



## Emotional Reactions to High-Risk Sex among Sexual Minority Men: Exploring Potential Opportunities for Just-In-Time Intervention

Tyler B. Wray, Noah N. Emery & John P. Guigayoma

**To cite this article:** Tyler B. Wray, Noah N. Emery & John P. Guigayoma (2023) Emotional Reactions to High-Risk Sex among Sexual Minority Men: Exploring Potential Opportunities for Just-In-Time Intervention, The Journal of Sex Research, 60:5, 718-727, DOI: [10.1080/00224499.2022.2113854](https://doi.org/10.1080/00224499.2022.2113854)

**To link to this article:** <https://doi.org/10.1080/00224499.2022.2113854>



Published online: 13 Sep 2022.



Submit your article to this journal [↗](#)



Article views: 75



View related articles [↗](#)



View Crossmark data [↗](#)



## Emotional Reactions to High-Risk Sex among Sexual Minority Men: Exploring Potential Opportunities for Just-In-Time Intervention

Tyler B. Wray<sup>a</sup>, Noah N. Emery<sup>b</sup>, and John P. Guigayoma<sup>a</sup>

<sup>a</sup>Center for Alcohol and Addictions Studies, School of Public Health, Brown University; <sup>b</sup>Department of Psychology, Colorado State University

### ABSTRACT

Rates of HIV and other sexually transmitted infections (STIs) are high among sexual minority men (SMM). A large body of research has explored determinants of HIV/STI risk behavior, but few studies have explored emotional consequences of these events. Understanding the valence, timing, and strength of emotional reactions to sexual risk could inform use of specific behavior change techniques in interventions (such as anticipated regret) and identify new opportunities for intervention, including just-in-time interventions. We analyzed data from an ecological momentary assessment (EMA) study of 100 HIV-negative/unknown-status SMM to understand patterns of positive affect, negative affect, shame, and stress in the 24 hours after sex. Mixed-effects models showed that the probability of negative affect was higher in the hours following condomless anal sex (CAS) with high-risk partners during which SMM reported being under the influence of alcohol or drugs (A/D involved CAS), versus all other types of sex events ( $OR = 0.92$ ,  $SE = 0.03$ ,  $p = .017$ ). The probability of shame was also higher after A/D-involved CAS, versus other sex events ( $OR = 1.14$ ,  $SE = 0.07$ ,  $p = .035$ ). Findings suggest that the hours following A/D-involved CAS events may be an opportune time to intervene to help SMM avoid similarly aversive experiences in the future.

### Introduction

Sexual minority men (SMM) comprised 70% of new HIV infections in the United States (US) in 2018 (Centers for Disease Control and Prevention, 2020), and a substantial majority of new HIV infections in this population are due to condomless anal sex (CAS; CDC, 2017). Recent biomedical prevention strategies such as pre-exposure prophylaxis and treatment as prevention can reduce HIV infection in this population (Paz-Bailey et al., 2016). However, rates of other sexually transmitted infections (STIs) remain high among SMM (CDC, 2019), suggesting that efforts to encourage more consistent condom use with non-exclusive partners is still an important goal. For these reasons, research identifying unique opportunities to promote condom use in SMM remains a high priority.

Although individual-level interventions encouraging condom use have been shown to reduce STI infections in SMM, the effect sizes of these interventions are often small (Henderson et al., 2020; Wohlfeiler & Ellen, 2007). Although many limitations likely explain these narrow effects, one important drawback is that these interventions are nearly always delivered in settings and at times that are far removed from when and where sex often occurs (Henderson et al., 2020; Wohlfeiler & Ellen, 2007), such as at clinics or community organizations during business hours. As a result, the content provided in these interventions could have limited salience for recipients and could be difficult to remember and apply in the moments when they are needed (Nahum-Shani et al., 2018).

Just-in-time interventions (JITIs) provide a framework for delivering behavior change interventions at more relevant times, such as just before or after a specific sexual encounter (Nahum-Shani et al., 2018). JITIs most often use technologies such as smartphones to deliver interventions that provide users with support at especially opportune moments for behavior change (Nahum-Shani et al., 2018). Although past research has shown that JITIs are efficacious for a variety of other health issues, including mental health, addiction, and diet (Wang & Miller, 2020), research exploring JITIs and opportunities for intervention to reduce HIV/STI risk among SMM is limited (Jin et al., 2020; Platteau et al., 2020; Rawat et al., 2018; Wray, Luo et al., 2019; Wray, Pérez et al., 2019).

An important first step toward designing effective JITIs for SMM involves identifying relevant “states of vulnerability” or “states of opportunity” (p. 449; Nahum-Shani et al., 2018). These states are moments when individuals are especially susceptible to risk behavior or are most receptive to behavior change, respectively. To date, most basic behavioral research that can inform JITI design has been primarily focused on identifying states of vulnerability to engaging in CAS (Grov et al., 2010; Huebner & Perry, 2015; Mustanski, 2007). This research is mainly helpful for informing interventions that could help SSM avoid CAS *before* it occurs by alleviating or reducing the vulnerable state (Huebner & Perry, 2015; Nahum-Shani et al., 2018). However, it could also be important to identify “moments of opportunity” for facilitating behavior change. One such moment could potentially include so-called “teachable moments,” which

have been described as “naturally occurring [...] health events thought to motivate individuals to spontaneously adopt risk-reducing health behaviors” (p. 156; McBride et al., 2003). For example, individuals often experience legal, social, emotional, or health-related consequences *after* engaging in a given health risk behavior (Barnett et al., 2014), and the suffering or distress of these consequences could prompt some to avoid or reduce engagement in these risk behaviors in the future (Barnett et al., 2002). Barnett et al. (2002) explored a specific example of this process among adolescents who were treated for alcohol-related injury at a hospital emergency department and found that those who had more severe injuries or who were more afraid during their visits were more likely to report intending to reduce their drinking in the future. Other studies reported similar findings (Barnett et al., 2006). Thus, teachable moments such as these could be important moments of opportunity because they may prompt individuals to consider the role of their behavior in the negative consequence and reflect on the possibility of behavior change (Lawson & Flocke, 2009). Interventions that recommend practical and achievable ways to help SMM avoid or reduce health risk behaviors in the future could help them consolidate their motivation to change and help them translate it into concrete, effective plans for change (Nahum-Shani et al., 2018). However, few studies have explored whether such moments of opportunity might accompany sexual risk behaviors among SMM.

Negative self-referent emotions such as regret, guilt or shame after a health risk behavior or consequence may be important indicators of such moments of opportunity. Although each of these emotions are somewhat unique, they all commonly arise in response to the individual's appraisal that their behavior or character differs from important personal, social, or moral norms (Lickel et al., 2014). Shame is thought to occur when an individual's appraisal focuses on negative traits or characteristics of themselves (e.g., “I am a bad person”), while related emotions such as guilt are thought to arise when individuals focus on negative aspects of their behavior (e.g., “I did something wrong”; Baumeister et al., 2007). As such, guilt has largely been considered the more adaptive of the two, given evidence suggesting that it can motivate individuals to approach the situation and repair relationships (Tangney et al., 1996). However, research also suggests that shame may be uniquely associated with an increased desire for self-change (Lickel et al., 2014), particularly when one's failure or reputation are repairable (Leach & Cidam, 2015). These negative, self-referent emotions inherently arise from the individual assessing their actions and considering whether they align with valued standards (Lickel et al., 2014), meaning that experiencing them could be an important indication that the individual is reflecting on their behavior.

