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Sex-related marijuana expectancies as predictors of sexual risk behavior following smoked marijuana challenge

Linda M. Skalski, PhD^{2,1}, Rachel L. Gunn, BA¹, Amy Caswell, PhD³, Stephen Maisto, PhD⁴, and Jane Metrik, PhD^{2,5,1}

¹Department of Psychiatry and Human Behavior, Alpert Medical School of Brown University, Providence, RI, 02912

²Providence VA Medical Center, Providence, RI, 02908

³Department of Psychology, University of Bath, UK BA2 7AY

⁴Department of Psychology, Syracuse University, Syracuse, NY 13244

⁵Center for Alcohol and Addiction Studies, Brown University School of Public Health, Providence, RI, 02903

Abstract

Marijuana use has been associated with sexual risk behavior, but the mechanisms that underlie this relationship are not well-understood. The present study examined whether marijuana acutely increased sexual risk on a behavioral decision-making task and whether sex-related marijuana outcome expectancies influenced sexual risk decisions after marijuana administration. Participants were heterosexual marijuana users ($n=126$) who were randomly assigned to one of four study conditions using a two \times two factorial design crossing drug administration (Received 2.8% delta-9-tetrahydrocannabinol (THC) or 0% THC) with instructional set (Told THC or Told Placebo). Participants completed a self-report measure of sex-related marijuana outcome expectancies at baseline and estimated likelihood of using condoms with a new and a steady partner in an interactive sexual role-play task (SRT) post smoking. In gender-specific analyses, there was a significant interaction of drug administration by sex-related outcome expectancies, such that for men in the Received Placebo conditions, more salient sex-related marijuana outcome expectancies were associated with increased likelihood for sex without a condom with a new partner. Among women, there was no interaction or main effect of drug administration but more salient sex-related marijuana outcome expectancies were associated with increased likelihood of sex without a condom with a steady but not new partner. Findings suggest marijuana does not acutely increase risk for engaging in sexual risk behaviors. By contrast, sex-related marijuana

Correspondence regarding this article should be directed to Jane Metrik, PhD, Center for Alcohol and Addiction Studies, Brown University, Box G-S121-4, Providence, RI 02912. Jane_Metrik@brown.edu.

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outcome expectancies may play a more significant role in sexual decision-making process among marijuana users.

Keywords

THC; marijuana; sexual risk; expectancies; balanced placebo design

Introduction

Marijuana use has been linked with impulsive decision-making and risk-taking, such as sexual behavior that incurs increased risk for sexually transmitted infections and HIV (Brodbeck, Matter, & Moggi, 2006; Valera, Epperson, Daniels, Ramaswamy, & Freudenberg, 2009; Zhang & Wu, 2017). Despite some evidence of the association between marijuana use and sexual risk behaviors in some studies, there are also a number of contradictory null findings (Hensel, Stupiansky, Orr, & Fortenberry, 2011; Leigh, Ames, & Stacy, 2008; Metrik, Caswell, Magill, Monti, & Kahler, 2016; Vosburgh, Mansergh, Sullivan, & Purcell, 2012; Walsh, Fielder, Carey, & Carey, 2014). Furthermore, controlled research on marijuana's effects on decision-making processes that underlies sexual risk-taking propensity has been limited, and the mechanisms for these associations are not well-understood. The purpose of the present study was two-fold: 1) to examine, using a methodologically rigorous balanced-placebo design, whether marijuana acutely increases sexual risk on a behavioral decision-making task; and 2) whether sex-related marijuana outcome expectancies independently or in combination with marijuana's acute drug effect increase sexual risk behavior.

Correlational research has demonstrated an association between marijuana use and sexual risk behavior, including decreased likelihood of condom use (Anderson & Stein, 2011; Drumright et al., 2006; Guo et al., 2002; Kingree & Thompson, 2007; Shrier, 1996) and increased likelihood of having multiple sex partners (Bell, 1997; Brodbeck et al., 2006; Guo et al., 2002; Poulin & Graham, 2001; Valera et al., 2009; Zhang & Wu, 2017). However, a number of other correlational studies found no significant relationship between marijuana use and condom nonuse on a particular occasion (Hensel et al., 2011; Leigh et al., 2008; Metrik et al., 2016; Vosburgh et al., 2012; Walsh et al., 2014). To our knowledge, only one experimental study has examined marijuana's acute effects on sexual risk (Metrik et al., 2012). In this study, 2.8% THC decreased self-reported likelihood of expected positive consequences of unsafe sexual behavior with a non-exclusive dating partner among men and women. Additionally, among women expectancy of receiving THC increased awareness of risks of coercive sex. The observed increases in caution in relation to perception of sexual risk are consistent with a general tendency to compensate for the expected impairment from marijuana (Bates, 1999) and alcohol (Testa et al., 2006). However, marijuana research so far has used only self-report questionnaires assessing general risk behaviors, which are methodologically limited due to recall biases (Bradburn, Rips, & Shevell, 1987; Shiffman, Stone, & Hufford, 2008). Experimental research that includes behavioral tasks minimizes recall biases by assessing behaviors in the moment and may yield more conclusive evidence about sexual behavior when under the influence of marijuana. While not previously used

