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Psychophysiological Response Patterns and Risky Sexual Behavior in Heterosexual and Homosexual Men

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Abstract The past few years have seen an increased awareness of the relevance of studying the role of sexual response, emotion, and traits such as sensation seeking and the propensity for sexual inhibition in risky sexual behavior. The current study examined the association between self-reported sexual risk taking and psychophysiological response patterns in 76 heterosexual and homosexual men. Measures included genital, electrodermal, startle eyeblink, and cardiovascular responses, and stimuli included threatening (depicting coercive sexual interactions) and nonthreatening (depicting consensual sexual interactions) sexual film excerpts. Sexual risk taking was hypothesized to be associated with decreased inhibition of sexual arousal and hyporeactive affective and autonomic responses to threatening sexual stimuli. Controlling for age and number of sexual partners in the past year, sexual risk taking (number of partners during the past 3 years with whom no condoms were used) was found to be associated with stronger genital responses and smaller eyeblink responses to both threatening and nonthreatening sexual stimuli. Correlations between genital and subjective sexual arousal were relatively low. Sexual risk taking was related to sensation seeking but not to the propensity for sexual inhibition. The findings suggest that risky sexual behavior may involve a role for psychophysiological mechanisms that are specific to sex as well as for ones that are associated with more general approach/avoidance response tendencies.

Keywords Sexual arousal · Risky sexual behavior · Condom use · Psychophysiology

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Introduction

Sexual behavior carries the potential for both positive and negative outcomes. It can serve reproductive purposes, foster intimacy, and, in the process or as a goal in itself, bring about pleasure and other positive emotions (Bancroft, 1989; Everaerd, 1988; Frijda, 2006). At the same time, engaging in sexual behavior can have a number of negative outcomes, including physical, emotional, and social ones (e.g., STIs/HIV, unwanted pregnancy, pain, disappointment, damage to one's reputation; Janssen, Vorst, Finn, & Bancroft, 2002a). Thus, sexual behavior can be "risky" in various ways and varying degrees. In the sexual health literature, however, the term "risky sexual behavior" tends to be more narrowly defined and is predominantly reserved for those sexual behaviors, including engaging in sex with a high numbers of partners and failing to use condoms (e.g., Noar, Cole, & Carlyle, 2006), that put one at risk for contracting a sexually transmitted infection (STI) or to being exposed to human immunodeficiency virus (HIV).

Although definitions of risky sex as well as theories of its determinants are still evolving, the past few years have seen an increased awareness of the relevance of studying the role of individual differences in sexual response, emotion regulation, and personality-related variables, such as impulsivity and sensation seeking, in the understanding of risky sexual behavior (Bancroft, 2000; Canin, Dolcini, & Adler, 1999; Hoyle, Rejfar, & Miller, 2000). This development may, at

least in part, be attributed to an increased openness of prevention researchers to include individually oriented factors in the design of STI and HIV intervention programs, which before largely relied on social-cognitive models of behavior and behavioral change (cf. Kalichman & Weinhardt, 2001; Ross & Schönnesson, 2000). The relative lack of research on individual differences in sexual and affective response patterns, including psychophysiological ones, and their relationship to risky sexual practices, stands in stark contrast to other areas of sexual health research. For example, a substantial research base exists on the developmental, temperamental, and psychophysiological correlates of sexual orientation (e.g., Chivers, Rieger, Latty, & Bailey, 2004; Mustanski, Chivers, & Bailey, 2002; Sakheim, Barlow, Beck, & Abrahamson, 1985), paraphilic sexual interests (e.g., Marshall & Marshall, 2000; Seto, 2004), sexual offending and aggression (e.g., Lohr, Adams, & Davis, 1997; Patrick, Bradley, & Lang, 1993), and sexual dysfunction (e.g., Bancroft & Janssen, 2001; Basson & Brotto, 2003; Rowland, Tai, & Brummett, 2007).

One of the questions emerging from the literature is whether sexual risk taking is best approached as a behavior or a trait—and if as a trait, whether it is specific to sex. Some have argued that studies on sexual risk taking should have a stronger basis in general theories of personality, and that personality variables should be related to relatively enduring patterns of behavior, rather than to specific behavioral events (Hoyle et al., 2000). Others (e.g., Jaccard & Wilson, 1991), while in agreement with the second point, emphasize the need to conceptualize personality more specifically in sexual terms. Examples of general, nonsexual traits that have been studied and found relevant to the prediction of risky sexual behavior (e.g., number of sexual partners, consistency in using condoms) are sensation seeking, impulsivity, and harm avoidance (Bancroft et al., 2003, 2004; Gil, 2005; Hoyle et al., 2000; Lejueza, Bornovalovaa, Daughtersa, & Curtin, 2005), Examples of *sexuality*-related traits that have been found to be associated with risky sexual behavior are erotophilia (e.g., Fisher & Fisher, 1999) and the propensity for sexual inhibition (Bancroft et al., 2003, 2004), as measured by the Sociosexual Orientation Survey (SOS) and the Sexual Inhibition/Sexual Excitation scales (SIS/SES), respectively. Interestingly, both measures have been found to be predictive of sexual responses in the laboratory (e.g., Janssen, Vorst, Finn, & Bancroft, 2002b; Janssen & Bancroft, 2007; Fisher, Byrne, White, & Kelley, 1988), which further supports the relevance of considering not just the role of (general and sexual) personality factors in risky sexual behavior, but also their possible psychophysiological correlates.

The theoretical model underlying the SIS/SES scales postulates that sexual response and associated behavior depend on dual control mechanisms, involving excitatory and inhibitory neurophysiological systems (Bancroft & Janssen, 2000; Janssen & Bancroft, 2007). It is an example of a state-trait model, although most research so far has focused on the trait dimension of the model. The model proposes that the weighing of excitatory and inhibitory processes determines whether or not a sexual response occurs within an individual in a given situation (state) and, at the same time, it assumes individual variability in the propensity for these processes (trait). In addition, it is assumed that the putative sexual inhibition and excitation systems reflect sexual rather than general mechanisms of activation and inhibition (cf. Gray, 1982). Also, the model proposes that a high propensity for sexual inhibition is associated with a vulnerability to sexual dysfunction and a low propensity for sexual inhibition with an increased likelihood of sexual risk taking. A number of studies have provided support for several of these assumptions (for a review, see Janssen & Bancroft, 2007).