Despite the importance these emotions may play in behavior change, few quantitative studies have explored whether these or similar emotions might arise in response to sexual risk behaviors. A handful of primarily qualitative studies have explored SMM's emotional reactions to CAS (Boulton et al., 1995; Parsons et al., 2004; Reback & Larkins, 2010; Strong et al., 2005) and found that many SMM report a sense of regret after CAS with unknown or casual partners (Boulton et al., 1995; Strong et al., 2005), with some specifically noting more

pronounced regret after CAS that occurred while under the influence of alcohol or other drugs (Boulton et al., 1995; Parsons et al., 2004; Reback & Larkins, 2010; Strong et al., 2005). Identifying the *type* of emotional response is critical for determining if a moment of opportunity might exist. Characterizing the *timing* of these responses is also critical, given that the premise of JITIs relies on delivering interventions at very specific times when these moments of opportunity occur. Some participants in these studies also noted that the onset of these feelings most often occurred immediately after sex (Reback & Larkins, 2010; Strong et al., 2005), but few other insights are available about when these feelings are strongest and how long they last. Quantitative research that addresses these questions could help inform the type and timing of JITI support so that the content is most relevant to the situation and appears during these potential moments of opportunity.

Finally, although specific emotional reactions could occur relatively consistently across all SMM, it is also possible that their strength may vary across SMM and depend on individual differences, such as personality traits. One potentially relevant trait could be sexual sensation seeking (SSS), which is a preference for new and uninhibited sexual experiences such as CAS with new or casual partners and alcohol and drug use before sex (Kalichman et al., 1994). Individuals with high sexual sensation seeking may not experience the same increase in negative emotions following these sexual experiences than those lower in this trait. Instead, individuals with high sexual sensation seeking may be more likely to experience those events as enjoyable or exciting. For example, in a daily diary study, Grov et al.'s study (2010) showed that SMM were less likely to engage in CAS on days when they also experienced high levels of negative emotional states, such as sadness, fear, and anger, but this relationship was attenuated for participants who were high in a trait similar to sexual sensation seeking. Although the timing of emotional states and CAS is difficult to disentangle in Grov et al., these results provide evidence that those high in traits such as sexual sensation seeking may be generally less emotionally responsive to sex that involves risk. As such, conducting research to determine which individuals are most likely to experience emotional reactions to CAS can help identify who might benefit the most from interventions delivered that target these possible moments of opportunity.

In this study, we used data from an ecological momentary assessment (EMA) study of heavy-drinking SMM in the northeastern US to test whether specific emotional states varied in the hours after sex across different types of sex events. This dataset has been the focus of several previous analyses (Wray, Luo et al., 2019; Wray & Monti, 2020; Wray et al., 2020). Broadly, we hypothesized that SMM would experience higher levels of several negative emotional states, such as general negative affect, shame, and stress, and lower levels of positive affect, in the 24 hour period following sex events that involved some degree of HIV/STI risk (high-risk CAS, alcohol/drug involved CAS) versus lower-risk sex events. We also hypothesized that the odds and/or strength of negative emotional states would be higher in the hours immediately following the sex event (tapering off over the course of the full 24 hour period) and among those with low levels of sexual sensation seeking.

## Method

### Participants

In the original EMA study, we recruited 100 participants through gay-oriented dating applications (e.g., Grindr, Scruff), social networking sites (e.g., Facebook, Instagram), and in-person outreach (e.g., flyers) in the northeastern US from January 2016 to October 2018. Eligible participants were 1) at least 18 years old, 2) assigned male sex at birth, 3) current male gender, 4) HIV-negative or unknown status, 5) able to read and speak English fluently, and 6) were not currently using PrEP. Participants also reported 7) condomless anal sex with a non-exclusive partner in the past 30 days and 8) consuming five or more drinks on a single occasion at least once in the last 30 days.

### Measures

*Sexual behavior* was assessed in daily diary prompts by asking participants to report the number of oral, anal, or vaginal sex partners (0–4 partners total) they had over the previous 24 hours. Participants reported characteristics of the sex event, including the time the sex event began, each sex act they engaged in (e.g., oral sex, insertive or receptive anal sex, vaginal sex), and whether they used a condom for each act. Participants also reported partner characteristics for each sex act, such as HIV status and partner sexual exclusivity. We classified partners as “low-risk” if they were 1) on PrEP or 2) mutually sexually exclusive and with a known HIV status (HIV-positive or HIV-negative). We classified partners as “high-risk” if they were 1) not on PrEP and either 2a) unknown HIV status and not mutually sexually exclusive, 2b) unknown HIV status and sexually mutually exclusive, or 2c) known HIV status and not sexually mutually exclusive. We classified HIV-positive partners who were mutually sexually exclusive with participants as low-risk because of the increase in viral suppression among HIV-positive SMM (Jeffries et al., 2020) and high rates of treatment as prevention adoption among serodiscordant sexual partnerships (Meunier et al., 2020; Mitchell et al., 2021).

*Alcohol/drug effects* during sex were assessed in daily diary reports by asking participants whether they were under the influence of alcohol or drugs at the time of sex with each partner and if so, what drugs they used. Participants could select from among the following categories of drugs: alcohol, marijuana, cocaine, heroin, hallucinogens, methamphetamine, ecstasy/MDMA, prescription painkillers, or stimulants.

*Positive affect (PA) and negative affect (NA)* were assessed in all experience sampling and event-contingent/follow-up prompts using items from the Positive and Negative Affect Schedule – Expanded Form (PANAS-X; Watson et al., 1988) using the stem “How \_\_\_\_ are you feeling right now?” Participants rated each item on a scale from 1 (*not at all*) to 5 (*extremely*). PA was assessed using the following three items: happy, excited, and enthusiastic. NA was assessed using the following three items: sad, nervous, irritated. Similar to past EMA studies (Berg et al., 2015; Steptoe et al., 2007), we summed and standardized participants ratings of these items to create composite scores of PA and NA at each momentary

assessment. PA scores had excellent per moment reliability ( $\alpha = 0.91$ ), and NA scores had acceptable reliability ( $\alpha = 0.73$ ).

*Other emotional states* (stress and shame) were also assessed in all experience sampling and event-contingent/follow-up prompts and collected in the same way as all other affect variables. Since these are conceptually distinct from PA and NA, we included each of these states as a separate outcome in our primary models.

*The sexual sensation seeking scale* is a 10-item measure of individuals’ tendency to pursue novel, exciting, and stimulating sexual encounters (Kalichman et al., 1994). Participants completed this scale in the online baseline survey. Example items include rating statements such as “I like wild ‘uninhibited’ sexual encounters” and “I enjoy the sensation of intercourse without a condom.” The sexual sensation seeking scale has been shown to be reliable ( $\alpha = .79$ ) and valid in past studies (Kalichman et al., 1994).