with marijuana, an interactive sexual role-play task (SRT) has been empirically validated in alcohol administration studies (Maisto, Carey, Carey, & Gordon, 2002; Maisto, Carey, Carey, Gordon, & Schum, 2004; Maisto, Carey, Carey, Gordon, Schum, et al., 2004) using similar procedures in validating a set of video-delivered role-play scenarios that were used in an experimental study of alcohol effects and sexual risk behaviors in gay and bisexual men (Woolf-King, Maisto, Carey, & Venable, 2010). The SRT involves computer-based video role-plays that measure participants' intention to have sex without a condom. Among both men and women, the SRT was sensitive to the acute effects of alcohol and to alcohol manipulations (Maisto et al., 2002; Maisto, Carey, Carey, Gordon, & Schum, 2004; Maisto, Carey, Carey, Gordon, Schum, et al., 2004). For instance, willingness to engage in risky sex during the SRT was positively associated with alcohol intoxication (Maisto, Carey, Carey, Gordon, & Schum, 2004; Maisto, Carey, Carey, Gordon, Schum, et al., 2004) and stronger alcohol expectancies (Maisto, Carey, Carey, Gordon, & Schum, 2004).

The mechanisms that might explain an association between marijuana use and sexual risk have received little empirical attention. A drug-taking situation involves several drug expectancies including expectations about the administration of a drug (i.e., stimulus expectancy) and expectancies about the effect or consequence associated with the drug (i.e., outcome expectancies) (Metrik & Rohsenow, 2013). These expectancies are activated sequentially to influence the behavioral response to a drug or to a placebo (Kirsch, 1999; Vogel-Sprott, 1999). For example, believing that marijuana was smoked can provide a socially acceptable justification for some behaviors and a strong disinhibiting effect for desired but socially prohibited acts (e.g., having unprotected sex with an acquaintance at a college party). Expectancies about marijuana use (e.g., "After I smoke marijuana, I am less likely to ask a partner to use a condom") can also modulate sex risk behavior. Few studies have examined sex-related marijuana outcome expectancies explicitly. Two studies conducted in juvenile offender populations used an adapted measure of sex-related alcohol outcome expectancies to provide initial evidence that marijuana outcome expectancies are associated with risky sexual behaviors (Hendershot, Magnan, & Bryan, 2010; Kingree & Thompson, 2007). Specifically, use of marijuana during most recent incident of sexual intercourse was positively associated with expectancies that marijuana increases sexual enhancement, but not related to expectancies that marijuana use increases sexual risk (Kingree & Thompson, 2007). Additionally, marijuana use was associated with lower likelihood of condom use for those who reported high sexual disinhibition expectancies and for those reporting high sexual risk expectancies (Hendershot et al., 2010).

No studies thus far have examined the role of sex-related marijuana outcome expectancies in conjunction with marijuana's acute effects on sexual risk-taking behavior. Studies using balanced placebo design (BPD) (Marlatt, 1980) make it possible to disentangle pharmacological effects from the cognitive expectations of receiving the drug and its effects (Metrik & Rohsenow, 2013). Recent BPD studies demonstrated differential effects of marijuana due to pharmacology or stimulus expectancy on subjective effects (Metrik et al., 2009), affect (Metrik, Kahler, McGeary, Monti, & Rohsenow, 2011) and impulsivity (Metrik et al., 2012). The present study extends prior research by using the BPD to examine marijuana's pharmacologic and stimulus expectancy effects on likelihood of condom use. Given our prior findings on marijuana's pharmacologic and stimulus expectancy effects on

increased caution in evaluation of sexual risk behaviors (Metrik et al., 2012), we hypothesized that marijuana will similarly increase inhibition in terms of sexual decision-making during an interactive role-play that approximates a realistic sexual encounter. Furthermore, the influence of marijuana's sex-related outcome expectancies was examined as a moderator of drug and stimulus expectancy responses on the task. Because individuals with more salient sex expectancies show greater sexual disinhibition while under the influence of a substance (Corbin & Fromme, 2002; Leigh, 1990), we expected that marijuana's acute effects would be conditional upon such outcome expectancies. Specifically, we expected individuals with more salient sex-related marijuana outcome expectancies to report lower likelihood of condom use on the SRT.

