

Relations Between Trait Impulsivity, Behavioral Impulsivity, Physiological Arousal, and Risky Sexual Behavior Among Young Men

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Abstract The current study examined how impulsivity-related traits (negative urgency, sensation seeking, and positive urgency), behavioral measures of risk taking and reward seeking, and physiological reactivity related to three different risky sexual behaviors in sexually active undergraduate men ($N = 135$). Regression analyses indicated that sensation seeking and behavioral risk-taking predicted unique variance in number of sexual partners. These findings suggest that, for young men, acquisition of new partners is associated with need for excitement and reward and willingness to take risks to meet those needs. Sensation seeking, behavioral risk-taking, and skin conductance reactivity to arousing stimuli was related to ever having engaged in sex with a stranger, indicating that, for men, willingness to have sex with a stranger is related not only to the need for excitement and risk-taking but also with innate responsiveness to arousing environmental triggers. In contrast, regression analyses indicated that young men who were impulsive in the context of negative emotions were less likely to use condoms,

suggesting that emotion-based impulsivity may be an important factor in negligent prophylactic use. This study adds to the current understanding of the divergence between the correlates of risky sexual behaviors and may lend utility to the development of individualized HIV prevention programming.

Keywords Risky sex · Condom use · Psychophysiology · Sensation seeking · Negative urgency

Introduction

Individuals who engage in risky sexual behavior are at risk for a host of negative, long-term consequences, including unplanned pregnancy, HIV transmission, and other sexually transmitted diseases (STDs) (Weinstock, Berman, & Cates, 2004). The impact of a few risky sexual encounters can have considerable consequences: the Center for Disease Control (2010) reported that, as of 2010, there were 19 million new STD infections each year in the United States, greatly affecting these individuals' overall health and costing the U.S. health care system \$17 billion every year in treatment efforts. Notably, STDs pose a particular threat to adolescents and young adults. The CDC report on 2010 data suggests that rates of gonorrheal infections was highest in men 20–24 years old, indicating that young adults are at particular risk for adverse outcomes of risky sex.

Due to numerous possible negative outcomes, considerable time and effort have been directed at understanding the causes of risky sexual behavior, particularly for young adults who may be most at risk. At this point, there have been several initial areas of investigation, including measures of disposition (Hoyle, Fejfar, & Miller, 2000; Zapolski, Cyders, & Smith, 2009), measures that reflect more proximal decision-making, such as behavioral measures of risk-taking and disinhibition (Lejuez, Simmons, Aclin, Daughters, & Dvir, 2004; Macapagal, Janssen, Fridberg,

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Finn, & Heiman, 2011), and physiological measures of arousal (Janssen, Goodrich, Petrocelli, & Bancroft, 2009). While each of these studies has made a valuable contribution to the literature, understanding sexual risk taking in terms of personality and physiological arousal is still quite new. Given the need for prevention and intervention programs for young adults, a more in-depth understanding of the multiple correlates of risky sexual behavior could be a valuable contribution to the development of successful prevention and treatment. The current study examined several potential correlates of risky sexual behavior in an effort to explore how they were associated with different types of sexual risk.

Risky Sex and Trait Impulsivity

Several aspects of impulsivity have emerged as standout predictors of risky sexual behavior (see Hoyle et al., 2000), but the characteristic of sensation seeking has received the most attention (Fisher & Misovich, 1990; Kalichman, Heckman, & Kelly, 1996; Newcomb & McGee, 1991). Zuckerman (1990) described sensation seeking as the need for "... varied, novel and complex sensations and experience and the willingness to take physical and social risks for the sake of such experience" (p. 313). Based upon this definition, it is not surprising that this trait has been utilized in many conceptualizations of risk. Measures of sensation seeking have shown associations with several risky sexual outcomes, such as number of sexual partners and unfamiliar sex partners (Bancroft, Carnes, & Janssen, 2005; Newcomb & McGee, 1991; Temple, Leigh, & Schafer, 1993), indicating that the need for novelty extends into sexual practices.

More recent work has indicated that trait impulsivity is multifaceted in nature and that different aspects of the broader construct of "impulsivity" may be uniquely associated with different types of behaviors. Using multiple measures of impulsivity and personality as a basis, Whiteside and Lynam (2001) developed the UPPS (*urgency*, lack of *premeditation*, lack of *perseverance*, *sensation seeking*) model of impulsivity to assess different aspects of impulsivity. According to Whiteside and Lynam (2001) and Lynam, Smith, Whiteside, and Cyders (2006), *urgency* is the tendency to engage in rash or regrettable behavior when experiencing intense emotion and can be separated into responses to negative affect (negative urgency) or responses to positive affect (positive urgency). Although highly related, these aspects of urgency have shown some unique predictive utility (Cyders & Smith, 2007, 2008). Lack of premeditation refers to the failure to reflect on the potential consequences of an act before engaging in that act, lack of perseverance is the failure to focus or follow through on difficult or boring tasks, and sensation seeking refers to the need for excitement. Zapolski et al. (2009) investigated the utility of several facets of impulsivity in the prediction of risky sexual behavior over the course of a year in a sample of college students (75 % female). They found that baseline levels of lack of

perseverance, positive urgency, and sensation seeking related to a broad measure of risky sexual behavior one year later, suggesting that utilizing a more articulated model of impulsivity may be particularly useful in understanding risky sex. However, it should be noted that the measure of risky sex used in this study was a broad measure encompassing multiple different risk behaviors; little is known about how facets of impulsivity relate to specific forms of sexual risk taking.