The SIS/SES scales consist of one excitation (SES) and two inhibition factors: sexual inhibition due to the "threat of performance failure" (SIS1) and sexual inhibition due to the "threat of performance consequences" (SIS2; Janssen et al., 2002a, b). The majority of items making up the SIS2 scale reflect situations in which existing sexual arousal is lost due to the introduction of some intra- or interpersonal threat (e.g., related to norms and values, physical and psychological harm). In heterosexual and homosexual men (Bancroft et al. 2003, 2004), and in heterosexual women (Carpenter, Janssen, Graham, Vorst, & Wicherts, 2008), low SIS2 scores have been predictive of risky sexual behavior, in particular behaviors related to condom use, above and beyond personality traits, such as sensation seeking (in contrast, SES has been found to be relevant to interest in casual sex and number of sexual partners, but not to condom use; Janssen & Bancroft, 2007). These findings thus suggest that individuals who engage in risky sexual behavior may differ from those who do not in the regulation or, more specifically, the inhibition of sexual arousal in potentially risky situations. The current study was designed to explore this proposition using a psychophysiological approach, as this methodology allows for a systematic assessment of both the physiological and subjective dimensions of sexual arousal.

The association between SIS/SES and psychophysiological response patterns was first tested (in a study unrelated to sexual risk taking) in a group of heterosexual college-aged men (Janssen et al., 2002b). Two types of erotic films were used, one nonthreatening (involving consensual sex) and the other threatening (involving the depiction of coercive sex; Laan, Everaerd, & Evers, 1995; van der Velde, Laan, & Everaerd, 2001). High and low SIS2 groups did not differ significantly in genital responses to the consensual sexual stimuli, but men with low SIS2 scores showed, as predicted, significantly greater genital response to the threatening sexual stimuli. This pattern was not apparent for subjective sexual arousal, as both groups reported low levels of sexual

arousal, and of particular interest, both groups showed evidence of negative affect, including augmented startle eyeblink responses (e.g., Graham, Janssen, & Sanders, 2000) in response to the coercive sexual stimuli.[1] Although this study was not designed for this purpose, it presents a paradigm for exploring the relationship among personality traits, psychophysiological responses, and sexual risk taking.

Whereas the psychophysiological characteristics of individuals engaging in risky sexual behavior have yet to be reported in the literature, a large number of studies have examined psychophysiological correlates of behavioral and personality-related variables that are associated with or of potential relevance to our understanding of sexual risk taking. These include studies on substance abuse (Finn, Zeitouni, & Pihl, 1990; Taylor, 2004), harm avoidance (e.g., Grillon & Ameli, 2001), impulsivity and impulsive asociality (e.g., Benning, Patrick, & Iacono, 2005; Verschuere, Crombez, De Clercq, & Koster, 2005), fearlessness (e.g., van Goozen, Snoek, Matthys, van Rossum, & van Engeland, 2004), conduct problems (Quay, 1997), and antisocial personality characteristics (e.g., Babcock, Green, Webb, & Yerington, 2005; Lorber, 2004; Patrick et al., 1993; Patrick, Cuthbert, & Lang, 1994). Among the most widely studied psychophysiological measures are cardiovascular (e.g., heart rate, blood pressure), electrodermal, and startle eyeblink responses. Although the underlying mechanisms are still debated—but may involve poor avoidance learning/fear conditioning, low anxiety/anxiety responding, and deficits in executive function (e.g., Fowles, 2000; Gray, 1982; Patrick et al., 1993; Raine, 1993)—a recurring and relatively stable finding is that behavior or personality characteristics that involve decreased inhibitory control (Iacono, Carlson, & Malone, 2000) are associated with hyporeactive emotional and autonomic responding. For example, decreased electrodermal responsiveness to aversive stimuli (and low electrodermal resting levels) has been associated with low anxiety, disinhibition, and poor control of emotional expression (Fowles, 2000), as well as with antisocial personality characteristics (Lorber, 2004) and substance abuse (e.g., Taylor, 2004). Also, the absence of increased startle responses to aversive stimuli has been related to the presence of psychopathology and low harm avoidance (e.g., Benning et al., 2005; Grillon & Ameli, 2001; Patrick et al., 1993).

[1] Startle eyeblink responses (most commonly generated by presenting participants with sudden loud sound bursts) index the disposition of a person to react with either appetitive (approach) or aversive (avoidance) responses (Lang, Bradley, & Cuthbert, 1990). Startle responses are typically enhanced (i.e., stronger eyeblinks, measured using facial EMG) during the presentation of stimuli that induce negative emotional states and reduced (weaker eyeblinks) during the presentation of stimuli that induce positive emotional states. An attractive characteristic of this paradigm, as compared to the use of self-report measures, is that the startle reaction is a reflexive response and thus not subject to intentional processes (e.g., social desirability).

The goal of the current study was to examine, using a modification of the experimental design used by Janssen et al. (2002b), the association between risky sexual behavior and psychophysiological responses to threatening and nonthreatening sexual stimuli. Risky sexual behavior was, despite the conceptual complexities but in line with the extant empirical literature, operationally defined in terms of condom use. More specifically, whereas much of the research on risky sexual behavior tends to rely on the measurement of either the number of partners with whom one has had sex (leaving open the possibility that one consistently used condoms) or the number of partners with whom one did not use a condom (leaving open the possibility that one used condoms with other partners; Noar et al., 2006), we decided to focus on the latter while controlling for the first.

Consistent with the findings of our previous questionnaire studies (revealing a negative relationship between sexual risk taking and SIS2, Bancroft et al., 2003, 2004) and our earlier psychophysiological study (showing SIS2 to be associated with genital responses to threatening, but not nonthreatening, sexual stimuli, Janssen et al., 2002b), we predicted that sexual risk taking would be associated with stronger sexual responses to, in particular, threatening sexual stimuli. In addition, cardiovascular, electrodermal, and startle blink measures were measured during the various stimulus conditions to allow us to explore whether sexual risk taking would be associated with decreased inhibition of specifically sexual responses to threatening sexual stimuli or (also) with other, nonsexual psychophysiological response patterns that could reflect hyporeactive affective or autonomic responses to such stimuli and, thus, could imply a role for more general inhibitory mechanisms (cf. Iacono et al., 2000).