Methods

Sample Description and Procedures

Data were obtained from participants who completed a larger BPD experimental study investigating marijuana's acute effects on impulsivity (Metrik et al., 2012). Participants reporting exclusive homosexual status on the Kinsey scale described below ($n = 10$) were excluded given the SRT was designed for use with heterosexual individuals. Analyses were completed on the remaining participants ($n = 126$). As previously described (for details, see Metrik et al., 2012), the inclusion criteria for this institutional review board-approved study were: native English speakers, 18–30 years old, marijuana use at least once a week in the past month and at least 10 times in the past 6 months, and self-reported ability to abstain from marijuana for 24 hours without withdrawal. Exclusion criteria were: history of substance use treatment; intent to quit or receive treatment for cannabis misuse; other illicit drug use; pregnancy; nursing; past month affective disorder or history of panic attacks, psychotic, or suicidal state assessed by psychiatric interview; alcohol dependence; contraindicated medical issues; smoking 20 or more tobacco cigarettes a day; and prior knowledge about the study procedures or contact with participants.

Participants (mean age (SD) = 21.4 (3.0), 34.1% female, 67.5% White Non-Hispanic) used marijuana on an average of 41.8% of all days ($SD = 24.0$) in the past 60 days. Participants were randomly assigned to one of four study conditions using a two \times two factorial design crossing drug administration (2.8 % THC or 0 % THC) with instructional set (Told THC or Told Placebo). The participants were informed that the study evaluated the effects of marijuana on mood and behavior, and that they would be randomly assigned to smoke one marijuana cigarette that contained THC or one marijuana placebo cigarette with THC removed. They were informed that marijuana cigarettes came from the National Institute of Drug Abuse and marijuana was grown by the government for research purposes. For the two study days (baseline non-smoking and experimental smoking session), participants were instructed to abstain from marijuana and tobacco smoking for 12 hours, alcohol for 24 hours, and caffeine for 1 hour before the session. An alveolar carbon monoxide (CO) of 6 ppm was used to confirm no recent smoking (Cooper & Haney, 2009; Metrik et al., 2012) with a Bedfont Scientific Smokelyzer®. Tobacco smokers were given an opportunity to smoke a tobacco cigarette following the CO test in the session. Zero breath alcohol

concentration was verified with an Alco-Sensor IV (Intoximeters, Inc., St Louis, MO., USA).

At baseline, participants completed descriptive measures and measures of sex-related marijuana outcome expectancies and behavioral intentions to engage in risky sex. At the second session, participants were instructed about whether they will be receiving a marijuana cigarette containing THC or a placebo cigarette not containing THC. In the Told THC conditions, they were told that we needed to test how smoking marijuana would affect their mood, responses and behavior. In the Told Placebo conditions, they were told that smoking a placebo cigarette would have no effect on their mood and behavior (see Metrik et al., 2012 for additional details of the instructional set manipulation procedures). Cannabis cigarettes (placebo or 2.8% THC) were provided by the National Institute on Drug Abuse, rolled at both ends, humidified, and smoked according to the standardized paced puffing procedure (Foltin, Fischman, Pedrosa, & Pearlson, 1987). In the parent study (Metrik et al., 2012), as well as prior studies this dose of THC has been shown to produce significant effects on subjective and behavioral measures (McDonald, 2003; Wachtel, 2002). After smoking, participants completed the SRT along with behavioral impulsivity tasks (previously described in Metrik et al., 2012) in a counterbalanced order. Participants in Told THC or Received THC conditions remained in the laboratory for 4 hours after smoking, passed a field sobriety test, received payment, and were transported home in a taxi.

