



Evaluating Personalized Feedback Intervention Framing with a Randomized Controlled Trial to Reduce Young Adult Alcohol-Related Sexual Risk Taking

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Abstract

The purpose of this study was to evaluate personalized feedback intervention (PFI) framing with two web-delivered PFIs aimed to reduce young adult alcohol-related risky sexual behavior (RSB). Combined PFIs typically use an additive approach whereby independent components on drinking and components on RSB are presented without the discussion of the influence of alcohol on RSB. In contrast, an integrated PFI highlights the RSB-alcohol connection by presenting integrated alcohol and RSB components that focus on the role of intoxication as a barrier to risk reduction in sexual situations. In a randomized controlled trial, 402 (53.98% female) sexually active young adults aged 18–25 were randomly assigned to a combined PFI, an integrated PFI, or attention control. All assessment and intervention procedures were web-based. At the 1-month follow-up, those randomly assigned to the integrated condition had a lower likelihood of having any casual sex partners compared to those in the control group. At the 6-month follow-up, the combined condition had a lower likelihood of having any casual sex partners compared to those in the control group. When examining alcohol-related RSB, at the 1-month follow-up, both interventions showed a lower likelihood of any drinking prior to sex compared to the control group. When examining alcohol-related sexual consequences, results showed a reduction in the non-zero count of consequences in the integrated condition compared to the control at the 1-month follow-up. For typical drinks per week, those in the combined condition showed a greater reduction in the non-zero count of drinks than those in the control condition at the 1-month follow-up. While there were no significant differences between the two interventions, the current findings highlight the utility of two efficacious web-based alcohol and RSB interventions among a national sample of at-risk young adults.

Keywords Personalized feedback intervention · Young adults · Alcohol · Sexual risk taking · Negative consequences

Heavy episodic drinking (HED), defined as 4+/5+ drinks over a 2-h period for women/men, and its relation to risky sexual behavior (RSB) during young adulthood are an important public health concern, as young adults are at risk for experiencing consequences associated with alcohol use (Hingson and White 2014; White et al. 2013) and also RSB (Satterwhite et al. 2013). HED is associated with RSB, which is often defined as multiple or casual partners and unprotected sexual activity. HED may contribute to RSB through its effects on cognitive impairment. According to

alcohol myopia theory (Steele and Josephs 1990), acute alcohol intoxication creates cognitive impairment that results in an inability to attend fully to situational cues. For RSB, acutely intoxicated individuals may be less likely to attend to less salient and more distal cues (i.e., STI risk) and more likely to attend to more salient and proximal cues (i.e., sexual arousal in the moment) resulting in a greater likelihood of RSB (Davis et al. 2007; Rehm et al. 2012). Both survey and experimental studies have demonstrated a connection between drinking alcohol and RSB (e.g., Kiene et al. 2009; Rehm et al. 2012). Because young adults continue to be at risk from HED and associated RSB, it is important to develop and evaluate efficacious interventions to reduce risk.

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Personalized Feedback Interventions

While there are personalized feedback interventions (PFIs) targeting college students, there is little research on PFIs targeting

young adults outside of a college setting; since 30% of young adults do not attend college and these individuals engage in risk behaviors at higher rates, there is a need to develop an effective intervention targeting young adults not necessarily attending college. Brief interventions have been developed to address heavy drinking and alcohol-related RSB among college students, with the most successful involving the use of personalized feedback (e.g., Carey et al. 2007; Cronce and Larimer 2011; Lewis et al. 2014a; Patrick et al. 2014). Personalized feedback often includes summaries of self-reported drinking and/or sexual behavior and consequences, normative comparisons, protective behavioral strategies, expectancies, and other didactic information. Herein these interventions are collectively referred to as PFIs. Research has demonstrated evidence for the efficacy of web-based PFIs in reducing drinking (e.g., Bewick et al. 2008; Doumas et al. 2009) and alcohol-related RSB (Lewis et al. 2014a, b) among college students. Web-based methods provide a promising avenue for intervention, as they are inexpensive to implement and are accessible to large numbers of at-risk individuals.

Approximately 30% of individuals do not attend college following high school, and these individuals are at risk for heavy alcohol use and sexual risk taking (Chandra et al. 2011).

Notably, the intervention literature is relatively bereft of studies evaluating brief alcohol and RSB interventions in high-risk populations that include both college and non-college attending young adults. One potential reason for the lack of intervention studies with non-college young adults is the challenge to identify a setting within which to implement the selected prevention strategies. Given the rates at which this population utilizes technology (Madden and Zickuhr 2011), an efficacious web-based PFI could improve options for delivering preventive interventions to the young adult population. Studies that examined the efficacy of web-based PFIs among young adults have targeted specific at-risk populations, such as young adult veterans (e.g., Martens et al. 2015), men who have sex with men (Kuerbis et al. 2014), African American women (Billings et al. 2015), and emergency department patients (Monti et al. 2016). The current study will fill this gap by evaluating PFIs among a young adult sample without restrictions on education status, biological sex, or sexual orientation.

