

ORIGINAL ARTICLE

The Effectiveness of the ‘What Do You Drink’ Web-based Brief Alcohol Intervention in Reducing Heavy Drinking among Students: A Two-arm Parallel Group Randomized Controlled Trial

Carmen V. Voogt^{1,*}, Evelien A.P. Poelen¹, Marloes Kleinjan¹, Lex A.C.J. Lemmers² and Rutger C.M.E. Engels¹

¹Radboud University Nijmegen, Behavioural Science Institute, Nijmegen, P.O. Box 9104, 6500 HE Nijmegen, The Netherlands and ²Trimbos Institute, Netherlands Institute of Mental Health and Addiction, Utrecht, The Netherlands

*Corresponding author: Tel.: +31-24-3612140; Fax: +31-24-3612776; E-mail: c.voogt@bsi.ru.nl

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Abstract — Aims: To evaluate the effectiveness of a web-based brief alcohol intervention ‘What Do You Drink’ (WDYD) among heavy drinking students at 1- and 6-month post-intervention. Additionally, it was investigated whether certain subgroups would benefit more than others from the WDYD intervention. **Methods:** A two-arm parallel group randomized controlled trial was conducted online in the Netherlands in 2010–2011. Inclusion criteria were: (1) being between 18- and 24-year old, (2) reporting heavy drinking in the past 6 months, (3) being motivated to change alcohol consumption, (4) having access to the Internet and (5) giving informed consent. Participants ($n = 913$) were randomized to the experimental (WDYD intervention) or control condition (no intervention). Measures were heavy drinking, frequency of binge drinking and weekly alcohol consumption. **Results:** Analyses according to the intention-to-treat principle revealed no significant main intervention effects in reducing the alcohol measures at the follow-up assessments. Secondary analyses revealed that gender, freshmen and fraternity or sorority membership did not moderate the effect of the WDYD intervention at both follow-ups. Readiness to change, problem drinking and carnival participation moderated intervention effects such that contemplators, those with severe symptoms of alcohol abuse or dependence, and those who participated in carnival benefited more than others from the WDYD intervention regarding weekly alcohol consumption at 1-month follow-up. **Conclusions:** The WDYD intervention was not effective in reducing the alcohol measures among heavy drinking students at 1- and 6-month post-intervention. However, there is preliminary evidence that the WDYD intervention is effective in lowering drinking levels for subgroups of heavy drinking students in the short term.

INTRODUCTION

The high prevalence of heavy drinking among students, especially among those who are affiliated with fraternities or sororities, is cause for concern (Karam *et al.*, 2007; Wicki *et al.*, 2010; Maggs *et al.*, 2011; Ragsdale *et al.*, 2011). Heavy drinking among young adults significantly increases the risk of adverse consequences in terms of mortality and morbidity (Hingson *et al.*, 2009). Adequate interventions are needed to curb the prevalence and associated consequences of heavy drinking among young adults. What is remarkable, however, is that few alcohol intervention programs that target young adults are available in the Netherlands (De Graaf *et al.*, 2010; Van Laar *et al.*, 2011; Geels *et al.*, 2012).

Over the past decade, alcohol interventions are increasingly being delivered via the web with the growth of computer technology and the Internet (White *et al.*, 2010). Prior studies suggested that web-based brief alcohol interventions providing personalized normative feedback are a promising way to reduce heavy drinking among young adults (Bewick *et al.*, 2008), students (Doumas *et al.*, 2009; Kypri *et al.*, 2009), freshmen (Saitz *et al.*, 2007; Hustad *et al.*, 2010) and fraternity or sorority members (Larimer *et al.*, 2001). The majority of web-based brief alcohol interventions are based on Motivational Interviewing principles (Miller and Rollnick, 2002) and social influence models (Bandura, 1986) and endeavor to detect harmful alcohol consumption and encourage non-treatment seeking heavy drinkers to alter their behavior (Spijkerman *et al.*, 2010). Web-based brief alcohol interventions are beneficial over traditional face-to-face ones since they can target non-treatment seeking groups, are accessible 24 h a day, can safeguard the users’ anonymity, and are cost-effective to implement (Riper *et al.*, 2009).

