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Online First Publication, August 26, 2021. http://dx.doi.org/10.1037/adb0000657

CITATION
Personalized Normative Feedback for Hazardous Drinking Among College Women: Differential Outcomes by History of Incapacitated Rape

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Objective: Personalized normative feedback (PNF) interventions are effective at reducing hazardous drinking in college. However, little is known about who is most receptive to PNF. College women with a history of alcohol-related incapacitated rape (IR) are at elevated risk for hazardous drinking, but it is unclear what impact intervention messaging may have on this group and how their outcomes compare to those without past IR. To address this gap, this study involved secondary data analysis of a large web-based clinical trial. Method: Heavy drinking college women (N = 1,188) were randomized into PNF (n = 895) or control conditions (n = 293). Postintervention, women reported their reactions to intervention messaging. Hazardous drinking outcomes (typical drinking, heavy episodic drinking [HED], peak estimated blood alcohol content [eBAC], blackout frequency) were assessed at baseline and 12 months. Results: Past IR was reported by 16.3% (n = 194) of women. Women with a history of IR reported more baseline hazardous drinking and greater readiness to change than women without IR. For those who received PNF, history of IR related to greater perceived impact of the intervention, but no difference in satisfaction with the message. After controlling for baseline drinking, regressions revealed the effect of PNF was moderated by IR for frequency of HED at 12 months. Simple main effects revealed PNF was associated with lower levels of hazardous drinking at follow-up among women with past IR. Conclusions: This initial investigation suggests PNF is a low resource and easily disseminated intervention that can have a positive impact on college women with past IR.

Public Health Significance Statement
A web-based personalized normative feedback intervention for alcohol use was compared to a control condition in college women. This preliminary study revealed the intervention was particularly effective for women with a history of incapacitated rape in leading to less frequent heavy episodic drinking 1 year later.

Keywords: alcohol intervention, alcohol-involved sexual assault, drug-facilitated rape, web-based intervention, stages of change

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This research was funded by grants from the National Institute of Alcohol Abuse and Alcoholism (NIAAA); data collection was funded by ROI1AA012547 (PI: Mary Larimer); manuscript preparation was supported by R37AA012547 (PI: Mary Larimer), T32AA007455 (PI: Mary Larimer), and K08AA021745 (PI: Cynthia A. Stappenbeck). The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIAAA.

Data for this study were collected as part of two larger randomized clinical trials. Treatment outcomes of the first randomized clinical trial (RCT-1) have only been reported in one prior publication (LaBrie et al., 2013). That publication focused on alcohol consumption in men and women assigned to personalized normative feedback (PNF), an online version of the Brief Alcohol Screening and Intervention for College Students (Web-BASICS), or control conditions (excluding minimal assessment control), whereas the present study focused on hazardous drinking in women assigned to any PNF or control. LaBrie et al. (2013) did not report participants’ history of incapacitated rape (IR). Although several additional published manuscripts reported aspects of the data collected within the larger trial, none involved analysis of treatment outcomes or consideration of IR. Treatment outcomes of the second randomized clinical trial (RCT-2) have only been reported in one prior manuscript (Larimer et al., 2021), which did not report participants’ history of IR.

Anna E. Jaffe served as lead for coordinating the development and conceptualization of the overall manuscript, formal analysis, and writing of original and revised drafts. Jessica A. Blayney and Scott Graupensperger contributed to conceptualization, interpretation of analyses, and writing original and revised drafts. Cynthia A. Stappenbeck and Michele Bedard-Gilligan contributed to the writing of original and revised drafts. Mary Larimer secured funding, oversaw data collection and management, and contributed to conceptualization, reviewing, and editing of the manuscript.

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Incapacitated rape (IR)—nonconsensual sex when an individual is unable to consent or resist due to intoxication—is a pervasive problem on college campuses (Carey et al., 2015; Mohler-Kuo et al., 2004). Alcohol is central to the settings where college women socialize (e.g., parties, bars; Borsari & Carey, 2001), and is the primary substance in the vast majority of IR (Kilpatrick et al., 2007). Drinking alcohol—heavy episodic drinking in particular (HED; 4+ drinks for women; National Institute on Alcohol Abuse and Alcoholism [NIAAA], 2004)—is not only a risk factor for IR (McCaul et al., 2010), but can also be a consequence. Compared to women without IR or another type of sexual assault, women with a history of IR engage in more HED (Lawyer et al., 2010; McCaul et al., 2010; Norris et al., 2019), use fewer alcohol-related protective behavioral strategies (Gilmore, Stappenbeck, et al., 2015), and experience more alcohol-related consequences (Kaysen et al., 2006), including black-outs (Voloshyna et al., 2018). Consistent with the self-medication hypothesis (Khanzian, 1997), hazardous drinking may reflect efforts to cope with IR-related distress. However, hazardous drinking can also prolong postassault distress (Kaysen et al., 2011; Read et al., 2013) and increase risk for subsequent IR (Griffin & Read, 2012; Messman-Moore et al., 2013; Testa et al., 2010; Valenstein-Mah et al., 2015). Thus, intervention efforts to reduce hazardous drinking in this at-risk group should be a high priority.

One prominent approach to alcohol intervention is based on social norms theory, which holds that behaviors like hazardous drinking are shaped by perceptions of peers’ attitudes toward, and involvement with, that behavior (Cialdini & Goldstein, 2004). Indeed, perceived social norms are one of the most robust predictors of college student alcohol use (Neighbors et al., 2007). The findings consistently show that college students overestimate their peers’ drinking, which increases risk for their own hazardous drinking (Cox et al., 2019; Lewis & Neighbors, 2004). Many harm-reduction strategies leverage these powerful peer influences by correcting normative misperceptions.