### Procedure

Prospective participants completed an online screener that assessed basic eligibility criteria. Eligible individuals met with study staff for enrollment through in-person appointments at study offices or through videoconferencing. During these appointments, study staff reviewed study procedures with participants, obtained informed consent, and guided participants through downloading an EMA app (MetricWire) onto their personal smartphones. Staff then explained the app’s features and walked participants through a typical day with the app, including how to answer various assessments. For 30 days, participants would receive 1) a daily diary assessment sent each morning and 2) up to six experience sampling assessments every day sent at random times in roughly three-hour windows between the hours of 9 am and midnight. If participants started drinking or using drugs based on responses to the experience sampling assessments, they were also asked to initiate an event-contingent assessment as soon as possible, and a timed follow-up assessment was delivered three hours after they initiated this assessment. Staff coached participants to achieve target response rates of 100% of daily diaries and at least 80% of random assessments. Participants received weekly e-mail updates of their response rates, and staff provided additional coaching to participants who fell below targets. Participants received \$2 for every completed daily diary and a \$10 bonus for every 10 days they completed 100%. Participants also received \$0.50 for every completed random assessment and a \$10 bonus for every 10 days they completed at least 80%. In total, participants could earn \$210 for participating. The Brown University Institutional Review Board approved all study procedures.

### Analysis

We used the timestamps of submitted experience sampling/event-contingent (ES/EC) assessments to create a timeline of collected surveys. We then arranged the assessments into “periods” that started with the first ES/EC assessment collected after participants reported a sex event and continued until either 1) 24 hours had passed, or 2) another sex event occurred.

The result was that ES/EC prompts assessing current emotion (level 1) were nested and ordered within periods that represented up to 24 hours following a sex event (level 2), and these periods were nested within participants (level 3; Figure 1). As the outcomes of these analyses were emotions after sex, we dropped all observations that did not occur in the 24 hours after a sex event.

We first calculated basic summary statistics about the number of sex events that were analyzed and their characteristics. We also calculated descriptive statistics for demographics of the sample. We then coded the focal predictor of interest, which was whether the current sex event involved CAS with a high-risk partner versus sex events that: (1) did not include anal sex, (2) involved condom-protected anal sex, or (3) involved a lower-risk partner. We also coded a similar dummy variable representing whether that period involved alcohol/drug-involved condomless anal sex with a high-risk partner (alcohol/drug-involved CAS), versus all other sex acts. Another focal predictor was time after sex, which we coded as the number of hours after sex in which each ES/EC survey was submitted. Finally, we included standardized total scores of sexual sensation seeking as a person-level predictor of emotions after sex.

To test our hypotheses, we estimated several three-level mixed-effects models with random intercepts that included each emotional state (PA, NA, stress, and shame) as primary outcomes, hours after sex as a level 1 predictor, high-risk CAS and alcohol/drug-involved CAS as level 2 predictors, and sexual sensation seeking as a level 3 predictor, with two- and three-way interactions between time, sexual sensation seeking, and the two sex-related dummy variables included. When examining each outcome, we discovered that although momentary positive affect had a normal distribution, negative affect had a positive skew such that participants responded with 1 (*not at all*) to all three negative affect items at most moments throughout the study and only rarely submitted higher ratings (2–5). Given this distribution, we estimated two models for negative affect: one testing the odds of reporting *any* negative affect in the hours after sex (negative affect as a binary outcome) and another testing the severity of negative affect when participants reported more negative affect than “none at all” (>1). Stress and shame had similar positive skew

such that participants rarely endorsed these emotions. For stress and shame, we also recoded these variables into binary outcomes so that models tested the odds of reporting each state in the hours after sex. For each model we estimated, we reported coefficients/odds ratios with corresponding standard errors, p-values, and 95% confidence intervals in tables, since these are key results. Statistical significance was set at  $p < .05$ . For any statistically significant interactions in these models, we estimated marginal effects for the highest-order interaction, which provides the predicted means of each emotional state at meaningful levels of each predictor involved in the interaction (for example, after high-risk CAS events versus “safer” sex events, or high versus low sexual sensation seeking). We reported these marginal effects in the text and plotted these interactions. We conducted all analyses in Stata Version 16.

## Results

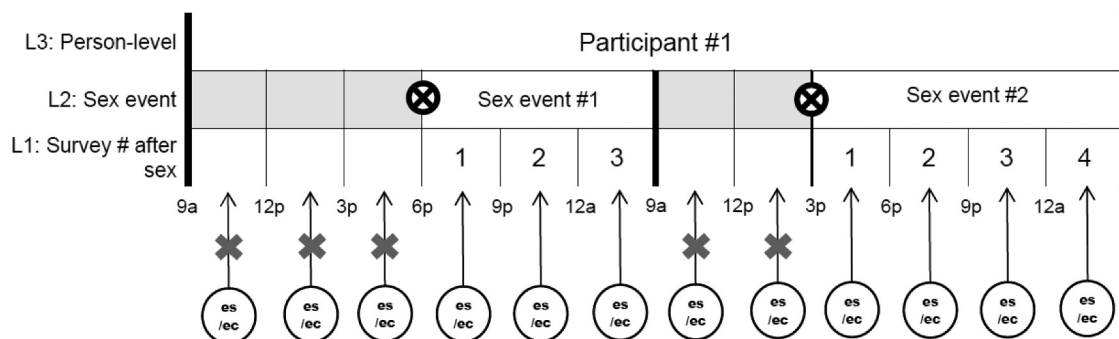
Table 1 summarizes basic demographics for study participants. As previously reported (Wray et al., 2020), participants submitted an average of 97.3% of all assigned daily diary surveys

**Table 1.** Demographic characteristics and key variables (N = 100).

Characteristics	Mean (SD) or N (%)
Age (Range: 18–54)	27.1 (7.7)
Race	
White	76 (76.0)
Black or African American	4 (4.0)
Asian	8 (8.0)
American Indian/Alaska Native	1 (1.0)
Multiracial	6 (6.0)
Chose not to respond	5 (5.0)
Ethnicity (Hispanic or Latino)	16 (16.0)
HIV-status (self-reported)	
Negative	83 (83.0)
Don't know	17 (17.0)
Currently in sexually-exclusive relationship	5 (5.0)
Average length of relationship (months)	1.4 (0.9)
College degree	54 (54.0)
Low income <sup>1</sup>	29 (29.0)
Unemployed	13 (13.0)
Identify as gay or bisexual	94 (94.0)

Note. <sup>1</sup>Represents those with a household annual income <\$30,000/year.

EMA = ecological momentary assessment; DD = daily diary, ES = experience sampling, CAS = condomless anal sex.



**Figure 1.** Timeline of study surveys and our approach to nesting and ordering surveys collected after sex events. Note. ES = Experience sampling survey. EC = Event-contingent survey. X Represents the time at which a sex event occurred. Numbers on Level 1 represent the number of ES/EC survey submitted after a sex event. Grayed cells and “x” symbols represent experience samples that would be dropped in our approach.



( $SD = 0.06$ ) and 77.3% of all prompted experience sampling surveys ( $SD = 0.13$ ). Participants also reported 622 total sex events, 43.4% of which involved CAS. Of these CAS events, 69.6% occurred with high-risk partners. Participants reported feeling the effects of alcohol or drugs during 36.6% of all sex events and 45.7% of all high-risk CAS events. Of all alcohol/drug-involved CAS events, participants reported using only alcohol during 59.2% of events, marijuana during 30.7%, cocaine during 2.2%, amphetamines during 2.6%, ecstasy during 0.4%, and prescription stimulants during 0.9%.

Table 2 reports results for models examining positive affect and negative affect after sex. In the model of positive affect after sex, positive affect did not significantly differ across high-risk CAS events or alcohol/drug-involved CAS events, versus all other types of sex events. However, we found that hours after sex was negatively associated with positive affect, suggesting that participants' ratings of positive affect after any type of sex

declined over the 24 hours following sex. No two- or three-way interactions between the type of sex event, hours after sex, and sexual sensation seeking were significant.

