Prevention Science (2019) 20:873–883
https://doi.org/10.1007/s11121-018-0939-9

The Efficacy of an Event-Specific, Text Message, Personalized Drinking Feedback Intervention

Jennifer M. Cadigan[1] · Matthew P. Martens[2] · Emily R. Dworkin[1] · Kenneth J. Sher[3]

Published online: 27 July 2018

Abstract

Tailgating drinking prior to a football game is a type of event-specific drinking associated with increased alcohol use and related problems. Personalized drinking feedback interventions (PFI) are efficacious in reducing alcohol use and problems. The current study aimed to advance understanding of event-specific interventions by examining: (1) the efficacy of an event-specific, text message PFI on tailgating alcohol outcomes, and (2) the extent to which intervention effects generalize to "typical" alcohol outcomes at 1-month follow-up. College students ($N = 130$; 71% female; 92% white) who reported tailgating within the past 30 days and binge drinking when tailgating in the past year completed assessments on tailgating and typical alcohol use. They were randomly assigned to one of two text message conditions delivered on the morning of a home football game: event-specific PFI (TXT PFI) or a control condition. Multilevel modeling examined the association of treatment condition on tailgating and 1-month alcohol outcomes. When tailgating, participants in TXT PFI reported lower estimated peak blood alcohol concentration (eBAC) and consumed less drinks than the control condition. At the 1-month "typical" drinking follow-up, participants in TXT PFI reported lower peak eBAC and fewer alcohol-related problems than the control condition. Perceived tailgating drinking norms were found to statistically mediate the relationship between condition and alcohol outcome at tailgating and 1-month follow-ups. Findings provide preliminary support for the efficacy of an event-specific, text message PFI in reducing both tailgating and typical drinking alcohol outcomes. Event-specific TXT PFI can be used for prevention/intervention of alcohol misuse.

Keywords Event-specific · Tailgate · Text message · Personalized feedback · Alcohol

Specific events have been associated with excessive alcohol use among college students, such as 21st birthdays, Spring Break, New Year's Eve, and sporting events (Neighbors et al. 2006a; Rutledge et al. 2008). These events are particularly harmful above and beyond typical drinking, as event-specific use is associated with an escalation in alcohol use and related consequences (Neighbors et al. 2007). Sporting events, particularly tailgating at college football games (i.e., the practice of partying before a sporting event; Vicary and Karshin 2002), are associated with increased alcohol consumption and alcohol-related problems among college students (Hustad et al. 2014; Moser et al. 2014; Neal and Fromme 2007). In one study, over 75% of students consumed alcohol when tailgating (Neighbors et al. 2006a), and sports fans tend to consume more alcohol when tailgating than on other drinking occasions (Glassman et al. 2007). Rees and Schnepel (2009) found that home college football games were associated with an increase in deviant behavior, including a 9% increase in assaults, an 18% increase in vandalism, a 13% increase in arrests for drunk driving, a 41% increase in arrests for disorderly conduct, and a 76% increase in arrests for liquor law violations. Further, consumption of alcohol while tailgating is associated with negative outcomes, including an increase in fights and arrests for drunk driving and disorderly conduct (Coons et al. 1995).

Personalized Feedback Interventions

Personalized drinking feedback interventions (PFI) are commonly used as a selective prevention strategy for reducing alcohol use and related problems among college students.

✉ Jennifer M. Cadigan
CadiganJ@uw.edu

[1] Department of Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, USA

[2] Department of Educational, School, and Counseling Psychology, University of Missouri, Columbia, MO, USA

[3] Department of Psychological Sciences, University of Missouri, Columbia, MO, USA

Although specific components of feedback can vary among interventions, PFIs generally incorporate social norms comparisons (e.g., how a student's typical drinks per week compares to campus norms, often expressed as a percentile rank), a summary of different indicators of alcohol consumption and their associated risks (e.g., self-reported estimated blood alcohol concentration (BAC) levels and consequences typically associated with such levels), and alcohol-related problems experienced over some time interval (Carey et al. 2012). A meta-analysis suggested that, when compared to control groups, both PFIs delivered in-person and as stand-alone computer-based interventions are efficacious in reducing alcohol use and related problems among college students (Carey et al. 2012).

Perceived descriptive drinking norms are defined as the perception of the quantity and frequency of alcohol use among a specific reference group (Borsari and Carey 2001; Neighbors et al. 2006b). Ample research has shown that perceived descriptive drinking norms influence one's own alcohol use behavior, as students who overestimate peer alcohol use are more likely to engage in heavier alcohol use themselves (Neighbors et al. 2007). These norms are significantly elevated for high-risk, event-specific occasions (Neighbors et al. 2007), and students who overestimate peer tailgating alcohol use are more likely to consume more alcohol themselves when tailgating (Neal and Fromme 2007). Receiving normative feedback and subsequently correcting normative misperceptions (e.g., correct the discrepancy between perceived and actual drinking norms) is a primary mechanism of behavior change in PFIs (Borsari and Carey 2001).

Event-Specific Interventions

The majority of existing PFIs target alcohol use in general (e.g., over a specific time-frame of the past month or past 6 months) which may fail to account for the context of a specific event that can influence use. Event-specific drinking is qualitatively different than "typical" alcohol use in terms of its implications for intervention, as such events can be anticipated, are time limited, and include a unique population of drinkers (Neighbors et al. 2011). Findings suggest students who are typically light drinkers and engage in hazardous event-specific drinking are at increased risk for alcohol-related consequences. Therefore, there is a need for targeted, event-specific interventions to address heavy drinking occasions. Recent work has shown event-specific PFIs may be effective in reducing heavy drinking among college students, with support for web-based PFIs in reducing 21st birthday alcohol use and correcting normative misperceptions of alcohol use as a mediator of intervention efficacy (Neighbors et al. 2012b). Web-based Spring Break PFIs have not resulted in a reduction of alcohol consumption (Patrick et al. 2014), although an in-person PFI did show reductions in Spring Break alcohol use (Lee et al. 2014). Neighbors and colleagues (Neighbors et al. 2012a) suggested interventions focused on event-specific alcohol use could generalize to reducing typical alcohol use, in addition to consumption at specific events, although this has not been empirically evaluated.

