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Effects of a Smartphone Intervention on Unprotected and Regretted Sex among Heavy Drinking Young Adults

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Abstract

Alcohol consumption is associated with negative sexual outcomes among heavy drinking young adults. Smartphone interventions are a promising approach to reducing alcohol consumption. This study aimed to test whether a smartphone app designed to reduce heavy drinking (via feedback on the cued go/no-go task) would reduce reports of negative sexual outcomes, including unprotected sex and regretted sex. It was hypothesized that app use would be associated with fewer negative sexual outcomes, especially among women. Participants were young adult heavy drinkers ($N = 49$) aged 21 to 25 years old. Participants completed an in-person drinking session as well as a four-week field use period during which they used the app in drinking situations. Participants reported on their drinking consequences via the Young Adult Alcohol Consequences Questionnaire (YAACQ) at baseline, two- and four-week follow-ups, and six- and twelve-month follow-ups. No significant associations were found between app use and unprotected or regretted sex, but the results were in the predicted directions, especially among women. Given encouraging preliminary results, future studies with larger samples should test smartphone app interventions for young adult heavy drinking.

Keywords: young adult, drinking, intervention, regretted sex, unprotected sex

Introduction

Heavy alcohol use among young adults is a public health concern, with 35% of young adults in a 2018 survey reporting heavy drinking in the past month (Substance Abuse & Mental Health Services Administration, 2018). Compared to other demographic groups, college students are more likely to engage in high rates of excessive drinking and binge drinking (White & Hingson, 2013). Negative sexual outcomes, such as unprotected sex (Gillman et al., 2018), as well as sexual assault victimization and perpetration (Abbey, 2011; Abbey et al., 2014), are associated with alcohol use in this population. In particular, alcohol-related unprotected sex (i.e., unprotected from sexually transmitted infections [STIs] and unwanted pregnancy; Dir et al.,

2018), as well as alcohol-related regretted sex (Peterson, 2020) are significant problems on college campuses, and among young adults, broadly. STI cases among young adults 15-24 years of age are high, with as many as 50% of 26 million annual STI cases occurring among this age group (Centers for Disease Control and Prevention [CDC], 2021). Additionally, regretted sex is a common experience among young adults, with as many as 72% of college students reporting regretted sex, and 31.7% of the incidents reported involved alcohol (Oswalt et al., 2005).

There is a well-documented relationship between alcohol use and negative sexual outcomes, and reducing alcohol use may reduce the associated risk (Gillman et al., 2018). Several aspects of young adults' lives facilitate heavy alcohol use (e.g., fewer adult responsibilities; Arnett, 2019). Relatedly, they tend to have limited motivation to change their behavior, necessitating novel targeted interventions to be used in the moment (Leeman et al., 2022). Technology-based interventions are appealing because young adults use technology frequently (Mason et al., 2014) and are open to technology use for health purposes (Castro et al., 2017). There are smartphone applications (apps) that provide in-the-moment blood alcohol content (BAC) estimates (Luczak et al., 2018), but there are no apps that provide effective, personalized, in-the-moment measurement of impairment to reduce negative consequences (Leeman et al., 2022). The current study aims to test the efficacy of an app, Alcadec, designed to measure impairment due to drinking in the moment using the cued go/no-go task (CGNG), which is a reaction time (RT) task that can determine inhibition (Donders, 1868), with implications for sexual risk behavior (Nydegger et al., 2014). The app provides feedback and advice based on performance on the CGNG in an effort to reduce heavy drinking and negative consequences due to drinking.

This study tested whether the Alcadec app would reduce negative sexual outcomes due to drinking as an indirect effect of reducing heavy drinking. It was hypothesized that more frequent app use (i.e., playing the CGNG task, requesting feedback, requesting advice) would be associated with fewer negative sexual consequences. The negative sexual consequences examined in this study were alcohol-related unprotected and regretted sex measured via two items from the Young Adult Alcohol Consequences Questionnaire (Read et al., 2006). It was also hypothesized that women would use the app more than men because women use strategies to moderate their drinking more frequently than men (Prince et al., 2013) and exhibit greater changes in response to brief interventions (Carey et al., 2007).

