-making, is the factor by which the mean ratio comparing individuals one unit apart on sensation seeking is multiplied when their common impulsive decision-making score is raised by one unit. This is also the factor by which the mean ratio comparing individuals one unit apart on impulsive decision-making is multiplied when their common sensation seeking score is raised by one unit. A value of 1.0 for exp[b_3], thus, corresponds to a null hypothesis of no interaction.

For each of the remaining eight outcome variables, we fit a generalized logit regression model relating the outcome variable to sensation seeking, impulsive decision-making, and a term representing their interaction. A generalized logit regression model was used because the outcome variables were not interval, much less continuous, so that the assumption of normally distributed errors required for linear regression was untenable. Moreover, the proportional odds assumption underlying ordinal logistic regression was not satisfied for some of the outcome variables, thereby precluding use of that analytic approach. On the other hand, a generalized logit regression model makes no such assumption (Kleinbaum & Klein, 2002).

For readers new to generalized logit regression, we provide the following guide to our models. Let x_1 denote sensation seeking, x_2 denote impulsive decision-making, p_1 denote the probability of scoring 1 on the outcome variable, and p_2 denote the probability of scoring 2 on the outcome variable. If the outcome variable had only two categories, then p_2/p_1 would be the odds of scoring 2. With more than two categories, however, p_2/p_1 is instead referred to as an “odds-like quantity.” A generalized logit regression model is expressed, in part, by the following:

$$p_2/p_1 = exp\left[b_0 + b_1(x_1 - 3) + b_2(x_2 - 3) + b_3(x_1 - 3)(x_2 - 3)\right]. \quad (2)$$

The exponentiated regression coefficients are loosely analogous to odds ratios but, more precisely, have the following interpretations:

- exp[b_1] is the ratio of odds-like quantities comparing individuals who are one unit apart on sensation seeking, but who both have a score of 3 on impulsive decision-making. A value of 1.0 for exp[b_1], thus, corresponds to a null hypothesis of no association between sensation seeking and (the first two levels of) the outcome variable among those with a score of 3 on impulsive decision-making.
- exp[b_2] is interpreted like exp[b_1], but reverses the roles of sensation seeking and impulsive decision-making.
- exp[b_3], representing interaction between sensation seeking and impulsive decision-making, is the factor by which the ratio of odds-like quantities comparing

individuals one unit apart on sensation seeking is multiplied when their common impulsive decision-making score is raised by one unit. This is also the factor by which the ratio of odds-like quantities comparing individuals one unit apart on impulsive decision-making is multiplied when their common sensation seeking score is raised by one unit. A value of 1.0 for $\exp[b_3]$, thus, corresponds to a null hypothesis of no interaction.

A generalized logit regression model also entails analogues to Equation 2 for other odds-like quantities, such as p_3/p_1, p_4/p_1, and so forth, depending on the number of categories for the outcome variable. As shown above, p_3 and p_4 represent the probabilities of scoring 3 and 4 on the outcome variable, respectively. Note that all of the odds-like quantities have a common denominator corresponding to a reference category for the outcome variable.

Prior studies have shown that sexual risk-taking varies depending on several sociodemographic factors (Anderson, Wilson, Doll, Jones, & Barker, 1999; Lauritsen, 1994). Consequently, the preceding analyses were repeated with the following additional covariates: gender, race (White or non-White), ethnicity (Latino or non-Latino), age, and highest grade completed. The regression coefficients retain the specific interpretations presented earlier, except that any associations or interactions detected are now adjusted for sociodemographic factors.

Finally, each regression model was fit using data from all respondents, with complete information on the variables appearing in that particular regression model. Except for the outcome variable of number of unprotected acts in the last 30 days, the effective sample size for each regression model was at least 2,307 (out of 2,386 total respondents); effective sample sizes varied across the outcomes due to differing numbers of missing values on the outcomes. Data analyses were carried out using SAS® Version 9.2 (SAS Institute, Inc., Cary, NC). Statistical significance was defined by $p < .05$.

Results

The mean score for sensation seeking was 3.41 (*SD* = 0.69; range = 1–5), and the mean score for impulsive decision-making was 2.61 (*SD* = 0.52; range = 1–5). Their correlation was moderate, but statistically significant (Pearson's $r = .42$, $p < .001$).