In the model of any negative affect after sex, a two-way interaction between hours after sex and alcohol/drug-involved CAS was significant. Marginal effects showed that the odds of reporting any negative affect was 16.3% higher two hours after an alcohol/drug-involved CAS event relative to all other types of sex events ( $SE = 0.07$ ,  $p = .017$ ; Figure 2). Differences in the odds of reporting any negative affect after alcohol/drug-involved CAS versus other sex events gradually decreased as time after sex increased (14.2% after 4 hours, 12.1% after 6 hours), and differences were not significant at > 6 hours after sex. Main effects and interactions with sexual sensation seeking were not significant.

In the model testing the severity of negative affect, the three-way interaction between alcohol/drug-involved CAS, hours

Table 2. Positive and negative mood outcomes.

	Positive affect				Any negative affect				Negative affect – severity			
	Coeff.	SE	p	95% CI	OR	SE	p	95% CI	Coeff.	SE	p	95% CI
Hours	<b>−0.01</b>	<b>0.00</b>	<b>.022*</b>	−0.01, 0.00	1.00	0.01	.640	0.98, 1.01	0.00	0.00	.138	0.00, 0.01
High-risk CAS	0.05	0.09	.563	−0.13, 0.24	0.78	0.29	.511	0.38, 1.63	0.13	0.10	.211	−0.07, 0.33
High-risk CAS x hours	0.00	0.01	.808	−0.01, 0.01	1.02	0.02	.393	0.98, 1.07	−0.01	0.01	.340	−0.02, 0.01
SSS	0.25	0.14	.090	−0.04, 0.53	0.78	0.37	.599	0.31, 1.98	0.00	0.12	.974	−0.23, 0.23
Hours x SSS	0.00	0.00	.441	−0.01, 0.01	1.02	0.02	.226	0.99, 1.06	<b>0.01</b>	<b>0.01</b>	<b>.027*</b>	0.00, 0.02
High-risk CAS x SSS	−0.10	0.16	.545	−0.42, 0.22	1.11	0.71	.865	0.32, 3.89	−0.13	0.17	.445	−0.45, 0.20
High-risk CAS x hours x SSS	0.01	0.01	.103	0.00, 0.03	0.96	0.04	.291	0.89, 1.03	0.01	0.01	.305	−0.01, 0.03
A/D CAS	0.05	0.14	.713	−0.22, 0.32	<b>3.73</b>	<b>2.08</b>	<b>.018*</b>	1.25, 11.14	0.04	0.13	.771	−0.22, 0.30
A/D CAS x Hours	0.00	0.01	.808	−0.01, 0.02	<b>0.92</b>	<b>0.03</b>	<b>.017*</b>	0.86, 0.99	0.00	0.01	.653	−0.02, 0.01
A/D CAS x SSS	0.11	0.22	.609	−0.31, 0.54	0.71	0.62	.695	0.13, 3.99	0.33	0.22	.131	−0.10, 0.75
A/D CAS x hours x SSS	−0.01	0.01	.375	−0.03, 0.01	1.03	0.05	.590	0.93, 1.14	<b>−0.03</b>	<b>0.01</b>	<b>.025*</b>	−0.06, 0.00

\*Significance level is  $p < 0.05$ .

CAS = condomless anal sex, SSS = sexual sensation seeking, A/D = high-risk alcohol/drug-involved.

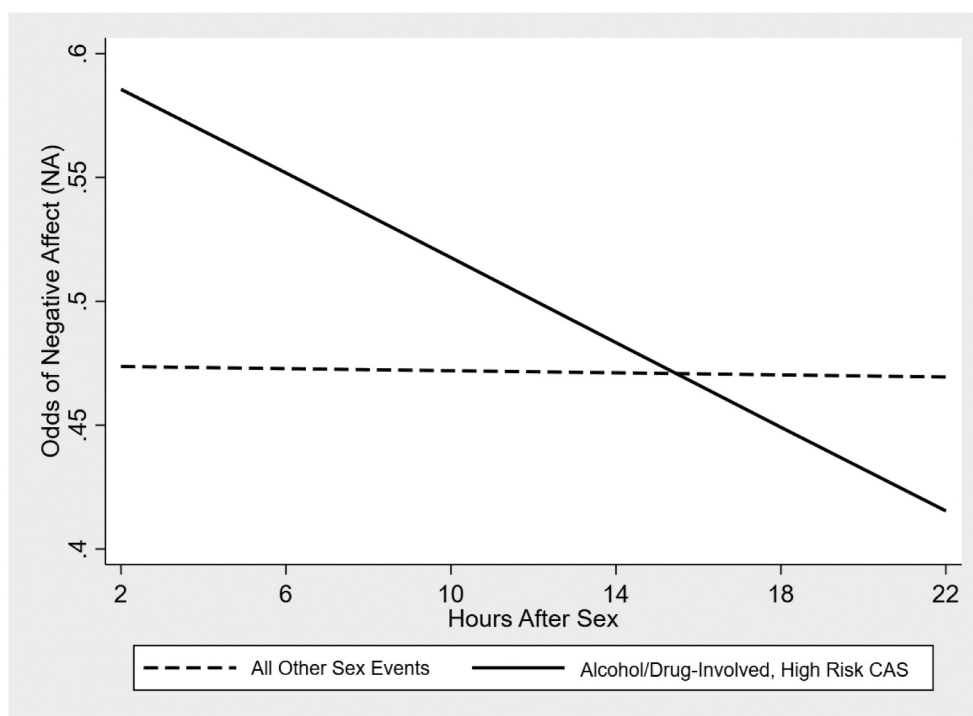
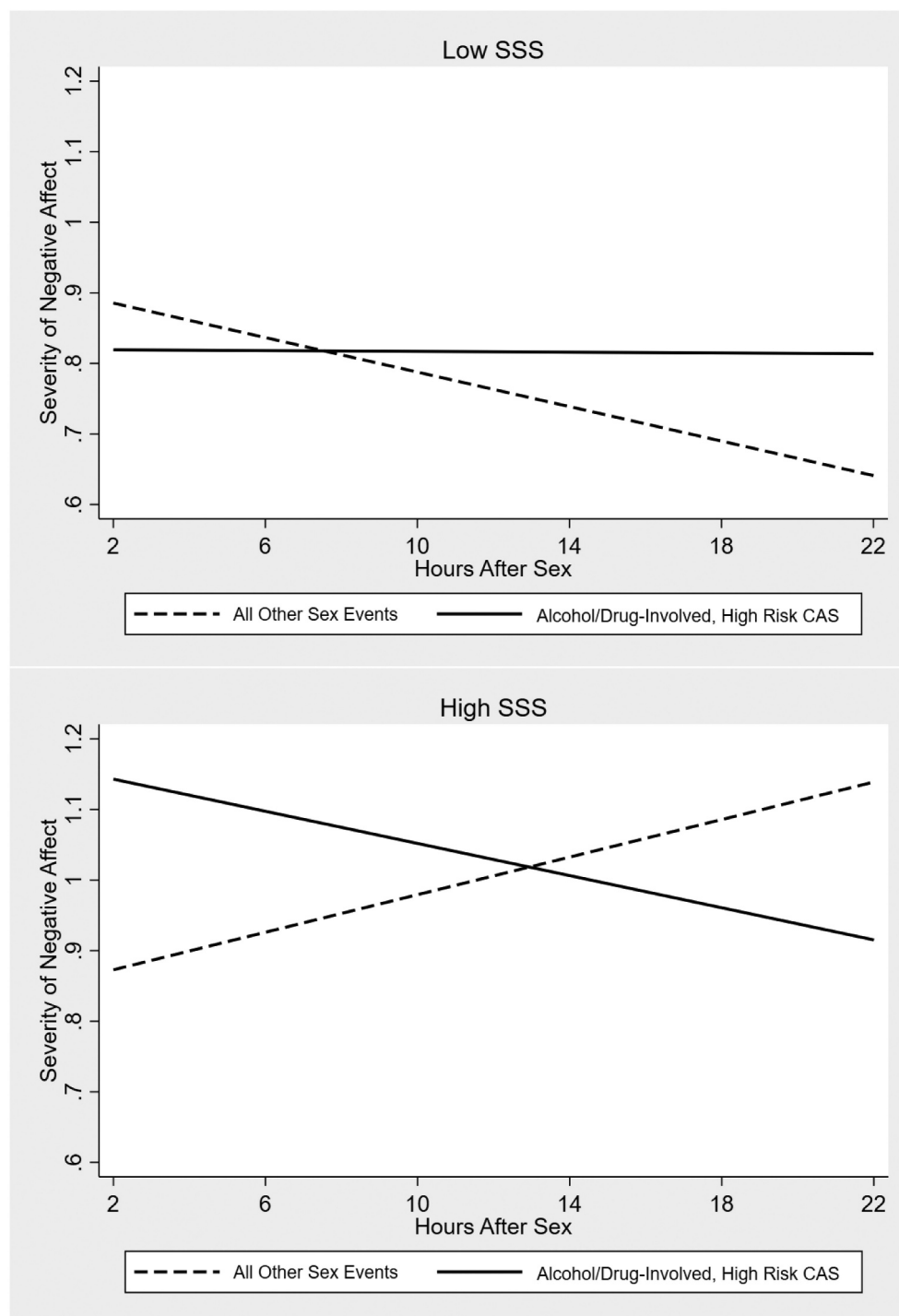