It should also be noted that, aside from impulsivity-related characteristics, other general personality traits are also associated with risky sexual behavior. In a meta-analytic review of this area, Hoyle et al. (2000) found that high neuroticism emerged as a significant predictor of unprotected sex. More recent research has also found state negative affect to have an influence on risky sexual practice although not always in consistent ways. For instance, Bancroft et al. (2003) found that, in gay men, anxiety was negatively related to use of prophylactics (higher anxiety was related to less unprotected sex), but for some individuals negative mood states increased need for sexual activity, such as higher numbers of partners and attempts at partner acquisition. Collectively, these findings suggest that research in this area should consider the impact of sensation seeking and impulsivity associated with positive and negative affect on risky sexual behaviors.

Risky Sex and Behavioral Impulsivity

In addition to self-reported impulsivity, behavioral performance measures of disinhibition are often presumed to be associated with risky sexual practices, as these measures reflect proximal and specific forms of impulsivity (for overviews of human laboratory tasks of impulsivity and related constructs, see Dick et al., 2010; Lejuez et al., 2010). Some behavioral measures of disinhibition appear to focus very specifically on areas commonly believed to reflect sexual risk taking, such as reward dependence (wanting a pleasurable experience) and sensitivity to punishment (not wanting to contract an STD), making them viable options for understanding discrete decision-making under mixed-contingency conditions.

Despite this potential link, few studies have actually examined this possibility. Lejuez et al. (2002) developed the Balloon Analogue Risk Task (BART), a measure of risk taking propensity, to simulate more "real world" decision-making. Specifically, the BART allows participants to engage in rewarding behavior (earning points by pumping up a simulated balloon by pressing a key) in the face of possible random punishment (the balloon may pop at any time). Risk-taking is measured by one of two related parameters, including the number of mean pumps the participant makes across trials, or the number of balloons popped. Lejuez et al. (2002) found that scores on the BART correlated with a risk-taking composite variable, which included the number of people an individual had unprotected sex with during the past year, in a community sample of men and

women. The BART was also examined as a measure of risk-taking in a sample of adults in residential substance use treatment (Lejuez et al., 2004) and performance was found to offer incremental utility in the prediction of risky sexual practices over measures of trait impulsivity, self-esteem, and internalizing psychopathology. This finding is consistent with the notion that laboratory-based performance tasks tap aspects of cognitive processing that are not assessed by self-report questionnaire measures of impulsivity-related traits (Dick et al., 2010), and thus that inclusion of these tasks may provide a fuller view of factors that influence risky sexual behavior.

Risky Sex and Psychophysiological Reactivity

Although self-report measures and behavioral indices may be important indicators of risk, these types of measurement rely upon awareness of arousal and intentions. However, exposure to rewarding stimuli may prime behavior outside of the individual's awareness (Demos, Heatherton, & Kelley, 2012; Nees, Diener, Smolka, & Flor, 2011) and may lead to the same outcomes as the conscious pursuit of goals (Bargh & Morsella, 2008; Dijksterhuis, Chartrand, & Aarts, 2007). Emerging research has suggested that risky sexual practices may be associated with individual's physiological reactivity to stimuli (Demos et al., 2012; Janssen & Bancroft, 2007; Janssen et al., 2009). While some of the work in this area has been directed specifically at sexual excitation (i.e., physiological measurement of sexual arousal), there is reason to believe that other forms of physiological reactivity, such as generalized sympathetic nervous system arousal, may also be related to sexual impulsivity (Demos et al., 2012). In fact, physiological reactivity to stimuli has long been theoretically linked to sensation seeking and is believed to represent a biological marker for this trait (Zuckerman, 1990).

Despite the potential link between physiological reactivity and risky sex, this remains a relatively unexplored area. Janssen et al. (2009) examined three psychophysiology measures in a sample of 76 heterosexual and homosexual men during threatening and non-threatening sexual film excerpts. Although there were no significant group differences in skin conductance and cardiac reactivity between sexual risk-taking groups (based upon a median split of reported condom use), attenuated startle response was found in the high sexual risk-taking group. Although this could be interpreted as evidence of physiological hypo-reactivity, attenuated startle may also occur in response to high attentiveness and/or arousal to appealing stimuli (Filion, Dawson, & Schell, 1998). In fact, attenuated startle in response to appetitive imagery has been found to occur in tandem with high skin conductance reactivity for other risky behaviors (Nees et al., 2011), suggesting that attenuated startle may be a marker of orienting and arousal toward a desired stimulus. In other support of the idea that physiological reactivity may be pronounced in individuals who engage in risky sex, Demos et al. (2012) examined neurological activity and appetitive responses to sexual

images and found that "heightened reward responsivity" in the nucleus accumbens was related to sexual desire and predicted later sexual activity, suggesting that physiological reactivity may indeed underlie sexual risk taking.

Why Look at Multiple Predictors of Risk Simultaneously?

Given the emerging research in multiple indicators of potentially risky behaviors, the field now has a starting point for future work in understanding how these factors work together. However, no study to date has examined the effects of these factors together on individual types of risky sexual behaviors. In fact, Janssen et al. (2009) suggested that physiological measurement should be used with both trait and laboratory indices of risk taking and future studies should incorporate more broad measures of sexual risk taking in addition to condom use.

Examining multiple indices of risk is potentially valuable information, given recent efforts at "targeted" prevention and intervention programming. Targeted treatment programs are based on personal characteristics, such as sensation seeking, and have been found to be effective at reducing risk in adolescents with substance use (Conrod et al., 2000), suggesting that similar approaches could be quite useful for risky sex. Targeted prevention programs utilize trait information to encourage rapport and personalize prevention by identifying unique points of risk. For example, for individuals with sensation seeking traits, current substance use prevention programming identifies times when the individual is most likely to make a mistake, such as when they are bored or in the company of other sensation seekers. By utilizing not only this trait information (an individual's propensity to behave a specific way), but also information on behavioral disinhibition and physiological reactivity, treatments can be expanded to address multiple points of intervention.