Table 1 shows the joint associations of sensation seeking and impulsive decision-making with the outcome variables, unadjusted for the sociodemographic factors listed in the Methods section. Sensation seeking was positively associated with all outcome variables, except number of unprotected acts in the last 30 days and acts with a partner who injected drugs, whereas impulsive decision-making was positively associated with all outcome variables, except acts with a partner who had an STD (although the *p* value was very close to the threshold for statistical significance). Significant interactions between sensation seeking and impulsive decision-making were noted for three outcome variables (acts using drugs, acts with a partner using alcohol, and acts with a partner using drugs), such that the positive associations of sensation seeking with these outcome variables were weaker at high levels of impulsive decision-making (and vice versa).

Table 2 shows the joint associations of sensation seeking and impulsive decision-making with the outcome variables, adjusted for the sociodemographic factors noted in the Method section. The results were qualitatively similar to those in Table 1, with two exceptions. First, impulsive decision-making was positively associated with the outcome variable of acts with a partner who had an STD. Second, a trend toward significant interaction ($p = .06$) between sensation seeking and impulsive decision-making was found for the outcome variable of number of partners in the respondent's lifetime.

Discussion

This study confirmed positive associations of sensation seeking (Arnett, 1990; Spitalnick et al., 2007) and impulsive decision-making (Brown, DiClemente, & Park, 1992; Kahn et al., 2002) with a variety of outcome variables representing risk factors for HIV/STD transmission. Indeed, sensation seeking and impulsive decision-making were both found to be consistently associated with sexual risk behaviors across 11 risk-related outcomes. Moreover, this study went beyond the previous literature by assessing the joint contribution of sensation seeking and impulsive decision-making to HIV/STD risk behaviors among young adults. Indeed, there were three possibilities for each outcome variable *a priori*:

1. Being high on both personality traits confers greater risk than being high on one trait, which, in turn, confers greater risk than being high on neither trait.
2. Being high on both personality traits confers greater risk than being high on one trait, but being high on one trait does not confer appreciably greater risk than being high on neither trait.
3. Being high on both personality traits does not confer appreciably greater risk than being high on one trait, but being high on one trait confers greater risk than being high on neither trait.

Results indicated that sensation seeking and impulsive decision-making operated synergistically (see the third possibility) with respect to the outcome variables of sex acts using drugs, acts with a partner using alcohol, and acts with a partner using drugs. This finding suggests that being low on sensation seeking does not reduce these HIV/STD risk behaviors much if one is high on impulsive decision-making; likewise, being low on impulsive decision-making does not reduce these HIV/STD risk behaviors much if one is high on sensation seeking.

On the other hand, with respect to the outcome variables not explicitly related to drug and alcohol use, sensation seeking and impulsive decision-making operated independently (see the first possibility). For example, with regard to these sexual risk outcomes, impulsivity was positively associated with risk outcomes among high sensation seekers, and it was also positively associated with risk among low sensation seekers (and vice versa). The association of impulsivity with risk was, thus, independent of sensation seeking.

From a theoretical perspective, there are differing views as to whether sensation seeking and impulsive decision-making should be considered separately in prevention theories and models of sexual risk-taking or joined as a "supertrait." Zuckerman (1994b) made a strong

case for sensation seeking as an important individual trait, and he and his colleagues have also developed an alternative five-factor model of personality, which includes impulsive sensation seeking as one of the dimensions (Zuckerman, 1994a). His work has, thus, suggested that these variables be joined together as a single supertrait. The theoretical implications of these findings, however, differ from this perspective; namely, these findings indicate that sensation seeking and impulsivity are both important with respect to HIV/STD risk behaviors—a phenomenon that cannot be captured by a supertrait. Thus, sensation seeking and impulsivity should be considered as distinct traits in prevention theories and models. Indeed, these traits may play different roles with regard to risk-taking behaviors, with sensation seekers being more likely to place themselves in risky situations and impulsive decision-makers being more likely to make bad decisions when in those situations (Donohew et al., 2000). Further theoretical work to advance an understanding of each of these traits and their relations to risk-taking behavior is warranted.