Text Message Interventions

The use of cell phones among college students is ubiquitous. Utilizing text messaging as a PFI delivery mechanism is an appealing alternative to traditional methods of computer-based or in-person delivery. Mobile phone technology is cost effective and considered an "emerging technology" in alcohol research (Cunningham et al. 2011). Text messages are especially appealing as they can deliver information to participants in real time and outside of the constraints of a laboratory setting, which increases the likelihood for eventual translation and dissemination of the intervention (Patrick et al. 2008).

Clinical trials utilizing personalized text messages have been shown to be efficacious in many health behaviors including smoking cessation (Whittaker et al. 2009) and reducing concurrent drinking and smoking (Witkiewitz et al. 2014). Suffoletto and colleagues (Suffoletto et al. 2015) found support for a 12-week text message intervention in reducing alcohol use among young adults. The authors randomized young adults who were recently discharged from the emergency department for heavy alcohol use into one of the three conditions: text message assessment with feedback (including normative drinking feedback and health consequences of alcohol), text message drinking assessments, or a control group. At a 9-month follow-up, participants in the text message assessment with feedback condition reported less binge drinking days and less drinks per drinking day than those in the control condition. Taken together, these studies provide promising initial support for utilizing text message technology in reducing alcohol use.

The Current Study

College student alcohol use is partially dependent on the context of specific events related to the drinking occasion. Although research has established the efficacy of traditional PFIs in reducing alcohol use and related problems, these interventions often target "typical" drinking and fail to assess the context of high-risk drinking events, such as football game tailgating. The current study aimed to advance understanding of event-specific intervention strategies by implementing a text message event-specific PFI as an innovative approach to reduce alcohol use and related problems. We hypothesized: (1) those in the text message PFI condition (TXT PFI) would report less alcohol consumption and fewer alcohol-related problems when tailgating than those in text message control

condition (TXT ED), (2) individuals in TXT PFI would report less alcohol consumption and fewer related problems during "typical" alcohol consumption in the month following the intervention than those in TXT ED, and (3) perceived drinking norms would mediate the relationship between condition and alcohol outcomes.

Method

Participants

The study was approved from the university Institutional Review Board and a Certificate of Confidentiality from the National Institute of Health was obtained to ensure the highest level of data protection and confidentiality for all participants. Participants were students at a large university in the Midwest. The football team at the university competes within the Southeastern Conference (SEC), which is one of the top football conferences in the country. The team has competed in bowl games and been ranked within the top 20 teams in the nation several times over the past decade. Home football games regularly have crowds in excess of 50,000 people.

Participants were recruited through a pre-screener survey administered from a University-wide email system that was sent to all students and assessed for inclusion criteria. Students were eligible to participate if they: (a) were at least 18 years of age, (b) had tailgated at a university home football game within the past 30 days, (c) had a binge drinking episode (i.e., 4+ drinks for women, 5+ drinks for men) when tailgating at a university home football game in the past year, (d) were planning on tailgating during the current university football season, and (e) had a cell phone with SMS (text message) capabilities. Students who completed the prescreener were entered into a raffle to win 1 of 10 $50 gift cards towards the university bookstore.

A total of 201 students responded to the pre-screener to determine study eligibility (Fig. 1). The final sample consisted of 133 students who were scheduled to come to the laboratory for an enrollment meeting where they provided informed consent, were randomized into one of two conditions (a text message event-specific PFI (TXT PFI) or a text message alcohol educational information control condition (TXT ED)) via a random number table stratified by gender, and completed baseline measures on a laboratory computer. The majority of the participants were women (71%), White (92.3%), and the mean age was 21.01 years (SD = 2.15). Participants completed two follow-ups: a tailgating follow-up (retention rate = 100%) assessing tailgating alcohol outcomes and a 1-month typical drinking follow-up (retention rate = 99%) assessing past 30 days typical alcohol use. They were provided with a $10 gift card to the university bookstore for completing each assessment.

Measures

At baseline, measures assessed both typical drinking in the past 30 days and tailgating-specific experiences in the past 30 days. At the tailgating follow-up, all measures were

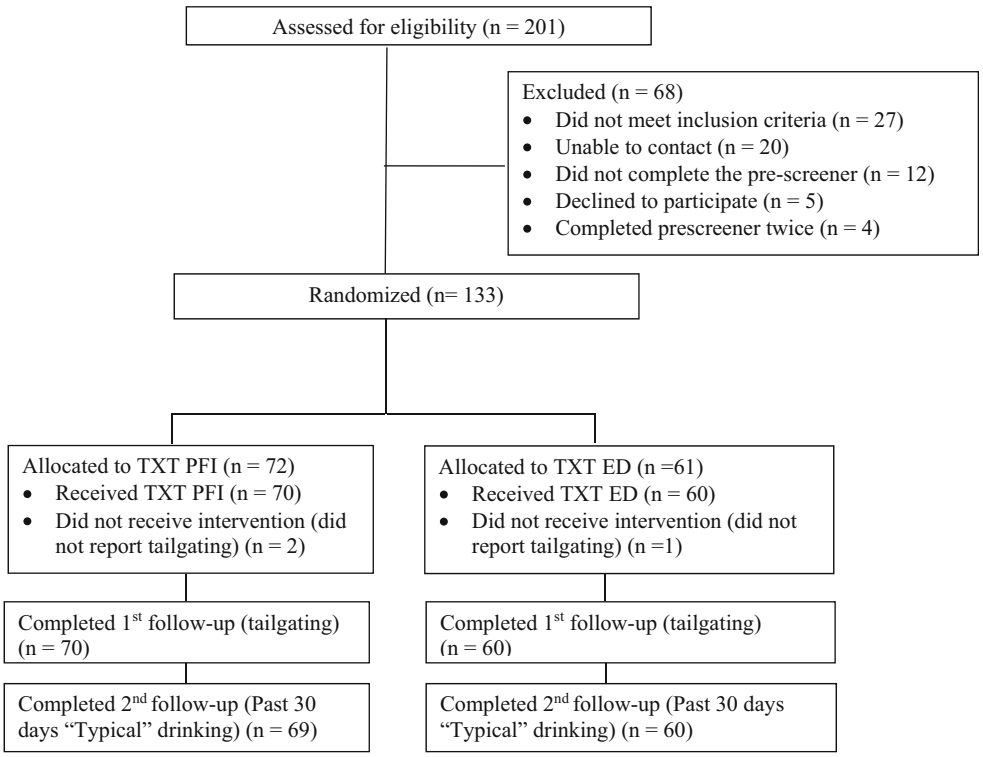

Fig. 1 Participant flow diagram. *TXT PFI* text message personalized drinking feedback, *TXT ED* text message alcohol education control condition

modified to assess experiences specific to tailgating. At the 1-month typical drinking follow-up, measures assessed experiences in the past 30 days.