The Current Study

Following emerging research in trait, behavioral, and physiological domains, the purpose of the current study was to explore relations between trait impulsivity, behavioral measures of risk-taking and reward-seeking, physiological reactivity to emotionally valenced stimuli, and risky sexual behaviors. To do this, we utilized trait indicators of impulsivity from the UPPS impulsivity model, a behavioral risk-taking task, a behavioral task of reward-seeking, and an emotionally valenced (unpleasant and pleasant stimuli) skin conductance reactivity task. In addition, we sought to explore the construct of risky sexual behavior in a more nuanced way, as distinct behaviors may result from distinct processes. For instance, having multiple sex partners may arise from a need for excitement whereas choosing not to use a condom during sexual activity may arise from failure to interrupt sexual arousal to take precautions. Therefore, we used three individual behaviors as indicators of risky sex, including number of sexual partners, ever

had sex with a stranger, and irregular condom use. These specific behaviors have been previously utilized in the sexual risk-taking literature (Bancroft et al., 2004) and are indicators of behavior that could result in negative outcomes.

Based upon previous research (Bancroft, Carnes, & Janssen, 2005; Kalichman, Heckman, & Kelly, 1996; Newcomb & McGee, 1991; Temple, Leigh, & Schafer, 1993), we hypothesized that risky sexual practices that appear to address the need for novelty (i.e., number of sexual partners and ever had sex with a stranger) would be significantly, positively related to sensation seeking. We also hypothesized that, based upon previous findings with strong affect and poor prophylactic use (Bancroft et al., 2005; Hoyle et al., 2000; Zapolski et al., 2009), both negative urgency and positive urgency would evidence significant, negative relations with regular condom use. Due to previous positive relations between number of unprotected sexual encounters and behavioral measures of risk taking (Lejuez et al., 2004), we hypothesized that number of sexual partners and ever had sex with a stranger would be associated with both tasks of risk-taking and reward seeking. Finally, research on physiological activity and risky sex appears to suggest muscular indicators of attentiveness (Janssen et al., 2009) and neurological evidence of heightened arousal (Demos et al., 2012). We therefore hypothesized that skin conductance reactivity to pleasant stimuli would be positively related to number of sexual partners and ever had sex with a stranger, and negatively related to regular condom use.

Method

Participants

Participants were 135 male undergraduates who had previously engaged in sexual intercourse. Age of participants ranged from 17 to 26, with a mean of 19.40 years. The study was made available through an online registration system to all students in an introductory psychology course to earn course credit through participation in research. Male undergraduates were sampled due to the higher likelihood of engagement in risky behaviors. In addition, e-mail invitations to participate in the study were sent to members of the participant pool who had obtained a high score (the top 25 % of men in the entire group, with a total score >54) on a psychopathy screening measure, the Hare Self-Report Psychopathy Scale (HSRP) (Paulhus, Hemphill, & Hare, in press), which had been included in a packet of screening measures administered at the beginning of the semester to identify potential participants for numerous studies. This selection process served to ensure that the top of the general distribution of delinquency and behavioral problems was well represented. This study initially recruited 193 participants for data collection.

Of these individuals, 32.6 % scored in the top quartile of the HSRP. However, the current results only include data from participants who endorsed having previously engaged in sexual intercourse.

Measures

Trait Impulsivity

The UPPS Impulsivity Scale (Lynam et al., 2006; Whiteside & Lynam, 2001) is a 59-item self-report measure designed to assess five impulsivity-related traits: negative urgency (12 items), lack of premeditation (11 items), lack of perseverance (10 items), sensation seeking (12 items), and positive urgency (14 items). Whiteside and Lynam found that the UPPS demonstrated excellent internal consistency and convergent validity. More recent studies have indicated that the traits of the UPPS make unique contributions to different disorders, suggesting that these subscales represent important aspects of impulsivity not assessed in other impulsivity measures (Whiteside et al., 2005). No UPPS items ask about or make reference to sexual behaviors. The UPPS was scored using a 5-point Likert scale (1 = *Strongly Disagree* to 5 = *Strongly Agree*). Reliabilities (i.e., coefficient alphas) for the subscales in the current sample ranged from .82 to .91. Only negative urgency, positive urgency, and sensation seeking were used in the current study.

Risky Sexual Behaviors

The CAB (Lynam, Whiteside, & Jones, 1999) is a 69-item self-report inventory that asks the participant about aggression (i.e., intimate partner violence, fighting, use of weapons), delinquency (i.e., substance use, stealing, driving while intoxicated), and risky sexual behaviors. Two risky sexual behavior variables were not used due to very low base rates (less than 2 % endorsement: ever diagnosed with an STD and ever had a sexual partner have an abortion). Three variables were used for the study. These included: number of sexual partners (scored as actual number of partners reported); sex with a stranger; (ever had sex with someone known for less than 24 h; scored as 0 = no, 1 = yes); and irregular condom use. Irregular condom use was scored on a 1–5 scale, with 1 representing “always use condoms” and 5 representing “never use condoms.”

Skin Conductance Reactivity

Participants viewed 27 images from the International Affective Picture System (IAPS) previously chosen and categorized by Patrick, Bradley, and Lang (1993): Nine pleasant images included opposite sex nudes, food, sports scenes, and children; nine neutral images included household objects and neutral

faces; nine unpleasant images included mutilations, aimed guns, and snakes.¹ Images were randomly presented for 6 s each in blocks of nine, with three pleasant, three neutral, and three unpleasant images in each block.