Baseline descriptive and individual difference measures

Descriptive items from the *Cognitive Appraisal of Risky Events Questionnaire-Revised, Past Frequency scale* (Fromme, Katz, & Rivet, 1997; Katz, 2000) assessed the number of sexual partners, the number of new sexual partners, and the number of weeks dating an exclusive partner in the past 6 months. *Kinsey's Heterosexual-Homosexual Rating Scale* (Kinsey, Pomeroy, Martin, & Sloan, 1948) was used to assess sexual orientation. The scale ranges from 0 (for those who identify themselves as exclusively heterosexual) to 6 (for those who identify themselves as exclusively homosexual), and 1–5 for those who identify with varying levels of sexual activity with either sex. The *Sex-related Marijuana Expectancy* questionnaire (adapted from Sex-related Alcohol Expectancy questionnaire by (Dermen & Cooper, 1994) assessed participants' outcome expectations about the effects of marijuana on sexual feelings and behaviors. The 13-items were preceded by the stem "after I smoke marijuana" and followed by a statement such as, "I feel closer to a sexual partner." Responses ranged from 1 (strongly disagree) to 5 (strongly agree). A total sex-related marijuana expectancy score was created by averaging all 13 items and was internally consistent in our sample ($\alpha = .85$). In alcohol studies, this method is commonly used as a measure of global sex-related alcohol expectancies (Gilmore et al., 2014; Stephens & George, 2004). The *Behavioral Intentions measure* (Carey, 1997) assessed intentions to engage in sexual risk-reduction behavior (condom use, discuss safer sex, avoid alcohol and drugs prior to sex) and indicated motivation to perform risk reduction behavior. Behavioral intentions to use a condom during sexual activity have been shown to predict subsequent behavior (Sheeran, 1999). Participants read a description of a scenario of risky sex behaviors and responded to 7 items on 6-point scale ranging from 1 (definitely will not do) to 6 (definitely will do). Responses were recoded to increase interpretability with 1 indicating

lowest and 6 highest intention to engage in sexual risk behaviors. This measure was used to validate the SRT, which has not previously been used in a sample of marijuana users. Internal consistency in this sample was good ($\alpha = .88$).

Dependent Measures

The SRT (Maisto et al., 2002) was used to assess participants' likelihood of having sex without a condom post-smoking. This task consists of two gender-specific interactive video vignettes about a "steady partner" and a "new partner" enacted by professional actors and tailored to heterosexual individuals. These scenarios were specifically developed to (a) be familiar to participants, (b) pose moderate difficulty to communicate feelings about condom use, and (c) elicit moderate sexual interest while negotiating their sexual experience. The steady partner scenario depicted two individuals who are in a committed relationship. The new partner scenario for women depicted two individuals who are close friends and for men depicted two acquaintances who met at a party. In all scenarios, the couple must decide whether to use condoms. Scenario order was counter-balanced between participants. Participants responded verbally to built-in video prompts that called for behavioral skills required to negotiate condom use (e.g., a woman urges to have condomless sexual intercourse saying there is no risk for pregnancy because she is "on the pill"). Participants' responses to each of the prompts (for men three prompts in a steady partner scenario, two prompts in a new partner scenario; for women three prompts in both scenarios) were audio-recorded and subsequently rated for intention of safer sexual behavior or refusal of unsafe sexual behavior (0 or 1) based on coding guidelines (Forsyth, Carey, & Fuqua, 1997; Gordon, Carey, & Carey, 1997; Maisto et al., 2002). Data representing binary verbal responses on the task were used descriptively. Following the presentation of each of the role-play scenarios, participants completed self-report post-video ratings on a Likert-type scale of various dimensions (e.g., realism of the situation; attractiveness of the actor) ranging from 0 (not at all) to 6 (extremely). The primary dependent variable used in the analyses was participants' self-reported likelihood of having sex without a condom in each of the two scenarios (two for men and two for women) ranging from 0 (would not) to 6 (absolutely 100% certain). Other video ratings were used descriptively.

Inter-rater reliability—Four research assistants were first trained to criterion on the coding system for the verbal responses on the SRT. Each participant response was independently coded by two raters. The coding manual was used to resolve coding differences. Responses with inconsistent classifications were systematically reviewed by the last author (JM). Responses that could not be scored due to unclear meaning were omitted ($n = 22$ in steady partner scenario; $n = 24$ in new partner scenario). The intraclass correlations reflect strong interrater reliability for each of the two scenarios. For the statement of intention to have safer sex, the intraclass correlation for the average rater was 0.93 in the steady relationship scenario and 0.89 in the new partner scenario.