One of the most widely used norm-correction strategies is personalized normative feedback (PNF; Dotson et al., 2015). PNF is designed to correct normative misperceptions by providing individuals with feedback that contrasts (a) their own alcohol use, (b) their perceptions of how much peers drink, and (c) how much peers actually drink. Discrepancies between perceived and actual peer drinking are highlighted through text and graphics alongside individuals’ own alcohol use for a personalized comparison. Relative to control conditions, PNF interventions have considerable short-term efficacy (Crone & Larimer, 2012; Neighbors et al., 2016), and may be particularly effective in women (Saiz et al., 2007). Despite promising short-term effects, web-based alcohol interventions including PNF have been less likely to demonstrate long-term efficacy (e.g., at 12 months; Dedert et al., 2015; Donoghue et al., 2014; Riper et al., 2014) and less is known about which students might be most receptive to these interventions.

As with any harm-reduction strategy, PNF interventions are effective to the extent to which students resonate with the goal of reducing hazardous drinking. For example, there is initial evidence that students who report more readiness to change also respond more effectively to PNF and other web-based substance use interventions (Lee et al., 2010; Palfai et al., 2016; Young, 2016; for exception, see Collins et al., 2010). In one study, students with more alcohol-related consequences were more receptive to PNF, showing reduced weekly drinking and HED at 1-month postintervention (Palfai et al., 2011). Given that IR can also be conceptualized as a serious consequence of alcohol use, students with past IR may be particularly motivated to reduce their hazardous drinking, and thus, more responsive to PNF.

More than just a negative consequence of drinking, IR is also a traumatic event that can trigger negative cognitions. Similar to other traumas, IR can “shatter” positive assumptions and contribute to negative beliefs about the world, others, and oneself (Janoff-Bulman, 1992; Vogt et al., 2012). Negative cognitions regarding self-blame can be particularly prominent following alcohol-involved sexual assaults including IR, even relative to other forms of sexual assault (Donde, 2017; Littleton et al., 2009; Peter-Hagene & Ullman, 2015, 2018). The perpetrator holds the sole responsibility for IR, yet to obtain a sense of control, survivors may be motivated to view drinking as a controllable behavior that, if avoided, could prevent past or future victimization, contributing to behavioral self-blame. Survivors who tell peers about the IR can also be met with negative social reactions (Relyea & Ullman, 2015; Ullman & Najdowski, 2010), as informal supports may convey blame for drinking (e.g., “That’s what happens when girls drink”; Ullman, 2010, p. 67). These negative cognitions may complicate the delivery of alcohol-focused interventions for individuals who have experienced IR. Content standard in PNF, such as highlighting that an individual’s alcohol use is higher than their peers, could activate negative cognitions about drinking and unhelpful beliefs about blame. From this perspective, PNF might create discomfort for those with a history of IR. It is unclear what implications this might have for effectiveness of the PNF intervention on alcohol-related outcomes.

Whereas complex cognitions regarding post-IR drinking could be carefully navigated by a therapist, web-based interventions, such as PNF, include standardized content that has not yet been widely tested in relation to IR. A small, yet growing literature suggests women with a sexual assault history—including both IR and other forcible or coerced unwanted sexual experiences—report some degree of discomfort in response to web-based alcohol intervention content (Jaffe et al., 2018) and may inaccurately fear that drinking connotes blame for the assault (Gulati et al., 2021). Only one known study (Gilmore, Lewis, et al., 2015) has evaluated the efficacy of a web-based alcohol intervention by sexual assault history. This intervention also included content on sexual assault risk reduction. Treatment efficacy was moderated by sexual assault severity, such that treatment effects for the combined intervention on reducing HED frequency was stronger at higher levels of assault severity. Although these findings did not distinguish between IR and other sexual assaults not involving alcohol, IR represents nearly three quarters of sexual assaults in college women (Mohler-Kuo et al., 2004). Whether differences in response to web-based alcohol interventions are specific to IR given the unique implications for alcohol-related cognitions remain unknown.

The Present Study

In sum, although prior research supports the efficacy of PNF interventions relative to control in reducing alcohol use, it is unknown if this treatment effect differs by history of IR. The response to alcohol interventions among women with a history of IR is particularly important given that these women are at elevated risk for hazardous drinking, and may also react negatively to alcohol intervention messaging. To better understand whether reactions to and efficacy of PNF differs for survivors of IR, the present study involved secondary analysis of two large randomized clinical trials of PNF targeting alcohol consumption...
in college students (LaBrie et al., 2013; Larimer et al., 2021). We focus here on women as the gender disproportionately affected by rape (reported by 21.3% of women and 2.6% of men in the U.S.; Smith et al., 2018) and hazardous drinking as particularly relevant and problematic after IR (e.g., increasing risk for subsequent IR; Testa et al., 2010; Valenstein-Mah et al., 2015).

Our first aim was to characterize baseline differences between college women with and without a history of alcohol-related IR. Consistent with past research, we expected IR would be associated with more hazardous drinking and greater readiness to change. Our second aim was to characterize reactions to the intervention among women randomly assigned to PNF. We expected IR to be associated with lower satisfaction with the intervention message (given concerns about blame for past IR) and greater perceived impact of the message (given greater readiness to change). Our final aim was to explore differential treatment effects on hazardous drinking by history of IR. One possibility is that alcohol-related intervention content may feel personally relevant to women with past IR, leading to greater treatment-related changes in hazardous drinking. On the other hand, PNF may be insufficient to reduce drinking to cope with IR-related distress. Women with past IR may also react negatively to and disengage from intervention content, and in turn show fewer treatment-related changes in hazardous drinking over time.