Participants' skin conductance reactivity to these same images was recorded with two disposable 8-mm Ag–AgCl electrodes placed on the distal phalanges of the index and middle fingers of the participant's non-dominant hand. The raw skin conductance was amplified with a Biopac GSR100C amplifier (Biopac Systems, Inc., Santa Barbara, CA; Gain = 200, Low Pass = 10 Hz, High Pass = .05 Hz, DC) and was sampled at a rate of 200 Hz. Due to data recording errors, data from 26 of the 135 participants were excluded from analyses. Baseline (resting) scores for each participant were acquired during the 5 min after the stimuli presentation ended. The dependent variable was defined as the largest increase in microsiemens above baseline occurring during the period between the .5 and 3.5 s following the onset of image presentation. From skin conductance scores, two variables were created: skin conductance reactivity during unpleasant image presentation and skin conductance reactivity during pleasant image presentation. Higher skin conductance reactivity scores indicated a greater autonomic response to images, calculated as the difference from individuals' baseline skin conductance score.

Behavioral Reward-Seeking

The Go/No-Go (Newman & Kosson, 1986) is a mixed incentive discrimination task with four reward stimuli (S+) and four punishment stimuli (S–). All stimuli were two digit numbers and no characteristic of numbers was differentially associated with either the S+ or S– stimuli. The participant's first task was to learn, through trial and error, which stimuli were rewarded (S+) and which were punished (S–). In subsequent trials, participants were to press a button whenever an S+ appeared on the computer screen and to inhibit responding (i.e., not press the button) when an S– appeared. Each correct response was rewarded with the presentation of \$.10 and each incorrect response was punished by the loss of \$.10. A correct key press to an S+ stimulus was followed immediately by music and the message "you won \$.10" on the computer screen whereas a buzzer and the message "you lose \$.10" followed a key press to an S– stimulus. There were no monetary consequences (or feedback) when the participant did not respond to a stimulus. Stimuli were presented for 2 s or until a response was made. All participants received 68 trials, with the first 4 trials serving as the pretreatment phase to establish which stimuli were associated with reward. Blocks consisted of 4 S+ stimuli and 4 S– stimuli presented in random order. Testing required approximately

5 min to complete. The dependent variable was the total number of commission errors (i.e., responses to punishment stimuli) across all 8 trial blocks (excluding the pretreatment phase). Participants' total earnings were recorded for payment at the end of the study.

Behavioral Risk-Taking

The Balloon Analogue Risk Task (BART) is a computer-simulated measure of risk-taking behavior where participants earn rewards under conditions of increasing potential for punishment (Hunt, Hopko, Bare, Lejuez, & Robinson, 2005; Lejuez et al., 2002). The task has been used extensively as a measure of risk-taking behavior in adults, adolescents, and children (Humphreys & Lee, 2011; Lejuez et al., 2007) in relation to a wide range of health risk behaviors, including risky sexual behavior (Lejuez et al., 2004; Lejuez, Bornovalova, Daughters, & Curtin, 2005), as well as clinical disorders such as borderline personality disorder (e.g., Coffey, Schumacher, Baschnagel, Hawk, & Holloman, 2011) and attention-deficit/hyperactivity disorder (e.g., Humphreys & Lee, 2011). During the task, a small image of a balloon and balloon pump was presented on the computer screen along with a reset button labeled "Collect \$\$\$" and a display of total money earned. Participants used the computer's mouse to click the balloon pump and inflate the balloon, but were not given any information about the probability of a balloon exploding (it could explode after the first pump or only after the balloon filled the entire screen after 134 pumps). In actuality, the task was programmed to have balloons burst at a set time on each trial to ensure that all participants received the same experience although the predetermined explosions appeared random to participants. Each click inflated the balloon about .125 in in all directions and \$0.02 was added to a temporary reserve that was added to the "Total Earned" display if the participant clicked "Collect \$\$\$" before the balloon exploded. If the balloon exploded before the participant clicked "Collect \$\$\$," the money accumulated in the temporary reserve was lost. Participants were instructed that they would receive 20 balloons over the course of the task. The dependent variable was the mean number of balloon pumps on completed trials (i.e., trials without pops). Participants' total earnings were recorded for payment at the end of the study.

Procedure

The current study was part of a larger protocol administered over the course of two 1.5-h testing sessions. Participants were tested individually. In the first session, participants were asked to provide informed consent before completing laboratory tasks, including the skin conductance reactivity task, the BART, and the Go/No-Go. Participants were told that due to good performance on the tasks, they would be paid the maximum of \$20 available for the tasks, and were paid immediately after participation in the first session. During the

¹ The IAPS slide numbers were as follows: pleasant—160, 226, 465, 720, 803, 808, 418, 421, 425; neutral—220, 550, 700, 702, 705, 708, 710, 716, 718; unpleasant—109, 212, 300, 310, 313, 315, 620, 623, 904

second session, participants were administered five self-report questionnaires, including the UPPS impulsivity scale and the CAB. Measures were presented in counterbalanced order. Participants were paid \$10 immediately after participation in the second session. For completion of both parts of the study, participants received a total of \$30. A researcher was always present during testing and participants were encouraged to ask questions if clarification was necessary. The university Institutional Review Board approved procedures for recruitment, data collection, and data storage.

Results

Descriptive statistics for all variables are shown in Table 1. Next, correlational and regression analyses were used to test specific hypotheses.

Correlational Analyses

Correlations among impulsivity and physiological variables are shown in Table 2. Notably, there were significant intercorrelations between facets of trait impulsivity, particularly between negative urgency and positive urgency. In addition, skin conductance reactivity to unpleasant images was significantly and positively related to skin conductance reactivity to pleasant images. Skin conductance reactivity to pleasant images was positively and significantly associated with sensation seeking.