Alcohol Use Alcohol use in the past month was assessed using the Daily Drinking Questionnaire (DDQ: Collins et al. 1985). The DDQ assesses drinking via a calendar-based method and is frequently used in alcohol studies among college students. Standard definitions of an alcoholic drink were provided: a 12-oz. beer (i.e., most bottled or canned beer), a 5-oz. glass of wine (i.e., a regular-sized glass of wine), or a 1.25-oz. (one shot) drink of hard alcohol. Participants were asked to indicate the number of drinks typically consumed each day of the week over the past 30 days. For each drinking day, participants were asked to indicate over how many hours they typically consumed alcohol, making it possible to estimate typical blood alcohol concentration (eBAC) with a standard formula (Matthews and Miller 1979) incorporating number of standard drinks, time spent drinking, body weight, and sex. A sum of average drinks consumed per day was used to create a drinks per week variable. This measure was used at baseline and at the 1-month typical drinking follow-up.

Quantity/Hours of Tailgating Alcohol Use At baseline, participants indicated the typical number of drinks consumed when tailgating over the past 30 days and reported the typical number of hours spent drinking when tailgating. This was used to provide feedback on typical eBAC and average number of drinks consumed when tailgating. At the tailgating follow-up, participants indicated the number of drinks consumed and the number of hours spent drinking when tailgating the previous day.

Drinking Norms Rating Form (DNRF) Perceived normative drinking was assessed with the DNRF (Baer et al. 1991). Participants were asked to estimate the number of drinks consumed by a "typical" same-gender student on each day of the week. The DNRF has good test-retest reliability and convergent validity with other measures of alcohol use (Baer et al. 1991). It was used at baseline and at 1-month typical drinking follow-up.

Tailgating Drinking Norms Rating Form (T-DNRF) The DNRF was modified to reflect drinking norms of individuals who are tailgating. Participants were asked to estimate the number of drinks consumed when tailgating by a "typical" same-gender, college student when tailgating. Changes in perceived norms were examined as mediators of intervention effects (Lewis and Neighbors 2007). This measure was used at baseline and at the tailgating follow-up.

Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ) The B-YAACQ (Kahler et al. 2005) is a 24-item, self-report, dichotomously scored measure assessing past-30-day alcohol-related consequences. In validating a 30-day version, Kahler and colleagues (Kahler et al. 2008) found the measure had high internal consistency ($\alpha = 0.89$), high test-re-test reliability over 6 weeks ($r = 0.70$), and was sensitive to changes in drinking. The coefficient alpha for the current study was 0.82 at baseline and 0.89 at follow-up. This measure was used at baseline and at the 1-month typical drinking follow-up.

Tailgating Brief Young Adult Alcohol Consequences Questionnaire (T-B-YAACQ) A modified 24-item B-YAACQ was used to assess consequences specific to tailgating in the past 30 days (i.e., "When tailgating, I have passed out from drinking"). The internal consistency estimate (alpha) for the current study was 0.82 at baseline and 0.88 at follow-up. This measure was used at baseline and at the tailgating follow-up.

Procedure

Participants received a text message the morning of a university home football game asking if they intended to tailgate today and to please reply "yes" or "no." If they responded "yes," they were sent a text message with their personalized feedback or alcohol education (depending on their random assignment) and asked to reply "read" to confirm they had received and read the text message. If they responded "no," they were sent a text message thanking them for responding and indicating that they would be contacted again at the next home football game. These individuals continued to receive a text messages inquiring if they were tailgating during each home football game until they responded positively and the personalized feedback or alcohol education information were delivered. Three students did not report tailgating at any point during the football season, and therefore were subsequently were excluded from analyses.

The morning (Sunday) after the text message was delivered, participants were emailed a link to access the tailgating follow-up that assessed their alcohol behavior when tailgating at the previous day (Saturday). Other effect-specific interventions have utilized a short-term follow to test for immediate effects on specific, high-risk drinking occasions (Neighbors et al. 2012b). A second follow-up (1-month typical drinking) was delivered to participants via an email link and assessed typical alcohol use in the month after receiving the text message intervention.

The text message was delivered to participants at one of four home football games during the 2014 season. Among those randomized to the TXT PFI condition, 14 students received the text at game 1, 17 received it at game 2, 17 received it at game 3, and 22 received it at game 4. Among those randomized to TXT ED, 13 students received the text at game 1, 14 received it at game 2, 14 received it at game 3, and 19 received it at game 4. The text message (TXT PFI or TXT ED)

was delivered at 10:30 am for a 2:30 pm game or 9:00 am for an 11:00 am game.

TXT Event-Specific PFI (TXT PFI) Participants randomly assigned to the TXT PFI condition received a text message the morning of a home football game with content tailored to the individual's tailgating alcohol use, alcohol-related problems, and drinking norms from the baseline assessment. The personalized feedback was modeled after existing efficacious interventions (e.g., Larimer et al. 2007), and included information specific to tailgating. Gender-specific tailgating drinking norms utilized within the personal feedback were previously collected by the university Wellness Resource Center from a sample of 1283 randomly selected students from Fall 2010, 1109 randomly selected students from Fall 2011, and 1417 randomly selected students from Fall 2012. The tailgating drinking norms were nearly identical to other college student tailgating norms at similar institutions (e.g., Neal and Fromme 2007; Neighbors et al. 2006a). The personalized feedback included: (a) alcohol use when tailgating and a percentile rank in terms of drinks consumed during typical tailgating of same-gender college students at the same university, (b) perceived tailgating drinking norms and how this compares to actual drinking norms, (c) personalized eBAC when tailgating and associated-risk, and (d) up to three alcohol-related problems when tailgating. Alcohol problems selected for feedback were determined by items with the highest levels of severity, with findings from Kahler and colleagues (Kahler et al. 2005; Kahler et al. 2008) used to determine rank-order. For example, a text message would say "According to the information you provided, on average you consume 4 drinks when tailgating. In comparison to other typical female tailgaters at this university your percentile rank is 74%, which means you currently drink more than 74% of female tailgaters. You think the typical female tailgater at this university consumes 5 drinks when tailgating. Based on research, female students at this university report drinking an average of 3 drinks when tailgating. Your typical BAC when tailgating is .07, which means your cognitive judgment may be impaired. You reported experiencing 3 alcohol-related problems when tailgating: your drinking has created problems between yourself and significant others, you have had less energy or felt tired because of your drinking, and you have felt badly about yourself because of your drinking." In the TXT PFI condition ($n = 70$), the majority were female (70%) and White (94.3%). A total of 8.6% were freshmen, 17.1% sophomore, 20% junior, 32.9% senior, and 21.4% graduate students. A total of 37.1% were fraternity/sorority members. The average age was 21.03 years old ($SD = 2.19$).