Framing the Role of Alcohol in Personalized Feedback Interventions

Most web-based PFIs that focus on reducing RSB include minimal alcohol content. Of the PFIs that have included alcohol content, most were in-person rather than web-based and/or only focused on college students (e.g., Dermen and Thomas 2011; Lewis et al. 2014a, b). Dermen and Thomas (2011) evaluated an in-person PFI to reduce college student RSB. PFI conditions included an alcohol PFI, a RSB PFI, and a combined alcohol and RSB PFI. Findings indicated that the

alcohol PFI reduced drinking but not RSB. Those who received the RSB PFI reduced their RSB. The combined PFI did not reduce drinking or RSB. In contrast, Lewis et al. (2014a, b) evaluated three single component web-based PFIs (normative comparisons) that focused on alcohol only, RSB only, and combined alcohol and RSB to reduce college student alcohol-related RSB. There were significant reductions in drinking for the alcohol only and the combined alcohol and RSB PFIs. Furthermore, there were significant reductions in alcohol-related RSB for the RSB only and the combined alcohol and RSB PFIs. The combined PFI was the only intervention successful at reducing both drinking and alcohol-related RSB outcomes. Although these studies evaluated a combined PFI, the combined PFI was primarily the drinking PFI plus the RSB PFI with little integration of alcohol and RSB content; none of these studies evaluated a PFI that solely focused on addressing the role of alcohol use in sexual risk taking with fully integrated alcohol-related RSB components.

Combined PFIs for related health outcomes have typically used an additive, rather than integrated approach, whereby independent components on drinking and components on RSB are presented without the discussion of the influence of alcohol on RSB and without any integration of the two behaviors (e.g., norms for number of drinks prior to sex). Thus, combined PFI requires participants to understand and recall information regarding two risk behaviors (i.e., drinking and RSB). Furthermore, the link between alcohol and RSB could be lost in combined PFIs as these PFIs assume young adults will make the connection between the two behaviors as well as make generalizations from the personalized feedback about how alcohol influences sexual decision-making. It is uncertain if one set of information may overshadow the other or if both sets of information may exhibit issues with recall. In contrast, an integrated PFI highlights the RSB-alcohol connection for young adults by presenting integrated alcohol and RSB components that focus on the role of intoxication as a barrier to risk reduction in sexual situations. With an integrated PFI, only one set of integrated information needs to be understood and recalled. As such, integrated PFI may be more efficacious in helping individuals avoid sexual risk situations when intoxicated. Because it can be difficult to resist impelling cues when intoxicated (Steele and Josephs 1990), it may be ideal to target both risk behaviors with an integrated PFI to emphasize the importance of alcohol in sexual risk decision-making prior to getting into these sexual situations and thus increase the likelihood of avoiding these situations when engaging in HED. This is the first study using an innovative PFI content that explicitly tests the efficacy of an integrated PFI against a combined PFI to reduce alcohol-related RSB. If the integrated PFI is more efficacious than the combined PFI, then the integrated PFI approach can then be expanded to other risk behaviors that co-occur with alcohol use, leading to new directions in preventive interventions.

The Present Study

The purpose of the present study was to evaluate the efficacy of two web-delivered PFIs on sexual risk taking (i.e., number of casual sexual partners, number of times using a condom), alcohol-related RSB (i.e., number of times consuming alcohol prior to sex), alcohol-related sexual consequences, and typical drinks per week among sexually active young adult drinkers aged 18–25. We hypothesized that receipt of integrated PFI and combined PFI will be associated with reductions in sexual risk taking and alcohol-related RSB compared to the attention control group. Furthermore, we expected that the integrated PFI will be associated with greater reductions in these outcomes compared to the combined PFI.