In the domain of theory, one may also ask whether impulsive/sensation seeking people just behave impulsively and in a sensation-seeking manner. Similar questions about circularity have been posed to personality theorists before. One answer is provided by Contrada and Guyll (2001), who made a distinction between particular behavior patterns associated with a given trait and the personality structure which gives rise to that trait, where "*Structure* refers to neurobiological and/or psychological entities that are real and exist beneath the person's skin … the personality structure and the behavior pattern are conceptually distinct, with the former the putative cause of the latter" (p. 61). Those concerned with impulsivity and sensation seeking have provided descriptions of the neuropsychological structures underlying these personality variables, and have clarified that the behaviors described in measurement scales for the traits do not define the traits themselves. Rather, as Zuckerman (1994b) explained, the behaviors contained in the various measurement scales are *behavioral expressions* of the biological and neuropsychological substrates of the underlying traits.

Among the implications of this study for practitioners and researchers working in HIV/STD prevention are that these trait measures may be useful patient screening tools. This study strongly suggests, however, that to most accurately classify individuals with regard to HIV/STD risk, *both* traits should be measured and viewed as distinct. This suggestion is consistent with current psychological perspectives on risk-taking, which acknowledge the need for fundamentally different treatment approaches depending on whether an individual is predisposed to sexual risk-taking because of consistent personality tendencies, rather than situational or transitory factors (Harkness & Lilienfeld, 1997).

Of course, making such distinctions is only fruitful if effective risky sex interventions can be targeted or tailored to the sensation seeking and impulsive decision-making levels of the participants. Indeed, several meta-analyses suggest that highly targeted (and individually tailored) interventions have the greatest success in reducing risky sexual behaviors (Noar, 2008; Noar, Black, & Pierce, 2009). Although attempts to target HIV/STD prevention programs and messages to high sensation seekers and impulsive decision-makers have been made, this remains an area in need of further research (Zimmerman et al., 2008; Zimmerman et al., 2007). For example, although the types of messages that may be effective with high

sensation seekers have been widely studied within the sensation-seeking targeting framework (Palmgreen & Donohew, 2003), far fewer studies have examined the types of messages that may be effective with impulsive decision-makers.

There were some limitations to this study. First, respondents were asked to report on their sexual behaviors and the behaviors of sexual partners. Self-report data are vulnerable to social desirability bias and faulty recall. To reduce these possibilities, several strategies were utilized, including self-administered questionnaires, confidentiality assurances, short recall periods, and survey administration in private settings. Second, given that the BSSS was used, only two items per sensation-seeking subscale were used in assessment. Future research might use longer sensation-seeking scales and examine how various sub-dimensions of sensation seeking (e.g., experience seeking and disinhibition) predict sexual risk behaviors. Third, because findings came from cross-sectional data, hypothesized variable ordering may not reflect actual causal relationships. Finally, the study sample had limited racial diversity and a high proportion of college students, which may reduce generalizability of these findings.

Conclusion

This study addressed some important questions about the joint contributions of sensation seeking and impulsive decision-making to sexual risk-taking in young adults. However, given the large public health consequences of HIV/STD transmission, there is an urgent need for additional theoretical and translational research to explicate the relationships discovered in this study and incorporate them into group-targeted and individually tailored sexual health interventions.

Acknowledgments

This research was supported by Grant No. R01-MH63705 from the National Institute of Mental Health (principal investigator: Rick S. Zimmerman).

References

Anderson JE, Wilson R, Doll L, Jones TS, Barker P. Condom use and HIV risk behaviors among U.S. adults: Data from a national survey. Family Planning Perspectives. 1999; 31:24–28. [PubMed: 10029929]

Arnett J. Contraceptive use, sensation seeking and adolescent egocentrism. Journal of Youth and Adolescence. 1990; 19:171–180. [PubMed: 12288788]

Brown LK, DiClemente RJ, Park T. Predictors of condom use in sexually active adolescents. Journal of Adolescent Health. 1992; 13:651–657. [PubMed: 1290763]

Centers for Disease Control & Prevention. Sexually transmitted disease surveillance report. Author; Atlanta: 2006. Retrieved from http://www.cdc.gov/std/stats06/toc2006.htm

Chesson HW, Blandford JM, Gift TL, Tao G, Irwin KL. The estimated direct medical cost of sexually transmitted diseases among American youth, 2000. Perspectives on Sexual and Reproductive Health. 2004; 36:11–19. [PubMed: 14982672]

Contrada, RJ.; Guyll, M. On who gets sick and why: The role of personality and stress. In: Baum, A.; Revenson, TA.; Singer, JE., editors. Handbook of health psychology. Lawrence Erlbaum Associates, Inc.; Mahwah, NJ: 2001. p. 59-84.