TXT Alcohol Educational Information (TXT ED) Participants randomly assigned to the TXT ED received a text message the morning of a home football game that provided general information regarding the effects of alcohol on the body. The content of the text was modeled after education-only conditions used in other PFI trials (e.g., Doumas et al. 2009; Martens et al. 2010). The length of the texts in the TXT ED condition had a similar word count to the ones in the TXT PFI condition (approximately 125 words). In the TXT ED condition ($n = 60$), the majority were female (73.3%) and White (90%). A total of 8.3% were freshmen, 15% sophomore, 25% junior, 36.7% senior, and 15% graduate students. A total of 35% were fraternity/sorority members. The average age was 21.00 years old (SD = 2.14).

Analytic Procedure

Preliminary analyses examined extreme values and the distribution of variables among each outcome. Boxplots of each variable's distribution were examined. Data were cleaned using the guidelines by Tabachnick and Fidell (2013). Values greater than 3.3 standard deviations above the mean value were winsorized to the next highest integer (< 3% of cases were recoded).

We first assessed the amount of variation in outcomes that was present at the level of individual participants versus games by conducting two-level models predicting each dependent variable with a random intercept for game and no independent variables. Resulting values from these models were used to calculate ICC1, which represents the proportion of variance that is present at level 2 (i.e., between games) as opposed to level 1 (i.e., within games). That is, ICC1 characterizes the degree to which variation in an outcome is attributable to attendance at a particular game, rather than individual-level variation. Higher values of ICC1 indicate nonindependence in observations that should be accounted for by multilevel modeling to avoid violating basic regression assumptions. ICC1 values for tailgating alcohol-related problems, past 30 days drinks per week, past 30 days alcohol-related problems, and past 30 days peak eBAC were close to zero, suggesting that most variation in these outcomes was at the level of individual participants. ICC1 values for tailgating number of drinks consumed and tailgating peak eBAC indicated substantial variation between games (ICC1 range 0.16 to 0.23), suggesting multilevel modeling is necessary for these variables. For the sake of consistency and conceptual clarity, all models accounted for game-level variation.

Given the nested data structure—participants (level 1) were nested in game cohorts (level 2)—and evidence of nonindependence from ICC1 values, we fit random intercept models in R 3.3.1 (R Development Core Team 2008). All models controlled for sex and for baseline values of the dependent variable. Because all other outcomes with the exception of peak eBAC were skewed count variables without evidence for zero inflation, they were analyzed using

generalized linear mixed models using a negative binomial distribution in the R package glmmadmb (Fournier et al. 2012; Skaug et al. 2013). Peak eBAC was a continuous variable with evidence for significant skew at post-intervention that remained evident with log-transformation, so for the purposes of the main analyses, peak eBAC at baseline and follow-up were transformed to a count variable by multiplying all values to 1000 and rounding to integers (Neighbors et al. 2011). As a result, the skewness of the peak eBAC variables could be appropriately modeled via a negative binomial distribution using the same procedures as for other dependent variables. Multilevel mediation analyses with random intercepts for game cohort were performed using the R packages mediation (Tingley et al. 2014) and lme4 (Bates et al. 2014) using a Poisson model with log-link. Confidence intervals were estimated with 100 bootstrap simulations.

Results

A total of 95% of participants confirmed they received and read the intervention text message the morning of a home university football game. There were no differences in alcohol outcomes between those who did and did not provide confirmation at the tailgating follow-up and at the 1-month typical drinking follow-up (p's > 0.05). Table 1 shows baseline and follow-up means and standard deviations for each outcome by condition. There were no significant between-group baseline differences on any demographic or alcohol variable.

At the tailgating follow-up, the odds of having an eBAC ≥ 0.08 when tailgating were 120% greater for those in the control condition compared to TXT PFI (OR = 2.20; 95% CI = .1.068, 4.547). The odds of endorsing at least one alcohol-related problem when tailgating were 312% greater for those in the control condition compared to TXT PFI (OR = 4.12; 95% CI = 1.544, 11.022). At the past 30 days typical drinking follow-up, the odds of having at least one alcohol-related problem were 450% greater for those in the control condition compared to TXT PFI (OR = 5.50; 95% CI = 1.167, 25.912).

Multilevel Models

See Table 2 for model results. Sex was not significant in any models, and baseline value for each dependent variable was significant in every model.

Intervention Efficacy on Tailgating Alcohol Outcomes There was a statistically significant effect for condition for number of drinks consumed, $B = 0.21$, SE = 0.07, $p < 0.01$, with the TXT PFI condition reporting less alcohol consumption when tailgating ($M = 5.67$, SD = 4.18) than those in the TXT ED condition ($M = 7.08$, SD = 4.27). There was a statistically significant effect for condition for peak eBAC, $B = 0.04$, SE = 0.01, $p < 0.001$, with the TXT PFI condition reporting a significantly lower peak eBAC when tailgating ($M = 0.092$, SD = 0.078) than the TXT ED condition ($M = 0.126$, SD = 0.080). There was no significant effect for condition on alcohol-related problems ($p > 0.05$).

When assessing change in tailgating alcohol use from baseline to tailgating follow-up, on average, individuals in TXT PFI condition consumed 0.46 less drinks (SD = 2.76) and

Table 1 Baseline and follow-up means and standard deviations for alcohol outcomes.