Data analysis plan

First, bivariate correlations were used to examine the associations between baseline measures of behavioral intentions to engage in safe sex, sex-related marijuana outcome expectancies, and post-smoking likelihood of engaging in sex without a condom with a new

partner and with a steady partner. Multiple regression was used to investigate the pharmacologic and stimulus expectancy effects of marijuana as well as sex-related marijuana outcome expectancies on likelihood of sex without a condom on the SRT. Separate multiple regression analyses were tested for men and women, as well as for new partner and steady partner scenarios. In all four models, task order, marital status, and race (White non-Hispanic vs. all other racial or ethnic groups) were entered in the first step as covariates, two main effects of stimulus expectancy and drug manipulations entered in the second step, sex-related marijuana outcome expectancies on the third step, and two interactions of sex-related marijuana outcome expectancies with stimulus expectancy and drug manipulation entered in the fourth step. Because of the successful manipulation of drug and stimulus expectancy effects (Metrik et al., 2012), analyses were conducted on all participants; analyses excluding participants for whom the deception failed produced the same findings on all dependent measures. Likelihood of having sex without a condom with a new partner was square root transformed for women to correct for positive kurtosis. All tests of statistical significance were conducted with an alpha level of .05.

Results

Descriptive Statistics

Demographic and marijuana use variables are presented separately by sex in Table 1. The majority of participants did not indicate agreement to sex without a condom with either partner during the SRT (see Table 2). Chi-square analysis revealed men were significantly more likely than women to agree to sex on the third prompt in the new partner scenario ($\chi^2 = 5.91, p = .01$) and on both prompts in the steady partner scenario ($\chi^2 = 4.73, 4.19, p < .05$). Post-SRT ratings assigned to dimensions of realism of the video, attractiveness of the actor, interest in having any sex with the actor (use of condom not specified), and difficulty of responding to prompts are presented in Table 3. On average, men and women rated video scenarios as at least “somewhat” realistic.

Bivariate correlations are presented in Table 4. For both men and women, baseline behavioral intentions were significantly positively correlated with the post-smoking ratings of likelihood of having sex without a condom across partner types ($r = .30 - .57, ps < .05$). Sex-related marijuana outcome expectancies were significantly positively correlated with SRT’s likelihood of sex without a condom with a new partner for men ($r = .28, p < .01$) and with a steady partner for women ($r = .33, p < .05$). SRT ratings for steady and new partner were significantly positively associated with each other among men ($r = .37, p < .01$) but not women.

Predicting likelihood of having sex without a condom (SRT)

Men—Among men, a significant interaction between sex-related marijuana outcome expectancies and drug manipulation was observed on the SRT with a new partner ($B = -1.49, SE = .61, sr^2 = .06, p = .02$). In the Received THC conditions, there was no significant effect of sex expectancies on the SRT’s likelihood of sex without a condom. However, in the Received Placebo conditions, higher sex expectancies were associated with increased likelihood of condomless sex with a new partner ($B = 1.30, SE = .34, sr^2 = .25, p = .001$). There

were no experimental main or interaction effects of stimulus expectancy on the SRT. There were no main or interaction effects of drug or stimulus expectancy manipulations or of sex expectancies on the SRT's likelihood of sex with a steady partner. Relative to other participants, White non-Hispanic men indicated increased likelihood of condomless sex on the SRT with a steady partner ($B = 1.01$, $SE=.51$, $sr^2 = .04$, $p=.048$).

Women—Among women, there were no significant effects in models carrying the interaction terms (sex-related marijuana outcome expectancies by stimulus expectancy and by drug manipulation). Re-analysis with interaction terms removed revealed the main effect of sex-related marijuana outcome expectancies was significant in one of the two models, such that more salient sex outcome expectancies were associated with increased likelihood of sex without a condom with a steady partner ($B = .99$, $SE=.45$, $sr^2=.11$, $p=.033$), but not a new partner. There were no significant main effects of stimulus expectancy or drug manipulation in either model.

DISCUSSION

To our knowledge, this is the first study to utilize BPD experimental methodology to examine whether marijuana acutely increased sexual risk on a behavioral decision-making task and whether sex-related marijuana outcome expectancies moderated marijuana's acute effect on risky sexual behavior. Contrary to our expectations, the pharmacologic effects of THC and expectancy of having smoked THC did not influence sexual decision making on the SRT. However, sex-related marijuana outcome expectancies did affect risk behavior. Specifically, men who received placebo marijuana and held stronger beliefs that marijuana impacts their sexual feelings and behaviors were more likely to consider having condomless sex with a new partner. Women who had these stronger sex-related marijuana expectancies were more likely to consider having condomless sex with a steady partner independent of drug condition.