Method

Participants and Procedures

Participant flow throughout this study is presented in Fig. 1. Participants for this study were recruited nationally through various methods and asked to complete a brief, 5-min web-based screening survey to determine if they met inclusion criteria for the longitudinal study. Recruitment methods included online recruiting (e.g., Facebook, Craigslist, Amazon Mechanical Turk), in-print advertisements, flyers, participant referrals, and in-person recruiting. The most commonly endorsed recruitment sources were Craigslist (75.12%) and participant referrals (11.44%), while each of the other sources of recruitment (e.g., [Researchmatch.org](https://www.researchmatch.org), [Facebook.com](https://www.facebook.com)) was endorsed by less than 5% of the sample. Upon logging into the screening survey, participants were presented with a brief information statement, and those who consented were routed to the screening survey. Of the 10,242 individuals who completed the web-based screening survey, 860 (8.4%) met study eligibility criteria: reside in the USA; age 18–25; provide a birthdate that is consistent with their age; provide phone number, first and last names, birth sex, and sexual desire; have a valid email address; correctly answer check questions (i.e., select 4 for what is 2 + 2, select the color green); not be in a monogamous relationship (i.e., single, not dating; dating, not serious); not used a condom during vaginal or anal sex after drinking in the past month; have had an alcoholic drink at least once a week on average over the past 3 months; and have had one episode of HED (4+/5+ drinks for women/men in one sitting) in the past month.

Once participants screened into the study via the survey, each participant had to complete a telephone screening to verify the information they provided before being invited to complete the baseline survey. At the telephone screen, 216 individuals were excluded from the study prior to being invited to

the baseline survey. Reasons individuals were not invited to participate included not meeting current recruitment goals pertaining to stratification; duplicate participation; staff were unable to obtain consistent participant information across the telephone screening and the screening survey; or individuals declined further participation. Of the 860 who met screening criteria, 457 (53.1%) were invited to the baseline survey. For study inclusion, to ensure a diverse sample, we enrolled participants by biological sex, education level, and race/ethnicity.

If individuals were eligible after the phone call and wished to participate, they were invited to complete a 30–45-min baseline survey, for which they received a \$20 gift certificate and were entered in a drawing to win an Apple iPad or \$100 gift card. Upon receiving the invitation to the baseline survey, participants were presented with a full information statement and those who agreed to participate were routed to the baseline survey. Participants were informed that, immediately following the survey, they would be randomly assigned to receive information regarding their drinking and/or sexual behavior in comparison to the behavior of other women/men their age or to receive information regarding nutrition and diet. In addition, participants were asked to complete two follow-up surveys at 1 and 6 months, for which they were compensated \$25 and \$30, respectively.

Out of the 457 participants invited to the baseline survey, 402 (88%) enrolled in the study and completed the baseline survey, thus constituting the final sample. Of the 402, 354 (88%) and 333 (83%) completed the 1-month and 6-month follow-up assessments, respectively. The mean age of participants in the final sample was 22.44 years old ($SD = 1.89$) at baseline. Biological sex, ethnic, and racial representation of the sample was 54% female, 14% Hispanic/Latino, 68% White, 12% Other/Mixed, 11% African American, 7% Asian, 1% American Indian/Alaska Native, and 1% Native Hawaiian/Pacific Islander. Participants reported having an average of 1.89 ($SD = 2.43$) sexual partners (vaginal or anal sex) in the last month with 45% reporting one sexual partner in the last month.

A Federal Certificate of Confidentiality was obtained to help ensure privacy of research participants. All study procedures were approved by the University's institutional review board, and no adverse events were reported. All measures and interventions were completed entirely via the Internet. Recent research has shown no significant reactivity effects from online assessments combined with alcohol interventions (Fazzino et al. 2016). Participants were carefully monitored at each assessment for consumption of potentially lethal amounts of alcohol (blood alcohol concentration of .35% or greater). Those reporting consumption at this potentially lethal level (baseline $n = 67$, 1-month $n = 34$, 6-month $n = 23$) were sent information regarding the risks of drinking at their reported level, regardless of study condition.