Donohew L, Zimmerman R, Cupp PS, Novak S, Colon S, Abell R. Sensation seeking, impulsive decision-making, and risky sex: Implications for risk-taking and design of interventions. Personality and Individual Differences. 2000; 28:1079–1091.

Eysenck SBG, Eysenck HJ. The place of impulsiveness in a dimensional system of personality description. British Journal of Social and Clinical Psychology. 1977; 16:57–68. [PubMed: 843784]

Harkness AR, Lilienfeld SO. Individual differences science for treatment planning: Personality traits. Psychological Assessment. 1997; 9:349–360.

Hilbe, JM. Negative binomial regression. Cambridge University Press; Cambridge, England: 2007.

Hoyle RH, Fejfar MC, Miller JD. Personality and sexual risk taking: A quantitative review. Journal of Personality. 2000; 68:1203–1231. [PubMed: 11130738]

Hoyle RH, Stephenson MT, Palmgreen P, Lorch EP, Donohew L. Reliability and validity of a brief measure of sensation seeking. Personality and Individual Differences. 2002; 32:401–414.

Hur Y-M, Bouchard TJ Jr. The genetic correlation between impulsivity and sensation seeking traits. Behavior Genetics. 1997; 27:455–463. [PubMed: 9336082]

Kahn JA, Kaplowitz RA, Goodman E, Emans SJ. The association between impulsiveness and sexual risk behaviors in adolescent and young adult women. Journal of Adolescent Health. 2002; 30:229–232. [PubMed: 11927234]

Kleinbaum, DG.; Klein, M. Logistic regression: A self-learning text. 2nd ed.. Springer; New York: 2002.

Lauritsen JL. Explaining race and gender differences in adolescent sexual behavior. Social Forces. 1994; 72:859–884.

Nelson CA, Bloom FE, Cameron JL, Amaral D, Dalh RE, Pine D. An integrative, multidisciplinary approach to the study of brain–behavior relations in the context of typical and atypical development. Development and Psychopathology. 2002; 14:499–520. [PubMed: 12349871]

Noar SM. Behavioral interventions to reduce HIV-related sexual risk behavior: Review and synthesis of meta-analytic evidence. AIDS & Behavior. 2008; 12:335–353. [PubMed: 17896176]

Noar SM, Black HG, Pierce LB. Efficacy of computer technology-based HIV prevention interventions: A meta-analysis. AIDS. 2009; 23:107–115. [PubMed: 19050392]

Noar SM, Zimmerman RS, Palmgreen P, Lustria M, Horosewski ML. Integrating personality and psychosocial theoretical approaches to understanding safer sexual behavior: Implications for message design. Health Communication. 2006; 19:165–174. [PubMed: 16548707]

Palmgreen, P.; Donohew, L. Effective mass media strategies for drug abuse prevention campaigns. In: Sloboda, Z.; Bukoski, WJ., editors. Handbook of drug abuse prevention: Theory, science, and practice handbooks of sociology and social research. Kluwer Academic/Plenum; New York: 2003. p. 27-43.

Panksepp, J. Affective neuroscience: The foundations of human and animal emotions. Oxford University Press; New York: 1998.

Romer D, Hennessy M. A biosocial-affect model of adolescent sensation seeking: The role of affect evaluation and peer-group influence in adolescent drug use. Prevention Science. 2007; 8:89–101. [PubMed: 17286212]

Spear LP. The adolescent brain and age-related behavioral manifestations. Neuroscience and Biobehavioral Reviews. 2000; 24:417–463. [PubMed: 10817843]

Spitalnick JS, DiClemente RJ, Wingood GM, Crosby RA, Milhausen RR, Sales JM, et al. Brief report: Sexual sensation seeking and its relationship to risky sexual behaviour among African-American adolescent females. Journal of Adolescence. 2007; 30:165–173. [PubMed: 17140653]

Weinstock H, Berman H, Cates W. Sexually transmitted diseases among American youth: Incidence and prevalence estimates, 2000. Perspectives on Sexual and Reproductive Health. 2004; 36:6–10. [PubMed: 14982671]