Method

Participants

Participants were 49 heavy drinking young adults who were 21-25 years old. Participants were recruited via flyers posted on college university campuses in Gainesville, Florida, and surrounding areas, as well as via social media posts on Instagram.

inclusion criteria.

Eligible participants were 21-25 years of age, able to read English, and complete study evaluations. In the past 30 days, participants must have reported drinking on at least one day to an estimated blood alcohol concentration (eBAC) of 0.12% or higher, and reported heavy episodic drinking (i.e., four or more drinks for women and five or more drinks for men) on at least four days. Participants must have also reported consuming at least one alcoholic drink on a minimum of 12 days in the past 30 days. Based on Diagnostic And Statistical Manual Of Mental Disorders (Fifth Edition; DSM-V) criteria, participants must have met, at minimum, criteria for mild Alcohol Use Disorder (AUD: i.e., endorse at least two diagnostic criteria). Participants had to perform within two standard deviations of normative levels with regard to RT and number of errors on the CGNG task (see measures) at the in-person screening and have access to an iPhone/iOS-compatible phone to be used for study-related tasks.

exclusion criteria.

Participants were ineligible if they reported seeking treatment for AUD or other addictive behaviors, or if they had been in inpatient or intensive outpatient treatment within the past 12 months. Participants were excluded if they used a smartphone application to facilitate moderate drinking more than once in the past 12 months or if they provided two positive breath alcohol concentration (BrAC) readings (i.e., > 0.00%) at an in-person screening appointment (or on the day of the alcohol drinking session). Participants who provided one positive BrAC were allowed to reschedule their session. A second positive BrAC resulted in exclusion from the study. Potential participants were ineligible if a positive urine screen for opiates, cocaine, phencyclidine, amphetamines, methamphetamine, barbiturates, methadone, or benzodiazepines was obtained at the in-person screening or the day of an alcohol drinking session. Meeting the criteria for moderate or severe DSM-V Cannabis Use Disorder, or a mild, moderate, or severe DSM-V Substance Use Disorder for any other drug, excluding alcohol, resulted in exclusion. Participants were ineligible if current use of psychotropic drugs including anxiolytics and

antidepressants, or receiving a prescription for any psychotropic drug in the 30 days prior to study enrollment was reported. Participants were not eligible if psychotic or otherwise psychiatrically disabled, or if a medical condition was reported that would contraindicate the consumption of alcohol (e.g., liver disease, cardiac abnormality, pancreatitis, diabetes, neurological problems, and gastrointestinal disorders). No participants could have a history of clinically significant withdrawal from alcohol, defined as either a lifetime history of seizures, delirium, or hallucinations during alcohol withdrawal, a Clinical Institute Withdrawal Assessment scale (CIWA-Ar; Sullivan et al., 1989) score above eight, a report of drinking to avoid withdrawal symptoms in the past 12 months, or a lifetime history of medical treatment for withdrawal. Participants could not be pregnant, nursing, or engaging in sexual activity with opposite-sex partners without a reliable method of birth control, weigh less than 110 pounds or greater than 220 pounds, or report disliking vodka or vodka mixed drinks. Finally, potential participants could not be colorblind or a foreign national.

Procedures

Potential participants filled out a web screener survey and sent a code word to the study team. If initially eligible, participants then participated in a screening session, either in person or remotely, for approximately two to three hours, which included a urine test, drinking measures, and other screening measures. If still eligible, participants took part in the individual drinking session and used one of three versions of the Alcadec app (randomized) in the lab for 4 to 6 hours. The three version of the app involved (1) no feedback, (2) just accuracy and RT feedback, or (3) accuracy and RT feedback in addition to intervention materials.

Following the individual drinking session, participants used the Alcadec app during a four-week field use period. Participants were granted full access to the app in real drinking situations during either the first or last two weeks of the field use period. A brief questionnaire was administered through the app each day of the four weeks. Following the four-week field use period, there was a one-hour follow-up appointment as well as six- and 12-month follow-up surveys.