Figure 2. Odds of reporting negative affect in the hours after sex by whether sex involved alcohol/drug-affected, high-risk condomless anal sex (CAS), versus other types of sex.

after sex, and sexual sensation seeking was significant, but effects were not consistently in the hypothesized direction. Participants high in sexual sensation seeking (+1 *SD*) reported more severe negative affect in the hours immediately after a sex event when sex involved alcohol/drug-involved CAS compared to other types of sex events. Marginal effects also suggested that among those high in sexual sensation seeking, negative affect severity decreased in the hours after alcohol/drug-involved CAS ( $\beta = 0.01$ ,  $SE = 0.01$ ,  $p = .004$ ) and increased after all other sex events (Figure 3). In addition, among those low in

sexual sensation seeking (−1 *SD*), negative affect remained stable in the hours after alcohol/drug-involved CAS and decreased after all other sex events.

Table 3 reports results for models of other emotional states. In the model of shame after sex, the two-way interaction between alcohol/drug-involved CAS and hours after sex was significant. Marginal effects showed the odds of reporting any shame were significantly higher after alcohol/drug-involved CAS events relative to others ( $\beta = 0.14$ ,  $SE = 0.07$ ,  $p = .048$ ), starting at 18 hours or later on a given day. The odds of reporting shame were an average



**Figure 3.** Associations between severity of negative affect and hours after sex by whether sex involved alcohol/drug-involved, high-risk condomless anal sex (CAS) at high and low ( $\pm 1$  *SD*) levels of sexual sensation seeking (SSS).

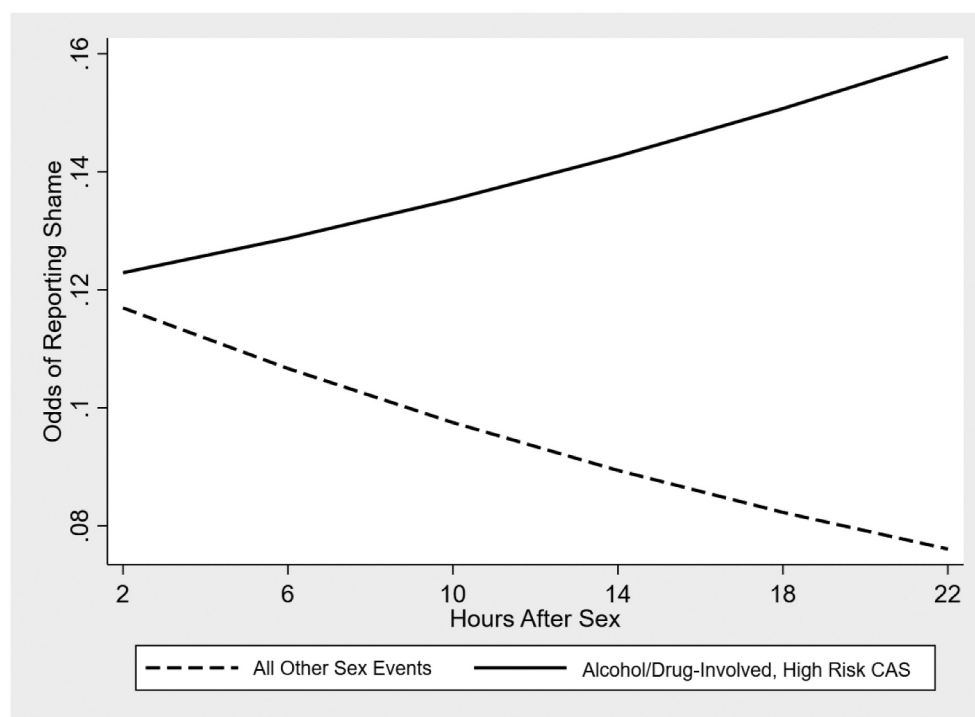


Figure 4. Odds of reporting shame in the hours after sex by whether sex involved alcohol/drug-affected, high-risk condomless anal sex (CAS), versus other types of sex.

Table 3. Individual mood outcomes.

	Shame – none v. any				Any stress				Stress – severity			
	OR	SE	p	95% CI	OR	SE	p	95% CI	Coeff.	SE	p	95% CI
Hours	0.97	0.02	.189	0.93, 1.01	1.00	0.01	.814	0.98, 1.03	0.01	0.00	.065	0.00, 0.02
High-risk CAS	2.22	1.49	.236	0.59, 8.29	0.31	0.20	.063	0.09, 1.06	0.06	0.18	.747	–0.29, 0.41
High-risk CAS x hours	0.94	0.05	.220	0.85, 1.04	1.03	0.04	.488	0.95, 1.10	–0.01	0.01	.329	–0.03, 0.01
SSS	0.80	0.59	.766	0.19, 3.39	0.43	0.30	.224	0.11, 1.68	0.00	0.17	.998	–0.34, 0.34
Hours x SSS	1.07	0.04	.106	0.99, 1.15	1.04	0.03	.210	0.98, 1.11	0.01	0.01	.519	–0.01, 0.02
High-risk CAS x SSS	1.13	1.29	.916	0.12, 10.67	3.11	3.42	.300	0.36, 26.7	<b>–0.75</b>	<b>0.30</b>	<b>.012*</b>	–1.34, –0.17
High-risk CAS x hours x SSS	0.97	0.08	.674	0.83, 1.13	0.97	0.06	.642	0.86, 1.10	0.02	0.02	.211	–0.01, 0.05
A/D CAS	0.50	0.45	.437	0.08, 2.91	4.15	3.80	.121	0.69, 25.02	0.18	0.23	.420	–0.26, 0.63
A/D CAS x Hours	<b>1.14</b>	<b>0.07</b>	<b>.035*</b>	1.01, 1.28	0.95	0.05	.333	0.85, 1.06	–0.01	0.01	.683	–0.03, 0.02
A/D CAS x SSS	1.36	2.08	.842	0.07, 27.32	0.15	0.25	.241	0.01, 3.50	<b>0.93</b>	<b>0.37</b>	<b>.013*</b>	0.19, 1.66
A/D CAS x hours x SSS	0.91	0.09	.362	0.75, 1.11	1.09	0.10	.347	0.91, 1.31	–0.04	0.02	.069	–0.08, 0.00

\*Significance level is  $p < 0.05$ .