Because of the high prevalence of heavy drinking among young adults and its consequences, the lack of Dutch alcohol prevention programs targeting young adults, the advantages of web-based delivered interventions, and the fact that the majority of young adults have access to the Internet and are actively using it (Escoffery *et al.*, 2005), a web-based brief alcohol intervention targeting heavy drinking young adults was developed. This intervention, entitled ‘What Do You Drink’ (WDYD), was developed using the intervention mapping (IM) protocol (see Voogt *et al.*, 2011), which is a stepwise approach for theoretical and evidence-based development, implementation, and evaluation of effective behavior change interventions (Bartholomew *et al.*, 2001). The WDYD intervention was intended to reduce alcohol consumption among heavy drinking young adults by (a) increasing their awareness of potential problems, consequences, and risks associated with drinking behavior through providing personalized normative feedback and (b) strengthening drinking refusal self-efficacy through providing tips to maintain drinking goals in situations in which it is hard to resist alcohol. Personalized normative feedback comprised comparative information about personal drinking levels and drinking levels of same-sex peers. The underlying idea was to correct misperceptions of descriptive drinking norms, which conforms to social influence models. Moreover, the personalized normative feedback was delivered in a non-judgmental, non-confrontational and non-aversive manner to meet Motivational Interviewing principles.

The aim of the present study was to evaluate the effectiveness of the WDYD intervention among heavy drinking students at 1- and 6-month post-intervention. It was hypothesized that exposure to the WDYD intervention would be more effective in reducing heavy drinking, frequency of binge

drinking and weekly alcohol consumption compared with no intervention at the 1- and 6-month follow-up.

Because the population of heavy drinking students is not likely to be a homogeneous group, we further explored whether certain theory-based subgroups would benefit more than others from the WDYD intervention to improve the intervention and to identify the needs of different subgroups (Chiauzzi *et al.*, 2005; Carey *et al.*, 2007a; Riper *et al.*, 2008; Turrisi *et al.*, 2009). Six moderators were identified on the basis of moderators previously reported in the literature.

Gender

The moderating role of gender in web-based brief alcohol interventions remains ambiguous. In some studies, males show better outcomes than females (e.g. Spijkerman *et al.*, 2010), yet other studies indicate the opposite pattern (e.g. Chiauzzi *et al.*, 2005; Riper *et al.*, 2008) and yet others indicate that males and females are equally receptive (Ballesteros *et al.*, 2004; Bewick *et al.*, 2008; Carey *et al.*, 2009; Kypri *et al.*, 2009). The differential gender effectiveness of web-based brief alcohol interventions necessitates further research.

Readiness to change

Readiness to change is a proximal predictor of behavior change in multiple cognitive-behavioral theories, such as the Theory of Planned Behavior (Ajzen, 1991) and the Transtheoretical Model (Prochaska and Velicer, 1997). Evidence regarding the moderating role of readiness to change in web-based brief alcohol intervention effectiveness has been mixed, with some studies showing that a high degree of readiness to change resulted in alcohol consumption reductions (Carey *et al.*, 2007a; Mun *et al.*, 2009), whereas other studies showed opposite effects (e.g. Maisto *et al.*, 2001). The inconsistent findings of differences in readiness to change support further investigation of readiness to change as a moderator of web-based brief alcohol intervention effectiveness.

Problem drinking

Several studies have found that severity of alcohol consumption acted as moderator in the effectiveness of alcohol interventions (e.g. Lewis *et al.*, 2007; Sher and Rutledge, 2007), yet other studies did not (e.g. Riper *et al.*, 2008; Barnett *et al.*, 2010). Those with higher levels of alcohol consumption, might be more inclined to seek help or advice when they receive personalized feedback and normative comparisons with alarming content (White *et al.*, 2010; Fraeyman *et al.*, 2012). The contradicting findings of previous studies and the limited research on the impact of the severity of alcohol consumption on web-based brief alcohol intervention response in a student population warrants investigation of problem drinking as a moderator.

