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A Text Message Program as a Booster to In-Person Brief Interventions for Mandated College Students to Prevent Weekend Binge Drinking

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Abstract

Objective—To evaluate a text message (SMS) program as a booster to an in-person alcohol intervention with mandated college students.

Participants—Undergraduates (n=224; 46% female) who violated an on-campus alcohol policy over a 2 semester period in 2014.

Methods—The SMS program sent drinking-related queries each Thursday and Sunday and provided tailored feedback for 6 weeks. We examined response rates to SMS drinking-related queries and the associations between weekend drinking plans, drinking-limit goal commitment and alcohol consumption. Gender differences were explored.

Results—90% of SMS queries were completed. Weekend binge drinking decreased over 6 weeks, and drinking-limit goal commitment was associated with less alcohol consumption. Compared with women, men had greater reductions in alcohol consumption when they committed to a drinking-limit goal.

Conclusions—Preliminary evidence suggests that an SMS program could be useful as a booster for helping mandated students reduce weekend binge drinking.

Keywords

alcohol; text message; college student; mandated

Alcohol use is a major contributor to student morbidity and mortality[1] and there are thousands of alcohol policy violations per year on college campuses.[2,3] College students who violate campus alcohol policies have been shown to drink at higher quantities than general college populations,[4] and are therefore an important sub-population to target for interventions aimed at reducing consumption.[5] Individual-level interventions have been

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shown to produce small reductions in alcohol consumption and alcohol-related problems in general college student populations,[6] but exhibit diminished effects over time and may be less effective for mandated college students.[7]

In non-college settings, investigators have attempted to boost the effects of in-person alcohol interventions by incorporating booster sessions, either through letters,[8] face-to-face sessions,[9] or over the phone.[10,11,12] There have also been in-person boosters added to alcohol interventions in college settings, but little evidence of effect.[13] One potential explanation for sub-optimal effects may be the relatively low frequency of booster delivery.[14]

A communication modality that may help boost effects of interventions for mandated students is mobile phone text messaging (e.g. short message service: SMS). SMS programs have been shown to be effective at reducing hazardous alcohol use in young adult emergency department populations as a stand-alone intervention,[15,16] and are beginning to be explored in college students.[17,18] To our knowledge, no study has reported on the implementation of an SMS program with college students who violate a campus alcohol policy.

The present study analyzes anonymous data obtained from a database of text responses collected as part of an SMS program (PantherTRAC) aimed at reducing weekend binge drinking. PantherTRAC was implemented as an adjunct to an existing in-person program mandated to students who violated a campus alcohol policy. In brief, PantherTRAC was designed to help young adults (1) understand their own weekend drinking patterns, (2) commit to drinking-limit goals to limit their weekend drinking below binge drinking thresholds, and (3) change their attitudes, perceived norms and self-efficacy regarding drinking (consistent with the Theory of Planned Behavior). The software program accomplishes these tasks by conducting text-based dialogue with users each Thursday and Sunday. Each Thursday, users are asked to report their weekend drinking plans, and if they report that they plan on drinking, are asked whether they are willing to commit to a drinking limit goal. Users are provided feedback messages tailored to their drinking plan and goal commitment. Each Sunday, users are asked to report the largest number of drinks they consumed on any single day over the weekend, and based on their report, are provided with feedback tailored to their consumption report. (***See*** Appendix ***for PantherTRAC Flow Diagram)***

The primary aim of this study was to describe initial estimates of response rates to SMS drinking-related queries, and the associations between weekend drinking plans, drinking-limit goal commitment and alcohol consumption. We hypothesized that enrolled students would respond to the majority of SMS queries sent over 6 weeks. We also hypothesized that reports of weekend binge drinking would decrease over the 6 weeks of program exposure. Because change plans are key components of motivational interviewing[19] and have been shown in prior research to be active ingredients of brief interventions[20] , we hypothesized that committing to a pre-weekend drinking-limit goal would be associated with lower maximum drinks and lower odds of any binge drinking episode over that weekend. By using text responses for dependent and independent variables, we were able to reduce the biases associated with retrospective recall and uniquely examine associations between goals and

alcohol consumption independent of time. Finally, we explored the effects of gender on adherence and outcomes, given that prior research suggests differences in how man and women respond to alcohol interventions.[6,21,22]

METHODS

Design

This study was a secondary analysis of an existing de-identified data set which was constructed from text message data collected each Thursday and Sunday over the course of a 6-week SMS program. Prospective informed consent was not possible because the program was implemented as a service provided as part of routine student health for individuals who have violated a campus alcohol policy. The University of Pittsburgh Institutional Review Board reviewed and approved the study to review the de-identified database.