Building on the study by Janssen et al. (2002b), which was limited to a sample of heterosexual men, the current study included both heterosexual and homosexual men. This allowed us to compare, in heterosexual men, the findings of the current study with those of Janssen et al. (2002b) and to test in homosexual men, on whom much of the sexual risk taking literature is based, the same hypotheses. We did not a priori have a clear empirical basis or theoretical rationale to expect differences for homosexual and heterosexual men in the association between risky sexual behavior and psychophysiological response patterns.

Method

Participants

A total of 76 heterosexual and homosexual men participated in this study. They were recruited from a larger questionnaire study on the relevance of personality traits to sexual risk taking (Bancroft et al., 2003, 2004). Sexual orientation was

based on self-identification. Recruitment sites were selected to ensure a range of sexual risk behavior and included STD clinics, bars, churches, and various other community venues and organizations. The mean age of participants was 31.2 years (*SD*, 10.0, range, 18–54). Ninety-five percent had attended college (54% were still in college), 57% were in full-time employment, and the majority (78%) was white. For income level, 27% were "lower" or poverty; 52% "lower middle" or "middle," and 21% "upper middle" or "upper." For self-reported relationship status, 30% were in an exclusive or monogamous relationship, 35% in a non-exclusive, "open" relationship, and 35% were not currently in a relationship. Sixty-eight percent of the men reported having been HIV tested. Of those whose results were known, none were HIV+. Participants were tested in one of two Kinsey Institute laboratories (Indianapolis or Bloomington, Indiana) and received $30 for their participation. Study approval was obtained from the university's Human Subjects Committee.

Measures

Stimuli

The participants were shown a series of six sexual film clips, two threatening and four nonthreatening. Of the nonthreatening sexual clips, two (3 and 8 min in duration, SS1 and SS2, respectively) were selected by the participants ("self-selected") and two (both 3 min in duration, RS1 and RS2) were the same for all subjects and had been selected by the researchers ("researcher-selected"). Heterosexual and homosexual participants were presented with different stimuli, but the content of the film clips was matched (e.g., similar amounts of petting, oral, and penetrative sex for the nonthreatening researcher-selected clips). For the self-selected film clips, participants were presented at the beginning of the study session with a set of ten 10-second previews of videos that depicted a wider range of sexual behaviors (e.g., group sex, interracial sex, sadomasochism).[2] The heterosexual and homosexual versions of the set of 10 videos were compiled by the researchers and represented similar themes and content. The threatening, erotic excerpts were taken from the commercially available movies "Extremities" (T1) and "A Reason to Believe" (T2) for the heterosexual sample and from "Cruising" (T1) and "Spetters" (T2) for the homosexual sample. All four excerpts depicted coercive sexual interactions (rape), although no explicit sexual acts were shown. The use of these stimuli was based on earlier work using sexual videos that present coercive sexual interactions (e.g., Janssen et al., 2002b; Laan et al., 1995). The term "threatening" is meant to reflect the finding that these stimuli are not just relevant to the activation of sexual responses, but in most people co-activate negative affect (e.g., anxiety, the subjective feeling of threat) and other avoidance-related responses (e.g., Janssen et al., 2002b).

Presentation of the film excerpts was counterbalanced using Latin square designs (Kirk, 1968). A 15-min neutral film excerpt (taken from a documentary about cats) was used for the determination of physiological baseline levels, and further neutral film excerpts were used for the 3-min return-to-baseline intervals between erotic stimuli.

Physiological Measures

Genital Response Penile tumescence and rigidity was monitored by means of the RigiScan device (Timm Medical Technologies; for a discussion of its reliability and validity, see Janssen, 2002; Janssen, Prause, & Geer, 2007). This computerized system measures penile circumference at 15 s intervals and, by means of controlled compression of the penile shaft, measures rigidity at 30 s intervals once the circumference has increased by 20%. Genital response will be reported in terms of maximum penile rigidity at the base of the penis (Janssen et al., 2002b).

Cardiovascular Response Systolic and diastolic blood pressure, as well as heart rate, were monitored using the arterial-volume clamp method (Biomedical Instrumentation TPD-TNO Portapres Model 2; Eckert, 2002; Langewouters, Settels, Roelandt, & Wesseling, 1998) from the middle phalanx of the middle and ring fingers of participants' non-dominant hand. A hydrostatic reference was used to compensate for vertical movement with respect to heart level by attaching a height transducer to the participants' arm and finger. The data were processed using the Modelflow method, which extrapolates several common cardiovascular signals from an arterial pressure waveform (Wesseling, Jansen, Settels, & Schreuder, 1993).

Startle Response Acoustic startle probes were presented binaurally through a headphone, each probe consisting of a 50-ms burst of 120 dBA white noise with near instantaneous rise time. Participants were informed that they would hear a few brief loud sound bursts. A total of nine startle probes were presented during each 3 min film excerpt, with three startles per minute (at 5 or 15 s, 25 or 35 s, and 45 or 60 s). One randomized scheme of startle presentations was used for all participants. To enhance unpredictability of startle probes, 10 additional startle stimuli were presented during the return-to-

[2] We initially planned to use, in unmodified form, the design described by Janssen et al. (2002b). However, of the first 25 participants (*M* age = 29 years) who were run using that design, 12, or almost 50%, did not respond to the sexual stimuli (i.e., penile rigidity of less than 5% to the nonthreatening sexual clips). We therefore redesigned the study and eliminated the distraction and performance demand manipulations used by Janssen et al. (2002b) to include newer and more varied film clips and had the new sample of 76 participants select two clips themselves.

baseline intervals. Eyeblink responses were recorded from orbicularis oculi EMG activity with Ag/AgCl disk electrodes. A sampling rate of 400 Hz was used in a time window from 100 ms prior to onset to 600 ms after onset of blink-eliciting stimuli. Raw EMG was digitized using a Contact Precision Instruments (CPI) system and an IBM-compatible computer. The CPI PSYLAB software enables off-line visual inspection of the EMG signal, and after removal of artifacts, the calculation of the amplitude for each blink.

Electrodermal Response Electrodermal activity was recorded using Ag/AgCl electrodes attached to the volar surface of the distal phalanges of the first and second fingers of the nondominant hand. A neutral base cream mixed with saline (isotonic mixture) was used as the conducting medium (Dawson, Schell, & Filion, 2007). The signal was digitized using the same system as was used for the startle blink measurement.