Freshmen

Freshmen are at high risk of developing and adopting heavy drinking patterns due to increased independence and decreased parental monitoring in the transition from high school to college or university. Moreover, freshmen are found to perceive alcohol consumption as a way to make new friends (Borsari *et al.*, 2007). Considering that perceived peer norms of alcohol consumption are influential, interventions

providing personalized normative feedback about drinking levels of same-sex peers might be especially beneficial for freshmen (Borsari *et al.*, 2007).

Fraternity or sorority membership

The moderating role of fraternity or sorority membership in web-based brief alcohol intervention effectiveness has not been well evaluated. Students affiliated with fraternities or sororities engage in heavy drinking more often than those who are not members of fraternities and sororities, partly due to selection and socialization processes (Maalsté, 2000; Park *et al.*, 2008; Ragsdale *et al.*, 2011). Fraternity or sorority members who are frequently exposed to situations where alcohol is present might benefit more than others from guidelines to resist alcohol in high-risk drinking situations provided by the WDYD intervention.

Carnival participation

Most web-based brief alcohol interventions do not take into account the fluctuating nature of alcohol consumption among students during the year (Del Boca and Darkes, 2003; Maggs *et al.*, 2011) and merely focus on reducing heavy drinking in general rather than heavy drinking associated with specific events (Neighbors *et al.*, 2011). Carnival, a 4-day event celebrated in February before spring in the southern provinces in the Netherlands and associated with excessive drinking, coincided with our 1-month follow-up. Although the WDYD intervention was not designed as a prevention strategy for specific high-risk drinking events, it is worthwhile to explore whether carnival participants benefit more than others from the WDYD intervention.

METHODS

Trial design

The effectiveness of the WDYD intervention for heavy drinking students was evaluated in a two-arm parallel group randomized controlled trial. Participants were randomly assigned to either the experimental ($n = 457$: WDYD intervention) or control condition ($n = 456$: no intervention). Data were collected employing an online diary study with 30 ecological momentary assessments. In the current study, we solely report on the findings of three data points, that is, baseline and the 1- and 6-month follow-up. The findings of the online diary study and alcohol-related cognitions, will be reported elsewhere (see Voogt *et al.*, 2011).

Participants and procedure

Study participants were students aged 18–24-year old who reported heavy drinking in the past 6 months and who were motivated to change alcohol consumption. Additionally, participants needed to have daily access to the Internet and to have signed an informed consent electronically. Problem drinkers (i.e. participants scoring 20 or higher on the Alcohol Use Disorders Identification Test (AUDIT: (Saunders *et al.*, 1993)) and/or received treatment for alcohol-related problems), do not belong to the target group and are, therefore, advised to seek treatment and are excluded from our sample. The WDYD intervention was not developed for the

prevention of problem drinking, but instead focuses on the prevention of heavy drinking. Power analysis (G-Power) revealed that to detect an increase in the percentage of participants showing low-risk drinking after 1 month of 42% in the experimental condition versus 31% in the control condition (Boon *et al.*, 2011) with a two-sided 5% significance level and a power of 80%, a sample size of 908 participants was necessary given an anticipated dropout rate of 30% after randomization.

From September until December 2010, students were recruited by distributing flyers at higher professional education institutions and universities in the Netherlands. Students were informed that the study was about the evaluation of newly developed health education materials addressing alcohol consumption. The cover story was used to reduce the risk of social desirability bias. Students who were willing to participate were given an e-mail address to obtain additional information about the study. A screening survey was used to select study participants. Respondents who fulfilled the inclusion criteria signed the informed consent electronically. They were then randomized to the experimental and the control conditions in blocks of four by using a computerized random number generator. Randomization occurred before baseline assessment in January 2011 and was stratified by gender and an education level to ensure equal groups. Four weeks after baseline assessment, participants in the experimental condition received access to the WDYD intervention, whereas participants in the control condition received no intervention. Participants received a monetary reward of 100 euro after they had completed the final assessment. Ethical approval was granted by the Ethical Committee of the Faculty of Social Sciences of Radboud University Nijmegen.