The nonsignificant relationship between acute marijuana intoxication and risky sex is consistent with our prior findings that marijuana does not increase risk of engaging in sexual risk behaviors (Metrik et al., 2016). In fact, it appears to acutely increase caution in perception of sexual risk (Metrik et al., 2012). This is also consistent with correlational research that does not support a link between marijuana use and sexual risk (Hensel et al., 2011; Leigh et al., 2008; Vosburgh et al., 2012; Walsh et al., 2014). Our findings revealed that individual differences in sex-related marijuana outcome expectancies was a more powerful predictor of sexual decision making than the actual drug effect.

Surprisingly, the positive relationship between men's sex-related marijuana outcome expectancies and risky sex with a new partner was only observed in the absence of THC, in a drug-free state of placebo. This finding may be explained by the impairing effects of acute THC on memory functioning (Ranganathan & D'Souza, 2006). Memory retrieval is an essential component of expectancy theory, which posits that outcome expectancies are associative memory links that are stored in long-term memory and activated by relevant cues (Goldman, 1999; Metrik & Rohsenow, 2013). Under the acute influence of marijuana, retrieval and activation of outcome expectancies may be disrupted. Prior experimental

studies demonstrate that smoking marijuana impairs associative memory processes (Block, 2002). For instance, individuals under the influence of THC produced significantly more uncommon associations compared to controls during both cued and free recall verbal association tasks (Block, 2002). Similarly, individuals in our study who received THC may not have had the cognitive resources available to efficiently retrieve relevant associations from marijuana cues, thus reducing the influence of outcome expectancies in this group. An effect of expectancies on condomless sex with a steady partner was not observed, which may be due to participants rating less interest in general in having sex with the actor in the steady partner scenario.

Failure to find a significant effect of sex-related marijuana expectancies among women having sex with a new partner may be explained by a limited sample size of women ($n = 43$) and lack of variability in this subgroup. The majority of women (81%) reported they would not have sex without a condom in the new partner scenario with only two women indicating there was more than a 50/50 chance. This limited the power to detect significant effect of possibly lower magnitude and may explain the lack of relationship between sex-related marijuana expectancies and sexual risk taking in women. However, our findings suggest that more salient sex-related marijuana expectancies were related to increased likelihood of sex without a condom with a steady partner. Women are more likely to use a condom during sex with a new and casual partner, compared to a steady partner (Macaluso, Demand, Artz, & Hook III, 2000), which may have increased response variability during the steady partner scenario. Future research with larger sample sizes are warranted to understand how marijuana use may influence this high-risk sex behavior among women.

Findings suggest a subset of individuals with stronger sex-related marijuana expectancies are more likely to consider sex without a condom. Even in the context of a steady relationship, unprotected sex is associated with risk of sexually-transmitted infections and HIV (O'Leary, 2000), highlighting the importance of addressing outcome expectancies in risk-reduction interventions. Individuals with stronger beliefs that marijuana use enhances sex or increases disinhibition may be using marijuana intentionally to facilitate or enhance a sexual encounter (Leigh, 1990). To date, the modifiability of marijuana outcome expectancies has not been examined. However, interventions designed specifically to challenge beliefs about alcohol have been shown to successfully lower sex-related alcohol outcome expectancies (Scott-Sheldon, Terry, Carey, Garey, & Carey, 2012).

Future research is needed to determine whether modifications in outcome expectancies leads to reductions in sexual risk behaviors. Future research is also needed to consider other individual differences that may affect the sexual decision making process. For instance, sex-related alcohol expectancies are related to the personality trait of sensation seeking, and in turn both are related to sexual risk outcomes (Kalichman, Weinhardt, DiFonzo, Austin, & Luke, 2002). It is possible that the relationship between sex-related marijuana expectancies and sexual risk behaviors is explained by personality characteristics or another individual difference variable not measured in our study. In addition to individual difference in personality, it is possible that gender differences in attitudes towards relationships and non-monogamous intercourse may explain sex difference found in our study. Compared to women, men report more casual sex and more permissive attitudes towards casual sex

(Petersen & Hyde, 2010). Neurobiological differences may also play a role given emerging evidence that the neurocognitive and subjective effects of cannabis use vary by sex due to differences in regional CB1 densities and hormones (Cooper & Haney, 2014; Crane, Schuster, Fusar-Poli, & Gonzalez, 2013).