Method

Participants and Procedure

Participants were drawn from two large randomized clinical trials (RCTs) assessing the efficacy of web-based PNF interventions on alcohol use (see LaBrie et al., 2013; Larimer et al., 2021). Both RCTs entailed identical recruitment procedures, and the same items were used to assess relevant constructs at similar follow-up intervals. Both RCTs were integrated in the current secondary data analyses in order to increase the number of participants with past IR (to avoid small cell sizes) and is justified given the intervention components of aggregated conditions and procedures were nearly identical across the two studies.

To facilitate generalizability, the larger trials recruited college students from two U.S. sites: a large public Pacific Northwest university (Campus 1) and a mid-sized private West Coast university (Campus 2). Both RCTs recruited participants from the same two universities. The institutional review boards of both universities approved all research procedures, and a Federal Certificate of Confidentiality was obtained to further protect research participants.

In the first RCT (i.e., RCT-1; LaBrie et al., 2013), 11,069 students were invited to complete baseline screening (4,818 responses; 43.5% response rate) and 2,034 (42.2%) met screening criteria of at least 1 past-month event of HED (i.e., 4+5+ drinks per occasion for females/males, respectively) and identifying as either White or Asian to facilitate race-specific analyses. Of those, 1,367 (91.5%) completed the baseline survey and were randomized into one of six conditions. Randomization in RCT-1 was stratified by sex, race, and/or Greek status, and total drinks per week (<11 drinks vs. ≥11 drinks). Eight conditions involved PNF with descriptive norms presented in reference to specific groups, including typical student as well as one to three specific reference groups via all possible combinations of gender, race, and/or Greek status. One condition involved more comprehensive, motivational feedback based on the Brief Alcohol Screening and Intervention for College Students (BASICS; Dimeff et al., 1999), referred to as Web-BASICS.

Two control conditions not involving an active intervention were: (a) a generic feedback control with similar design and length as the PNF, but with content covering media usage instead of alcohol use and (b) a minimal assessment condition with no PNF. All participants completed a postintervention follow-up survey at 12 months. Those not in the minimal assessment condition also completed surveys at 1, 3, and 6 months (not reported on here). Participants were compensated $15 for screening, $25 for baseline, $30 for 1-, 3-, and 6-month follow-ups, $40 for 12-month follow-up, and $30 as a bonus for completing all procedures. Results from the larger trial (LaBrie et al., 2013) revealed that PNF normed to a "typical student" was more effective than more specific reference groups. Still, considered in aggregate, PNF was more effective than the generic feedback control in reducing alcohol consumption, though effects were modest.

Following similar procedures, the second RCT (i.e., RCT-2; Larimer et al., 2021) invited 5,998 students to complete baseline screening (2,688 responses; 44.8% response rate). A total of 1,494 (55.6%) students met the RCT-2 screening criteria of at least 1 past-month event of HED (i.e., 4+5+ drinks per occasion for females/males, respectively). Of those, 1,367 (91.5%) completed the baseline survey and were randomized into one of six conditions. Randomization in RCT-2 was stratified by total drinks per week (<11 drinks vs. ≥11 drinks). The three PNF conditions were (a) descriptive norms feedback (in reference to a typical student), (b) injunctive norms feedback, and (c) both descriptive and injunctive norms feedback. One condition entailed Web-BASICS, one was a generic feedback control condition with repeated assessments (identical to the control condition in RCT-1), and the final condition was a minimal assessment control. Participation incentives included $15 for the screening survey, $25 for the baseline survey, $25 for completing the 3-month follow-up, $30 for the 6-month follow-up, and $35 for completing the 12-month follow-up. The primary findings from RCT-2 indicated that PNF conditions (including the descriptive-norms-only condition) yielded favorable effects on weekly drinking and alcohol-related consequences compared to the repeated assessment control condition (Larimer et al., 2021).

Several factors were considered when selecting participants for the present study. First, given that sexual victimization is disproportionately higher in college women than men (Hines et al., 2012), analyses were limited to cisgender women (sample limited to n = 1,872). Second, analyses were designed with the small number of participants with IR per cell in mind. Each condition from the parent studies contained between 10 and 28 women with a history of IR. Because these findings may be unstable from small cell sizes, only aggregated conditions (i.e., representing two or more trial conditions with a comparable intervention component) were considered. Specifically, a treatment group involving descriptive PNF was created by combining the eight descriptive norms PNF conditions from RCT-1 and the descriptive-norms-only PNF from RCT-2. The Web-BASICS conditions were excluded from the current analysis.

1 Birth sex was important for interpretation of alcohol consumption variables. Of 1,877 individuals who were assigned female sex at birth, only five participants indicated their current gender identity was male or transgender, a subsample too small to examine in the current study. Thus, analyses focused on cisgender women.
analyses because it was a substantially longer intervention (Web-BASICS: 26 pages, PNF: 4 pages) and contained a greater range of content that might evoke unique reactions from women with past IR (e.g., feedback on alcohol and sexual behavior). A control comparison group was created by combining the two generic feedback control conditions from each larger trial along with the minimal assessment condition\(^2\) from RCT-1 (minimal assessment in RCT-2 did not assess IR at baseline). Because the minimal assessment control did not complete surveys at 1, 3, or 6 months, full data from the aggregate control condition were not available at these time points. Thus, current analyses focused only on the baseline and 12-month follow-up surveys. Third, because IR was a focus of the present study, 1 participant assigned to treatment was excluded for missing IR data.

The present study involved 1,188 college women. On average, participants were 19.86 years of age (SD = 1.31). With regard to racial background, 75.9% identified as White, 20.0% as Asian, 2.0% as Black/African American, 0.3% as Native Hawaiian/Pacific Islander, 0.1% as American Indian/Alaskan Native, and 0.8% as another race. In addition, 30.7% were members of a Greek organization. Considering the aggregated trial conditions, among the 194 women with a lifetime history of IR, about half (93; 47.9%; n = 201) had experienced IR but not in the past year (1 time: 37.1%, n = 72; 2 times: 13.4%, n = 26; 3+ times: 1.5%, n = 3), and the other half (93) had experienced IR but not in the past year, with no difference between PNF and control, \(\chi^2(1, N = 194) = 0.69, p = .405\).