CAS = condomless anal sex, SSS = sexual sensation seeking, A/D = high-risk alcohol/drug-involved.

of 12.7% higher following an alcohol/drug-involved CAS event than other sex events at 18 hours after sex, 14.5% at 22 hours, and 16.4% at 24 hours (see Figure 4). However, no main effects or interactions involving sexual sensation seeking were significant.

Finally, in the model of any stress, no main effects, two-, or three-way interactions were significant. However, in the model of stress severity, a two-way interaction between high-risk CAS and sexual sensation seeking was significant. Marginal effects showed that those very high in sexual sensation seeking (+ 1.5 SD) reported less severe stress after a high-risk CAS event across the 24 hours following sex ( $\beta = -0.49$ ,  $p = .036$ ) when compared to those very low (–1.5 SD;  $\beta = 0.34$ ,  $p = .137$ ) in sexual sensation seeking. A two-way interaction between alcohol/drug-involved, high-risk CAS and sexual sensation seeking was also significant, but marginal effects of alcohol/drug-involved CAS at values of sexual sensation seeking exceeding even the most extreme observed values ( $\pm 2.5$  SDs) were not significant ( $ps > .05$ ).

## Discussion

In this study, we found that SMM were more likely to report a variety of negative emotions in the hours following (CAS) events with high-risk partners that occurred while they were under the influence of alcohol or other drugs, relative to all other types of sex events. Our results also showed that the strength of this association often varied across the 24-hour period following sex. Finally, our findings also showed that severity of negative affect after alcohol/drug-involved CAS events also varied depending on participants' level of sexual sensation seeking. Together, these results generally support our hypotheses that SMM frequently experience specific negative emotional states following sex events that involve some risk, and that the odds of experiencing certain emotional states or their severity often vary over the course of the day after sex events occurred and depending on whether SMM are high or



low in sexual sensation seeking. These findings have several important implications for sexual risk in SMM and intervention design, particularly in terms of JITIs.

Likely the most notable finding of this study was that, at varying degrees/times, SMM reported significantly higher levels of general negative affect (including sadness, nervousness, and irritation), shame, and stress in the 24 hours following high-risk CAS events that occurred specifically while under the influence of alcohol or drugs versus all other sex events, but not after high-risk CAS generally. These findings suggest that negative affect may uniquely increase following sexual risk behavior that occurred under the influence of substances, as opposed to just high-risk CAS. As such, alcohol/drug use was likely a key factor that contributed to engaging in high-risk sex that SMM were ultimately nervous about or felt ashamed of. This pattern of findings is similar to past qualitative research in SMM, which has highlighted the important role alcohol and drug use plays in promoting sexual decisions that many later regret (Boulton et al., 1995; Parsons et al., 2004; Reback & Larkins, 2010; Strong et al., 2005). Coupled with robust evidence that alcohol and drug use contributes to HIV/STI risk broadly (Sander et al., 2013; Woolf & Maisto, 2009), these results could help inform the design of interventions focused on HIV/STI prevention, alcohol/drug use, or both, by emphasizing that drinking/drug use along with sex increases the likelihood of acquiring HIV and other STIs and also often leads SMM to make decisions they later feel uncomfortable about.

Our findings also suggest that SMM were significantly more likely to report feeling shame specifically after alcohol/drug-involved CAS, relative to other sex events. This finding is consistent with past qualitative research on emotional reactions to CAS in SMM (Strong et al., 2005; Boulton et al., 1995). Feeling shame in response to alcohol/drug-involved CAS may signal that SMM frequently reflect on their behavior after events like this, and therefore, could be more open to considering change in these moments. Delivering evidence-based interventions, including JITIs, at the specific times in which motivation to change is high could help convert that motivation into a concrete plan for change and elicit a clear commitment to it. Although the importance of similar “teachable moments” in behavior change has not yet been firmly established, studies across other health behaviors raise the possibility that some interventions may be more effective when delivered in these moments (McBride et al., 2008; Nayan et al., 2013; Williams et al., 2005). Qualitative research also adds support to this possibility, given that many people who successfully change their behavior report that their decision to change was often precipitated by a specific event (Heatherton & Nichols, 1994).

These findings also speak to the *timing* of emotional reactions to sexual risk events, such as alcohol/drug-involved CAS. Specifically, our results show that the odds of reporting negative affect after alcohol/drug-involved CAS were highest in the 6 hours or so immediately after sex. The odds of reporting shame also similarly varied over the 24 hours after sex, but increased primarily toward the end of the 24 hour period after sex. Together, these findings suggest that SMMs’ more immediate reactions to sex that posed high risk for HIV/STIs and occurred under the influence were initially characterized

by general negative emotions like nervousness and sadness, but that the odds of experiencing shame increased as the 24-hour period after sex progressed. This sequence of events would be consistent with conceptualizations of shame arising from an appraisal of an adverse situation (Lickel et al., 2014; Tangney et al., 1996), since the feeling of shame may only set in after SMM had some time to process the situation. These findings suggest that JITIs delivered soon after these events would be most relevant if they acknowledged recipients’ nervousness and could help reduce it by connecting them with HIV/STI testing and/or HIV post-exposure prophylaxis. JITIs delivered later that day might also help ease shame by helping recipients distinguish between their behavior and their character while encouraging them to consider options that could help reduce their risk in the future.

Finally, the severity of negative affect in the 24 hours after sex also varied based on whether sex involved alcohol/drug-involved CAS, time, and participants’ level of sexual sensation seeking. Contrary to our hypothesis, however, those high in sexual sensation seeking reported stronger negative affect, particularly in the hours immediately following alcohol/drug-involved CAS, relative to other sex events, when compared to those low in sexual sensation seeking. These findings are surprising, given that sexual sensation seeking characterizes individuals who seek exciting sexual experiences (Kalichman et al., 1994), so it seems plausible that they would experience less negative affect after potentially risky experiences. However, few studies have explored how those high in sexual sensation seeking respond after risk. It could be that while these individuals are attracted to exciting sexual experiences, they also realize the potential hazards involved after engaging in sexual risk while intoxicated and respond more strongly than those low in sexual sensation seeking. However, this possibility is speculative and future research should explore this association further.

Although this study had a number of strengths, several limitations are also important to note. First, the timing of sex events was assessed retrospectively in daily diary surveys completed each morning. Future studies and JITIs can more adequately assess this information through randomly administered experience sampling surveys that gather data closer to a sex event. Second, we coded CAS that occurred with sexually mutually exclusive HIV-positive partners as low-risk, because we did not believe these partners should be intrinsically characterized as “high-risk” simply because of their status. While this could raise concerns that some of participants’ primary, HIV-positive partners may have had detectable viral loads and thus conferred some risk for HIV, only one participant reported one CAS event with an HIV-positive partner, and that partner was not sexually exclusive. As such, this event would have been characterized as high-risk due to the lack of exclusivity. Finally, this study involved primarily White, non-Hispanic, relatively well-educated sample, and the findings reported here may not generalize to more diverse samples.