Procedure

Participants (N=224, 46% female) were undergraduate college students who had violated campus alcohol policy at a 4-year, public university located in Western Pennsylvania and were sanctioned to complete a mandated alcohol intervention consisting of 2 class sessions, which each last about 2 hours, and a one-on-one follow up appointment between the student and instructor. In addition to attending the sessions, each student was required to complete a pre-assessment, homework assignments and a post-assessment. Class sessions addressed a variety of topics such as alcohol and the body, alcohol emergencies, health, social and legal risks. The instructors were graduate-level interns, managed through the Office of Health Education and Promotion at Student Health Service.

Between February-April and July-December, 2014, mandated students who completed all in-person sessions and the post-assessments were required to enroll in a 6-week SMS alcohol program (PantherTRAC). This recruitment occurred on a rolling basis as students were identified as having violated a campus alcohol policy. Mandated students were not given a choice regarding enrollment in the SMS program as it was considered part of the sanction. University staff did not monitor individual-level SMS engagement. Students were not incentivized monetarily or otherwise to complete SMS queries. To introduce the PantherTRAC program, students were provided with information as follows: “PantherTRAC is a text-message program aimed at helping young adult drinkers lower health risks and negative consequences of hazardous drinking. PantherTRAC will conduct brief text-message dialogue with students every Thursday and Sunday for 6 weeks. PantherTRAC is completely private, meaning the texts you send us will not be shared with anyone else. You can stop the program at any time by texting “STOP” to our phone number. To enroll, text “Panther” to XXX-XXX-XXXX.”

PantherTRAC

PantherTRAC was an automated two-way text message program designed by a multi-disciplinary team of investigators at the University of Pittsburgh and administered through servers housed in the Office of Academic Computing at Western Psychiatric Institute and Clinic. It was based on a 12-week SMS program that was shown to be effective at reducing

alcohol consumption in young adults identified with past hazardous alcohol consumption in the emergency department.[15,16] PantherTRAC participants received a series of welcome text messages within 1 hour of enrollment describing what to expect over the course of program exposure and to collect data on gender. Each Thursday at 12pm for 6 weeks, they were sent a text asking them to report whether or not they planned to drink the coming weekend. If they reported anticipating drinking, they were then asked whether they were willing to commit to a drinking-limit goal (<5 drinks per occasion for men or <4 drinks per occasion for women). Depending on the response to each query, participants were provided with real-time text feedback to either strengthen their low-risk drinking plan or goal or, alternately, to promote reflection on their drinking plan or decision not to commit to a low risk goal. Then, on Sunday at 12pm, participants were sent a text asking them to report the most number of drinks they had during a single occasion over the weekend. Depending on their response, they were provided with text feedback to either support their low-risk drinking behavior or to promote reflection on their binge drinking behavior. We chose to send both Thursday and Sunday queries at 12pm to give users ample time during the day to respond. If participants did not respond to a given query within 6 hours, they received a message telling them that we missed their response and will check in another day. All messages outside the range of expected responses from participants were designed to be tagged and emailed immediately to the investigators. No messages were received during implementation that indicated a student was in an emergency or needed immediate help.

Measures

We defined a “successful response” as an interpretable and appropriate text reply to the Thursday and Sunday text queries. Missing responses could be either a value that did not make sense (outside the range of acceptable answers) or queries that timed out without receiving a response. From Thursday text responses, we measured (1) plan to drink over the weekend (1=yes, 0=no) and (2) willingness to commit to a drinking-limit goal over the weekend (1=yes, 0=no). From Sunday text responses, we measured (1) the maximum number of alcoholic drinks consumed over any one occasion over the weekend (continuous), and (3) any weekend binge drinking episode (1= greater than or equal to 5/4 drinks for men/women, 0=less than 5/4 drinks).