### Measures

#### Demographics

At screening, students reported their birth sex, gender identity, racial background, and Greek membership.

#### History of IR

At baseline, participants were asked one item on the Young Adult Alcohol Problems Screening Test (YAAPST; Hurlbut & Sher, 1992) regarding history of alcohol-related IR. Consistent with past work on IR (Kaysen et al., 2006; Nguyen et al., 2010), participants were asked, “Have you ever been pressured or forced to have sex with someone because you were too drunk to prevent it?” Responses were dichotomized, with history of IR indicated by a response of yes, but not in the past year or one, two, or three or more times in the past year (IR = 1) and no IR indicated by a response of no, never (IR = 0).

#### Readiness to Change

At baseline, participants completed the Readiness to Change Questionnaire (Rollnick et al., 1992). A total of 12 items were rated on a scale from −2 (strongly disagree) to 2 (strongly agree). Based on Prochaska and DiClemente (1986) model, the following three stages of change were assessed with four items each: Precontemplation (i.e., not thinking about change), contemplation (i.e., thinking about change), and action (i.e., making changes). After reverse-coding precontemplation items, a total score was computed (−24 to +24), with higher scores reflecting greater readiness to reduce one’s drinking (α = .87). To further characterize baseline differences, each participant’s stage of change was also determined, as indicated by the highest rated subscale, or when subscales were equal, the furthest stage of change (Heather & Rollnick, 1993).

#### Reactions to PNF

Participants assigned to PNF were asked to provide feedback on their reactions immediately after the intervention. Questions were designed specifically for this study. Perceived impact of the message was assessed with four items (α = .87), including whether the personalized information “increased my confidence to avoid drinking,” “had a positive impact on me,” “will cause me to reduce the amount I drink,” and “has positively affected my decision to avoid drinking situations.” Satisfaction with the message was assessed with two items (α = .85): “I liked the personalized information” and “I liked the message presented in the personalized information.” Response options ranged from 0 (strongly disagree) to 6 (strongly agree) and mean scores were computed.

#### Hazardous Drinking

All drinking outcomes were assessed at screening or baseline (collectively referred to as “baseline”) and again at the 12-month follow-up. For all alcohol consumption measures, a definition of “standard drink” was provided.

**Alcohol Use Disorder Identification Test-Consumption Scale.** The three-item Alcohol Use Disorder Identification Test-Consumption scale (AUDIT-C; Bush et al., 1998) was used to assess hazardous drinking. Participants were asked how often they have a drink containing alcohol, the number of drinks on a typical drinking day, and the frequency of having six or more drinks on one occasion. Response options were specific to each question type and ranged from 0 (never/1–2 drinks) to 4 (+4 times a week/10+ drinks). Responses were summed to create a total score (0–12). Prior work has supported the internal reliability and concurrent validity of the AUDIT-C in college students (Barry et al., 2015), and with a cut score of 5 recommended to detect hazardous drinking in college women (DeMartini & Carey, 2012). In the present study, α coefficients were .67 and .68 for baseline and 12 months, respectively.

**Peak Estimated Blood Alcohol Content.** Participants were asked (a) the maximum number of drinks consumed on a single occasion within the past 30 days and (b) the number of hours spent drinking on that occasion (Dimeff et al., 1999). Following recommendations from Matthews and Miller (1979), peak estimated blood alcohol content (eBAC) was calculated as: [(number of drinks/2) × (gender constant/body weight)−(0.016 × hours)]. Consistent with past research handling extreme values of peak eBAC (e.g., Martens et al., 2010), outliers were capped at 0.40.

\(^2\) There was a programming error in the RCT-1 minimal assessment condition, such that 35 women who were randomized to this condition were inadvertently directed to view the PNF intervention. These participants were excluded from analyses. An additional four participants were excluded due to other programming errors.
HED Frequency. Participants completed the Daily Drinking Questionnaire (Collins et al., 1985) to report the number of drinks typically consumed each day in the week in the past month. The number of days on a typical week in which participants reported HED (i.e., >4 drinks for women) was computed (possible range = 0–7).

Blackout Frequency. One item on the YAAPST (Hurlbut & Sher, 1992) assessed past-year blackout frequency. Specifically, participants were asked, “Have you awakened the morning after a good bit of drinking and found that you could not remember a part of the evening before?” Responses were coded as 0 = no past-year blackouts (indicated by response options: No, never or Yes, but not in the past year), 1 = One time in the past year, 2 = Two times in the past year, and 3 = Three or more times in the past year.

Data Analysis

Preliminary analyses involved examining descriptive statistics and correlations among study variables. To address the first aim, t-tests and chi-square tests were conducted to evaluate baseline differences by IR. Regarding the second aim, in the subset of participants who completed PNF, reactions to PNF by IR were assessed with t-tests. Finally, for the third aim, hazardous drinking outcomes were evaluated using intent-to-treat analyses in Mplus Version 8.5 (Muthén & Muthén, 1998–2017). Separate regression models were estimated to predict each outcome at 12 months, controlling for the baseline value of the variable.3 Hierarchical models were conducted to evaluate main effects of IR and PNF (Step 1) and then interactive effects of IR and PNF (Step 2). Given that readiness to change was associated with both IR and drinking outcomes in bivariate associations, readiness to change was also explored as a possible covariate in Step 3. Simple main effects were calculated for the most conservative model (Step 3). All outcomes were considered continuous4 and modeled with maximum likelihood estimation and standard errors robust to nonnormality (MLR), which assumes data are missing at random. Data at the 12-month assessment were available for 87.1% (n = 1,035) of participants. Misingness was evaluated for associations with demographic and alcohol use variables at baseline; only older age was associated with missing follow-ups (p = 0.016). Intent-to-treat analyses were conducted, retaining all participants in each model, regardless of missing data. Specifically, covariances between exogenous variables were estimated to bring all variables into the likelihood and therefore, retain all participants with any data at baseline.