Zimmerman RS, Cupp PK, Donohew L, Sionéan CK, Feist-Price S, Helme D. Effects of a school-based, theory-driven HIV and pregnancy prevention curriculum. Perspectives on Sexual and Reproductive Health. 2008; 40:42–51. [PubMed: 18318871]

Zimmerman, RS.; Donohew, L. Sensation-seeking, decision-making style, and sexual risk-taking; Paper presented at the American Public Health Association conference; New York, NY. 1996, November;

Zimmerman RS, Palmgreen P, Noar SM, Lustria ML, Lu H-Y, Horosewski ML. Effects of a televised two-city safer sex mass media campaign targeting high-sensation-seeking and impulsive-decision-making young adults. Health Education & Behavior. 2007; 34:810–826. [PubMed: 17602097]

Zuckerman, M. An alternative five-factor model for personality. In: Martin, RP.; Halverson, CF.; Kohnstamm, GA., editors. The developing structure of temperament and personality from infancy to adulthood. Lawrence Erlbaum Associates, Inc.; Hillsdale, NJ: 1994a. p. 53-68.

Zuckerman, M. Behavioral expressions and biosocial bases of sensation seeking. Cambridge University Press; Cambridge, England: 1994b.

Zuckerman M, Buchsbaum MS, Murphy DL. Sensation seeking and its biological correlates. Psychological Bulletin. 1980; 88:187–214.

Table 1

Joint Associations of Sensation Seeking and Impulsivity with Outcome Variables, Unadjusted for Sociodemographic Factors