Limitations

Although this study has a number of important strengths, including assessment of sexual decision making in real time while under the influence of marijuana in a sample of regular marijuana users of both genders, it is not without limitations. First, scenarios in the SRT may not be representative of all diverse sexual encounters experienced in the real world. However, by adapting an interactive role-play task previously validated in alcohol studies (Maisto et al., 2002; Maisto, Carey, Carey, Gordon, & Schum, 2004; Maisto, Carey, Carey, Gordon, Schum, et al., 2004), it is likely our task has strong ecological validity. Future research can take advantage of technology to further substantiate the ecological validity of experimental stimuli such as the SRT. For example, EMA methods can be used to investigate the association between participants' responses to an analogue sexual risk situation such as the SRT in the laboratory when under the acute effects of alcohol or sober with their actual sexual risk behaviors under intoxicated and sober conditions in the natural environment.

Second, we did not experimentally manipulate or measure sexual arousal. Sexual arousal influences decision-making (Ariely & Loewenstein, 2006; Loewenstein, Weber, Hsee, & Welch, 2001), and is a mechanism whereby alcohol acutely influences sexual behavior (Maisto & Simons, 2016). It is possible that participants in our study experienced varied levels of arousal in response to the SRT that affected their willingness to engage in risk behaviors. Our data show that women reported very low interest in having sex with the actor in both scenarios. Prior studies utilizing the SRT also revealed relatively low interest in having sex with the actor among women (Maisto et al., 2002; Maisto, Carey, Carey, Gordon, & Schum, 2004), suggesting the SRT may incite less sexual interest among women than men. Despite less interest in sex, increased alcohol intoxication or stronger sex-related alcohol expectancies were associated with risky sexual behaviors among women, which supports the validity of the SRT (Maisto et al., 2002; Maisto, Carey, Carey, Gordon, & Schum, 2004). This highlights the importance of considering gender differences in sexual risk behaviors, especially when utilizing experimental tasks. In our sample women rated the attractiveness of the actor as low, and men rated the attractiveness as low to moderate. Future research would benefit from examining whether outcome expectancies have a differential effect on risk behaviors as a function of attractiveness and gender.

Third, we administered a low concentration of THC, larger THC doses may have produced greater effects on sexual decision-making. Fourth, as discussed above, few women endorsed having sex without a condom with a new partner, which limited our ability to understand motivations to engage in this high-risk sexual behavior in a small sample of women. Fifth, this sample was not recruited based on reports of sexual risk behaviors and thus was a relatively low sex-risk sample. This may have limited generalizability to populations endorsing greater sex risk behaviors. Future studies should examine the effect of THC on

sexual risk behaviors among more at-risk populations, such as men who have sex with men (Eaton, West, Kenny, & Kalichman, 2009; Landovitz et al., 2013).

Conclusion

Research on marijuana use and sexual risk behaviors has been primarily correlational and yielded mixed findings. Our study was the first to adapt a novel empirically-tested interactive role-play task previously established in alcohol administration studies (Maisto et al., 2002; Maisto, Carey, Carey, Gordon, & Schum, 2004; Maisto, Carey, Carey, Gordon, Schum, et al., 2004) for marijuana users. Strong associations between likelihood of engaging in sex without a condom following the SRT and baseline behavioral intentions supports the validity of the video role-play with marijuana users. The present study adds important information on sex-related decision-making to prior controlled studies of acute marijuana intoxication, demonstrating minimal deficits in impulsive decision-making after smoking marijuana (Hart, van Gorp, Haney, Foltin, & Fischman, 2001; Metrik et al., 2012). We find that individual differences in cognitive factors such as sex-related marijuana outcome expectancies play a more important role in the complex relationship between marijuana use and risky sex. Future research should evaluate the impact of other individual difference factors such as other sex-related cognitions, trait characteristics related to impulsivity and risk behaviors, as well as contextual factors on sexual risk behaviors. These findings have the potential to identify individuals who are at higher risk for marijuana-related risk behaviors and to inform behavioral interventions. The SRT allowed for immediate assessment of sexual risk behavior rather than relying on retrospective self-report. There is evidence that retrospective self-reports are inconsistently correlated with real-time assessments of behavior, and future research would benefit from increased use of ecological momentary assessment techniques to examine actual drug use and sexual behaviors in real-time (Shiffman et al., 2008). Future research is also warranted to understand whether cognitive interventions reduce marijuana use and sexual risk behaviors. It also will be important to examine these questions in samples that endorse higher rates of sexual risk behaviors, and in conjunction with alcohol's acute effects. Marijuana use combined with alcohol exacerbates cognitive impairment relative to use of each drug independently (Volkow, Baler, Compton, & Weiss, 2014) and may increase likelihood of having sex without a condom (Metrik et al., 2016). Future laboratory studies will benefit from examining the acute effects of concurrent marijuana and alcohol use on sexual decision-making process.