Self-Report Measures

Demographics and Sexual History Questionnaire (DSHQ) This questionnaire covers demographic information, health problems, sexual orientation, relationship status, and questions about sexual problems (e.g., erectile problems in the past 3 months, with answer possibilities "no," "occasionally," "less than half the time," "most of the time") as well as frequency of various types of sexual activity (Bancroft et al., 2003, 2004).

Risky Sexual Behavior Included in the DSHQ are the following three questions relevant to the assessment of risky sexual behavior, taken from the Sociosexual Orientation Inventory (SOI, Seal & Agostinelli, 1994; Simpson & Gangestad, 1991): (1) With how many different partners have you had sex (sexual intercourse) in the past year? (SOI1); (2) With how many different partners have you had sex on one and only one occasion in your lifetime ("one night stands")? (SOI2); (3) With how many different partners have you had sex during the past 3 years with whom no condoms were used (SOI3)? Bancroft et al. (2003), in a study with homosexual men, used a composite score of the three SOI items as an index of sexual risk taking. Bancroft et al. (2004), in a study with heterosexual men, analyzed the three items separately. As the sexual risk taking literature tends to equate risky sexual behavior with the absence of (consistent) condom use, we decided to use SOI3 as our primary index of sexual risk taking, while correcting for the number of sexual partners (SOI1; see Data Analysis section).

Sexual Inhibition/Sexual Excitation Scales (SIS/SES) This questionnaire (Janssen et al., 2002a, b), with 45 items, measures three factors: (1) propensity for sexual excitation (SES; range, 20–80; Cronbach's alpha = .90); (2) propensity for sexual inhibition due to "the threat of performance failure" (SIS1; range, 14–56; Cronbach's alpha = .75); and (3) propensity for sexual inhibition due to "the threat of performance consequences" (SIS2; range, 11–44; Cronbach's alpha = .78). These scales have good discriminant validity with only modest overlap with measures of global traits of behavioral inhibition, harm avoidance, and reward responsivity. The response for each item ranged from 1 = strongly agree to 4 = strongly disagree.

Sensation Seeking Scales (Form V) This questionnaire has a total of 40 items, each having two possible choices (Zuckerman, 1971, 1994). There are four subscales (Thrill and Adventure Seeking, Experience Seeking, Disinhibition, and Boredom Susceptibility) as well as a Total score. Each of the four subscales contains 10 items scored 0 or 1. The Total score, used in this study, was based on all 40 items, with a range of 0–40 (Cronbach alpha's = .77).

Affect and Arousal Ratings Participants were asked to indicate their subjective sexual arousal (overall and strongest feelings), and emotional state (e.g., how happy, threatened, or anxious they felt during film presentations), using visual analogue scales (VAS; Janssen et al., 2002b). Ratings were made from 0 (not at all) to 10 (very strongly) on a 100-mm line. In addition, the Self-Assessment Manikin (SAM) was used to measure valence, arousal, and dominance (Bradley & Lang, 1994). These measures were completed prior to the first film presentation, in-between film presentations and return-to-baseline periods, and after the last presentation. As an index of subjective sexual arousal, the item asking about "overall" feelings of sexual arousal was used for analysis.

Procedure

Upon arrival to the lab, participants, who were tested individually, entered a room furnished with a recliner, desk, and television monitor. A male experimenter explained the experimental procedures and assured the participant of the opportunity to withdraw at any time. After reading and signing an informed consent statement, the experimenter left the room and the participant put the RigiScan in place and a disposable sheet and towel over his lap. When the device was in place, the experimenter reentered the room and attached the electrodes for startle and electrodermal response and the finger cuffs for cardiovascular measurements. Following this, the experimenter retired to the adjoining room and started a 15 min adaptation period. During this adaptation period, the participant viewed a sexually neutral film. This was followed by the video-selection procedure (involving the

presentation of the ten 10 s previews) and the presentation of the threatening and nonthreatening sexual films, in a counterbalanced order, each followed by completion of the discrete subjective measures. After the video-selection procedure and between presentations of the sexual films, a neutral film was shown for 3 min to establish return-to-baseline levels. At the end of the testing session, payment arrangements were made and participants were debriefed regarding the purpose and hypotheses of the study. Testing sessions took approximately 90 min.

Data Analysis

Data Transformations and Scoring

Startle response data were *z*-transformed within subjects and then averaged within stimulus conditions to establish a common metric (e.g., Patrick et al., 1993). Analyses of skin conductance were performed using raw skin conductance scores (Benning et al., 2005). Electrodermal activity was expressed by the number of nonspecific fluctuations as well as by average and total skin conductance amplitude per condition. Between-subjects correlations were *z*-transformed prior to averaging. SPSS 14 for Windows and SPSS 11 for Mac OS X were used for all analyses. The Greenhouse—Geisser epsilon procedure was applied to all mixed-factor ANCOVAs to correct for the violation of the sphericity assumption in repeated—measures designs (Vasey & Thayer, 1987).

Sexual Risk Taking analyses Low and high sexual risk taking groups were created by using a median split of the participants' SOI3 scores (i.e., number of partners in the past 3 years with whom no condom was used). Participants whose SOI3 responses corresponded to the median were assigned to the low-risk group. In the ANOVAs involving psychophysiological responses, in which risky sexual behavior and sexual orientation were used as between-subjects factor, we controlled for the total number of sexual partners participants reported having had sex with during the past year (SOI1), by including it as a covariate.

Results

Sample Characteristics

The heterosexual participants were, on average, younger than the homosexual participants, had higher sensation seeking scores, lower SES and SIS1 scores, less experience with erotic films, and reported a lower number of sexual partners within the past year (see Table 1). However, the heterosexual and homosexual participants did not differ with respect to our primary sexual risk taking indicator (the number of partners within the past 3 years with whom they had had sex without using a condom, SOI3). Close to 25% of the participants reported having had unprotected sex with 5 or more partners during the past 3 years (29% of heterosexual and 17% of homosexual men). The median response to SOI3 for the total sample was two, resulting in the assignment of 21 heterosexual and 27 homosexual participants to the "low" and 14 heterosexual and 14 homosexual participants to the "high" sexual risk taking groups. The low and high-risk groups did not differ in age and in SIS/SES scores. However, they