Outcome Variable and Effective Sample Size	Sensation Seeking Estimate of exp[b_1], (95% CI), *p*	Impulsivity Estimate of exp[b_2], (95% CI), *p*	Interaction Estimate of exp[b_3], (95% CI), *p*
Partners in last year[a] (*n*=2,350)	1.23, (1.16–1.31), *p*<.0001	1.22, (1.13–1.33), *p*<.0001	0.98, (0.90–1.07), *p*=.6731
Partners in lifetime[a] (*n*=2,330)	1.16, (1.08–1.24), *p*<.0001	1.17, (1.07–1.28), *p*=.0006	0.98, (0.90–1.07), *p*=.6646
Unprotected acts in last 30 days[a] (*n*=1,903)	1.06, (0.95–1.19), *p*=.3142	1.31, (1.14–1.52), *p*=.0002	0.96, (0.83–1.10), *p*=.5163
Acts using alcohol in last 3 months[b] (*n*=2,382)	5 vs. 1: 3.62, (2.16–6.07)	5 vs. 1: 1.53, (0.68–3.42)	5 vs. 1: 0.72, (0.33–1.57)
	4 vs. 1: 3.00, (2.18–4.13)	4 vs. 1: 3.74, (2.22–6.32)	4 vs. 1: 0.54, (0.32–0.92)
	3 vs. 1: 1.74, (1.40–2.17)	3 vs. 1: 1.92, (1.49–2.48)	3 vs. 1: 0.95, (0.71–1.26)
	2 vs. 1: 1.32, (1.04–1.68), *p*<.0001	2 vs. 1: 1.10, (0.85–1.43), *p*<.0001	2 vs. 1: 0.84, (0.62–1.13), *p*=.1662
Acts using drugs in last 3 months[b] (*n*=2,383)	5 vs. 1: 2.82, (1.38–5.74)	5 vs. 1: 1.35, (0.43–4.30)	5 vs. 1: 0.99, (0.36–2.73)
	4 vs. 1: 1.76, (1.26–2.45)	4 vs. 1: 5.07, (2.73–9.42)	4 vs. 1: 0.29, (0.15–0.55)
	3 vs. 1: 1.59, (1.28–1.97)	3 vs. 1: 2.50, (1.79–3.48)	3 vs. 1: 0.72, (0.51–1.02)
	2 vs. 1: 1.52, (1.17–1.98), *p*<.0001	2 vs. 1: 1.63, (1.12–2.38), *p*<.0001	2 vs. 1: 0.72, (0.49–1.08), *p*=.0017
Acts with partner who had an STD in last 3 months[b] (*n*=2,377)	4 vs. 1: 0.84, (0.48–1.45)	4 vs. 1: 1.28, (0.65–2.55)	4 vs. 1: 0.40, (0.17–0.95)
	3 vs. 1: 0.62, (0.38–1.02)	3 vs. 1: 2.04, (1.09–3.84)	3 vs. 1: 0.68, (0.32–1.46)
	2 vs. 1: 1.48, (1.22–1.79), *p*<.0001	2 vs. 1: 1.25, (0.96–1.62), *p*=.0594	2 vs. 1: 1.02, (0.79–1.33), *p*=.1528
Acts with partner who injected drugs in last 3 months[b] (*n*=2,377)	4 vs. 1: 2.16, (0.71–6.57)	4 vs. 1: 1.36, (0.24–7.62)	4 vs. 1: 1.56, (0.41–5.93)
	3 vs. 1: 1.51, (0.60–3.80)	3 vs. 1: 1.42, (0.40–5.08)	3 vs. 1: 1.93, (0.76–4.91)
	2 vs. 1: 1.15, (0.87–1.54), *p*=.3297	2 vs. 1: 2.00, (1.31–3.07), *p*=.0150	2 vs. 1: 0.83, (0.54–1.29), *p*=.3798
Acts with non-monogamous partner in last 3 months[b] (*n*=2,377)	4 vs. 1: 1.57, (1.17–2.12)	4 vs. 1: 1.21, (0.81–1.80)	4 vs. 1: 0.98, (0.65–1.47)
	3 vs. 1: 1.50, (1.21–1.87)	3 vs. 1: 1.44, (1.07–1.94)	3 vs. 1: 0.94, (0.69–1.28)
	2 vs. 1: 1.48, (1.18–1.86), *p*<.0001	2 vs. 1: 1.44, (1.06–1.97), *p*=.0204	2 vs. 1: 0.92, (0.67–1.26), *p*=.9498
Acts with partner who has sex with both men and women in last 3 months[b] (*n*=2,377)	4 vs. 1: 1.97, (1.35–2.87)	4 vs. 1: 1.60, (0.88–2.90)	4 vs. 1: 1.04, (0.60–1.79)
	3 vs. 1: 2.45, (1.66–3.60)	3 vs. 1: 1.15, (0.63–2.10)	3 vs. 1: 1.07, (0.62–1.84)
	2 vs. 1: 1.17, (0.88–1.55), *p*<.0001	2 vs. 1: 1.73, (1.16–2.58), *p*=.0260	2 vs. 1: 0.71, (0.46–1.10), *p*=.4790
Acts with partner using alcohol in last 3 months[b] (*n*=2,310)	4 vs. 1: 2.04, (1.50–2.79)	4 vs. 1: 4.08, (2.45–6.78)	4 vs. 1: 0.46, (0.27–0.77)
	3 vs. 1: 1.54, (1.24–1.90)	3 vs. 1: 1.63, (1.26–2.10)	3 vs. 1: 0.86, (0.66–1.13)
	2 vs. 1: 1.06, (0.84–1.35), *p*<.0001	2 vs. 1: 1.08, (0.83–1.41), *p*<.0001	2 vs. 1: 0.66, (0.49–0.89), *p*=.0034
Acts with partner using drugs in last 3 months[b] (*n*=2,354)	4 vs. 1: 1.38, (1.00–1.92)	4 vs. 1: 4.08, (2.31–7.23)	4 vs. 1: 0.41, (0.22–0.75)
	3 vs. 1: 1.21, (0.98–1.50)	3 vs. 1: 2.32, (1.70–3.18)	3 vs. 1: 0.73, (0.52–1.01)
	2 vs. 1: 1.35, (1.06–1.71), *p*=.0203	2 vs. 1: 1.55, (1.11–2.14), *p*<.0001	2 vs. 1: 0.87, (0.62–1.22), *p*=.0128

Note. exp[b_1], exp[b_2], and exp[b_3] are defined in the Data Analysis section of the article.

CI = confidence interval; STD = sexually transmitted disease.