Zero-order correlations indicated that number of sexual partners was significantly and positively related to sensation seeking, risk-taking behavior on the Balloon Analog Risk Task (BART), and reward-driven behavior (errors of commission) on the mixed incentive Go/No-Go task. Relations with skin conductance measures were not significant. Ever having sex with a stranger was significantly and positively related to sensation seeking, and skin conductance reactivity to both unpleasant and pleasant images. However, relations with behavioral tasks were not significant. In contrast to number of sexual partners and sex with a stranger, irregular condom use was significantly and negatively related to negative urgency, and significantly and positively related to skin conductance reactivity to unpleasant images, but not pleasant images.

Regression Analyses

Unique relations between risky sexual behaviors and predictor variables of trait impulsivity, behavioral impulsivity, and physiological arousal were explored using regression analyses. All predictor variables were standardized for analyses. Number of sexual partners and irregular condom use were non-normally distributed: number of sexual partners had a skewness of 2.41

Table 1 Descriptive statistics

Variable	<i>N</i>	<i>M</i>	<i>SD</i>	Percent endorsed
Age	126	19.50	1.55	
Negative urgency	135	2.73	.72	
Sensation seeking	135	3.95	.64	
Positive urgency	135	2.37	.84	
Skin conductance reactivity—pleasant	109	0.23	.56	
Skin conductance reactivity—unpleasant	109	0.19	.56	
Go/No-Go ^a	135	14.24	5.08	
Balloon Analog Risk Task ^b	135	35.57	12.30	
Number of sexual partners ^c	135	4.19	4.57	
Sex with stranger	135			28 %
Irregular condom use	135	4.20	1.08	

^a Range, 3–26

^b Range, 7.26–67.78

^c Range, 1–23

($SE = 0.21$) and kurtosis of 6.39 ($SE = 0.41$); irregular condom use had a skewness of 0.61 ($SE = 0.20$) and kurtosis of -1.31 ($SE = 0.41$). Due to non-normality of data, Poisson regressions were conducted for these variables. A logistic regression was conducted to predict risk of having had sex with a stranger. Predictor variables were entered simultaneously in all analyses, but due to high inter-relations among negative and positive urgency ($r = .71$), only negative urgency was used. Due to very high multicollinearity between skin conductance reactivity to unpleasant and pleasant images ($r = .92$), these variables were averaged for regression analyses. Exponentiated coefficients and 95 % confidence intervals for all predictors in all models can be found in Table 3.

Sensation seeking and risk-taking on the BART accounted for unique variance in predicting number of sexual partners ($B = .19$; $p = .030$, and $B = .18$; $p = .048$, respectively). A one SD in sensation seeking average number of sexual partner by an estimated 12 %, and a one-SD in risk-taking on the BART task increased the average number of sexual partners by an estimated 20 %. Sensation seeking, risk-taking on the BART, and skin conductance reactivity accounted for unique variance in risk of ever having sex with a stranger ($B = .60$; $p = .029$, $B = .52$; $p = .045$, and $B = .53$; $p = .035$, respectively). A one SD in sensation seeking multiplied the estimated probability of having sex with a stranger by 1.82, a one SD in risk-taking on the BART task multiplied this estimated probability by 1.68, and a one SD in skin conductance reactivity multiplied this estimated probability by 1.70. Only negative urgency predicted unique variance in irregular condom use ($B = .14$; $p = .021$). A one SD in negative urgency increased the likelihood of more irregular condom use by an estimated 15 %.

Table 2 Zero-order correlations between trait impulsivity, impulsive behavior, physiological arousal, and risky sex variables

	1	2	3	4	5	6	7	8	9
1. Negative urgency									
2. Sensation seeking	.16								
3. Positive urgency	.71***	.25***							
4. Skin conductance reactivity: pleasant	.12	.20*	.11						
5. Skin conductance reactivity: unpleasant	.12	.13	.10	.92***					
6. Go/No-Go	.09	.02	.11	-.05	-.04				
7. BART	-.03	.08	-.01	-.14	-.09	.08			
8. Number of sexual partners	.15	.23*	.14	-.05	-.04	.18*	.18*		
9. Sex with stranger	.17	.21*	.16	.22*	.22*	.13	.14	.52***	
10. Irregular condom use	.22*	-.03	.14	-.19*	-.15	.11	.03	.06	-.09

For all correlations utilizing skin conductance response variables, $N = 109$, for all other correlations, $N = 135$. BART Balloon Analog Risk Task

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 3 Logistic and poisson regression models predicting number of sexual partners, sex with a stranger, and irregular condom use

	Exp (B)	95 % CI
Number of sexual partners ^a		
Negative urgency	1.14	.95–1.36
Sensation seeking	1.21*	1.02–1.46
Go/No-Go	1.15	.95–1.40
BART	1.20*	1.01–1.43
Skin conductance reactivity ^c	1.02	.89–1.17
Sex with stranger ^b		
Negative urgency	1.43	.88–2.34
Sensation seeking	1.82*	1.06–3.12
Go/No-Go	1.30	.81–2.08
BART	1.68*	1.01–2.80
Skin conductance reactivity ^c	1.70*	1.04–2.79
Irregular condom use ^a		
Negative urgency	1.15*	1.02–1.29
Sensation seeking	.95	.82–1.10
Go/No-Go	1.00	.89–1.13
BART	.95	.83–1.09
Skin conductance reactivity ^c	.89	.79–1.01

BART Balloon Analog Risk Task

* $p < .05$, ** $p < .01$, *** $p < .001$

^a Poisson regression conducted

^b Logistic regression conducted

^c Average of skin conductance reactivity scores across pleasant and unpleasant images