	Baseline				Tailgating follow-up				Past 30 days follow-up			
	TXT PFI ($n = 70$)		TXT ED ($n = 60$)		TXT PFI ($n = 70$)		TXT ED ($n = 60$)		TXT PFI ($n = 69$)		TXT ED ($n = 60$)	
	M	SD	*M*	SD	*M*	SD	*M*	SD	*M*	SD	*M*	SD
Tailgating measures												
Drinks	6.14	3.13	6.33	2.95	5.67	4.18	7.08	4.27	–	–	–	–
Peak eBAC	0.128	0.077	0.127	0.072	0.092	0.078	0.126	0.080	–	–	–	–
Problems	4.06	3.95	4.88	3.57	3.20	4.27	4.05	3.69	–	–	–	–
Norms	6.84	2.81	6.80	2.46	4.75	2.03	7.04	2.76	–	–	–	–
Past 30 days measures												
Drinks per week	15.36	8.60	17.16	10.03	–	–	–	–	13.32	10.14	16.15	10.72
Peak eBAC	0.164	0.074	0.158	0.081	–	–	–	–	0.123	0.077	0.159	0.084
Problems	7.67	4.74	8.02	4.39	–	–	–	–	4.91	4.89	6.63	4.80
Norms	18.37	9.66	18.18	7.73	–	–	–	–	14.71	8.67	19.73	10.27

There were no significant differences between conditions at baseline for any variable

TXT PFI text message personalized drinking feedback, *TXT ED* text message alcohol education control condition, *Peak eBAC* peak estimated blood alcohol concentration, *Problems* alcohol-related problems, *Norms* perceived descriptive normative drinking

Table 2 Mixed models examining intervention impact

Dependent variable	Independent variable	*B* (SE)	*p*
Tailgating alcohol outcomes			
Number of drinks			
	Intercept	0.85 (0.15)	< 0.0001
	Condition	0.21 (0.07)	0.01
	Sex	− 0.09 (008)	0.26
	BL tailgating drinks	0.13 (0.01)	< 0.0001
Alcohol-related problems			
	Intercept	0.16 (0.21)	0.44
	Condition	0.14 (0.17)	0.42
	Sex	0.25 (0.19)	0.19
	BL tailgating alcohol-related problems	0.15 (0.02)	< 0.0001
Peak eBAC			
	Intercept	3.32 (0.25)	< 0.0001
	Condition	0.45 (0.16)	0.001
	Sex	− 0.01 (0.18)	0.95
	BL tailgating peak eBAC	0.01 (0.00)	< 0.0001
Past 30 days "typical" alcohol outcomes			
Drinks per week			
	Intercept	1.66 (0.12)	< 0.0001
	Condition	0.10 (0.08)	0.20
	Sex	− 0.06 (0.09)	0.52
	BL past 30 days drinks per week	0.05 (0.00)	< 0.0001
Alcohol-related problems			
	Intercept	0.37 (0.17)	0.03
	Condition	0.32 (0.12)	0.01
	Sex	0.03 (0.13)	0.85
	BL past 30 days alcohol-related problems	0.13 (0.01)	< 0.0001
Peak eBAC			
	Intercept	3.75 (0.20)	< 0.0001
	Condition	0.31 (0.13)	0.01
	Sex	0.02 (0.14)	0.19
	BL past 30 days peak eBAC	0.01 (0.00)	< 0.0001

BL baseline

their peak eBAC was lowered 0.036 (SD = 0.055), while those in TXT ED consumed 0.75 more drinks (SD = 2.98) and their peak eBAC essentially did not change ($\Delta M = -0.001$, SD = 0.055).

Intervention Efficacy on Past 30 Days "Typical" Alcohol Outcomes No significant condition effect was observed for drinks per week consumed, $p > 0.05$. There was a significant condition effect for peak eBAC, $B = 0.04$, SE = 0.01, $p < .001$, with the TXT PFI condition reporting a significantly lower peak eBAC ($M = 0.123$, SD = 0.077) than the TXT ED condition ($M = 0.159$, SD = 0.084). There were significant between-group differences for alcohol-related problems, $B = 0.32$, SE = 0.12, $p < 0.01$, with the TXT PFI condition reporting fewer alcohol-related problems ($M = 4.91$, SD = 4.89), than the TXT ED condition ($M = 6.63$, SD = 4.80).

When assessing change in past 30 day alcohol use from baseline to typical alcohol use follow-up, on average, those in TXT PFI condition consumed 2.18 less drinks (SD = 6.33), their peak eBAC was lowered 0.041 (SD = 063), and they had 2.82 less alcohol-related problems (SD = 4.16), while those in TXT ED consumed 1.01 less drinks (SD = 5.53), their peak eBAC increased by 0.001 (SD = .062), and they had 1.38 less alcohol-related problems (SD = 3.07).

Mediation Analyses Table 3 summarizes results for mediation models. Results are presented by treatment condition and averaged across condition.

Tailgating Alcohol Outcomes Mediation models examined if perceived tailgating drinking norms mediated the relationship between treatment condition and alcohol outcome at tailgating follow-up. For the model with tailgating drinks, the average indirect effect across conditions was statistically significant, but no statistically significant direct effect of intervention condition on tailgating drinks was observed. Similarly, for the model with tailgating peak eBAC, the average indirect effect was statistically significant, but the direct effect of intervention condition on tailgating peak eBAC was nonsignificant.

Table 3 Coefficients and 95% confidence intervals for mediation by tailgating drinking norms

	Tailgate drinks	Tailgate peak eBAC	Past 30 days alcohol-related problems	Past 30 days peak eBAC
Mediated effects	1.94 (0.91, 3.13)**	0.57 (0.18, 1.06)**	1.10 (0.50, 1.99)**	26.27 (15.23, 37.89)**
Direct effects	− 0.75 (−1.77, 0.12)	0.31 (− 0.43, 1.03)	0.57 (− 0.19, 1.36)	9.53 (5.03, 14.54)**
Total effect	1.19 (0.14, 2.58)*	0.88 (0.13, 1.62)**	1.66 (0.78, 2.53)**	35.80 (22.16, 49.27)**

For tailgate drinks, results point towards statistical suppression; however, results from the main models do not indicate an iatrogenic effect for this outcome

*$p < 0.05$, **$p < 0.01$

Past 30 Days Alcohol Outcomes Mediation models examined if perceived tailgating drinking norms mediated the relationship between condition and alcohol outcome at the 1-month typical drinking follow-up. For the model with alcohol-related problems, the average indirect effect was not significant, and no statistically significant direct effect was observed. For the model with peak eBAC, the average indirect effect was statistically significant, and a statistically significant direct effect of intervention condition on past 30 days peak eBAC was observed.