Results

Preliminary Analyses

Descriptive statistics and correlations for the overall sample are presented in Table 1. Generally, drinking outcomes were interrelated within and across time points. Readiness to change was associated with more hazardous drinking at baseline and follow-up. Perceived impact and satisfaction with the PNF message were positively correlated. Readiness to change was associated with a greater perceived impact of the message, but not with satisfaction. Satisfaction with the PNF message was associated with lower AUDIT-C scores at follow-up; reactions to PNF were not associated with any other drinking outcomes.

Baseline Differences

Group differences by history of IR are shown in Table 2. Women with an IR history were slightly younger, but there were no other demographic differences between college women with and without past IR. At baseline, all indicators of hazardous drinking were higher in women with (vs. without) IR. For example, the proportion of women who met criteria for hazardous drinking based on the AUDIT-C cut score was 66.8% for women with IR compared to 53.0% without IR. Women with past IR also reported more readiness to change at baseline (41.2% in the action phase) compared to their peers without IR (29.3% in the action phase).

Reactions to Treatment

Among the 895 participants randomly assigned to PNF, 88.9% completed at least one of the measures on reactions to PNF, though there was no difference in completion of these questions by IR history (p = .412). Among those in PNF, women with a history of IR perceived greater impact of PNF on their drinking than women without a history of IR. However, there was no difference in satisfaction with PNF content based on women’s history of IR (Table 2).

Treatment Efficacy

Group means by IR history, condition, and time are represented in Figure 1. Regression results are presented in Table 3. The overall variance accounted for by the full models ranged from 19.3% for peak eBAC to 33.1% for AUDIT-C. At Step 1, there were no significant main effects of IR after controlling for baseline values on any 12-month measure of hazardous drinking, but there were significant main effects for PNF reducing peak eBAC and HED frequency. At Step 2, there was a significant interaction between IR and PNF for HED frequency, which remained significant at Step 3 when controlling for readiness to change—a nonsignificant predictor of all outcomes. To probe the interactions at Step 3, simple main effects were computed (see Table 4). PNF was associated with significantly less frequent HED among women with past IR, but not women without IR. Additionally, among those in the control condition, women with (vs. without) IR reported more frequent HED, whereas there was no such difference by IR history for women assigned to PNF. There were no significant interactions between IR and PNF for the other hazardous drinking outcomes.

3 Additional models were estimated with Campus (public vs. private) and Study (RCT-1 vs. RCT-2) as covariates, but these were not significant predictors in any model. Thus, the more parsimonious models without Campus or Study are represented here.

4 Alternate distributions of outcomes were considered. HED frequency was also estimated with MLR as a count variable with a negative binomial distribution and a log link. Blackout frequency was also estimated with MLR as an ordinal, four-category variable. The pattern of all findings was the same, and therefore, the simpler MLR models with continuous outcomes are presented for ease of interpretation and comparability across outcomes.
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**Treatment**

IR may lead to complex or competing cognitions regarding alcohol intervention by IR history. Both in past research and the present study, IR was associated with hazardous drinking, suggesting college women with past IR are at an at-risk population meritng intervention. Although web-based interventions have the potential to be widely disseminated to heavy drinking women, we expected that IR may lead to complex or competing cognitions regarding alcohol use that may be difficult to navigate in standardized web-based content. However, the findings suggested women with IR perceived PNF to be more impactful than women without IR and were similarly satisfied with the PNF message. Further, PNF was particularly effective in college women with a history of IR in that it was associated with lower HED in the year following the intervention.

The first aim of this study was to characterize baseline differences between college women with and without IR prior to the intervention. Within this large sample of heavy drinking college women, 16.3% reported a lifetime history of IR. This rate is higher than 16.3% reported a lifetime history of IR. This rate is higher than

**Discussion**

This secondary analysis of two PNF trials represents the first known investigation of reactions to and outcomes of a web-based alcohol intervention by IR history. Both in past research and the present study, IR was associated with hazardous drinking, suggesting college women with past IR are at an at-risk population meritng intervention. Although web-based interventions have the potential to be widely disseminated to heavy drinking women, we expected that IR may lead to complex or competing cognitions regarding alcohol use that may be difficult to navigate in standardized web-based content. However, the findings suggested women with IR perceived PNF to be more impactful than women without IR and were similarly satisfied with the PNF message. Further, PNF was particularly effective in college women with a history of IR in that it was associated with lower HED in the year following the intervention.