Data Analysis

To assess adherence to the SMS program, we describe the proportion of text queries successfully responded to on Thursday and Sunday over 6 weeks. To understand changes in weekend alcohol cognitions and consumption, we describe the proportion of participants who reported: (1) plan to drink over the weekend, (2) willingness to commit to a drinking-limit goal, and (3) any weekend binge drinking episode. We also describe the mean number of drinks consumed over any one occasion. These descriptive analyses were conducted using STATA statistical software, version 13.1.

To assess the independent association of time and gender on any binge drinking episode and mean number of drinks consumed, as well as to examine the independent effect of goal commitment on any binge drinking episode and mean number of drinks consumed, we used hierarchical linear modeling (HLM) conducted in the HLM 7.01 program.[23] HLM was

appropriate as our data were nested within participants across time, and given our interest in both between-person (Level 2) effects (i.e., gender) and within-person (Level 1) effects (i.e., time, goal commitment) on alcohol use outcomes. HLM analyses began with a screen for missing data. An advantage of HLM is its flexibility in handling missing data at the within-person level, allowing us to retain for analysis any participant that responded to at least one SMS query. Of the original sample of 224, two participants did not contribute any text message response data. Four additional participants texted "STOP" to discontinue participation at some point during the 6-week program, but were not excluded from analyses. Therefore, the person-period data set for analysis was represented by 1332 possible observations (N=222 participants*6 assessments). The distribution of mean number of drinks consumed was examined, and 8 outliers falling above the 75th percentile plus three times the interquartile range were recoded to the highest non-outlying value plus one.[24] In addition, we relied on robust standard errors when homogeneity of variance assumptions were violated. Models were run using full maximum likelihood estimation and all intercept and slope effects were specified as random.

First, to test our hypothesis that enrolled students would report reductions in alcohol consumption over the course of exposure, a hierarchical linear growth model for continuous outcomes was used to examine the slope of mean number of drinks consumed over time. To test our hypotheses that the odds of any binge drinking episode would decrease over time, we used Bernoulli (unit-specific) models for binary data, which use a logit link function. All models controlled for gender as a predictor of intercepts of the outcome variable. Further, we included exploratory analyses of whether associations of interest differed by gender. That is, gender was regressed on the slopes representing change over time in each of the models. Prior to forming interactions, gender was recoded using effects coding, to remove collinearity with interaction terms so that all main effects of time could be evaluated in the context of significant interactions. In addition, simple slopes were probed following procedures outlined by Aiken & West[25].

Next, among the subset of participants who reported a plan to drink over the weekend during at least one assessment (n=134, 44% women), an additional linear growth and an additional Bernoulli model were used to test our hypotheses that goal commitment is associated with lower mean number of drinks consumed and odds of any binge drinking episode, respectively. Again, gender was controlled as a predictor, and we conducted an exploratory test of whether gender moderated the impact of goal setting on drinking outcomes.

RESULTS

PantherTRAC Adherence

We sent a total of 1,344 Thursday texts querying whether the participant had a plan to drink that weekend over 6 weeks to the 224 participants; 133 (9.9%) responses were missing. The percentage of participants responding to the Thursday plan to drink queries increased from 84.8% on week 1 to 87.9% on week 6. Contingent upon a plan to drink, we sent a total of 392 Thursday texts querying whether the participant was willing to commit to a drinking-limit goal; 17 (4.3%) responses were missing. The percentage of participants responding to the drinking-limit goal queries increased from 98.5% on week 1 to 100% on week 6. We

sent a total of 1,344 Sunday texts querying the mean number of drinks consumed; 105 (7.8%) responses were missing. The percentage of participants responding to mean number of drinks consumed queries decreased from 97.4% on week 1 to 91.6% on week 6. Figure 1 illustrates the response rates to Thursday and Sunday texts over the 6 weeks.