Measures

Data was collected using RedCap surveys to record demographic information and medical history. To determine if a participant was eligible in terms of their alcohol use, the timeline-follow back (TLFB; Sobell & Sobell, 2003) measure was used. In this secondary analysis study, the Young Adult Alcohol Consequences Questionnaire (YAACQ; Read et al., 2006) and app use data (i.e., use of the CGNG task), were used as variables of interest. Additional measures used to determine eligibility and/or not used in analyses presented here were a breath alcohol content test, Structured Clinical Interview for DSM, Clinical Institute Withdrawal Assessment of Alcohol Scale Revised, Columbia Suicide Severity Rating Scale, Systematic Assessment for Treatment Emergent Events, THRIVE, Alcohol Purchase Task Now, and Alcohol Purchase Task Hypothetical.

young adult alcohol consequences questionnaire (YAACQ).

The YAACQ is a questionnaire that lists consequences experienced in the past six months (measured at baseline), past two weeks (2-week follow-up; 4-week follow-up), or past three months (6-month follow-up; 12-month follow-up) either during or after drinking alcohol. The response options included "yes," "no," and "choose not to answer." This study focused on two items including, "As a result of drinking, I neglected to protect myself or my partner from a sexually transmitted disease (STD) or an unwanted pregnancy," (hereafter referred to as "unprotected sex") and "My drinking has gotten me into sexual situations I later regretted" (hereafter referred to as "regretted sex"). The YAACQ was administered at baseline and at the two-week follow-up, four-week follow-up, six-month follow-up, and twelve-month follow-up. Because the timeframe of the YAACQ administered at the two- and four-week follow-ups was "past two-weeks," and thus rates of endorsement were low (see Table 1), we present analyses from baseline (during which past six-month consequences were assessed) and the six- and twelve-month follow-ups only (during which past three-month consequences were assessed).

cued go/no-go task (CGNG).

The CGNG is a reaction time (RT) task that tests how quickly participants respond to "go" targets while withholding responses to "no-go" targets. While participants' blood alcohol content (BAC) is less than the legal limit (.05-.06%), the CGNG is effective at measuring the ability of participants to refrain from "no-go" targets, representing a measure of participants' inhibition errors. At higher BAC levels, the CGNG is effective at measuring participants' ability to respond

quickly to "go" targets, thus measuring RT. Feedback using motivational interviewing consonant language compared RT and inhibition errors after alcohol to those before drinking.

app use. App use data was collected and included total CGNG task gameplay, total times feedback was requested, and total times advice was requested. Participants had access to the full version of the app for two weeks, during which they could play the game and request feedback (e.g., "you played the game more slowly compared to before drinking") and advice (e.g., "try having a water instead of another drink").

Results

Descriptive Statistics

The sample comprised 49 participants, including 25 women and 23 men (one participant did not report their gender). Approximately 87.8% of participants were White, 2% were Black, 6.1% were Asian, and 2% identified as other. Most participants identified as not Hispanic or Latino (65.3%), and 26.5% identified as graduate students. Most participants were 21 years old (42.9%), and the remaining participants were either 22 years old (30.6%), 23 years old (8.2%), 24 years old (8.2%), or 25 years old (8.2%). See Table 1 for rates of sexual consequences reported from baseline to 12-month follow-up. Participants used the app an average of 5.98 times, requested feedback 4.24 times, and requested advice 1.71 times during the field use period.

Table 1
Rates of Alcohol-Related Unprotected Sex and Regretted Sex

	Unprotected Sex		Regretted Sex	
Time	N	%	N	%
Baseline (past 6-month)	7	14.3	15	30.6
Two-Week (past two-weeks)	3	6.1	1	2
Few-Week (past two-weeks)	1	2	0	0
Six-Month (past 3-month)	1	2	1	2
12-Month (past 3-month)	2	4.1	4	8.2

Gender Differences

gender differences in alcohol consequences at baseline.

Independent samples *t*-tests were conducted to evaluate the hypothesis that women would report

fewer instances of unprotected and regretted sex at baseline compared to men. The gender differences were not significant (*p*s > .84), but the results were in the predicted direction (see Table 2).