Table 1 Sample characteristics by risk group and sexual orientation

Variable	Low-risk group						High-risk group					
	Heterosexual ($N = 21$)		Homosexual ($N = 27$)		Total ($N = 48$)		Heterosexual ($N = 14$)		Homosexual ($N = 14$)		Total ($N = 28$)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age	25.8	8.6	33.9	9.0	30.4	9.6	29.7	12.4	35.1	8.1[a]	32.4	10.6
SSS	23.4	3.9	19.6	5.2	21.2	5.0	26.6	6.9	22.6	5.0[a]	24.6	6.3[b]
SES	54.5	10.7	60.5	7.2	57.9	9.3	57.0	6.1	59.6	10.6[a]	58.3	8.6
SIS1	26.1	5.1	28.5	5.9	27.4	5.6	26.0	5.1	29.4	6.1[a]	27.6	5.8
SIS2	27.0	5.0	28.8	6.8	28.0	6.1	26.1	4.1	27.9	5.0	27.0	4.6
Erotic films seen past year	2.3	0.5	2.7	0.9	2.5	0.8	2.3	0.5	2.9	0.8[a]	2.6	0.7
Sexual partners past year	2.2	2.0	4.1	4.5	3.3	3.7	5.8	5.0	13.8	12.5[a]	9.8	10.2[b]
Partners w/o condom past 3 yrs	0.9	0.8	0.9	0.7	0.9	0.7	5.9	2.5	5.0	2.5	5.5	2.5[b]

Note: SDs are enclosed in parentheses. SSS = Sensation Seeking Scale; SES = Sexual Excitation Scale; SIS1 = Sexual Inhibition Scale-1; SIS2 = Sexual Inhibition Scale-2. For the number of erotic films seen in the past year, answer categories were: 1 (none), 2 (1–10), 3 (10–50), 4 (50–100), or 5 (more than 100)

[a] Significant difference between orientation groups, $t(74)$, $p < .05$

[b] Significant difference between risk groups, $t(74)$, $p < .05$

differed significantly in sensation seeking and the total number of sexual partners during the past year (see Table 1).

Manipulation Check

A 2 (Sexual Orientation: heterosexual, homosexual) × 2 (Sexual Risk Taking: low, high) × 6 (Film) mixed-factor analysis of variance (ANOVA) was conducted to examine whether the sexual films depicting coercive sexual interactions (rape) were experienced as more threatening than the other sexual films. Only the main effect of Film was significant, $F(5, 345) = 15.31$, $p < .001$. Contrasts revealed that self-reports of feeling threatened were significantly higher during T1 ($M = 1.68$ $SE = .23$) and T2 ($M = 1.63$ $SE = .22$) than during the other four sexual films (range $M = 0.45$, $SE = .08$–$M = 0.58$, $SE = .16$, all contrasts $p < .001$). The difference between the two threatening sexual films was not significant, $F(1, 72) < 1$.

Sexual Responses[3]

Genital Responses

A 2 (Sexual Orientation: heterosexual, homosexual) × 2 (Sexual Risk Taking: low, high) × 6 (Film) mixed-factor analysis of covariance (ANCOVA) was conducted to examine the effects of the film excerpts on genital response. The reported number of partners that participants had sex with in the past year was included as a covariate (correlation between SOI1 and SOI3: $r = .38$, $p < .001$). Because there was a significant age difference between heterosexual and homosexual participants and as this variable—in contrast to SSS, SES, and SIS1—was significantly correlated with overall genital response levels (using the average of all conditions, $r = .40$, $p < .001$), we included this variable as a second covariate.

The main effect of Sexual Orientation was not significant (see Table 2). The main effects of Sexual Risk Taking and Film were significant but were qualified by a three-way interaction of Sexual Orientation × Sexual Risk Taking × Film. Follow-up tests on the three-way interaction, which were conducted by film, revealed significant two-way interactions of Sexual Orientation × Sexual Risk Taking for the two self-selected film clips (see Tables 3, 4). Further tests revealed that responses to these films differed significantly for the homosexual risk groups only. For the two researcher-selected films, a main effect of Sexual Risk Taking was found, with no other significant effects, indicating that, regardless of sexual orientation, high-risk participants experienced stronger genital responses to these films than low-risk participants. For the first threatening sexual film (T1), no significant effects were found. However, the main effect of Sexual Risk Taking was significant for the second threatening sexual film (T2), indicating that, regardless of sexual orientation, high risk taking participants responded more strongly to this film than low-risk participants. We also found a significant main effect of Sexual Orientation, indicating that homosexual responded stronger than heterosexual men to this film.

Subjective Sexual Responses

A similar 2 (Sexual Orientation) × 2 (Sexual Risk Taking) × 6 (Film) mixed-factor ANCOVA, with age and SOI1 as covariates, showed a different pattern for subjective sexual arousal (see Table 5). The main effects of Sexual Orientation, Sexual Risk Taking, and Film were all significant. In contrast to genital responses, which did not differ for the two sexual orientation groups, homosexual participants felt more sexually aroused than heterosexual participants. Similarly, the high sexual risk taking group reported higher levels of subjective sexual arousal than the low sexual risk taking group. Post-hoc tests on the main effect of Film revealed that the longer self-selected film resulted in the highest levels and the threatening sexual films in the lowest levels of subjective sexual arousal.

Relationship Between Genital and Subjective Sexual Responses

Correlations between genital responses and subjective reports of sexual arousal were relatively low (average $r = .23$). Greater correspondence between subjective reports and physiological arousal was observed for homosexual participants (average $r = .36$) than for heterosexual participants (average $r = .13$); however, this difference was not statistically significant ($z = -1.02$, ns). While not significant ($z = -.59$, ns), correlations were also higher in the high (average $r = .32$) than in the low (average $r = .18$) sexual risk taking group.

Other Psychophysiological Responses

Cardiovascular Responses

Systolic and diastolic blood pressure and heart rate responses were also subjected to 2 (Sexual Orientation) × 2 (Sexual

[3] The films used in the final design were generally effective in inducing genital responses. However, about one-quarter of the sample (20 participants) responded with penile rigidity of <10% to the long self-selected film. A hierarchical cluster analysis (Ward, 1963), using the average of the erectile responses to the four nonthreatening sexual films, revealed two distinct clusters, a low and a high response cluster, which differed in genital responses to all of the nonthreatening and the second threatening sexual film. The clusters did not differ in subjective sexual arousal to any of the films. High responders, however, were younger and higher in SES.