Pre-Weekend Drinking Plans, Drinking-Limit Goal Commitment, and Alcohol Consumption

On average, students reported a weekend drinking plan on 32.3% of weekends studied, which decreased from 35.3% on week 1 to 25.4% on week 6. If they planned on drinking, participants reported willingness to commit to a drinking-limit goal on 60.5% of weekends, with no discernable changes over the 6 weeks. On average, participants reported a binge drinking episode on 17.6% of the weekends, which decreased from 31.0% on week 1 to 2.9% on week 6. On weekends with a report of any drinking, the mean number of drinks consumed was 5.4 (SD 4.0), and decreased from 5.8 (SD 3.9) to 4.0 (2.8) from week 1 to 6. Figure 2 illustrates the change in the percentage of participants with a weekend drinking plan and any binge drinking episode over the 6 weeks. Participants reported a weekend binge drinking episode on 34.8% of the weekends they committed to a goal (GOAL) versus 63.5% of weekends they did not commit to GOAL, the changes across weeks illustrated in Figure 3.

Multilevel Models

As seen in Table 1, the odds of a weekend binge drinking episode declined over the course of the intervention and the change in odds of having a binge drinking episode over time did not differ by gender. Similarly, the mean number of drinks consumed significantly declined over the course of the intervention, with no differences in the rate at which drinking declined between women and men.

As seen in Table 2, the odds of a binge drinking episode were lower on weeks when participants reported being willing to commit to a drinking-limit goal compared to when they were not, controlling for gender and time. However, the independent effect of goal commitment on odds of binge drinking did not differ by gender. On weeks when participants reported a goal commitment, mean number of drinks consumed were significantly lower than when they were not willing to commit, controlling for gender and time. This effect was moderated by gender; the inverse association between committing to a goal and mean number of drinks consumed was significant for men (B=−2.73, SE=.63, t=−4.28, p<.001) but not for women (B=−0.61, SE=.51, t=−1.21, p=.23).

COMMENT

This study is the first to describe the implementation of a text message program as a booster to an in-person brief intervention in mandated college students with alcohol violations, with findings that support feasibility and utility. Adherence was 90% and, on average, participants reported reductions in alcohol consumption (both likelihood of weekend binge drinking and number of drinks consumed) over 6 weeks of exposure. Notably, students also reported reductions in pre-weekend *plans* to drink over the course of the SMS program. That is, consistent with the Theory of Planned Behavior[26], the intentions to drink less seemed to be

co-linear with lower rates of alcohol consumption. Moreover, consistent with prior literature supporting goal setting as a key component in behavioral change interventions[20,27], commitment to a low risk drinking goal was associated with reductions in the likelihood of binge drinking. In other words, we found preliminary support for the hypothesized processes by which the SMS program may influence drinking – both through intentions to drink and goal-commitment to limit drinking.

Comparing the reductions in binge drinking found in our study to other studies of brief interventions for mandated students is difficult due to differences in protocols, absence of reporting on individual weekend alcohol consumption in other studies, and no prior studies using SMS. In Borsari et al, 2012,[28] 80% of the mandated students exposed to in-person brief advice did not reduce their heavy drinking at 6-weeks follow-up. In Carey et al., 2009,[29] there were no significant mean reductions in alcohol consumption between the month post-sanction and the month post-exposure to a brief in-person intervention among mandated students. However, Terlecki et al., 2015,[30] reported that at 4 week follow-up, a brief intervention significantly decreased alcohol consumption relative to controls among non-mandated and mandated students (ds = .41–.92).

Exploratory tests of whether the SMS program influenced men and women differently revealed no gender differences in rate of change for the drinking outcomes examined. However, results did indicate gender differences in several other respects. On average, men had lower response rates, more frequent plans for weekend drinking, and higher levels of alcohol consumption. When men were willing to commit to a drinking-limit goal, they consumed significantly fewer drinks, whereas goal commitment was not associated with mean number of drinks consumed among women. In the context of general reductions of drinks consumed over time across *both* genders, this may suggest that women have a tendency to reduce their drinking after a violation of a campus alcohol policy regardless of whether they commit to a drinking-limit goal, whereas men are particularly apt to do so if they make a commitment to a drinking-limit goal. This is consistent with other research demonstrating that female students are more likely to change naturalistically following alcohol-related sanctions,[7,31] are naturally more motivated to avoid further sanctions,[32] and more likely to use protective behavioral strategies when prompted to do so.[33,34]