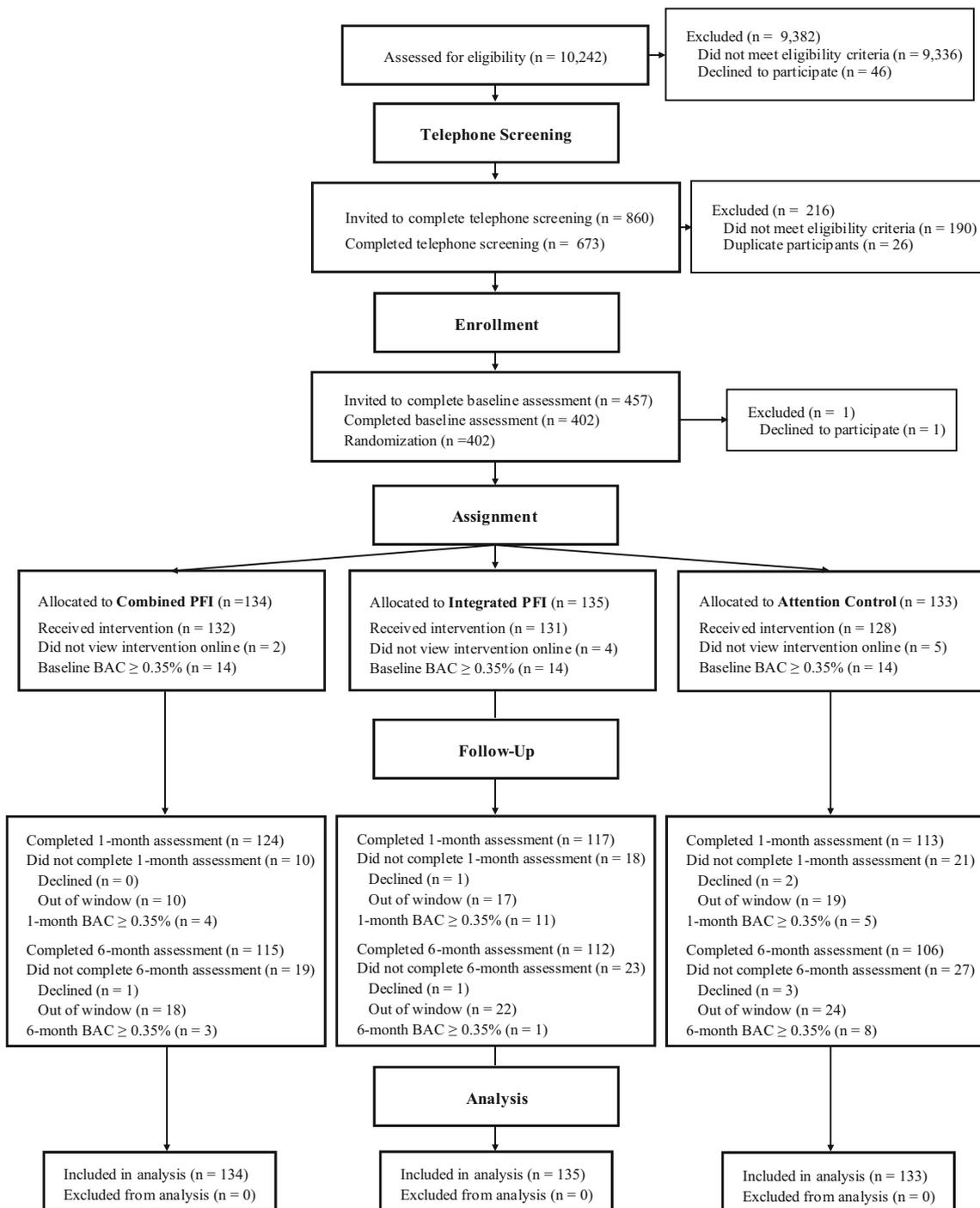


Fig. 1 Participant flow through the study process

Randomization

A longitudinal randomized experimental design was used in the present study. Following baseline completion, participants were randomized into conditions using stratified random assignment based on biological sex. The study conditions were (1) combined PFI, (2) integrated PFI, and (3) attention control. Random assignment was administered automatically using a computer algorithm and occurred in blocks of three to keep cell sizes equal.

Intervention

Following the baseline survey, participants were presented a link that routed them to view their feedback. Participants were also sent an email inviting them to view their feedback at any time. Those who did not view their feedback directly following the baseline survey received up to five email reminders to do so. The majority of participants (97.26%) viewed their feedback at least once with 59.45% viewing it one time,

27.36% viewing it two times, and 10.45% viewing it three or more times. The three conditions did not differ in the proportion of participants who viewed the feedback one time versus multiple times, $\chi^2(2, N = 391) = 2.34, p = .31$. Overall, 4.98% of participants printed their feedback. The total amount of time all participants spent viewing the feedback was, on average, 5.19 min ($SD = 6.67$), with the maximum time capped at 30 min. The average amount of time spent viewing the feedback was 6.81 min ($SD = 7.75$) for the combined condition, 5.48 min ($SD = 6.10$) for the integrated condition, and 3.27 min ($SD = 5.51$) for the attention control group, which reflects differences in the length of the feedback across the three conditions. The PFI interventions were modeled after PFIs that have been shown to be efficacious for reducing college student high-risk drinking and related sexual risk taking (Lewis et al. 2014a, b) and after the Brief Alcohol Screening and Intervention for College Students (BASICS) intervention (Dimeff et al. 1999).