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**Table 1**

**Descriptive Statistics and Correlations**

| Variable                              | Observed range | M     | SD   | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   |
|---------------------------------------|----------------|-------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1. Readiness to change                | –24–23         | –3.39 | 8.34 |      |      |      |      |      |      |      |      |      |      |      |
| 2. PNF: Perceived impact              | 0–6            | 2.94  | 1.22 | 34** |      |      |      |      |      |      |      |      |      |      |
| 3. PNF: Satisfaction of message      | 0–6            | 4.30  | 1.20 | 0.00 | 28** |      |      |      |      |      |      |      |      |      |
| 4. AUDIT-C: Baseline                  | 1–11           | 5.07  | 1.95 | 26** | –0.06| –0.05|      |      |      |      |      |      |      |      |
| 5. AUDIT-C: 12 months                 | 1–11           | 4.78  | 1.96 | 15** | –0.03| –0.08| 57** |      |      |      |      |      |      |      |
| 6. Peak eBAC: Baseline                | 0.00–0.40      | 0.17  | 0.09 | 18** | 0.06 | –0.03| 56** | 30**  |      |      |      |      |      |      |
| 7. Peak eBAC: 12 months               | 0.00–0.40      | 0.14  | 0.09 | 13** | –0.03| –0.05| 43** | 67**  | 44**  |      |      |      |      |      |
| 8. HED frequency: Baseline            | 0–7            | 1.13  | 1.17 | 23** | 0.05 | –0.08| 72** | 46**  | 35**  |      |      |      |      |      |
| 9. HED frequency: 12 months           | 0–7            | 0.96  | 1.17 | 14** | 0.02 | –0.07| 48** | 71**  | 31**  | 57**  | 46**  |      |      |      |
| 10. Blackout frequency: Baseline      | 0–3            | 1.44  | 1.23 | 34** | 0.01 | 0.50 | 37** | 33**  | 32**  | 42**  | 29**  |      |      |      |
| 11. Blackout frequency: 12 months     | 0–3            | 1.23  | 1.24 | 0.20 | 0.02 | 0.40 | 53** | 25**  | 43**  | 40**  | 53**  |      |      |      |

Note. PNF = personalized normative feedback; AUDIT-C = alcohol use disorders identification test, consumption scale; eBAC = estimated blood alcohol content; HED = heavy episodic drinking.

* p < .05. ** p < .01.

**Table 2**

**Group Differences**

<table>
<thead>
<tr>
<th>Variable</th>
<th>No IR (n = 994)</th>
<th>History of IR (n = 194)</th>
<th>Test of difference</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RCT-1 (vs. RCT-2)</td>
<td>76.0% (755)</td>
<td>74.7% (145)</td>
<td>χ²(1) = 0.13, p = 0.718</td>
<td>φ = –0.01</td>
</tr>
<tr>
<td>Public campus (vs. private)</td>
<td>58.9% (585)</td>
<td>57.2% (111)</td>
<td>χ²(1) = 0.18, p = 0.672</td>
<td>φ = –0.01</td>
</tr>
<tr>
<td>Age at baseline</td>
<td>19.91 (1.32)</td>
<td>19.63 (1.22)</td>
<td>t(1186) = 2.64, p = 0.008**</td>
<td>d = –0.21</td>
</tr>
<tr>
<td>Asian</td>
<td>20.7% (204)</td>
<td>16.8% (32)</td>
<td>χ²(1) = 1.53, p = 0.216</td>
<td>φ = –0.04</td>
</tr>
<tr>
<td>Greek member</td>
<td>30.0% (297)</td>
<td>34.5% (67)</td>
<td>χ²(1) = 1.56, p = 0.211</td>
<td>φ = 0.04</td>
</tr>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AUDIT-C score</td>
<td>4.98 (1.95)</td>
<td>5.52 (1.87)</td>
<td>t(1183) = –3.53, p &lt; .001***</td>
<td>d = 0.28</td>
</tr>
<tr>
<td>AUDIT-C ≥ 5</td>
<td>53.0% (526)</td>
<td>66.8% (129)</td>
<td>χ²(1) = 12.47, p &lt; .001***</td>
<td>φ = 0.10</td>
</tr>
<tr>
<td>Peak eBAC</td>
<td>0.17 (0.09)</td>
<td>0.20 (0.09)</td>
<td>t(1186) = –3.88, p &lt; .001***</td>
<td>d = 0.30</td>
</tr>
<tr>
<td>HED frequency</td>
<td>1.08 (1.14)</td>
<td>1.39 (1.29)</td>
<td>t(1183) = –3.35, p &lt; .001***</td>
<td>d = 0.26</td>
</tr>
<tr>
<td>Blackout frequency</td>
<td>1.34 (1.23)</td>
<td>1.95 (1.14)</td>
<td>t(1185) = –6.42, p &lt; .001***</td>
<td>d = 0.50</td>
</tr>
<tr>
<td>Readiness to change score</td>
<td>–4.02 (8.16)</td>
<td>–1.04 (8.50)</td>
<td>t(1186) = –6.01, p &lt; .001***</td>
<td>d = 0.47</td>
</tr>
<tr>
<td>Stage of change</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precontemplation</td>
<td>55.6% (563)</td>
<td>38.1% (74)</td>
<td>χ²(2) = 22.37, p &lt; .001***</td>
<td>V = 0.14</td>
</tr>
<tr>
<td>Contemplation</td>
<td>14.1% (140)</td>
<td>20.6% (40)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Action</td>
<td>29.3% (291)</td>
<td>41.2% (80)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Randomly assigned to PNF</td>
<td>75.7% (752)</td>
<td>73.7% (143)</td>
<td>χ²(1) = 0.33, p = 0.566</td>
<td>φ = –0.02</td>
</tr>
<tr>
<td>PNF: Perceived impact</td>
<td>2.89 (1.19)</td>
<td>3.16 (1.34)</td>
<td>t(792) = –2.23, p = .026*</td>
<td>d = 0.22</td>
</tr>
<tr>
<td>PNF: Satisfaction with message</td>
<td>4.31 (1.19)</td>
<td>4.29 (1.25)</td>
<td>t(791) = 0.18, p = .860</td>
<td>d = –0.02</td>
</tr>
<tr>
<td>Completed 12-month follow-up</td>
<td>88.0% (875)</td>
<td>88.1% (171)</td>
<td>χ²(1) = 0.00, p = .964</td>
<td>φ = 0.00</td>
</tr>
</tbody>
</table>

Note. IR = incapacitated rape; RCT-1 = first randomized clinical trial; RCT-2 = second randomized clinical trial; AUDIT-C = alcohol use disorders identification test, consumption scale; eBAC = estimated blood alcohol content; HED = heavy episodic drinking; PNF = personalized normative feedback. Means (standard deviations) or percentages (n) are reported for each group. Effect sizes should be interpreted with reference to the statistic reported; small, medium, and large effects are reflected by phi (φ) of 0.1, 0.3, and 0.5, respectively. Cell sizes vary slightly due to missing data (up to n = 2 missing for demographic and baseline values).