Discussion

The current study examined many of the possible correlates of risky sex, including trait impulsivity, risk taking and reward seeking behaviors, and physiological reactivity in a sample of undergraduate men. Rarely studied together, interrelations among these diverse risk factors were first examined. Consistent

with prior theory, sensation seeking was positively related to skin conductance reactivity to pleasant stimuli, replicating the “orienting” response believed to be characteristic of sensation seekers (Zuckerman, 1990). Next, we investigated zero-order relations and unique predictive utility of these trait, behavioral, and physiological variables to specific risky sexual behaviors. As predicted, sensation seeking was positively related to number of sexual partners and sex with a stranger at the zero-order level, and this trait emerged as a unique predictor of these risky sexual behaviors as well. This indicates that young men who are stimulated by new and exciting events are also likely to extend these characteristics into pursuing novel sexual experiences. Correlations indicated that number of sexual partners was positively related to behavioral risk-taking and reward-seeking, and regression results indicated that higher behavioral risk-taking predicted higher number of sexual partners and the likelihood of engaging in sex with a stranger above and beyond other trait and behavioral correlates, suggesting that there is unique predictive utility in this behavioral measure of risk. These results suggest that college-aged men who seek out and attain multiple sexual partners, including partners unknown to them, are also those men who show a willingness to act without caution, perhaps motivated by reward. This depiction makes intuitive sense, given that choosing new partners is a risk-taking activity likely motivated by the pleasure of a sexual experience.

Regression analyses also indicated that physiological reactivity to arousing images predicted unique variance in ever having sex with a stranger. These findings indicate that having sex with someone one does not know is associated with how the sensation seeking man reacts on an emotional or physiological level to the broader environment. This characterization is consistent with arguments that the sensation-seeker becomes oriented to arousing stimuli (see Zuckerman, 1990) and supports other research suggesting system-level arousal (Demos et al., 2012). Our results suggest that, for sensation seeking men, “arousing” stimuli can be either positive or negative.

In contrast with prior research on risky sexual behaviors with traits of impulsivity (Zapolski et al., 2009), only negative urgency was associated with irregular condom use, partly confirming our hypothesis and further suggesting that, in the moment, young men who are impulsive in the context of strong affect are less likely to practice safe sex. It is less clear why negative urgency, and not positive urgency, was significantly related to regular condom use, considering sex itself seems a positive experience. Perhaps it is the case that failure to use condoms may be a result of the urgency one may experience if one does not have a condom and faces a situation where sex is possible. Despite this contrast with Zapolski et al. (2009), the relation between negative urgency and regular condom use fits nicely with research on negative mood and risky sex (Bancroft et al., 2005; Hoyle et al., 2000) and extends this work by suggesting it may be the combination of negative mood and impulsivity that is responsible for this relation. Although skin conductance reactivity to unpleasant stimuli was positively associated with regular condom use in zero-order relations, it was not a unique predictor of the likelihood to use safe sex practices in the moment.

Implications

The results of this study suggest that a multi-method assessment of impulsivity and physiological reactivity can be an effective way to break down complex behaviors into more discrete elements. While it has long been known that personality is a good predictor of a range of behaviors, including risky sex (Hoyle et al., 2000), considerably fewer studies have examined behavioral and physiological correlates concurrently with impulsive personality measures. Use of multiple constructs across methods contributes to the breadth of information available on these specific acts; while related to sensation seeking, pursuit of multiple partners is also related to one's overall ability to make good decisions based on contingencies whereas impulsivity in the face of negative affect is associated with decisions to stop an ongoing pleasurable activity in the moment. These findings add dimensionality to our notion of sexual risk taking and suggest that there may be many aspects of system functioning and decision making that work together to promote risk.

The multimethod assessment has a number of benefits beyond understanding of behavior in the moment. If different characteristics and systems of physiological arousal are responsible for different types of risky sexual behaviors, this could be directly incorporated into HIV prevention and treatment programming. For instance, recently developed substance use prevention/intervention programs have attempted to make programs more meaningful and appealing by directly addressing individuals' personality characteristics as risk factors, including sensation seeking (Conrod et al., 2000). This same type of strategy may be useful for risky sexual practices and HIV prevention by incorporating information on the different types of sexual risk taking and what types of individuals may be at risk in different scenarios.

As an example, simple behavior replacement may be insufficient for the sensation seeker who engages in risky sex; if risk-taking is characteristic of the individual, participation in other exciting activities may be insufficient to inhibit broad-spectrum risk taking in the moment, such as at a party where there is no opportunity for extreme sports. Based upon current work, targeted programs should include risk awareness and goal-setting strategies that could potentially help these individuals consider the motivation behind their actions. Practice in good decision-making strategies (taking time to evaluate both the rewards and the punishments of different scenarios) might assist risk-taking sensation seekers in choosing when to engage in exciting activities and when to act more cautiously. The current findings also suggest that some sensation seekers may benefit from understanding how physiological reactivity is associated with risk-taking behaviors, possibly through misattribution of experience (e.g., I feel my heart racing, I must be attracted to that person) or through unconscious processes. Learning how to recognize physiological arousal as a possible trigger for risk taking behavior may help sensation seekers to evaluate situations before risk occurs.

Conversely, for individuals who react to negative affect with impulsive behavior, risk-reduction strategies should employ a very different set of strategies. Based upon the results from this study, young men who fail to use prophylactics may benefit from emotional awareness skills, emotion regulation exercises, and structured preparation for unpredicted scenarios, such as deliberately acquiring prophylactics before the opportunity for sex arises. By tailoring treatment to focus on coping with emotional distress, it is likely that individuals who react impulsively to negative affect may learn to rely on rational, rather than emotional, decision-making.

Limitations

Despite the benefits of exploring trait, behavioral, and physiological correlates of risky sex in young adult men, there were some limitations to the current design. First, because we did not include women in this study, we were unable to examine possible gender differences in relations and cannot generalize these findings to women. This may be a factor in why we failed to find relations with positive urgency, as reported in previous research that was conducted with a primarily female sample (Zapolski et al., 2009). Notably, there is evidence of gender differences in personality (Costa, Terracciano, & McCrae, 2001) and gender differences appear to be present in the UPPS impulsivity measure in initial studies (Cyders, 2013), suggesting that our entirely male sample may demonstrate different overall levels of these traits. Although gender differences may not alone account for divergent findings, the relations between risky sexual behavior and personality may be different for men and women, as other research in the risky behavior domain has suggested (McDaniel & Zuckerman, 2003). Future research would do well to utilize larger samples of men and women to address this possibility.