## Conclusions

In summary, SMM may experience several negative emotional states in the hours after engaging in sex that likely involved HIV/STI transmission risk, such as sadness, nervousness,

shame, and stress. Moreover, general negative affect and stress may arise more often in the hours immediately following these sex events, whereas shame may take longer to set in. These findings suggest that interventions delivered specifically in these moments could help SMM avoid similar consequences by intervening in these moments of opportunity to help them consider ways of reducing their risk in the future.

## Disclosure Statement

No potential conflict of interest was reported by the authors.

## Funding

This manuscript was supported by [P01AA019072] (to Peter Monti) and [L30AA023336] (to TW) from the National Institute on Alcohol Abuse and Alcoholism.

## References

- Barnett, N. P., Clerkin, E. M., Wood, M., Monti, P. M., O'Leary Tevyaw, T., Corriveau, D., Fingeret, A., & Kahler, C. W. (2014). Description and predictors of positive and negative alcohol-related consequences in the first year of college. *Journal of Studies on Alcohol & Drugs*, 75(1), 103–114. <https://doi.org/10.15288/jsad.2014.75.103>
- Barnett, N. P., Goldstein, A. L., Murphy, J. G., Colby, S. M., & Monti, P. M. (2006). "I'll never drink like that again": Characteristics of alcohol-related incidents and predictors of motivation to change in college students. *Journal of Studies on Alcohol & Drugs*, 67(5), 754–763. <https://doi.org/10.15288/jsa.2006.67.754>
- Barnett, N. P., Lebeau-Craven, R., O'Leary, T. A., Colby, S. M., Wollard, R., Rohsenow, D. J., Spirito, A., & Monti, P. M. (2002). Predictors of motivation to change after medical treatment for drinking-related events in adolescents. *Psychology of Addictive Behaviors*, 16(2), 106–112. <https://doi.org/10.1037/0893-164X.16.2.106>
- Baumeister, R. F., Vohs, K. D., DeWall, N., & Zhang, L. (2007). How emotion shapes behavior: Feedback, anticipation, and reflection, rather than direct causation. *Personality and Social Psychology Review*, 11(2), 167–203. <https://doi.org/10.1177/1088868307301033>
- Berg, K. C., Crosby, R. D., Cao, L., Crow, S. J., Engel, S. G., Wonderlich, S. A., & Peterson, C. B. (2015). Negative affect prior to and following overeating-only, loss of control eating-only, and binge eating episodes in obese adults. *International Journal of Eating Disorders*, 48(6), 641–653. <https://doi.org/10.1002/eat.22401>
- Boulton, M., McLean, J., Fitzpatrick, R., & Hart, G. (1995). Gay men's accounts of unsafe sex. *AIDS Care*, 7(5), 619–630. <https://doi.org/10.1080/09540129550126263>
- Centers for Disease Control and Prevention. (2017). *CDC fact sheet: HIV among gay and bisexual men*. U.S. Department of Health and Human Services. Retrieved March 1, 2022, from <https://www.cdc.gov/hiv/pdf/group/msm/cdc-hiv-msm.pdf>
- Centers for Disease Control and Prevention. (2019). *Sexually transmitted disease surveillance, 2018*. Retrieved March 1, 2022, from <https://www.cdc.gov/std/stats18/STDSSurveillance2018-full-report.pdf>
- Centers for Disease Control and Prevention. (2020). *HIV surveillance report, 2018 (Updated)*. Retrieved March 1, 2022, from <http://www.cdc.gov/hiv/library/reports/hiv-surveillance.html>
- Grov, C., Golub, S. A., Mustanski, B., & Parsons, J. T. (2010). Sexual compulsivity, state affect, and sexual risk behavior in a daily diary study of gay and bisexual men. *Psychology of Addictive Behaviors*, 24(3), 487–497. <https://doi.org/10.1037/a0020527>
- Heatherington, T. F., & Nichols, P. A. (1994). Personal accounts of successful versus failed attempts at life change. *Personality and Social Psychology Bulletin*, 20(6), 664–675. <https://doi.org/10.1177/0146167294206005>
- Henderson, J. T., Senger, C. A., Henninger, M., Bean, S. I., Redmond, N., & O'Connor, E. A. (2020). Behavioral counseling interventions to prevent sexually transmitted infections: Updated evidence report and systematic review for the US preventive services task force. *JAMA*, 324(7), 682–699. <https://doi.org/10.1001/jama.2020.10371>
- Huebner, D. M., & Perry, N. S. (2015). Do behavioral scientists really understand HIV-related sexual risk behavior? A systematic review of longitudinal and experimental studies predicting sexual behavior. *Archives of Sexual Behavior*, 44(7), 1915–1936. <https://doi.org/10.1007/s10508-015-0482-8>
- Jeffries, W. L., Dailey, A. F., Jin, C., Carter, J. W., Jr., & Scales, L. (2020). Trends in diagnosis of HIV infection, linkage to medical care, and viral suppression among men who have sex with men, by race/ethnicity and age—33 jurisdictions, United States, 2014–2018. *Morbidity and Mortality Weekly Report*, 69(38), 1337–1342. <https://doi.org/10.15585/mmwr.mm6938a1>
- Jin, X., Wang, H., Li, H., Chu, Z., Zhang, J., Hu, Q., Lv, W., Huang, X., Chen, Y., Wang, H., He, X., Zhang, L., Hu, Z., Bao, R., Li, S., Ding, H., Geng, W., Jiang, Y., Shang, H., & Xu, J. (2020). Real-time monitoring and just-in-time intervention for adherence to pre-exposure prophylaxis among men who have sex with men in China: A multicentre RCT study protocol. *BMC Public Health*, 20(1), 1160. <https://doi.org/10.1186/s12889-020-08709-2>
- Kalichman, S. C., Johnson, J. R., Adair, V., Rompa, D., Multhauf, K., & Kelly, J. A. (1994). Sexual sensation seeking: Scale development and predicting AIDS-risk behavior among homosexually active men. *Journal of Personality Assessment*, 62(3), 385–397. [https://doi.org/10.1207/s15327752jpa6203\\_1](https://doi.org/10.1207/s15327752jpa6203_1)
- Lawson, P. J., & Flocke, S. A. (2009). Teachable moments for health behavior change: A concept analysis. *Patient Education and Counseling*, 76(1), 25–30. <https://doi.org/10.1016/j.pec.2008.11.002>
- Leach, C. W., & Cidam, A. (2015). When is shame linked to constructive approach orientation? A meta-analysis. *Journal of Personality and Social Psychology*, 109(6), 983–1002. <http://dx.doi.org/10.1037/pspa0000037>
- Lickel, B., Kushlev, K., Savalei, V., Matta, S., & Schmader, T. (2014). Shame and the motivation to change the self. *Emotion*, 14(6), 1049–1061. <https://doi.org/10.1037/a0038235>
- McBride, C. M., Emmons, K. M., & Lipkus, I. M. (2003). Understanding the potential of teachable moments: The case of smoking cessation. *Health Education Research*, 18(2), 156–170. <https://doi.org/10.1093/her/18.2.156>
- McBride, C. M., Puleo, E., Pollak, K. I., Clipp, E. C., Woolford, S., & Emmons, K. M. (2008). Understanding the role of cancer worry in creating a "teachable moment" for multiple risk factor reduction. *Social Science & Medicine*, 66(3), 790–800. <https://doi.org/10.1016/j.socscimed.2007.10.014>
- Meunier, É., Siegel, K., Sundelson, A. E., & Schrimshaw, E. W. (2020). Stages of adoption of "treatment as prevention" among HIV-negative men who have sex with men who engage in exchange sex. *AIDS Patient Care and STDs*, 34(9), 380–391. <https://doi.org/10.1089/apc.2020.0062>
- Mitchell, J. W., Gamarel, K. E., Kam, K. K., & Pennington, J. T. (2021). Perceived facilitators of decision-making and usage of biomedical HIV prevention strategies: Findings from an online, qualitative study with same-gender male couples in the United States. *AIDS Care*, 33(9), 1209–1217. <https://doi.org/10.1080/09540121.2020.1808158>
- Mustanski, B. (2007). The influence of state and trait affect on HIV risk behaviors: A daily diary study of MSM. *Health Psychology*, 26(5), 618–626. <https://doi.org/10.1037/0278-6133.26.5.618>
- Nahum-Shani, I., Smith, S. N., Spring, B. J., Collins, L. M., Witkiewitz, K., Tewari, A., & Murphy, S. A. (2018). Just-in-time adaptive interventions (JITIs) in mobile health: Key components and design principles for ongoing health behavior support. *Annals of Behavioral Medicine*, 52(6), 446–462. <https://doi.org/10.1007/s12160-016-9830-8>
- Nayan, S., Gupta, M. K., Strychowsky, J. E., & Sommer, D. D. (2013). Smoking cessation interventions and cessation rates in the oncology population: An updated systematic review and meta-analysis. *Otolaryngology-Head and Neck Surgery*, 149(2), 200–211. <https://doi.org/10.1177/014599813490886>
- Parsons, J. T., Viciouso, K., Kutnick, A., Punzalan, J. C., Halkitis, P. N., & Velasquez, M. M. (2004). Alcohol use and stigmatized sexual practices of HIV seropositive gay and bisexual men. *Addictive Behaviors*, 29(5), 1045–1051. <https://doi.org/10.1016/j.addbeh.2004.03.001>