* p < .05. ** p < .01. *** p < .001.
previous studies of college women generally (e.g., Kilpatrick et al., 2007) and likely reflects higher prevalence of sexual victimization in heavier drinking populations (Testa & Livingston, 2018). At baseline, women with past IR also reported more hazardous drinking relative to women without IR. These findings are consistent with prior research demonstrating IR is associated with subsequent elevations in hazardous drinking (Kaysen et al., 2006) including HED (Lawyer et al., 2010; McCauley et al., 2010) and blackout frequency (Voloshyna et al., 2018), but extends this work to reveal elevations in past-month peak eBAC. Of note, these baseline differences are cross sectional and it is therefore unclear whether hazardous drinking patterns were established before the IR or escalated after the IR, though past prospective research (Kaysen et al., 2006) suggests both processes may contribute to drinking patterns in the current sample. Consistent with past work showing greater readiness to change among heavier drinkers with more alcohol-related consequences (Vik et al., 2000), women with past IR reported greater readiness to change than women without IR. Taken together, the findings suggest IR is associated with hazardous drinking, perhaps to cope with IR-related distress. At the same time, IR survivors may be acutely aware that heavy drinking confers risk, and many indicated they were considering or actively trying to reduce their drinking. Alcohol use and drinking settings may also be a reminder of past IR (Jaffe et al., 2019), and related distress may also motivate IR survivors to reduce their drinking.

Second, we considered responses to PNF. Primed for change, women with past IR were particularly likely to perceive the present study’s PNF message as impactful. Contrary to expectations, IR history was not associated with differences in satisfaction with the PNF message. This suggests alcohol-related PNF may not activate blame-related cognitions about drinking after IR, at least not in a way that interferes with receiving the PNF message. More research is needed to specifically examine perceptions of blame and other cognitions that may contribute to satisfaction with the message. These findings are consistent with a prior study that found no differences by sexual assault history in comfort with an alcohol-focused web-based intervention (Jaffe et al., 2018). Although satisfaction with PNF was not compared to any other conditions in the present study, Jaffe et al. (2018) also found that among college women with a sexual assault history, comfort was lower in the alcohol-only intervention relative to a sexual assault risk reduction intervention and minimal assessment. Considering these findings in aggregate, it is important to note that the current PNF intervention only involved corrective drinking norms, whereas the prior intervention also included instruction on protective behavioral strategies, which a recent qualitative study suggests may be perceived by

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**Figure 1**

Mean Drinking Outcomes Represented by Condition and History of Incapacitated Rape at Baseline and the 12-Month Follow-Up

<table>
<thead>
<tr>
<th>AUDIT-C</th>
<th>Peak eBAC</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Graph" /></td>
<td><img src="image2.png" alt="Graph" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HED Frequency</th>
<th>Blackout Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Graph" /></td>
<td><img src="image4.png" alt="Graph" /></td>
</tr>
</tbody>
</table>

*Note. PNF = personalized normative feedback; IR = incapacitated rape; AUDIT-C = alcohol use disorders identification test, consumption scale; eBAC = estimated blood alcohol content; HED = heavy episodic drinking.*
Blackout frequency 28.5% 28.5% 28.5%
Peak eBAC 19.3% 19.4% 19.6%

Baseline covariate refers to the baseline assessment of the corresponding drinking outcome. Baseline eBAC and Blackout frequency

IR = incapacitated rape; PNF = personalized normative feedback. Bolded values are statistically significant at $p < .05$. Bolded, italicized terms represent drinking outcomes. Baseline covariate refers to the baseline assessment of the corresponding drinking outcome.

Sexual assault survivors as evoking blame for drinking (Gulati et al., 2021). Thus, the current findings reveal that minimalist web-based information regarding drinking norms may be particularly impactful and similarly satisfactory after IR, but more research is needed to understand how women with past IR might react to specific strategies to prevent future alcohol-related harms. Additional research is also needed to understand if and how such subjective reactions may relate to intervention outcomes. In the present study, subjective reactions to PNF were not associated with hazardous drinking at baseline or follow-up, suggesting participants’ perceptions of PNF efficacy at the time of the intervention do not map onto observed outcomes in the long term.

Finally, we evaluated PNF efficacy by IR on hazardous drinking 12 months after the intervention. Initial models revealed that after controlling for baseline levels of drinking outcomes and IR history, there were significant effects of PNF on hazardous drinking outcomes of peak eBAC and HED frequency. The fact that PNF did not have significant effects on the AUDIT-C or blackout frequency is consistent with past research suggesting PNF is most effective at reducing hazardous drinking in the short term, with less robust effects over time (Dedert et al., 2015; Donoghue et al., 2014; Ripper et al., 2014).

Current findings also revealed that long-term PNF efficacy for reducing HED frequency was moderated by history of IR. For women without a history of IR, there were no significant differences between PNF and control on HED frequency at 12 months. This suggests the long-term effects of PNF—which were modest in the original RCT-1 trial—were too small to detect in this specific group. Consistent with the past findings that web-based alcohol interventions are more effective for those with greater baseline alcohol consequences (Palfai et al., 2011) and more severe sexual assault histories (Gilmore, Lewis, et al., 2015), PNF was significantly

<table>
<thead>
<tr>
<th>Predictor</th>
<th>AUDIT-C</th>
<th>Peak eBAC</th>
<th>HED frequency</th>
<th>Blackout frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>SE</td>
<td>p</td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>PNF versus control: no IR</td>
<td>0.02</td>
<td>0.13</td>
<td>.883</td>
<td>-0.01</td>
</tr>
<tr>
<td>PNF versus control: IR</td>
<td>-0.51</td>
<td>0.30</td>
<td>.093</td>
<td>-0.03</td>
</tr>
<tr>
<td>IR versus no IR: Control</td>
<td>0.10</td>
<td>0.17</td>
<td>.544</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Note. AUDIT-C = Alcohol use disorders identification test, consumption scale; eBAC = estimated blood alcohol content; HED = heavy episodic drinking; IR = incapacitated rape; PNF = personalized normative feedback. Bolded values are statistically significant at $p < .05$. Bolded, italicized terms represent drinking outcomes. Baseline covariate refers to the baseline assessment of the corresponding drinking outcome.
associated with lower HED frequency only among college women with past IR.