In addition to limitations in the population, other forms of measurement would be useful for future work in this area. For example, the risky sex measures employed in this design were single-item assessments, suggesting the need for replication of this type of research with multi-item measures of these constructs. However, it is also important to note that many risky sexual behaviors incorporated on multi-item measures assess behaviors that may not reflect the same forms of risk-taking; an item that addresses sex in public places, for instance, is likely tapping a very different underlying impulsivity profile than irregular condom use. Careful consideration about how risky sex scales are developed will be necessary to adequately identify correlates of these behaviors.

Further, future work would do well to assess some of the many other potential factors that are likely associated with risky sexual practices, such as one's relationship status. Notably, the current study did not differentiate relationship status in the assessment of condom use. This may be of considerable importance, given that the risk of sexually transmitted disease is considerably higher in short-term, non-monogamous relationships. Having unprotected sex in the context of a stable relationship is comparatively normative behavior that is unlikely to be associated with the risk factors explored here. Future work would do well to assess participants' relationship status to examine this possibility. In addition, other factors could provide more dimension to our understanding of risk, such as beliefs and attitudes about sex and susceptibility to influence by peers. Although personality, laboratory behavior, and physiological arousal are factors in predicting risky sexual behaviors, social factors undoubtedly play a very strong role in this type of behavior.

Finally, due to the intensive nature of the protocol, only 135 men participated in this study. Future work with larger sample sizes would allow for more complex analyses so that interactions between variables can be explored. The current study represents a possible starting point for multiple-method assessment of sexual risk, from which more targeted hypotheses can be made.

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References

- Bancroft, J., Carnes, L., & Janssen, E. (2005). Unprotected anal intercourse in HIV positive and HIV negative gay men: The relevance of sexual arousability, mood, sensation seeking, and erectile problems. *Archives of Sexual Behavior*, *34*, 299–305.
- Bancroft, J., Janssen, E., Carnes, L., Goodrich, D., Strong, D., & Long, J. S. (2004). Sexual risk taking in young heterosexual men: The relevance of sexual arousability, mood and sensation seeking. *Journal of Sex Research*, *41*, 181–192.
- Bancroft, J., Janssen, E., Strong, D., Carnes, L., Vukadinovic, Z., & Long, J. S. (2003). Sexual risk taking in gay men: The relevance of sexual arousability, mood, and sensation seeking. *Archives of Sexual Behavior*, *32*, 555–572.
- Bargh, J. A., & Morsella, E. (2008). The unconscious mind. *Perspectives in Psychological Science*, *3*, 73–79.
- Center for Disease Control and Prevention. (2010). *HIV and AIDS in the United States*. <http://www.cdc.gov/hiv/resources/factsheets/us.htm>.
- Coffey, S. F., Schumacher, J. A., Baschnagel, J. S., Hawk, L. W., & Holloman, G. (2011). Impulsivity and risk-taking in borderline personality disorder with and without substance use disorders. *Personality Disorders: Theory, Research, & Treatment*, *2*, 128–141.
- Conrod, P. J., Stewart, S. H., Pihl, R. O., Cote, S., Fontaine, V., & Dongier, M. (2000). Efficacy of brief coping skills interventions that match different personality profiles of female substance abusers. *Psychology of Addictive Behaviors*, *14*, 231–242.
- Costa, P. T., Terracciano, A., & McCrae, R. R. (2001). Gender differences in personality traits across cultures: Robust and surprising findings. *Journal of Personality and Social Psychology*, *81*, 322–331.
- Cyders, M. A. (2013). Impulsivity and the sexes: Measurement and construct invariance of the UPPS-P Impulsivity scale. *Assessment*, *20*, 86–97.
- Cyders, M. A., & Smith, G. T. (2007). Mood-based rash action and its components: Positive and negative urgency. *Personality and Individual Differences*, *43*, 839–850.
- Cyders, M. A., & Smith, G. T. (2008). Clarifying the role of personality dispositions in risk for increased gambling behavior. *Personality and Individual Differences*, *45*, 503–508.
- Demos, K. E., Heatherton, T. F., & Kelley, W. M. (2012). Individual differences in nucleus accumbens activity to food and sexual images predict weight gain and sexual behavior. *Journal of Neuroscience*, *32*, 5549–5552.
- Dick, D. M., Smith, G., Olausson, P., Mitchell, S. H., Leeman, R. F., O'Malley, S. S., & Sher, K. (2010). Understanding the construct of impulsivity and its relationship to alcohol use disorders. *Addiction Biology*, *15*, 217–226.
- Dijksterhuis, A., Chartrand, T. L., & Aarts, H. (2007). Effects of priming and perception on social behavior and goal pursuit. In J. A. Bargh (Ed.), *Social psychology and the unconscious: The automaticity of higher mental processes* (pp. 51–132). Philadelphia: Psychology Press.
- Filion, D. L., Dawson, M. E., & Schell, A. M. (1998). The psychological significance of human startle eyeblink modification: A review. *Biological Psychology*, *47*, 1–43.
- Fisher, J. D., & Misovich, S. J. (1990). Evolution of college students' AIDS-related behavior responses, attitudes, knowledge, and fear. *AIDS Education and Prevention*, *2*, 322–337.
- Hoyle, R. H., Fejfar, M. C., & Miller, J. D. (2000). Personality and sexual risk taking: A quantitative review. *Journal of Personality*, *68*, 1203–1231.
- Humphreys, K. L., & Lee, S. S. (2011). Risk taking and sensitivity to punishment in children with ADHD, ODD, ADHD + ODD, and controls. *Journal of Psychopathology and Behavioral Assessment*, *33*, 299–307.
- Hunt, M. K., Hopko, D. R., Bare, R., Lejuez, C. W., & Robinson, E. V. (2005). Construct validity of the Balloon Analog Risk Task (BART): Associations with psychopathy and impulsivity. *Assessment*, *12*, 416–428.
- Janssen, E., & Bancroft, J. (2007). The dual-control model: The role of sexual inhibition and excitation in sexual arousal and behavior. In E. Janssen (Ed.), *The psychophysiology of sex* (pp. 197–222). Bloomington, IN: Indiana University Press.
- Janssen, E., Goodrich, D., Petrocelli, J., & Bancroft, J. (2009). Psychophysiological response patterns and risky sexual behavior in heterosexual and homosexual men. *Archives of Sexual Behavior*, *38*, 538–550.
- Kalichman, S. C., Heckman, T., & Kelly, J. A. (1996). Sensation seeking as an explanation for the association between substance use and