Discussion

This study examined the efficacy of a text message event-specific PFI in reducing alcohol use and related problems for college students when tailgating before home football games. The extent to which the event-specific PFI would generalize to "typical" drinking in the past month after receiving the intervention was also examined. After receiving the text message intervention, participants in TXT PFI consumed less drinks and had a lower peak eBAC when tailgating than those in TXT ED control condition. The odds of having an elevated eBAC and endorsing alcohol-related problems were significantly greater for those in the control condition than those in TXT PFI. At the 1-month follow-up examining typical alcohol use, those in TXT PFI continued to report a lower peak eBAC and less alcohol-related problems than those in the control condition. Perceived tailgating drinking norms mediated the relationship between condition and alcohol outcome at both the tailgating event and the 1-month follow-up. This is the first study of knowledge to examine: (1) a text message PFI for tailgating alcohol use and (2) the extent to which the event-specific intervention generalizes to typical alcohol use 1 month later.

Implications for Event-Specific Interventions

The current study adds to the emerging literature on event-specific interventions by providing initial support for a tailgating alcohol intervention targeting heavy drinkers. Students who received the PFI consumed less alcohol and had a lower peak eBAC during a subsequent tailgate than those in the control condition, evidencing the durability of intervention effects over time. A difference between this study and other event-specific studies is that the personalized feedback utilized for 21st birthday (Neighbors et al. 2012b) and Spring Break (Lee et al. 2014) interventions are based on intended alcohol use, as the event has not yet occurred. Normative feedback is then generated using one's hypothesized alcohol use during the event, not actual alcohol use. Tailgating, unlike a birthday or Spring Break, repeats several times throughout a season. Therefore, the current study utilized a participant's alcohol outcomes from a previous tailgating event to generate the personalized feedback at the next game. This difference of receiving actual alcohol use feedback, as opposed to hypothesized use, might, in part, explain the strength of the current intervention effects relative to other event-specific studies.

Particularly unique is the finding that intervention effects generalized to typical alcohol use 1-month after receiving the event-specific intervention. Although it has been hypothesized that event-specific PFIs may generalize to reduce alcohol use during typical drinking occasions (Neighbors et al. 2012a), this is the first event-specific intervention that has examined typical drinking outcomes subsequent to the event in question. There are multiple explanations that may account for why the event-specific intervention led to reduced typical alcohol use. Receiving personalized feedback for a high-risk drinking event may be more salient than typical alcohol use feedback. Due to the salience of this event, students may be more likely to reflect on the nature of the feedback even after the high-risk drinking event occurred. When consuming alcohol in a typical fashion during the subsequent weeks after the intervention, students may be more likely to remember negative alcohol outcomes from a highly specific, memorable event. These findings have implications for other event-specific interventions. Targeting the heaviest drinking events may produce the greatest impact in terms of reducing overall alcohol outcomes as reductions are found at both the event and in the subsequent month.

Providing normative feedback on tailgating alcohol use in the PFI condition was effective in changing perceived drinking norms and alcohol consumption at both the tailgating and typical drinking follow-up, as evidenced by mediation model results. This suggests the intervention was effective in correcting normative misperceptions of tailgating alcohol use, which was subsequently associated with reduced alcohol consumption. These findings are consistent with previous studies identifying changes in perceptions of peer drinking as a mechanism of change (Walters et al. 2007). Feedback on normative drinking perceptions may be important for specific events, as perceived drinking norms are elevated for event-specific occasions, suggesting that heavy drinkers are more likely to overestimate alcohol use among their peers and therefore consume more alcohol themselves (Neighbors et al. 2006a, b).

Implications for Technology-Based Interventions

Research examining what groups of people benefit from technology-based approaches (i.e., moderators of technology approaches) is mixed and is still an emerging area of study. Technology-delivered brief interventions without an in-person contact component may be sufficient for low-to-moderate risk drinkers who are not actively pursuing treatment (Cunningham et al. 2011). Provider contact, in addition to

technology-delivered content, may be necessary for more acute, severe drinking populations (Muench 2014). For college students who have not developed a severe alcohol use disorder (AUD), the text message intervention utilized in the present study may be sufficient to reduce event-specific alcohol use. It is possible for those with a more severe AUD; the intervention would need to be supplemented with an in-person session. Findings from Suffoletto et al. (2015), though, suggest that young adults with hazardous alcohol use do respond to a text message only intervention.

There were several limitations to the current study. First, although the intervention was delivered in a novel way via text message, retrospective computer-based self-report measures were used for data collection. Self-report measures of alcohol use are a reliable and valid approach (Del Boca and Darkes 2003), but additional data sources could enhance accuracy. For example, future research could utilize transdermal ethanol sensors (Leffingwell et al. 2013) that could be used to assess real-time levels of alcohol consumption and subsequently a text message intervention could be delivered when a participant reaches a predetermined BAC. Second, data were collected from a large, NCAA Division 1, Midwest public university with a predominantly non-Hispanic, White, female sample, limiting generalizability. Sex, race, and ethnicity are uniquely related to alcohol use, consequences, and drinking trajectories (Mulia et al. 2017), and national datasets could examine these characterizes among tailgaters. Men consume more alcohol, on average, than females (Read et al. 2013), and racial/ethnic minorities, on average, report lower rates of alcohol use and endorse norms against heavy drinking, yet report increased alcohol-related problems, compared to Whites (Zapolski et al. 2014), so baseline means for alcohol variables would be expected to differ for these groups. Although there is considerable variability in alcohol-related variables within racial/ethnic groups and between sex (Caetano et al. 1998), our models controlled for sex, and the eligibility of a binge drinking episode in the past year may have reduced some race-related variability in drinking (i.e., those from minority groups that traditionally consume less alcohol may have been excluded). Perceived norms for reference groups at different levels vary (e.g., "typical male student"; "typical Asian, male student"); however, the highest perceived norms are reported for the most distal reference group (i.e., typical student) (Larimer et al. 2011). Future work could examine the influence of tailgating drinking norms for specific reference groups, including minority students from racial/ethnic backgrounds and sexual minority students.