Our findings suggest a few promising directions for future research and development of the SMS program for mandated students and other at-risk college populations. Most obviously, a randomized trial is needed to compare the effect of an SMS program to treatment as usual following a standard brief mandated intervention. Second, translational research is needed to determine how best to improve the effectiveness of SMS programs through personalization, tailoring, and other communication strategies. For example, given that individuals who committed to a drinking limit goal still reported a binge drinking episode roughly one-third of the time suggests that “just-in-time” support could increase success with goal striving. With regards to our gender-specific findings, it may be useful among men particularly to focus on goal commitment to help “break the chain” between intention and action. Third, research should explore the feasibility and effectiveness of longer SMS programs, perhaps utilizing periodic surveillance and contingent program re-initiation for those who slip back into heavy drinking episode drinking patterns. Fourth, further development of SMS

programs could use data generated through the individual SMS reports to create graphical displays periodically sent to individuals to help them track their progress. Finally, testing SMS programs for primary prevention of binge drinking and other hazardous drinking patterns in college students needs to be explored.

Limitations

The results of this initial implementation study need to be interpreted in the context of the limitations associated with an uncontrolled trial performed at a single site. Students underwent a mandated intervention that included 4 hours of group meetings, one individual counseling session, and homework, which occurred just prior to initiating the SMS program. This means that the effects of the in-person intervention cannot be separated from the effects of the SMS program. Since there was no comparison condition during the booster period, the extent to which the SMS program had an influence beyond what would have otherwise been observed is not known. The pattern of findings could also reflect the suppression of drinking associated with the sanction effect.[35,36] Another limitation is that the students were not given a choice about enrollment in the SMS program. Therefore, we cannot assume that the high response rates would be reproduced outside of the mandated context. The students were, however, given the choice to withdraw from the program, but only 4 (1.7%) did. Such a context may have biased reporting to under-estimate actual alcohol consumption amounts; however, that reductions in drinking were still observed across time is promising. The observed reductions in drinking behavior could be simply a product of repeatedly asking students about their drinking, however, research on repeated assessments of college drinking have found little evidence of assessment reactivity.[37] We were not able to examine the changes in alcohol consumption as influenced by seasonal variability[21] and there may be unmeasured seasonal confounding effects. We were not able to examine socio demographics other than gender, therefore we cannot comment on non-gender moderators of effectiveness. We did not examine longer outcomes, recidivism nor alcohol-related consequences. Finally, we cannot comment on the external validity of findings, for example, at other colleges or other contexts.

Conclusion

Despite limitations of study design, our findings provide preliminary evidence to support SMS program feasibility and utility as a booster to mandated in-person interventions – participants engaged with the SMS program and some evidence was found in support of the hypothesized change model. Controlled studies are needed to determine the effect of an SMS program as an adjunct to in-person brief interventions.

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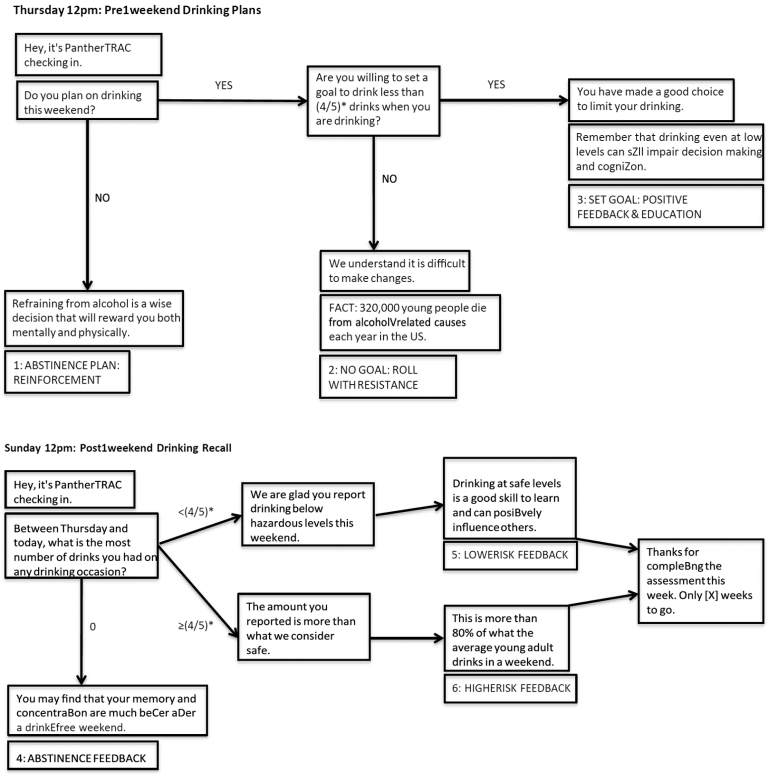
Appendix: Flow chart for PantherTRAC SMS dialogue on Thursday and Sunday