Table 2 Analysis of covariance for genital response

Source	*df*	*F*	η^2	*p*
Between subjects				
Sexual Orientation (SO)	1	<1	.00	ns
Sexual Risk Taking (SR)	1	8.59	.11	<.005
SO × SR	1	2.99	.04	ns
Error	70	(2409)		
Within subjects				
Film (F)	5	11.43	.14	<.001
SO × F	5	2.12	.03	ns
SR × F	5	2.70	.04	<.04
SO × SR × F	5	2.80	.04	<.04
Error	350	(427)		

Note: Values in parentheses are MS errors

Risk Taking) × 6 (Film) mixed-factor ANCOVA, with age and SOI1 as covariates. For systolic blood pressure, significant main effects of Sexual Orientation (homosexual men: $M = 9.2$, $SE = 1.0$; heterosexual men: $M = 4.7$, $SE = 1.0$) and Film were qualified by a significant Sexual Orientation × Sexual Risk Taking × Film interaction, $F(5, 270) = 2.53$, $p < .05$, partial $\eta^2 = .05$. Follow-up tests did not reveal any clear patterns, other than a marginally significant interaction ($p < .07$) of Sexual Orientation × Sexual Risk Taking for the two threatening sexual films, which appeared to result from the high risk homosexual participants experiencing the largest increase in blood pressure during these film conditions.

None of the main or interaction effects were significant for heart rate (range in heart rate change for the 6 films was −0.2 to 3.4) but for diastolic blood pressure significant main effects of Sexual Orientation, $F(1, 55) = 4.5$, $p < .04$, partial $\eta^2 = .08$, and Film $F(5, 275) = 5.9$, $p < .001$, partial $\eta^2 = .10$, were found. On average, homosexual men had larger increases in diastolic blood pressure ($M = 4.9$, $SE = .6$) than heterosexual men ($M = 3.2$, $SE = .6$). Follow-up tests on the main effect of Film showed that the threatening sexual films resulted in smaller increases in diastolic blood pressure than the other films.

Electrodermal Responses

A series of 2 (Sexual Orientation) × 2 (Sexual Risk Taking) × 6 (Film) mixed-factor ANCOVAs, with age and SOI1 as covariates, revealed no significant effects for any of the electrodermal (baseline or response) measures. Change from baseline in average amplitudes for the different films ranged from −.1 to .9, change in total amplitudes ranged from 4.4 to 29.4, and change in number of spontaneous fluctuations ranged from 4.4 to 29.4.

Startle Blink Responses

A significant main effect of Sexual Risk Taking was found in the 2 (Sexual Orientation) × 2 (Sexual Risk Taking) × 6 (Film) mixed-factor ANCOVA, with age and SOI1 as covariates, for startle eyeblink responses, $F(1, 48) = 4.8$, $p < .04$, partial $\eta^2 = .09$. Across conditions, startle responses were significantly smaller for the high risk ($M = -.03$, $SE = .07$) than for the low-risk group ($M = .17$, $SE = .05$).

Discussion

The goal of this study was to examine the association between risky sexual behavior and psychophysiological responses to threatening and nonthreatening sexual stimuli. We predicted

Table 3 Means and *SE* for genital response by risk group and sexual orientation

Film	Low-risk group						High-risk group					
	Heterosexual ($N = 21$)		Homosexual ($N = 27$)		Total ($N = 48$)		Heterosexual ($N = 14$)		Homosexual ($N = 14$)		Total ($N = 28$)	
	M	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*
Self-selected1 (SS1)	43.3	7.0	22.7	5.9	33.0	4.6	52.0	8.0	61.8	9.1[a]	56.9	6.1
Self-selected2 (SS2)	54.5	7.4	34.9	6.2	44.7	4.8	60.1	8.4	75.0	9.7[a]	67.5	6.4
Researcher-selected1 (RS1)	24.9	7.1	20.8	6.0	22.8	4.6	35.9	8.1	43.3	9.3	39.6	6.2[b]
Researcher-selected1 (RS1)	34.1	7.2	22.9	6.1	28.5	4.7	37.4	8.2	56.3	9.5	46.9	6.3[b]
Threatening1 (T1)	8.4	4.5	6.4	3.8	7.4	2.9	10.1	5.1	2.1	5.8	6.1	3.9
Threatening2 (T2)	0.0	5.1	13.3	4.3	5.7	3.3	11.5	5.8	28.5	6.6	20.0	4.4[b]
Total	27.2	4.7	20.2	4.0	23.7	3.1	34.5	5.4	44.5	6.2	39.5	4.1

Note: SS1/SS2 = Self-Selected Sexual Films; RS1/RS2 = Researcher-Selected Sexual Films; T1/T2 = Threatening Sexual Films

[a] Significant difference between high and low homosexual risk groups

[b] Significant difference between risk groups regardless of sexual orientation

Table 4 Analysis of covariance on genital response, follow-up tests by film

Source	*df*	*F*	η^2	*p*
SS1				
Sexual Orientation (SO)	1	<1	.01	ns
Sexual Risk Taking (SR)	1	8.92	.11	<.005
SO × SR	1	4.32	.06	<.05
Error	70	(886)		
SS2				
Sexual Orientation (SO)	1	<1	.00	ns
Sexual Risk Taking (SR)	1	7.32	.10	<.01
SO × SR	1	4.99	.07	<.05
Error	70	(984)		
RS1				
Sexual Orientation (SO)	1	<1	.00	ns
Sexual Risk Taking (SR)	1	4.25	.06	<.05
SO × SR	1	<1	.01	ns
Error	70	(910)		
RS2				
Sexual Orientation (SO)	1	<1	.00	ns
Sexual Risk Taking (SR)	1	3.96	.07	<.05
SO × SR	1	3.90	.05	ns
Error	70	(944)		
T1				
Sexual Orientation (SO)	1	<1	.01	ns
Sexual Risk Taking (SR)	1	<1	.00	ns
SO × SR	1	<1	.01	ns
Error	70	(359)		
T2				
Sexual Orientation (SO)	1	7.87	.10	<.007
Sexual Risk Taking (SR)	1	6.12	.08	<.02
SO × SR	1	<1	.00	ns
Error	70	(460)		

Note: Values in parentheses are mean square errors. SS1/SS2 = Self-Selected Sexual Films; RS1/RS2 = Researcher-Selected Sexual Films; T1/T2 = Threatening Sexual Films

that sexual risk taking would be associated with stronger sexual responses to threatening sexual stimuli. In addition, cardiovascular, electrodermal, and startle responses were measured to explore whether sexual risk taking was associated with specifically sexual responses or also with nonsexual psychophysiological response patterns.