- HIV-related risky sexual behavior. *Archives of Sexual Behavior*, 25, 141–154.
- Lejuez, C. W., Aklin, W. M., Daughters, S. B., Zvolensky, M. J., Kahler, C. W., & Gwads, M. (2007). Reliability and validity of the youth version of the Balloon Analogue Risk Task (BART-Y) in the assessment of risk-taking behavior among inner-city adolescents. *Journal of Clinical Child Adolescent Psychology*, 36, 106–111.
- Lejuez, C. W., Bornoalova, M., Daughters, S. B., & Curtin, J. J. (2005). Differences in impulsivity and sexual risk-taking behavior among inner-city crack/cocaine and heroin users. *Drug and Alcohol Dependence*, 77, 169–175.
- Lejuez, C. W., Magidson, J. F., Mitchell, S. H., Sinha, R., Stevens, M. C., & de Wit, H. (2010). Behavioral and biological indicators of impulsivity in the development of alcohol use, problems, and disorders. *Alcoholism, Clinical and Experimental Research*, 34, 1334–1345.
- Lejuez, C. W., Read, J. P., Kahler, C. W., Richards, J. B., Ramsey, S. E., Stuart, G. L., et al. (2002). Evaluation of a behavioral measure of risk taking: The Balloon Analogue Risk Task (BART). *Journal of Experimental Psychology*, 8, 75–84.
- Lejuez, C. W., Simmons, B. L., Aklin, W. M., Daughters, S. B., & Dvir, S. (2004). Risk-taking propensity and risky sexual behavior of individuals in residential substance use treatments. *Addictive Behaviors*, 29, 1643–1647.
- Lynam, D. R., Smith, G. T., Whiteside, S. P., & Cyders, M. A. (2006). *The UPPS-P: Assessing five personality pathways to impulsive behavior* [Technical Report]. West Lafayette, IN: Purdue University.
- Lynam, D. R., Whiteside, S., & Jones, S. (1999). Self-reported psychopathy: A validation study. *Journal of Personality Assessment*, 73, 110–132.
- Macapagal, K. R., Janssen, E., Fridberg, D. J., Finn, P. R., & Heiman, J. R. (2011). The effects of impulsivity, sexual arousability, and abstract intellectual ability on men's and women's Go/No-Go task performance. *Archives of Sexual Behavior*, 40, 995–1006.
- McDaniel, S. R., & Zuckerman, M. (2003). The relationship of impulsive sensation seeking and gender to interest and participation in gambling activities. *Personality and Individual Differences*, 35, 1385–1400.
- Nees, F., Diener, C., Smolka, M. N., & Flor, H. (2011). The role of context in the processing of alcohol-relevant cues. *Addiction Biology*, 17, 441–451.
- Newcomb, M. D., & McGee, L. (1991). Influence of sensation seeking on general deviance and specific problem behaviors from adolescence to young adulthood. *Journal of Personality and Social Psychology*, 61, 614–628.
- Newman, J. P., & Kosson, D. S. (1986). Passive avoidance learning in psychopathic and nonpsychopathic offenders. *Journal of Abnormal Psychology*, 95, 257–263.
- Patrick, C. J., Bradley, M. M., & Lang, P. J. (1993). Emotion in the criminal psychopath: Startle reflex modulation. *Journal of Abnormal Psychology*, 102, 82–92.
- Paulhus, D. L., Hemphill, J., & Hare, R. (in press). *Manual for the Self-report Psychopathy Scale (SRP-III)*. Toronto: Multi-Health Systems.
- Temple, M. T., Leigh, B. C., & Schafer, J. (1993). Unsafe sexual behavior and alcohol use at the event level: Results of a national survey. *Journal of Acquired Immune Deficiency Syndromes*, 6, 393–401.
- Weinstock, H., Berman, S., & Cates, W. (2004). Sexually transmitted diseases among American youth: Incidence and prevalence estimates, 2000. *Perspectives on Sexual and Reproductive Health*, 36, 6–10.
- Whiteside, S. P., & Lynam, D. R. (2001). The Five Factor Model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences*, 30, 669–689.
- Whiteside, S. P., Lynam, D. R., Miller, J. D., & Reynolds, S. K. (2005). Validation of the UPPS Impulsive Behaviour scale: A four-factor model of impulsivity. *European Journal of Personality*, 19, 559–574.
- Zapolski, T. C. B., Cyders, M. A., & Smith, G. T. (2009). Positive urgency predicts illegal drug use and risky sexual behavior. *Psychology of Addictive Behaviors*, 23, 348–354.
- Zuckerman, M. (1990). The psychophysiology of sensation seeking. *Journal of Personality*, 58, 313–345.