- Paz-Bailey, G., Mendoza, M. C., Finlayson, T., Wejnert, C., Le, B., Rose, C., Raymond, H. F., & Prejean, J. (2016). Trends in condom use among MSM in the United States: The role of antiretroviral therapy and seroadaptive strategies. *AIDS (London, England)*, 30(12), 1985–1990. <https://doi.org/10.1097/qad.0000000000001139>
- Platteau, T., Herrijgers, C., & de Wit, J. (2020). Digital chemsex support and care: The potential of just-in-time adaptive interventions. *International Journal of Drug Policy*, 85, 102927. <https://doi.org/10.1016/j.drugpo.2020.102927>
- Rawat, S., Wilkerson, J. M., Lawler, S. M., Patankar, P., Rosser, B. R. S., Shukla, K., Butame, S., & Ekstrand, M. L. (2018). Recommendations for the development of a mobile HIV prevention intervention for men who have sex with men and hijras in Mumbai: Qualitative study. *JMIR Public Health Surveillance*, 4(2), e46. <https://doi.org/10.2196/publichealth.9088>
- Reback, C. J., & Larkins, S. (2010). Maintaining a heterosexual identity: Sexual meanings among a sample of heterosexually identified men who have sex with men. *Archives of Sexual Behavior*, 39(3), 766–773. <https://doi.org/10.1007/s10508-008-9437-7>
- Sander, P. M., Cole, S. R., Stall, R. D., Jacobson, L. P., Eron, J. J., Napravnik, S., Gaynes, B. N., Johnson-Hill, L. M., Bolan, R. K., & Ostrow, D. G. (2013). Joint effects of alcohol consumption and high-risk sexual behavior on HIV seroconversion among men who have sex with men. *AIDS (London, England)*, 27(5), 815–823. <https://doi.org/10.1097/QAD.0b013e32835c4b>
- Steptoe, A., Gibson, E. L., Hamer, M., & Wardle, J. (2007). Neuroendocrine and cardiovascular correlates of positive affect measured by ecological momentary assessment and by questionnaire. *Psychoneuroendocrinology*, 32(1), 56–64. <https://doi.org/10.1016/j.psyneuen.2006.10.001>
- Strong, D. A., Bancroft, J., Carnes, L. A., Davis, L. A., & Kennedy, J. (2005). The impact of sexual arousal on sexual risk-taking: A qualitative study. *Journal of Sex Research*, 42(3), 185–191. <https://doi.org/10.1080/00224490509552273>
- Tangney, J. P., Miller, R. S., Flicker, L., & Barlow, D. H. (1996). Are shame, guilt, and embarrassment distinct emotions? *Journal of Personality and Social Psychology*, 70(6), 1256–1269. <https://doi.org/10.1037/0022-3514.70.6.1256>
- Wang, L., & Miller, L. C. (2020). Just-in-the-moment adaptive interventions (JITAI): A meta-analytical review. *Health Communication*, 35(12), 1531–1544. <https://doi.org/10.1080/10410236.2019.1652388>
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063–1070. <https://doi.org/10.1037/0022-3514.54.6.1063>
- Williams, S., Brown, A., Patton, R., Crawford, M. J., & Touquet, R. (2005). The half-life of the ‘teachable moment’ for alcohol misusing patients in the emergency department. *Drug and Alcohol Dependence*, 77(2), 205–208. <https://doi.org/10.1016/j.drugalcdep.2004.07.011>
- Wohlfeiler, D., & Ellen, J. M. (2007). The limits of behavioral interventions for HIV prevention. In L. Cohen, V. Chavez, & S. Chehimi (Eds.), *Prevention is primary: Strategies for community well being* (2nd ed., pp. 329–347). Jossey-Bass.
- Woolf, S. E., & Maisto, S. A. (2009). Alcohol use and risk of HIV infection among men who have sex with men. *AIDS & Behavior*, 13(4), 757–782. <https://doi.org/10.1007/s10461-007-9354-0>
- Wray, T., Luo, X., Ke, J., Pérez, A., Carr, D., & Monti, P. (2019). Using smartphone survey data and machine learning to identify situational and contextual risk factors for HIV risk behavior among men who have sex with men who are not on PrEP. *Prevention Science*, 20(6), 904–913. <https://doi.org/10.1007/s11121-019-01019-z>
- Wray, T., & Monti, P. (2020). Characteristics of sex events, partners, and motivations and their associations with HIV-risk behavior in a daily diary study of high-risk men who have sex with men (MSM). *AIDS & Behavior*, 24(6), 1851–1864. <https://doi.org/10.1007/s10461-019-02760-w>
- Wray, T., Monti, P., Kahler, C., & Guigayoma, J. (2020). Using ecological momentary assessment (EMA) to explore mechanisms of alcohol-involved HIV risk behavior among men who have sex with men (MSM). *Addiction*, 115(12), 2293–2302. <https://doi.org/10.1111/add.15053>
- Wray, T., Pérez, A., Celio, M., Carr, D., Adia, A., & Monti, P. (2019). Exploring the use of smartphone geofencing to study characteristics of alcohol drinking locations in high-risk gay and bisexual men. *Alcoholism: Clinical & Experimental Research*, 43(5), 900–906. <https://doi.org/10.1111/acer.13991>