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Public Significance Statement

This study indicates marijuana does not acutely increase risk for engaging in sexual risk behaviors. By contrast, beliefs about how marijuana impacts sexual feelings and behaviors play a more important role in sexual decision-making process among men and women. Findings contribute to the broader knowledge base on the role of marijuana-related cognitions in sexual risk behaviors.

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Table 1

Demographics, relationship and substance use characteristics by sex

	Total (N=126)	Men (N=83)	Women (N=43)
Variable	Mean (SD)	Mean (SD)	Mean (SD)
Age	21.4 (3.0)	21.5 (3.2)	21.3 (2.7)
% marijuana use days	41.8 (24.0)	43.6 (24.6)	38.1 (22.7)
Times used marijuana on an average day	1.8 (1.0)	1.9 (1.0)	1.7 (1.0)
# of weeks dated an exclusive partner, past 6 months	7.5 (6.0)	7.2 (6.0)	7.8 (5.9)
Total sexual partners, past 6 months	1.7 (1.6)	1.7 (1.8)	1.6 (1.3)
New sexual partners, past 6 months	1.0 (1.5)	1.1 (1.6)	.8 (1.3)
	<i>n (%)</i>	<i>n (%)</i>	<i>n (%)</i>
White non-Hispanic race/ethnicity	85 (68)	60 (72)	25 (58)
Married or living together	14 (11)	10 (12)	4 (9)
In college	81 (64)	49 (59)	32 (74)
DSM-IV cannabis dependence ^b	8 (6)	3 (4)	5 (12)

^bRefers to 3 dependence symptoms in the past 12 months

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Table 2

Frequencies of agreement to condomless sex on the sexual role-play task

Video prompt	n	%	n	%
Men (n = 69)				
<u>New partner</u>				
1. "What do you want to do about this?"	2	3	Women (n = 33)	
2. "I'm already on the pill, so do we have to use a condom?"	7	10	1	3
3. "C'mon, let's just have sex."	15	22	1	3
<u>Steady partner</u>				
1. "I'm really glad I started taking the pill, so you can put that condom away."	30	42	Women (n = 33)	
2. "Listen, you trust me and I trust you. Condoms don't feel right. I know we really don't want to use them. C'mon, make love to me."	29	41	7	21
			6	18
			3. "I thought that we had a serious relationship. Don't you trust me?"	

Table 3

Means, standard deviations, and medians of sexual role-play task

Dimension	Steady partner						New partner									
	Men (n= 83)			Women (n= 43)			Men (n= 82)			Women (n= 43)						
	M (SD)	Mdn	M (SD)	Mdn	M (SD)	Mdn	M (SD)	Mdn	M (SD)	Mdn	M (SD)	Mdn				
Realistic situation	2.71 (1.62)	3.00	3.53 (1.70)	4.00	2.96 (1.47)	3.00	3.51 (1.12)	4.00	2.42 (1.41)	3.00	1.21 (1.39)	1.00	3.60 (1.29)	4.00	1.47 (1.50)	1.00
Attractiveness of the actor	2.11 (1.68)	2.00	1.00 (1.63)	0.00	3.28 (1.72)	3.00	1.02 (1.46)	0.00	2.08 (1.68)	2.00	2.40 (1.59)	2.00	2.00 (1.59)	2.00	1.86 (1.66)	2.00
Difficulty of the role play																

Note: Ratings of dimensions were made on a 0 (not at all) to 6 (extremely) Likert-type scale.

Table 4

Variable correlations

Variable	Mean (SD)	Range	1.	2.	3.	4.
Men						
1. Baseline behavioral intentions	20.00 (7.31)	7–42	1			
2. Sex-related marijuana outcome expectancies	2.47 (0.61)	1–5	.15	1		
3. SRT likelihood of condomless sex, steady partner	1.94 (2.04)	0–6	.30**	.18	1	
4. SRT likelihood of condomless sex, new partner	1.73 (1.70)	0–6	.33**	.28**	.37***	1
Women						
1. Baseline behavioral intentions	30.26 (4.70)	7–42	1			
2. Sex-related marijuana outcome expectancies	2.19 (0.69)	1–5	.47**	1		
3. SRT likelihood of condomless sex, steady partner	1.79 (1.93)	0–6	.33*	.33*	1	
4. SRT likelihood of condomless sex, new partner	0.67 (1.70)	0–6	.57**	.21	.25	1

Note: SRT = Sexual role-play task.

* $p < .05$;

** $p < .01$;

*** $p < .001$.