* Indicates heavy drinking episode threshold: >3 for Women, >4 for Men.

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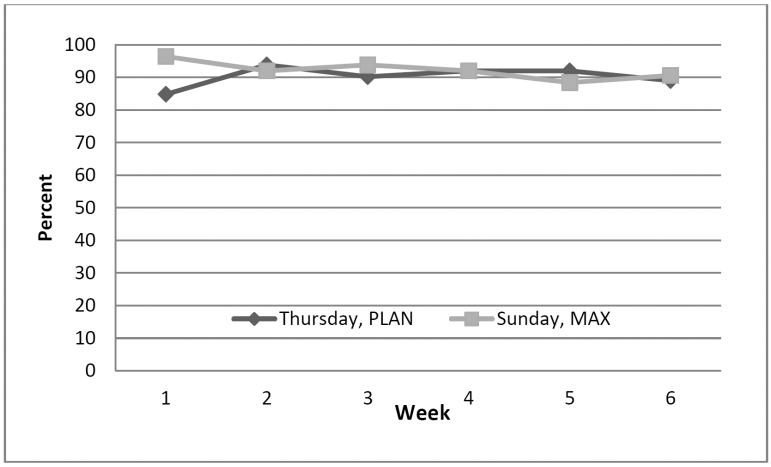

Figure 1.

Percent of Participants Responding to Thursday Drinking Plan and Sunday Alcohol Consumption Queries over 6 weeks

PLAN= plan to drink over the weekend; MAX= most number of alcoholic drinks consumed over any one occasion over the weekend.

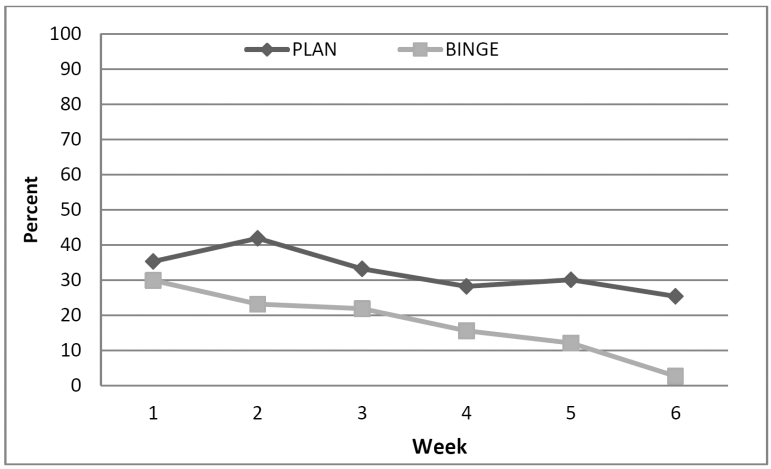

Figure 2.

Percent of Participants Reporting a Plan to Drink on Thursday and a Binge Drinking Episode on Sunday over 6 weeks

PLAN= plan to drink over the weekend (1=Yes, 0=No); BINGE= any weekend binge drinking episode (1= greater than 4/3 drinks for men/women, 0=less than 5/4 drinks for men/women).