Integrated PFI The integrated PFI synthesized alcohol use components specific to sexual behavior (e.g., normative comparisons for the number of drinks consumed prior to sex) and RSB components related to alcohol (e.g., condom-related protective behavioral strategies when drinking), which were drawn from previously efficacious web-based interventions, by presenting feedback highlighting how these behaviors relate. Descriptive normative comparison components consisted of alcohol-related RSB normative comparisons and highlighted discrepancies between the participant's own alcohol-related RSB and alcohol-related RSB normative perceptions as compared to the normative referent's (i.e., typical person your age and biological sex) actual alcohol-related sexual behavior. Feedback was presented about positive alcohol outcome expectancies (i.e., effects attributed to drinking that the participant sees as positive and likely to happen after consumption of alcohol) specific to sexual behavior to highlight discrepancies between participants' expectations regarding alcohol-related RSB and the actual outcomes associated with alcohol use and sexual behavior. Feedback included corrective information about commonly held positive expectancies related to alcohol and its role in sexual behavior (e.g., alcohol's role in sexual functioning and pleasure) and in particular addressed the positive expectancies that the participant endorsed. Feedback included information on alcohol myopia by addressing alcohol use in sexual contexts that emphasized the important role of intoxication as a barrier to risk reduction in sexual situations. Feedback highlighted how the use of protective behavioral strategies may increase the ability to avoid self-defined "bad" things that may result from drinking or engaging in alcohol-related RSB in a high-risk scenario and in general. Participants were asked to read a scenario involving the potential for them to use alcohol and to engage in risky sex. Participants received a summary of their self-reported

likelihood to engage in risk behaviors as well as skill training tips in order to avoid these risk behaviors in response to the risk-conducive situation in the alcohol and risky sex scenario.

Combined PFI The combined PFI consisted of the same feedback components (i.e., norms, expectancies, alcohol myopia, protective behavioral strategies), but information on alcohol was not integrated into the feedback on sexual behavior and vice versa. Components were presented without the discussion of the influence of alcohol on RSB.

Attention Control Feedback Attention control information was comparable with a focus on health-related behaviors (e.g., nutrition, exercise).

Measures

Sexual Behavior Three sexual behaviors and one alcohol-related sexual behavior were assessed using items adapted from Lewis et al. (2007) and Lewis et al. (2014a, b). The three sexual behaviors assessed were the number of times had sex, the number of casual sexual partners, and the number of times used a condom during sex with all partners. The alcohol-related sexual behavior assessed was the number of times the participant had consumed alcohol before or during a sexual encounter. All of the items referred to sexual behavior that included oral, vaginal, or anal sex during the past month. An open-ended response format was used with "999" as the maximum allowable response. Casual partner was defined as "a sexual partner that you do not have a monogamous relationship with (i.e., sex only with each other) or someone you have known for less than 24 hours" (Lewis et al. 2014b).

Alcohol-Related Sexual Consequences A range of alcohol-related sexual consequences from less severe to more severe were assessed using the 41-item Alcohol-related Sexual Consequences Scale (Fairlie et al. 2017 [in preparation]). Sexual behavior included digital, oral, vaginal, and anal sex. Participants indicated which of the problems they had experienced as a result of drinking alcohol in the past month by responding yes (1) or no (0). The 41 items were summed to create a total score (α ranged from .89 to .92 across the three assessments). Items covered a variety of sexual consequences or behaviors resulting from alcohol such as regretted sexual activity, unprotected sexual activity, and casual sex. Examples include "vaginal sex without a condom," "oral sex later regretted," and "vaginal sex with someone just met."

Typical Number of Drinks per Week The Daily Drinking Questionnaire (DDQ; Collins et al. 1985) was used to assess number of typical drinks per week. Participants were asked to "Consider a typical week in the past month. How much alcohol, on average (measured in number of drinks), do you drink

on each day of a typical week?” Weekly drinking was computed by summing the number of standard drinks for each day of the week.

Analytic Plan

Analyses were conducted according to the intent-to-treat principle such that participants were analyzed according to the condition to which they were randomly assigned. Because of the repeated assessments in this study, Bayesian generalized linear mixed models (GLMMs) with a random intercept for participant were performed to examine the effects of the intervention conditions on sexual behaviors, alcohol-related RSB outcomes, and typical alcohol use at the 1- and 6-month follow-ups. The outcomes in this study were non-negative integers showing a positive skew and a large number of zeroes. To account for this distribution, a hurdle form of the GLMM was performed such that two aspects of the outcome were modeled simultaneously: (1) the likelihood of any non-zero count (e.g., any vs. no casual sexual partners) using a logit model to estimate odds ratios (ORs) and (2) the non-zero count (e.g., the number of sexual partners among those who reported any casual sexual behavior) using a truncated count regression model (Atkins et al. 2013). Because of evidence of over-dispersion, a quasi-Poisson form of the count regression model was used. In count regression, covariates are connected to the outcome via a log link and can be exponentiated to yield rate ratios (RRs) that can describe the proportional change in the count in the intervention compared to control.