The low and high sexual risk groups indeed differed in their genital responses to the stimuli presented in this study, but in contrast to what we had predicted, the differences were not limited to the threatening sexual films. We found differences between low and high-risk groups in genital response to the second threatening sexual film, but also to the two researcher-selected films. Subjective sexual arousal was highest for the high-risk group as well and, in contrast to our findings on genital response, this effect was not restricted to a specific subset of stimuli. Overall, these results suggest, consistent with findings from questionnaire studies (Bancroft et al., 2003, 2004), that differences in the degree to which individuals engage in sexual risk behaviors are associated with their propensity for sexual arousal. Whereas we had predicted that such differences would be relatively specific to stimuli relevant to sexual inhibition (cf. Janssen et al., 2002b), and although the findings on the second threatening sexual film indeed suggest that differences in inhibitory control of sexual response may be involved, on the whole the findings also imply a role for more general sexual response mechanisms.

With respect to the other psychophysiological variables, we found a significant interaction between sexual orientation, sexual risk taking, and film for changes in systolic blood pressure, which seemed largely attributable to the homosexual high sexual risk group experiencing larger increases in systolic blood pressure during the threatening sexual film conditions than the other three groups. However, we did not find any effects related to sexual risk taking for diastolic blood pressure, heart rate responses, or any of the electrodermal variables, even though the films did induce changes in these measures.

Of the nonsexual psychophysiological variables, the most noteworthy and interesting finding involved the startle responses. While we failed to find an effect of specific films on eyeblink responses—in contrast to Janssen et al. (2002b), who found that eyeblink responses to threatening sexual films were stronger than those to nonthreatening sexual films—we did find a significant effect of sexual risk taking: Regardless of film type, eyeblink responses were smaller for the high than for the low sexual risk taking groups. In conjunction with the sexual response findings, the eyeblink effects suggest that risky sexual behavior may involve some role for a combination of psychophysiological mechanisms that are more or less specific to sexual response and ones that reflect more general approach/avoidance response mechanisms.

The finding that the risk groups differed in startle eyeblink but not in electrodermal responses is of potential relevance. Patrick et al. (1993, 1994) found, in male sex offenders, that startle eyeblink responses were associated with differences in the Emotional Detachment component of psychopathy (as measured using the Psychopathy Checklist; Hare, 1991), but not with Antisocial Behavior. In contrast, electrodermal hyporeactivity was found to be associated with Antisocial Behavior, but not with Emotional Detachment. On the basis of these and other findings (e.g., Benning et al., 2005), reduced startle responses, as the ones we found in our high-risk participants, have been interpreted to reflect possible defensive motivation or anxiety deficits (i.e., a lower reactivity to threat and fear cues), whereas differences in electrodermal responsivity may reflect deficits in higher level (e.g.,

Table 5 Analysis of covariance for subjective sexual arousal

Source	*df*	*F*	η^2	*p*
Between subjects				
Sexual Orientation (SO)	1	8.00	.10	<.007
Sexual Risk Taking (SR)	1	5.63	.08	<.03
SO × SR	1	<1	.00	ns
Error	69	(20.3)		
Within subjects				
Film (F)	5	8.36	.11	<.001
SO × F	5	1.15	.02	ns
SR × F	5	<1	.01	ns
SO × SR × F	5	1.29	.02	ns
Error	345	(3.4)		
Means and SE for significant effects:				
Sexual Orientation (SO):		*Film (F)*:		
Heterosexual participants: $M = 4.6$ ($SE = .3$)		SS1: $M = 6.4$ ($SE = .3$)		
Homosexual participants: $M = 5.9$ ($SE = .3$)		SS2: $M = 7.3$ ($SE = .3$)		
		RS1: $M = 5.6$ ($SE = .3$)		
Sexual Risk Taking (SR):		RS2: $M = 6.3$ ($SE = .3$)		
Low-risk group: $M = 4.7$ ($SE = .3$)		T1: $M = 3.0$ ($SE = .3$)		
High risk group: $M = 5.8$ ($SE = .4$)		T2: $M = 2.8$ ($SE = .3$)		

Note: Values in parentheses are mean square errors. SS1/SS2 = Self-Selected Sexual Films; RS1/RS2 = Researcher-Selected Sexual Films; T1/T2 = Threatening Sexual Films

executive) processes that are relevant to disinhibition (e.g., Fowles, 2000; Patrick & Lang, 1999). Thus, our findings suggest that sexual risk taking—in addition to more specifically sexual response mechanisms—may be associated with a tendency to approach (or not withdraw from) stimuli and situations that are potentially dangerous and that would induce anxiety and inhibition in others. In contrast, if we had found reduced electrodermal responsivity in high-risk takers, this could have been interpreted to mean that sexual risk taking is associated with the type of uncontrolled behavior more common to antisociality and that seems based on limited, impulsive considerations of possible outcomes (cf. Benning et al., 2005). Obviously, different subtypes of sexual risk takers may exist, with different combinations of and roles for sexual, affective, and autonomic processes (cf. Janssen & Bancroft, 2007), and future studies could further explore this possibility.

Sensation seeking was related to sexual risk taking but, contrary to our expectations, sexual inhibition (SIS2) was not. In contrast to the current findings, in a previous study (Janssen et al., 2002b), involving a sample of male heterosexual college students, SIS2 was associated with differences in genital responses to threatening sexual films. That study, however, did not focus on or incorporate any measures of sexual risk taking. In two other studies (Bancroft et al., 2003, 2004), we found evidence for a relationship between sexual inhibition/excitation proneness (and also sensation seeking) and sexual risk taking. Those two studies, however, did not involve any psychophysiological measures. The previous and current findings combined clearly suggest that the relationships among measures of risky sexual behavior, sensation seeking, and sexual excitation/inhibition proneness on the one hand, and psychophysiological responses on the other, are more complex than we initially assumed. Obviously, differences in samples, designs, and procedures all contribute to variability in research findings. However, other possible explanations need to be considered as well, including ones that involve limitations of or problems with the use of self-report measures to assess individual differences in not readily observable excitatory and inhibitory neurophysiological mechanisms (cf. Brenner, Beauchaine, & Sylvers, 2005). More specifically, the use of SIS/SES in a relatively small experimental study may be more problematic than its use in survey studies, which typically involve larger samples and thus provide more statistical power for the detection of trait effects. The psychophysiological study by Janssen et al. (2002b) may not have been affected by this as much, as participants in that study were recruited on the basis of their SIS/SES scores, allowing for a comparison of more extreme groups.