This intervention could be integrated into a large campus by incorporating it as part of a residence life requirement for students to learn about their drinking patterns and develop strategies for low-risk drinking. We also encourage future work examining longitudinal effects of a tailgating PFI throughout an entire season. The current study chose to provide personalized feedback on components that have been widely used: drinking profile, normative comparisons, risk associated with eBAC, and alcohol-related consequences. Active ingredients could be examined by dismantling approaches to determine what components are necessary ingredients.

In sum, findings offer preliminary support for the efficacy of an event-specific text message intervention in reducing alcohol use for heavy drinking college students when tailgating. Results generalized at the 1-month follow-up, suggesting event-specific interventions can impact typical drinking outcomes. Providing normative feedback on peer alcohol use was a mechanism of behavior change. Future research on event-specific alcohol use is encouraged.

Funding Data collection and manuscript preparation for this article was supported by National Institute on Alcohol Abuse and Alcoholism Grant F31AA022830 (PI: Cadigan). Manuscript preparation was also supported in part through National Institute of Alcohol Abuse and Alcoholism Grants F32AA025263 (PI: Cadigan), T32AA007455 (PI: Larimer), and K05AA017242 (PI: Sher).

Compliance with Ethical Standards

Conflicts of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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

References

Baer, J. S., Stacy, A., & Larimer, M. (1991). Biases in the perception of drinking norms among college students. *Journal of Studies on Alcohol, 52*, 580–586.

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2014). Fitting linear mixed-effects models using lme4. arXiv preprint arXiv:1406.5823.

Borsari, B., & Carey, K. B. (2001). Peer influences on college drinking: A review of the research. *Journal of Substance Abuse, 13*, 391–424.

Caetano, R., Clark, C. L., & Tam, T. (1998). Alcohol consumption among racial/ethnic minorities: theory and research. *Alcohol Research and Health, 22*, 233–241.

Carey, K. B., Scott-Sheldon, L. J., Elliott, J. C., Garey, L., & Carey, M. P. (2012). Face-to-face versus computer-delivered alcohol interventions for college drinkers: A meta-analytic review, 1998 to 2010. *Clinical Psychology Review, 32*, 690–703.

Collins, R. L., Parks, G. A., & Marlatt, G. A. (1985). Social determinants of alcohol consumption: The effects of social interaction and model status on the self-administration of alcohol. *Journal of Consulting and Clinical Psychology, 53*, 189–200.

Coons, C. J., Howard-Hamilton, M., & Waryold, D. (1995). College sports and fan aggression: Implications for residence hall discipline. *Journal of College Student Development, 36*, 587–593.

Cunningham, J. A., Kypri, K., & McCambridge, J. (2011). The use of emerging technologies in alcohol treatment. *Alcohol Research and Health, 33*, 320–326.

Del Boca, F. K., & Darkes, J. (2003). The validity of self-reports of alcohol consumption: State of the science and challenges for research. *Addiction, 98*, 1–12.

Doumas, D. M., McKinley, L. L., & Book, P. (2009). Evaluation of two web-based alcohol interventions for mandated college students. *Journal of Substance Abuse Treatment, 36*, 65–74.

Fournier, D. A., Skaug, H. J., Ancheta, J., Ianelli, J., Magnusson, A., Maunder, M. N., … & Sibert, J. (2012). AD model builder: Using automatic differentiation for statistical inference of highly parameterized complex nonlinear models. *Optimization Methods and Software, 27*, 233–249.

Glassman, T., Werch, C. E., Jobli, E., & Bian, H. (2007). Alcohol-related fan behavior on college football game day. *Journal of American College Health, 56*, 255–260.

Hustad, J. T., Mastroleo, N. R., Urwin, R., Zeman, S., LaSalle, L., & Borsari, B. (2014). Tailgating and pregaming by college students with alcohol offenses: Patterns of alcohol use and beliefs. *Substance Use & Misuse, 49*, 1928–1933.

Kahler, C. W., Strong, D. R., & Read, J. P. (2005). Toward efficient and comprehensive measurement of the alcohol problems continuum in college students: The brief young adult alcohol consequences questionnaire. *Alcoholism: Clinical and Experimental Research, 29*, 1180–1189.

Kahler, C. W., Hustad, J., Barnett, N. P., Strong, D. R., & Borsari, B. (2008). Validation of the 30-day version of the Brief Young Adult Alcohol Consequences Questionnaire for use in longitudinal studies. *Journal of Studies on Alcohol and Drugs, 69*, 611–615.

Larimer, M. E., Lee, C. M., Kilmer, J. R., Fabiano, P. M., Stark, C. B., Geisner, I. M., & … Neighbors, C. (2007). Personalized mailed feedback for college drinking prevention: A randomized clinical trial. *Journal of Consulting and Clinical Psychology, 75*, 285–293.

Larimer, M. E., Neighbors, C., LaBrie, J. W., Atkins, D. C., Lewis, M. A., Lee, C. M., … & Hodge, K. (2011). Descriptive drinking norms: For whom does reference group matter? *Journal of Studies on Alcohol and Drugs, 72*, 833–843.

Lee, C. M., Neighbors, C., Lewis, M. A., Kaysen, D., Mittmann, A., Geisner, I. M., & … Larimer, M. E. (2014). Randomized controlled trial of a Spring Break intervention to reduce high-risk drinking. *Journal of Consulting and Clinical Psychology, 82*, 189–201.

Leffingwell, T. R., Cooney, N. J., Murphy, J. G., Luczak, S., Rosen, G., Dougherty, D. M., & Barnett, N. P. (2013). Continuous objective monitoring of alcohol use: 21st century measurement using transdermal sensors. *Alcoholism, Clinical and Experimental Research, 37*, 16–22. https://doi.org/10.1111/j.1530-0277.2012.01869.x.