Separate models were performed for the four outcomes. Dummy-coded study conditions with control as the reference group, follow-up assessment (0: 1-month; 1: 6-month), and interactions between study condition and follow-up assessment were included as predictors in the model. Baseline level of the outcome, biological sex (0 = female; 1 = male), and baseline age (0 = <21 years; 1 = 21+ years) were included as precision variables. When examining past month condom use as an outcome, the model was further adjusted for the number of times the participant had sex in the past month. Given the computational demands of the models, the hurdle mixed models were fit using Markov Chain Monte Carlo (MCMC) methods (Hamra et al. 2013). Non-informative priors were specified and convergence was assessed using the Gelman-Rubin diagnostic. Analyses were performed in R statistical software version 3.2 using the “MCMCglmm” package (Hadfield 2010) to conduct the Bayesian MCMC models.

Missing Data

We observed high rates of retention over the course of follow-up with 93, 87, and 85% completing 1-month follow-up and 86, 83, and 80% completing 6-month follow-up in the combined PFI, integrated PFI, and attention control groups,

respectively. Differences in level of missingness across study conditions were not statistically significant. GLMMs should provide unbiased estimates assuming data are missing at random (MAR); that is, missingness is not related to unmeasured variables (Atkins 2005). Although the assumption is untestable, we did observe that baseline levels of outcomes were not statistically significantly associated with missingness at 3- or 6-month follow-up at $p < .05$, except for typical drinks per week which was associated with a higher likelihood of missingness.

Results

At baseline, there were no statistically significant differences among study conditions in demographic characteristics including age (21+ vs. < 21, $\chi^2(2) = 3.81$, $p = .15$), sex ($\chi^2(2) = .22$, $p = .89$), sexual orientation (non-heterosexual vs. heterosexual, $\chi^2(2) = .43$, $p = .81$), and race (White vs. non-White, $\chi^2(2) = 2.51$, $p = .28$). Further, there were no statistically significant baseline differences in the outcomes of interest across study condition for either proportion of any non-zero count or the non-zero count ($p > .20$ for all outcomes). Table 1 shows the percentage of participants with any non-zero count and the overall mean (SD) of primary outcomes measured at baseline and 1- and 6-month follow-ups. For each outcome, the prevalence of any non-zero count in the past month (e.g., any casual sexual partner) declined over the course of the study. At baseline, nearly all participants reported consuming at least one drink during a typical week, which is in line with the inclusion criteria for the study.

Table 2 shows model-predicted ORs and RRs and their 95% credible intervals (CIs; which are akin to confidence intervals) from the logit and count portions, respectively, of the hurdle mixed models for the four outcomes at both 1- and 6-month follow-ups. The first set of models examined effects of the intervention conditions on number of casual sexual partners. At 1-month, those randomly assigned to the integrated condition, compared to those in the control condition, had a statistically significant lower likelihood of having any casual sexual partners, but there was no significant difference in likelihood between the combined and control conditions. For the non-zero count portion of the model, among those reporting any casual sexual partners, there were no significant differences in number of casual sexual partners between either the combined condition or the integrated condition as compared to the control condition. At 6-month follow-up, there was no longer a statistically significant difference between the integrated and control conditions in likelihood of any casual sexual partners; however, those in the combined condition had a lower likelihood compared to the control condition. There were no statistically significant differences for either of the intervention conditions compared to the control condition on the non-zero count portion of the model.

Table 1 Distribution of outcomes at baseline, 1-month follow-up, and 6-month follow-up

	Baseline		1-month		6-month	
	% any ¹	Non-zero mean ² (SD)	% any ¹	Non-zero mean ² (SD)	% any ¹	Non-zero mean ² (SD)
Number of casual sexual partners	78.37	1.98 (2.77)	57.22	1.10 (1.66)	42.55	0.79 (1.30)
Number of times using a condom	48.23	5.55 (15.36)	40.96	4.63 (4.02)	34.80	4.92 (6.01)
Number of times drinking prior to sex	87.26	4.44 (6.91)	65.10	4.64 (5.45)	58.90	4.42 (4.74)
Alcohol-related sexual consequences	85.82	7.14 (5.37)	61.51	6.05 (6.01)	53.48	5.38 (4.65)
Typical number of drinks per week	99.49	19.87 (12.09)	92.77	15.99 (11.33)	87.88	14.30 (11.56)

¹ Reflects the percentage of participants reporting any non-zero count in the past month

² The mean among those who reported a non-zero count in the past month

The next set of models examined differences in condom use that also accounted for the number of times had sex in the past month. Comparing the intervention conditions to the control condition, there were no statistically significant differences on condom use at 1- or 6-month follow-up for any portion of the hurdle model.