[a]The results in these rows are based on negative binomial regression models. To exemplify their interpretation, consider the outcome of partners in the last year. Among people with an impulsivity score of 3, a one-unit increase in sensation seeking corresponds to an estimated 23% increase in the mean number of partners in the last year (because the estimate of exp[b_1] = 1.23). Among people with a sensation seeking score of 3, a one-unit increase in impulsivity corresponds to an estimated 22% increase in the mean number of partners (because the estimate of exp[b_2] = 1.22). Among

people with an impulsivity score of 4, a one-unit increase in sensation seeking corresponds to an estimated 21% increase in the mean number of partners (because the estimate of $\exp[b_3] \times \exp[b_1] = 1.21$ and $\exp[b_3]$ is the factor by which $\exp[b_1]$ is multiplied to compare people one unit apart on sensation seeking when their common impulsivity score is increased from 3 to 4).

[b]The results in these rows are based on generalized logit regression models. Labels of "2 vs. 1" pertain to odds-like quantities involving the second and first categories of the outcome variable, labels of "3 vs. 1" pertain to odds-like quantities involving the third and first categories, and so forth. To exemplify interpretation of the results, consider the outcome of acts using alcohol in the last three months. Among people with an impulsivity score of 3, a one-unit increase in sensation seeking corresponds to an estimated 74% increase in the odds-like quantity involving the third and first categories of acts using alcohol in the last three months (because the estimate of $\exp[b_1] = 1.74$). Among people with a sensation seeking score of 3, a one-unit increase in impulsivity corresponds to an estimated 92% increase in the odds-like quantity (because the estimate of $\exp[b_2] = 1.92$). Among people with an impulsivity score of 4, a one-unit increase in sensation seeking corresponds to an estimated 65% increase in the odds-like quantity (because the estimate of $\exp[b_3] \times \exp[b_1] = 1.65$ and $\exp[b_3]$ is the factor by which $\exp[b_1]$ is multiplied to compare people one unit apart on sensation seeking when their common impulsivity score is increased from 3 to 4).

Table 2

Joint Associations of Sensation Seeking and Impulsivity with Outcome Variables, Adjusted for Sociodemographic Factors[a]