Table 2
Gender Differences in Alcohol Consequences at Baseline and from Baseline to Twelve Months

	Unprotected Sex				Regretted Sex			
	Women		Men		Women		Men	
Time	M	SD	M	SD	M	SD	M	SD
Baseline	0.12	0.33	0.17	0.39	0.32	0.48	0.35	0.49
Baseline to 12-Months	0.20	0.50	0.35	0.57	0.44	0.65	0.39	0.58

gender differences in total alcohol consequences from baseline to twelve months.
Independent samples *t*-tests were also conducted to evaluate the hypothesis that women would report fewer instances of unprotected and regretted sex across the duration of the study compared to men. The gender differences were not significant (*p*s > .79), and for regretted sex, the results were not in the predicted direction (see Table 2).

gender differences in app use across the study.
Independent samples *t*-tests were conducted to evaluate the hypothesis that women used the app features (playing the game, requesting feedback, and requesting advice) more than men. The gender differences were not significant (*p*s > .08) for use of any of the app features, but the results were in the predicted direction (see Table 3).

Table 3
Gender Differences in App Use Across the Study

	Women		Men	
Time	M	SD	M	SD
Game Play	6.87	4.15	5.14	3.57
Feedback	5.04	4.10	3.57	3.79
Advice	2.43	4.01	0.86	1.06

Correlations

alcohol consequences and app use at baseline.

Point-Biserial correlation coefficients were computed to assess the relationship between reports of unprotected and regretted sex at baseline and use of the app features (playing the game, requesting feedback, and requesting advice). Baseline reports of unprotected sex were not correlated with the use of the app features (gameplay, $r[42] = -0.04$, $p = 0.811$; requesting feedback, $r(42) = -0.07$, $p = 0.655$; requesting advice, $r(42) = -0.06$, $p = 0.714$). Baseline regretted sex was not correlated with the use of the app features (gameplay, $r(42) = -0.23$, $p = 0.133$; requesting feedback, $r(42) = -0.17$, $p = 0.264$; requesting advice, $r(42) = -0.08$, $p = 0.593$).

app use and alcohol consequences at six and twelve months.

Point-Biserial correlations were not conducted due to low endorsement of alcohol consequences at the six and twelve month follow ups.

Discussion

Young adults are at high risk for negative sexual consequences due to their high rates of heavy drinking (White & Hingson, 2013). By reducing the rates of heavy drinking through targeted interventions in the moment, the frequency of negative sexual consequences might be mitigated (Gillman et al., 2018). The frequent use of technology among young adults makes smartphone apps a reasonable intervention to reduce young adult drinking and thus, negative sexual consequences (Mason et al., 2014). It was hypothesized that more frequent use of an app designed to reduce drinking would result in fewer negative sexual consequences. Differences in app use and alcohol consequences between men and women were also investigated and it was hypothesized that women would use the app more frequently than men, and experience fewer negative sexual outcomes. The results were not significant but were in the predicted direction. While the results were not significant, the hypotheses put forth and the utility of the app appear to warrant further research. No significant conclusions can be drawn from the data collected in this study, but in the future, with more data, significant associations between key variables might be found.

Limitations

The present research has limitations worth noting. First, the sample was restricted to young adults in the Gainesville, Florida area. There is the possibility that young adults in different

geographic locations might have different drinking habits and experience sexual consequences at different rates. Second, the sample size was small ($N = 49$) at baseline and declined as the study progressed due to attrition/loss-to-follow-up. This might be addressed in future studies by recruiting a larger initial sample size and following up more frequently. Third, the number of negative sexual consequences were obtained through self-report which is subject to bias. Finally, the study took place during the COVID-19 pandemic, which likely contributed to attrition/loss-to-follow up and may have altered drinking habits (Patrick et al., 2022), and subsequent negative sexual outcomes of participants in unanticipated ways.

Future Directions

Technology can facilitate the measurement of inhibition and provide feedback and advice in the moment. Future studies might incorporate the use of smartphone app interventions in samples of young adults due to the frequency with which young adults engage with technology. Given that there was some level of interaction with the app throughout the study, the app could be a feasible intervention to reduce heavy drinking and negative sexual outcomes in young adults. Future studies might replicate the study in different geographic locations and use personal health information reports as opposed to self-report. The study might be replicated to reevaluate the field use period without COVID-19 restrictions in place.

Conclusion

Young adult heavy drinking is common and can be dangerous, as alcohol inhibits one's judgment and self-awareness, resulting in associated negative sexual outcomes. Technology and smartphones may serve as promising intervention platforms for young adults. Future work should test smartphone apps designed to reduce heavy drinking among young adults in more diverse samples and with larger sample sizes to be powered to detect differences in negative sexual consequences over time.

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