Interventions

Participants in the experimental condition were exposed to WDYD, which is a single session web-based brief alcohol intervention to detect and reduce heavy drinking of adolescents. The WDYD intervention, developed by using the IM protocol (Voogt *et al.*, 2011), is based on Motivational Interviewing principles (Miller and Rollnick, 2002) and elements of the I-Change model (De Vries *et al.*, 1988). Knowledge, social norms and self-efficacy are embedded in the intervention as the most changeable determinants of behavior change (see for more details on the intervention (Voogt *et al.*, 2011)). The WDYD intervention took ~20 min to complete. The participants in the control condition received no intervention.

Measures

Heavy drinking

Heavy drinking was defined as consuming >21 glasses of standard alcohol units per week and/or five or more glasses of standard alcohol units at a single occasion (binge drinking) at least 1 day per week for males and for females consuming more than 14 glasses of standard alcohol units per week and/or five or more glasses of standard alcohol units at a single occasion (binge drinking) at least 1 day per week (Gezondheidsraad, 2006). Heavy drinking was analyzed as a dichotomous measure with 0 = 'no heavy drinking' and 1 = 'heavy drinking'.

Frequency of binge drinking

The frequency of participants' binge drinking was assessed by asking them how often they had drunk five or more glasses of standard alcohol units in the previous week on one drinking occasion (Hibell *et al.*, 2004). Responses were given on an eight-point scale ranging from (0) 'never' to (7) 'every day'. The scale was dichotomized into 0 = 'no binge drinking' and 1 = 'binge drinking'.

Weekly alcohol consumption

Participants' weekly alcohol consumption, operationalized as the mean number of glasses of standard alcohol units they consumed in the previous 7 days, was measured with the Dutch version of the Alcohol Weekly Recall (Lemmens *et al.*, 1992). To ensure standardized responses, an overview of standard units for various beverages was provided with one unit representing ten grams of ethanol. Weekly alcohol consumption was analyzed as a continuous measure. Participants who scored higher than the sample mean of the weekly alcohol consumption plus three times its standard deviation were given that latter value in order to retain outliers in the analyses (resulting range 0–108) (Tabachnick and Fidell, 2007).

Moderators

Readiness to change. Participants' readiness to change alcohol consumption was assessed through one item asking participants which statement applied best to them. Response choices were: (1) 'I do not drink alcohol anymore', (2) 'In the future I will keep drinking alcohol as much as I do now', (3) 'I want to reduce drinking alcohol in the future, but not within the upcoming 6 months', (4) 'I want to reduce drinking alcohol within the upcoming 6 months', (5) 'I want to reduce drinking alcohol within the upcoming month', (6) 'I have already reduced drinking alcohol, but <6 months ago' and (7) 'I have reduced drinking alcohol >6 months ago'. The seven response choices were dichotomized into 0 = 'readiness to change' and 1 = 'not readiness to change'. Participants who selected option four or five were considered to be in the contemplation stage of change (Rollnick *et al.*, 1992; Prochaska and Velicer, 1997), meaning that they were motivated to reduce their alcohol consumption in the near future, whereas those selecting one of the other statements were considered not motivated to reduce their alcohol consumption in the near future.

Problem drinking. The AUDIT was used to measure problem drinking. The scale consists of ten items with scores ranging from 0 to 40. Subscales of the AUDIT comprise sensible drinking (0–7), hazardous drinking (8–15), harmful drinking (16–19) and dependent drinking (20–40). An AUDIT score of ≥8 is indicative of problem drinking. However, an AUDIT score of ≥16 was assumed as a valid cut-off score in our heavy drinking student population. Therefore, the subscales of harmful and dependent drinking were merged and recoded into dichotomous variables with 0 = 'no problem drinking' (AUDIT scores of 0–15) and 1 = 'problem drinking' (AUDIT scores of 16–40).