Outcome Variable and Effective Sample Size	Sensation Seeking Estimate of exp[b_1], (95% CI), *p*	Impulsivity Estimate of exp[b_2], (95% CI), *p*	Interaction Estimate of exp[b_3], (95% CI), *p*
Partners in last year (*n*=2,347)	1.22, (1.15–1.31), *p*<.0001	1.21, (1.12–1.32), *p*<.0001	0.98, (0.90–1.06), *p*=.6409
Partners in lifetime (*n*=2,327)	1.21, (1.13–1.30), *p*<.0001	1.24, (1.14–1.35), *p*<.0001	0.92, (0.84–1.00), *p*=.0596
Unprotected acts in last 30 days (*n*=1,901)	1.06, (0.94–1.20), *p*=.3168	1.28, (1.10–1.48), *p*=.0013	0.95, (0.82–1.09), *p*=.4400
Acts using alcohol in last 3 months (*n*=2,379)	5 vs. 1: 3.08, (1.82–5.22)	5 vs. 1: 1.62, (0.73–3.62)	5 vs. 1: 0.71, (0.33–1.55)
	4 vs. 1: 2.84, (2.04–3.95)	4 vs. 1: 3.95, (2.33–6.70)	4 vs. 1: 0.53, (0.31–0.91)
	3 vs. 1: 1.65, (1.31–2.07)	3 vs. 1: 2.09, (1.61–2.71)	3 vs. 1: 0.93, (0.70–1.25)
	2 vs. 1: 1.29, (1.00–1.66), *p*<.0001	2 vs. 1: 1.16, (0.89–1.52), *p*<.0001	2 vs. 1: 0.83, (0.61–1.13), *p*=.1597
Acts using drugs in last 3 months (*n*=2,380)	5 vs. 1: 3.29, (1.56–6.96)	5 vs. 1: 1.54, (0.48–4.89)	5 vs. 1: 0.83, (0.29–2.37)
	4 vs. 1: 1.80, (1.27–2.55)	4 vs. 1: 4.93, (2.63–9.26)	4 vs. 1: 0.28, (0.15–0.53)
	3 vs. 1: 1.62, (1.30–2.03)	3 vs. 1: 2.41, (1.72–3.37)	3 vs. 1: 0.71, (0.51–1.01)
	2 vs. 1: 1.51, (1.15–1.98), *p*<.0001	2 vs. 1: 1.60, (1.10–2.33), *p*<.0001	2 vs. 1: 0.73, (0.49–1.08), *p*=.0015
Acts with partner who had an STD in last 3 months (*n*=2,374)	4 vs. 1: 1.01, (0.58–1.78)	4 vs. 1: 1.57, (0.78–3.19)	4 vs. 1: 0.38, (0.16–0.91)
	3 vs. 1: 0.83, (0.50–1.38)	3 vs. 1: 2.22, (1.15–4.27)	3 vs. 1: 0.63, (0.29–1.39)
	2 vs. 1: 1.59, (1.30–1.94), *p*<.0001	2 vs. 1: 1.29, (0.99–1.68), *p*=.0223	2 vs. 1: 1.01, (0.77–1.31), *p*=.1129
Acts with partner who injected drugs in last 3 months (*n*=2,374)	4 vs. 1: 2.34, (0.72–7.54)	4 vs. 1: 1.40, (0.24–8.01)	4 vs. 1: 1.57, (0.40–6.13)
	3 vs. 1: 1.42, (0.55–3.69)	3 vs. 1: 1.37, (0.37–5.03)	3 vs. 1: 1.79, (0.70–4.62)
	2 vs. 1: 1.11, (0.83–1.49), *p*=.4053	2 vs. 1: 2.02, (1.32–3.11), *p*=.0138	2 vs. 1: 0.83, (0.54–1.27), *p*=.4315
Acts with non-monogamous partner in last 3 months (*n*=2,374)	4 vs. 1: 1.82, (1.33–2.48)	4 vs. 1: 1.28, (0.85–1.93)	4 vs. 1: 0.92, (0.61–1.38)
	3 vs. 1: 1.63, (1.30–2.06)	3 vs. 1: 1.52, (1.12–2.07)	3 vs. 1: 0.89, (0.65–1.22)
	2 vs. 1: 1.61, (1.27–2.04), *p*<.0001	2 vs. 1: 1.48, (1.08–2.03), *p*=.0100	2 vs. 1: 0.88, (0.64–1.22), *p*=.8155
Acts with partner who has sex with both men and women in last 3 months (*n*=2,374)	4 vs. 1: 1.58, (1.07–2.31)	4 vs. 1: 1.68, (0.93–3.05)	4 vs. 1: 1.02, (0.60–1.73)
	3 vs. 1: 2.00, (1.34–3.00)	3 vs. 1: 1.05, (0.58–1.91)	3 vs. 1: 1.13, (0.67–1.93)
	2 vs. 1: 1.00, (0.75–1.34), *p*=.0014	2 vs. 1: 1.83, (1.22–2.73), *p*=.0122	2 vs. 1: 0.73, (0.47–1.12), *p*=.4740
Acts with partner using alcohol in last 3 months (*n*=2,307)	4 vs. 1: 2.15, (1.55–2.98)	4 vs. 1: 4.35, (2.60–7.27)	4 vs. 1: 0.45, (0.27–0.76)
	3 vs. 1: 1.60, (1.28–2.00)	3 vs. 1: 1.75, (1.35–2.27)	3 vs. 1: 0.86, (0.65–1.13)
	2 vs. 1: 1.10, (0.86–1.41), *p*<.0001	2 vs. 1: 1.17, (0.89–1.53), *p*<.0001	2 vs. 1: 0.65, (0.48–0.87), *p*=.0023
Acts with partner using drugs in last 3 months (*n*=2,352)	4 vs. 1: 1.62, (1.15–2.30)	4 vs. 1: 3.98, (2.22–7.11)	4 vs. 1: 0.39, (0.21–0.71)
	3 vs. 1: 1.36, (1.08–1.70)	3 vs. 1: 2.28, (1.66–3.14)	3 vs. 1: 0.71, (0.51–0.99)
	2 vs. 1: 1.39, (1.08–1.79), *p*=.0013	2 vs. 1: 1.50, (1.08–2.09), *p*<.0001	2 vs. 1: 0.88, (0.63–1.23), *p*=.0080

Note. exp[b_1], exp[b_2], and exp[b_3] are defined in the Data Analysis section of the article.

CI = confidence interval; STD = sexually transmitted disease.

[a]The estimated regression coefficients in this table have essentially the same interpretations as those in Table 1, except that now the following covariates are controlled for: gender, race (White or non-White), ethnicity (Latino or non-Latino), age, and highest grade completed.