Lewis, M. A., & Neighbors, C. (2007). Optimizing personalized normative feedback: the use of gender-specific referents. *Journal of Studies on Alcohol and Drugs, 68*, 228–237.

Martens, M. P., Kilmer, J. R., Beck, N. C., & Zamboanga, B. L. (2010). The efficacy of a targeted personalized feedback intervention among intercollegiate athletes: A randomized controlled trial. *Psychology of Addictive Behaviors, 24*, 660–669.

Matthews, D. B., & Miller, W. R. (1979). Estimating blood alcohol concentration: Two computer programs and their applications in therapy and research. *Addictive Behaviors, 4*, 55–60.

Moser, K., Pearson, M. R., Hustad, J. T., & Borsari, B. (2014). Drinking games, tailgating, and pregaming: Precollege predictors of risky college drinking. *The American Journal of Drug and Alcohol Abuse, 40*, 367–373.

Muench, F. (2014). The promises and pitfalls of digital technology in its application to alcohol treatment. *Alcohol Research: Current Reviews, 36*, 131–142.

Mulia, N., Karriker-Jaffe, K. J., Witbrodt, J., Bond, J., Williams, E., & Zemore, S. E. (2017). Racial/ethnic differences in 30-year trajectories of heavy drinking in a nationally representative US sample. *Drug and Alcohol Dependence, 170*, 133–141.

Neal, D. J., & Fromme, K. (2007). Event level covariation of alcohol intoxication and behavioral risks during the first year of college. *Journal of Consulting and Clinical Psychology, 75*, 294–306.

Neighbors, C., Oster-Aaland, L., Bergstrom, R. L., & Lewis, M. A. (2006a). Event- and context- specific normative misperceptions and high risk drinking: 21st birthday celebrations and football tailgating. *Journal of Studies on Alcohol, 67*, 282–289.

Neighbors, C., Dillard, A. J., Lewis, M. A., Bergstrom, R. L., & Neil, T. A. (2006b). Normative misperceptions and temporal precedence of perceived norms and drinking. *Journal of Studies on Alcohol, 67*, 290–299.

Neighbors, C., Walters, S. T., Lee, C. M., Vader, A. M., Vehige, T., Szigethy, T., & DeJong, W. (2007). Event-specific prevention: Addressing college student drinking during known windows of risk. *Addictive Behaviors, 32*, 2667–2680.

Neighbors, C., Atkins, D. C., Lewis, M. A., Lee, C. M., Kaysen, D., Mittmann, A., & … Rodriguez, L. M. (2011). Event-specific drinking among college students. *Psychology of Addictive Behaviors, 25*, 702–707. https://doi.org/10.1037/a0024051.

Neighbors, C., Foster, D., Fossos, N., & Lewis, M. A. (2012a). Windows of risk: Event and contexts associated with extreme drinking. In C. Correia, J. Murphy, & N. Barnett (Eds.), *College student alcohol abuse: A guide to assessment, intervention and prevention*. Hoboken: John Wiley & Sons, Inc.

Neighbors, C., Lee, C. M., Atkins, D. C., Lewis, M. A., Kaysen, D., Mittmann, A., Fossos, N., Geisner, I. M., Zheng, C., & Larimer, M. E. (2012b). A randomized controlled trial of event specific prevention strategies for reducing problematic drinking associated with 21st birthday celebrations. *Journal of Consulting and Clinical Psychology, 80*, 850–862.

Patrick, K., Griswold, W. G., Raab, F., & Intille, S. S. (2008). Health and the mobile phone. *American Journal of Preventive Medicine, 35*, 177–181.

Patrick, M. E., Lee, C. M., & Neighbors, C. (2014). Web-based intervention to change perceived norms of college student alcohol use and sexual behavior on spring break. *Addictive Behaviors, 39*, 600–606. https://doi.org/10.1016/j.addbeh.2013.11.014.

R Development Core Team. (2008). *R: A language and environment for statistical computing*. Vienna: R Foundation for Statistical Computing ISBN 3-900051-07-0.

Read, J. P., Wardell, J. D., & Bachrach, R. L. (2013). Drinking consequence types in the first college semester differentially predict drinking the following year. *Addictive Behaviors, 38*, 1464–1471. https://doi.org/10.1016/j.addbeh.2012.07.005.

Rees, D. I., & Schnepel, K. T. (2009). College football games and crime. *Journal of Sports Economics, 10*, 68–87.

Rutledge, P. C., Park, A., & Sher, K. J. (2008). 21st birthday drinking: Extremely extreme. *Journal of Consulting and Clinical Psychology, 76,* 511–516.

Skaug, H., Fournier, D., Nielsen, A., Magnusson, A., & Bolker, B. (2013). Generalized linear mixed models using AD model builder. R package version 0.7, 7.

Suffoletto, B., Kristan, J., Chung, T., Jeong, K., Fabio, A., Monti, P., & Clark, D. B. (2015). An interactive text message intervention to reduce binge drinking in young adults: A randomized controlled trial with 9-month outcomes. *PloS One, 10*.

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). Boston: Pearson.

Tingley, D., Yamamoto, T., Hirose, K., Keele, L., & Imai, K. (2014). Mediation: R package for causal mediation analysis. *Journal of Statistical Software, 59*, 1–38.

Vicary, J. R., & Karshin, C. M. (2002). College alcohol use: A review of the problems, issues, and prevention approaches. *The Journal of Primary Prevention, 22*, 299–331.

Walters, S. T., Vader, A. M., & Harris, T. R. (2007). A controlled trial of web-based feedback for heavy drinking college students. *Prevention Science, 8*, 83–88.

Whittaker, R., Borland, R., Bullen, C., Lin, R. B., McRobbie, H., & Rodgers, A. (2009). Mobile phone-based interventions for smoking cessation. *Cochrane Database System*.

Witkiewitz, K., Desai, S. A., Bowen, S., Leigh, B. C., Kirouac, M., & Larimer, M. E. (2014). Development and evaluation of a mobile intervention for heavy drinking and smoking among college students. *Psychology of Addictive Behaviors, 28*, 639–650.

Zapolski, T. C., Pedersen, S. L., McCarthy, D. M., & Smith, G. T. (2014). Less drinking, yet more problems: Understanding African American drinking and related problems. *Psychological Bulletin, 140*, 188–233.