When examining alcohol-related sexual behaviors, at 1-month follow-up, both the combined and integrated conditions, compared to the control group, showed a lower likelihood of any alcohol consumption prior to sex, but there were no differences in the non-zero count of number of times having alcohol prior to sex in the past month. At 6-month follow-up, neither the combined nor integrated conditions showed

any statistically significant differences compared to the control in either the logit or count portions of the model. The next set of models examined alcohol-related sexual consequences. At 1-month, neither the combined condition nor integrated condition showed a statistically significant difference in the likelihood of any alcohol-related sexual consequences compared to the control group. However, there was a statistically significant reduction in the non-zero count of consequences in the integrated condition compared to the control. At 6-month follow-up, the combined and integrated conditions did not show any statistically significant differences compared to the control in either the logit or count portions of the model. Finally, when assessing typical number of drinks per week,

Table 2 Results from hurdle mixed models¹ for outcomes in combined and integrated intervention conditions versus control condition

	1-month				6-month				
	Logit		Count		Logit		Count		
	OR	95% CI	RR	95% CI	OR	95% CI	RR	95% CI	
Number of casual sexual partners									
Combined condition	0.40	0.07, 2.18	1.09	0.38, 3.07	0.31	0.12, 0.79	1.08	0.62, 1.94	
Integrated condition	0.14	0.02, 0.88	0.94	0.35, 2.90	0.60	0.23, 1.55	0.88	0.49, 1.52	
Number of times using a condom ²									
Combined condition	1.05	0.43, 2.25	1.58	0.30, 9.34	0.65	0.27, 1.94	0.69	0.43, 1.15	
Integrated condition	0.82	0.34, 1.85	1.21	0.21, 7.26	0.70	0.28, 1.81	0.93	0.60, 1.46	
Number of times drinking prior to sex									
Combined condition	0.18	0.04, 0.95	1.80	0.90, 3.49	1.37	0.61, 2.93	0.74	0.51, 1.06	
Integrated condition	0.09	0.02, 0.43	1.50	0.70, 3.07	1.42	0.66, 3.10	0.81	0.56, 1.15	
Alcohol-related sexual consequences									
Combined condition	0.78	0.19, 3.44	0.82	0.45, 1.77	1.16	0.57, 2.50	0.76	0.52, 1.06	
Integrated condition	1.12	0.22, 5.52	0.47	0.23, 0.90	0.80	0.36, 1.73	1.10	0.69, 1.44	
Typical drinks per week									
Combined condition	0.97	0.18, 7.19	0.76	0.65, 0.91	0.49	0.09, 2.52	0.87	0.73, 1.04	
Integrated condition	0.63	0.10, 4.10	0.88	0.76, 1.05	1.01	0.16, 5.83	0.88	0.73, 1.06	

¹ Adjusted for sex, baseline age, and baseline level of the outcome

² Further adjusted for number of times having sex in the past month

those in the combined condition, but not the integrated condition, showed a greater reduction in the non-zero count of drinks than those in the control condition at the 1-month follow-up assessment. There were no statistically significant intervention effects at 6-month follow-up. When comparing the two interventions, there were no significant differences for any outcome on either the logit or count portions of the models.

Discussion

Previous PFIs for alcohol-related RSB have generally targeted either drinking behavior or sexual risk taking, without directly integrating intervention content regarding the influence of alcohol in sexual risk taking. The present study examined the efficacy of two web-based PFIs with alcohol and sexual risk taking content that was either combined (i.e., alcohol content and sexual risk taking content presented individually throughout intervention) or integrated (i.e., alcohol content integrated into sexual risk taking content throughout intervention). With a relatively small dose of the intervention, at the 1-month follow-up, the integrated intervention reduced the likelihood of having any casual sexual partners, the likelihood of any alcohol consumption prior to sex, and the number of alcohol-related sexual consequences (i.e., non-zero) as compared to the control condition. In contrast, the combined intervention showed a reduction at 1-month follow-up on the likelihood of any alcohol consumption prior to sex and the number of typical drinks per week (i.e., non-zero) as compared to the control condition. The combined intervention also showed a reduction at 6-month follow-up on the likelihood of having any casual sexual partners, as compared to the control condition. The main difference in intervention effects, at 1-month, was that the integrated condition reduced number of alcohol-related sex consequences and that the combined intervention reduced typical number of drinks per week. These differences are not surprising as the combined intervention was the only intervention to focus on normative comparisons for typical drinks per week and the integrated condition was the only condition to focus on alcohol-related sex consequences.

While these results did not support the hypotheses that the integrated intervention would be more efficacious than the combined intervention, the current findings highlight the efficacy of two web-based alcohol and RSB interventions among a national sample of at-risk young adults. Whereas prior research (Dermen and Thomas 2011; Lewis et al. 2014a, b) was inconsistent when evaluating the efficacy of combined interventions among college students, the current study expands the literature by demonstrating that both combined and integrated interventions are efficacious at reducing alcohol-related RSB outcomes among young adults. Future research should consider intervention length, participant burden, and the comorbidity of risk behaviors when considering to take a

combined or integrated approach. If there is an option to utilize a briefer, integrated intervention with lower participant burden in terms of questionnaire items to respond to as well as feedback to view and interpret than this should be considered.