Of note, IR only moderated PNF efficacy for one of four hazardous drinking outcomes examined in this study. It is possible that PNF in the presence of an IR history may specifically motivate changes in the occurrence of HED. That is, although PNF may lead to long-term reductions in consuming four or more drinks amongst women with past IR, when these women choose to engage in heavy drinking episodes, PNF may not substantially reduce the total number of drinks (above four), the rate of drinking, or other protective behaviors that contribute to the AUDIT-C score, eBAC, or blackouts. However, nonsignificant trends for PNF were observed amongst women with past IR for reducing both AUDIT-C and eBAC, suggesting some consistency in the direction of effects across hazardous drinking outcomes.

Taken together, PNF was associated with less post-IR hazardous drinking, perhaps because alcohol-related intervention content felt personally relevant to these women who then reduced their drinking. Although we focused on IR in this study, PNF may also be particularly effective in the long term for other trauma-exposed groups who are at risk for escalating alcohol use, or individuals with a personal history of serious alcohol consequences that motivates them to be receptive to intervention content. Although we expected IR-related readiness to change would contribute to these effects, readiness to change at baseline did not improve the prediction of hazardous drinking outcomes. This suggests factors beyond IR-related motivation to change (e.g., coping drinking motives, shifting social networks after IR) will be important to evaluate in future intervention research.

Strengths and Limitations

Strengths of the present study include a large sample and consideration of long-term PNF outcomes related to IR history. IR was assessed specifically with regard to preassault alcohol use, which may be more applicable to understanding reactions to alcohol interventions than sexual assault generally or IR involving drugs other than alcohol. Despite these strengths, the findings should be interpreted in light of study limitations. First, the original trials did not include a comprehensive assessment of sexual assault or trauma history. Thus, associations between treatment outcomes and assault severity or type could not be examined, and women who did not endorse alcohol-related IR in the present study may have experienced other forms of sexual victimization not captured by the single IR item (e.g., unwanted sexual touching, attempted rape, IR involving substances other than alcohol). Given that Gilmore, Lewis, et al. (2015) found that sexual assault severity moderated the efficacy of a combined alcohol and sexual assault risk reduction intervention, we encourage more comprehensive assessments of sexual assault in future alcohol intervention research to better understand whether severity, frequency, or recency of IR might affect responses to alcohol-specific interventions. In addition, IR may be associated with other predictors of PNF response that were not examined here but have been established in prior research, such as posttraumatic stress (Monahan et al., 2013), depression (Miller et al., 2020), and drinking to cope (Young et al., 2016). Future research should disentangle the occurrence of IR from its sequelae when examining response to alcohol interventions.

Second, we aggregated general feedback control conditions with a minimal assessment control to evaluate a meaningfully sized subgroup of women with IR. This meant drinking outcomes could only be evaluated at time points completed by minimal assessment (baseline and 12 months) and more nuanced postintervention trajectories of hazardous drinking could not be examined. Relatedly, we also aggregated across PNF conditions from the original RCT-1 trial, which evaluated norms presented for different reference groups and supplemented this with a PNF condition from a comparable RCT-2 trial. Although subgroup analyses were not possible within each of the PNF conditions, the variability in intervention effects may have added noise, making it more challenging to detect main and interactive effects of PNF. In addition, the original RCT-1 trial (LaBrie et al., 2013) revealed that one condition with PNF normed to a “typical student” was more effective to reduce drinking than the seven other conditions with PNF normed to more specific reference groups. Because most participants received these less effective versions of PNF, overall PNF efficacy may have been underestimated relative to more standard PNF administrations.

Finally, HED frequency was assessed for a typical week, which may underestimate HED over a set time period (e.g., past month). Although only heavy drinking college students were included in the original trial, typical HED frequency was relatively low in this sample and thus, the findings may be specific to students in this particular nontreatment seeking sample. Additionally, the findings may not be generalizable to men, noncollege students, or unrepresented ethnic/racial groups. Rates of IR may differ between ethnic/racial groups, and mechanisms underlying postassault drinking may be affected by cultural differences and differ by identity (Littleton et al., 2013; Nguyen et al., 2010). We encourage efforts to replicate and extend the current findings, particularly in racial and gender minorities and men who have experienced IR.

Conclusions

Results of the present study provide initial support for the use of a brief web-based PNF intervention to reduce hazardous drinking among college women with past IR involving alcohol. Notably, women were similarly satisfied with the intervention message regardless of IR history, suggesting PNF content may not elicit self-blame cognitions as indicated in previous web-based alcohol interventions. Thus, women with past IR may be able to connect with the PNF material presented and enact behavioral changes regardless of their initial readiness to change. This initial investigation suggests web-based PNF, a low-resource intervention that can be easily and widely disseminated, has promise to reduce hazardous drinking in college women with a history of alcohol-related IR. Research replicating and extending this finding is suggested to further understand efficacy of web-based alcohol interventions after IR.

References


Received May 15, 2020
Revision received April 20, 2021
Accepted April 21, 2021