Several differences were found between homosexual and heterosexual participants that warrant discussion. For instance, homosexual participants appeared to show stronger genital responses to the second threatening sexual film. However, different films were used for the two subsamples, and this film, inadvertently, may have had more sexual content than the corresponding film presented to heterosexual participants. However, the use of different stimuli may not be sufficient to explain why homosexual participants reported higher levels of subjective sexual arousal, as the two

groups did not differ, overall, in genital response. As we corrected for age differences between the two sexual orientation groups, other explanations may need to be considered (e.g., homosexual participants had higher SES scores). Another difference of interest between the heterosexual and homosexual participants involved the finding that, in the homosexual sample only, low and high risk taking groups differed in genital responses to self-selected films. Inspection of Table 3 suggests that these film conditions amplified the differences between low and high-risk groups for homosexual participants in particular. That is, while genital response of heterosexual participants, regardless of the risk group they had been assigned to, appeared to be the highest for these two films, genital responses of the high risk homosexual participants in particular seemed to be augmented by the self-selected sexual films. In comparison, the opportunity to select one's own stimuli did not contribute as much to the genital responses, which were comparatively low, of the low risk homosexual participants. However, the differences between the homosexual and heterosexual participants in responses to the self-selected films, as was true for the other differences found between the two groups (e.g., in genital and blood pressure responses), could be related to the fact that the two participant groups were presented with different stimuli.

In addition to the use of films selected by the researchers, the participants were allowed to select two clips from a larger set of ten videos (pre-selected by the researchers). An advantage of this approach is that it, as we had hoped, increased overall sexual response levels. A disadvantage is that it decreased the degree of experimental control over the content presented to the participants. However, this approach is not that different from the relatively common use of fantasy instructions in experimental and psychophysiological studies. In most cases, participants in such studies are asked to fantasize about sexual interactions and behaviors they find arousing. Participants can be expected to differ in the specific sexual fantasies they engage in (typically, they are not asked about the content of their fantasies), yet, the experimental condition was the same for all. Our procedure was analogous: Instead of selecting their own (internally generated) fantasy, we asked subjects to select their own film excerpts, which can be conceived of as being a visual representation of a fantasy or depiction of an arousing sexual scenario.

Genital responses were variable but substantial. Penile rigidity responses of 60% are generally believed to reflect "normal" sexual responding (e.g., Yang, Porter, & Penson, 2006) and both our heterosexual and homosexual participant (in particular the high risk) groups reached this level, especially for the self-selected films. Yet, a number of subjects did not respond as strongly. Nonresponse in sexual psychophysiological studies, however, is not uncommon, and increasingly researchers are acknowledging this and report the proportion of nonresponding subjects (e.g., Chivers et al., 2004; Rieger, Chivers, & Bailey, 2005; both studies found that approximately one-third of male subjects were nonresponders). The causes of nonresponse are not well understood but, in addition to higher age and lower sexual excitation proneness (as we found in this study), could be related to high levels of exposure to and experience with sexually explicit materials (Janssen & Bancroft, 2007). The current study was one of few psychophysiological studies for which participants were recruited from the community and in which recruitment sites included STD clinics, bars, churches, and other community venues and organizations. The presence of nonresponders, and also the relatively low correlations found in this study, may reflect the heterogeneity of the samples used, in terms of sexual experience, age, and other variables.

The current study, to our knowledge, is the first to explore relationships among sexual and nonsexual psychophysiological response patterns and risky sexual behavior. In general, the study provides support for the idea that sexual risk taking is associated with increased sexual responsiveness. That is, our findings suggest that men who engage in risky sexual behaviors—or more specifically, who use condoms inconsistently—are more easily aroused and, at the same time, do not lose their arousal as easily in more "threatening" sexual situations, compared to other men. In addition, sexual risk taking appeared to be associated with decreased defensive (avoidance) motivation, or a lower reactivity to threat and fear cues, as demonstrated by the startle eyeblink findings. Clearly, the two response patterns could be related, in that the stronger sexual responses to the threatening sexual stimuli may be partly due to differences in the appraisal of "threat." Future studies, by incorporating both sexual and nonsexual threatening stimuli (e.g., anxiety-provoking nonsexual films), could explore to what degree a decreased reactivity to threat cues is specific to sexual contexts or reflects a more general affective hyporeactivity in sexual risk takers.

Although preliminary in nature, it is worthwhile pointing out that our key findings were observed in both heterosexual and homosexual participants, who were recruited independently and presented with different stimuli. At the same time, the current study had a number of limitations that need to be acknowledged. For example, our operationalization of "risky sexual behavior" focused on condom use and relied largely on the use of a single item. This limitation, however, is not unique to the current study—it represents problems in definition and measurement that are more general to the sexual risk taking literature (Noar et al., 2006). Until recently (Turchik & Garske, 2008), multi-item measures of sexual risk taking have been lacking and the questionnaire on which we based the selection of our items, the Sociosexual Orientation Inventory (Seal & Agostinelli, 1994; Simpson & Gangestad, 1991), while it is one of the few more relevant measures, has the unfortunate characteristic that it contains both behavioral and attitudinal questions and that the time periods of the

behavioral questions vary (which is why we included number of partners as a covariate, instead of incorporating it in the calculation of some percentage or ratio score). Needless to say, future research exploring how and to what degree risky sexual behavior may involve sexual and nonsexual psychophysiological response mechanisms or tendencies would benefit from the incorporation of more reliable multi-item scales of sexual risk taking. Also, in addition to the use of threatening/nonthreatening sexual stimuli, future research could benefit from the inclusion of personality measures (e.g., harm avoidance, impulsivity) beyond the assessment of sexual excitation and inhibition and the implementation of behavioral tasks, which would allow for the exploration of the psychophysiological correlates of actual sexual behavior or risky sexual decision making. Finally, larger samples of (male or female) homosexual and heterosexual participants would allow for a more detailed comparison, both between and within sexual orientation groups, of sexual and nonsexual psychophysiological mechanisms.

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