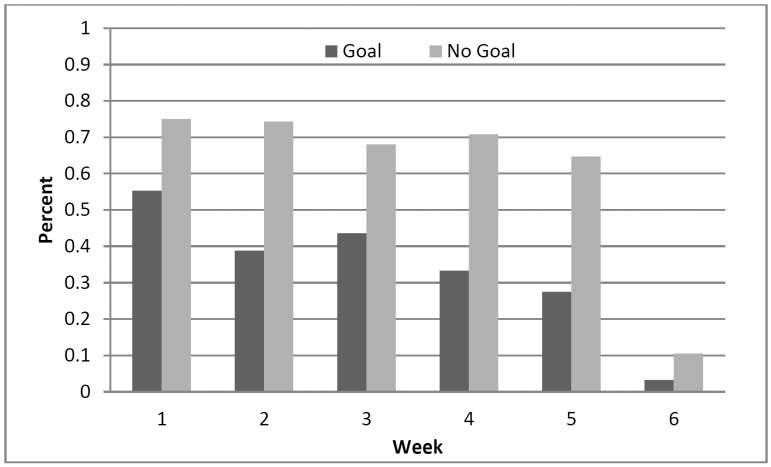

Figure 3.

Percent of Participants Reporting a Binge Drinking Episode by Willingness to Commit to a Goal over 6 weeks

Goal = willing to commit to a drinking-limit goal over the weekend; No Goal = not willing to commit to a drinking-limit goal over the weekend.

Table 1

A. Examining Change over Time in Binge Drinking Episodes Odds and Mean Number of Drinks Consumed (n=222)

Fixed Effect	B	SE	*t*-ratio	*p*-value	Odds Ratio	Confidence Interval
Intercept of BINGE	−0.35	0.18	−1.98	0.050	0.70	(0.49,1.00)
Gender	0.25	0.36	0.69	0.490	1.28	(0.63,2.60)
Slope of Time	−0.43	0.05	−9.45	<0.001	0.65	(0.60,0.71)
Gender × Time	−0.004	0.09	−0.04	0.968	1.00	(0.83,1.19)

Fixed Effect	B	SE	*t*-ratio	*p*-value
Intercept of MAX	3.02	0.25	12.18	<0.001
Gender	1.38	0.48	2.88	0.004
Slope of Time	−0.27	0.05	−5.96	<0.001
Gender × Time	−0.12	0.09	−1.36	0.175

BINGE= any weekend binge drinking episode (1= greater than 4/3 drinks for men/women, 0=less than 5/4 drinks for men/women); MAX= most number of alcoholic drinks consumed over any one occasion over the weekend (continuous); Time= Weeks (1–6).

Table 2

Testing Whether Committing to a Drinking-Limit Goal Relates to Changes in Alcohol Consumption in Subset Reporting a Weekend Plan to Drink (n=134)

Fixed Effect	B	SE	*t*-ratio	*p*-value	Odds Ratio	Confidence Interval
Intercept of BINGE	2.12	0.32	6.57	<0.001	8.35	(4.40,15.82)
Gender	−0.13	0.44	−0.30	0.768	0.88	(0.37,2.08)
Slope of Time	−0.45	0.07	−6.59	<0.001	0.28	(0.17,0.45)
Effect of GOAL	−1.28	0.25	−5.18	<0.001	0.28	(0.17,0.45)
Gender × Goal	−0.14	0.50	−0.28	0.781	0.87	(0.32,2.35)

Fixed Effect	B	SE	*t*-ratio	*p*-value
Intercept of MAX	7.12	0.45	15.92	<0.001
Gender	2.88	0.75	3.84	<0.001
Slope of Time	−0.40	0.11	−3.80	<0.001
Effect of GOAL	−1.80	0.43	−4.16	<0.001
Gender × Goal	−2.11	0.79	−2.68	0.008

PLAN= plan to drink over the weekend (1=Yes, 0=No); GOAL= willingness to commit to a drinking-limit goal over the weekend (1=Yes, 0=No); BINGE= any weekend binge drinking episode (1= greater than 4/3 drinks for men/women, 0=less than 5/4 drinks for men/women); MAX= most number of alcoholic drinks consumed over any one occasion over the weekend (continuous); Time= Weeks (1–6).