Although there were no baseline differences, all three conditions showed reduced risk behavior over the course of the study. Because the current study had several high-risk inclusion criteria, risk behavior for all conditions may have declined over time as a result. This also could reflect that assessment of risk behaviors can, in and of itself, change those behaviors (Fremouw and Brown 1980; Helzer et al. 2002; Mullen et al. 1997) although other studies have not found much of an effect of monitoring, even when it is intensive (Hufford et al. 2002; Simpson et al. 2005).

Although both interventions showed significant reductions in sexual risk taking and alcohol-related sexual risk taking outcomes, including negative consequences, most of the intervention effects were short-lived. This finding should not infer that a brief intervention might not have a clinical impact, because a brief web-based intervention could be utilized during periods of known high-risk for young adults. Given that the current intervention was efficacious at the 1-month follow-up, it could be delivered during periods of known high-risk among all young adults, such as 21st birthday celebrations. Experiencing a negative consequence or engaging in heavy drinking can alter trajectories in ways that lead to other negative outcomes (Hendershot and George 2007; Norris 2011; Rehm et al. 2012; Testa and Livingston 2009). For example, Geisner et al. (2017) found that those young adults who consumed higher amounts of alcohol during 21st birthday celebrations had a higher number of negative consequences during the next year. Thus, a brief and targeted intervention around higher-risk alcohol use and sexual behavior could potentially reduce the likelihood of having negative consequences associated with those behaviors in the future such as regretted sex, STIs, or unwanted pregnancies that may have far larger and lasting effects. However, the practical application of such an intervention must be considered within the context of implementation. To be effective, the intervention would have to reach high-risk young adults when they need it. Making this type of intervention available via the web or an app in high school health classes, as part of a universal prevention effort, would be one option or having this tool available for healthcare providers to disseminate when they see higher-risk patients, such as someone presenting for a STI screening.

Brief, web-based interventions have higher reach but smaller effects than in-person interventions and, based on our findings, also may not lead to lasting behavioral change. In general, web-based PFIs have shown success with reducing young adult drinking but have had more difficulty demonstrating longer-term intervention effects (Huh et al. 2015). One possible explanation for both the smaller effect sizes and the

lack of longer-term behavioral change is that the dosage (e.g., as measured by average time spent viewing the personalized feedback) for brief, web-based interventions is lower. Web-based interventions rely on individuals to effectively pace learning and engage in intervention content without distractions (Lewis and Neighbors 2015). Research should continue to study avenues for increasing the duration of PFI effects on health-risk behaviors, such as use of booster sessions as well as enhancement of intervention content to extend the duration and magnitude of effects. More adaptive and less static designs that would include briefer, timely interventions should be considered in future research.

Limitations and Conclusions

This study was inclusive of all sexual orientations, but evaluating intervention efficacy by sexual orientation was not a primary aim and the percentage of the sample who did not identify as heterosexual was relatively low (23%), precluding examination of sexual orientation as a moderator of intervention efficacy. Thus, it is unknown whether one or both the interventions were equally effective for same-sex and opposite-sex sexual behavior. While the present study was innovative in that it was able to address sexual risk behaviors across sexual identities, future research should examine sexual orientation or sexual desire as a moderator of intervention efficacy to continue to fill the gap in examining the generalizability of empirically supported interventions to the general young adult population. Results should also be interpreted with caution because there were multiple outcomes, study conditions, and time points assessed as part of this study, which increases the possibility that statistically significant intervention effects observed in this study were due to chance. However, for a given model with the multiple conditions and time points, GLMMs borrow information across individuals that tend to shift parameter estimates towards one another and lead to conservative estimates.

The present study contributes to the alcohol intervention literature as it provides support for the short-term effects of a brief, web-delivered integrated PFI to reduce alcohol-related sexual risk taking among young adults. This study provides important first steps in examining the generalizability of brief, web-based interventions for young adults attending and not attending college. By broadening reach by being inclusive of education status and sexual identity, this study will begin to fill the gap in considering the generalizability of empirically supported interventions to the general young adult population. Additional research is needed to extend the duration of intervention effects and/or to examine timing of intervention delivery as well as to examine relevant moderators of intervention efficacy.

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Compliance with Ethical Standards

Conflict of Interest There authors declare that they have no conflict of interest.

Ethical Approval This study had IRB approval. All applicable national and institutional guidelines for studies with human participants were followed.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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