Table 1. Baseline characteristics as a percentage of the sample, unless indicated otherwise

	Intervention (<i>n</i> = 456)	Control (<i>n</i> = 451)	Total sample (<i>n</i> = 907)	Significant difference I and C
Male	60.3	60.1	60.2	n.s.
Age, mean (SD)	20.9 (1.7)	20.8 (1.7)	20.8 (1.7)	n.s.
Education				n.s.
Higher professional education	26.5	25.9	26.2	
University	73.2	73.8	73.5	
Moderators				n.s.
Contemplation stage ^a	20.4	22.4	21.4	
Problem drinking ^b	38.8	39.2	39.0	
Freshmen	23.3	19.3	21.3	
Fraternity or sorority membership	50.4	52.3	51.4	
Carnival participation T1	43.9	45.5	44.7	
Measures				n.s.
Heavy drinking ^c	82.2	82.3	82.2	
Frequency of binge drinking	81.8	81.6	81.7	
Weekly alcohol consumption, mean (SD)	22.0 (15.9)	21.6 (16.0)	21.8 (15.9)	

Note. All differences between conditions were non-significant ($P > 0.05$). SD, standard deviation; T1, 1-month follow-up.

^aReadiness to change alcohol consumption was assessed through one item asking the participants which statement applied best to them. Participants selecting 'I want to reduce drinking alcohol within the upcoming 6 months' or 'I want to reduce drinking alcohol within the upcoming month' were considered to be in the contemplation stage of change, meaning that they were willing to reduce their alcohol consumption in the near future.

^bAssessed with the AUDIT and dichotomized into 0 = "no problem drinking" (AUDIT score of ≤ 15) and 1 = "problem drinking" (AUDIT score of ≥ 16).

^cDrinking > 14 or 21 (female/male) glasses of standard units of alcohol per week and/or drinking five or more glasses of standard alcohol units per occasion at least once per week (=binge drinking).

Freshmen. Participants were asked in which education year they were enrolled. Response choices were: (1) 'first year Bachelor', (2) 'second year Bachelor', (3) 'third year Bachelor', (4) 'fourth year Bachelor', (5) 'first year Master' and (6) 'second year Master'. The response choices were dichotomous into 0 = 'no freshmen' (response choices: 2–6) and 1 = 'freshmen' (response choice: 1).

Fraternity or sorority membership. Participants were asked if they were a member of a fraternity or sorority. Response choices were: (1) 'no' and (2) 'yes'.

Carnival participation. Participants were asked if they celebrated carnival in March 2011. Response choices were: (1) 'no' and (2) 'yes'.

Statistical methods

Primary statistical analyses involved *t*-tests, chi-square tests and logistic regressions to assess whether the randomization had resulted in two comparable groups at baseline and whether loss to the follow-up was distributed equally across the experimental and control condition at the 1- and 6-month follow-up (Table 1). Data were analyzed according to the intent-to-treat (ITT) principle and the completers-only framework. Missing data were imputed in SPSS 19 using the predictive mean matching method (MMS). Twenty imputed datasets were evaluated for statistical significance by averaging the results (i.e. pooling). In addition, completers-only analyses were conducted on participants who completed baseline and both the follow-up assessments.

Secondary statistical analyses included logistic regressions to assess how the WDYD intervention related to heavy drinking and frequency of binge drinking at follow-ups. Odds ratios (ORs) and 95% confidence intervals (CIs) were reported to determine the effectiveness of the WDYD intervention on these dichotomous measures. A linear regression was conducted to assess the effectiveness of the WDYD

intervention on the continuous measure of weekly alcohol consumption by reporting the r^2 -value, standardized coefficient (β), and the *P*-value. Moreover, interaction terms were computed and entered into the logistic (heavy drinking and frequency of binge drinking) and linear regression models (weekly alcohol consumption) to examine differences in intervention effectiveness between subgroups at the 1- and 6-month follow-up. Interaction terms were calculated as the products of the dummy coded intervention-control contrasts with each of the moderators, that is, (1) gender (male/female), (2) readiness to change (no/yes), (3) problem drinking (no/yes), (4) freshmen (no/yes), (5) fraternity or sorority membership (no/yes) and (6) carnival participation (no/yes).

RESULTS

Participant flow

The flow of the participants, follow-up rates and number analyzed are depicted in Fig. 1. In total, 4,992 students completed the screening survey, of whom 4,079 (81.7%) did not meet the inclusion criteria of the study, mainly because they did not report heavy drinking in the past 6 months and/or were not motivated to change. Before baseline assessment, 913 students were randomized to the experimental condition ($n = 456$) or control condition ($n = 451$). Six students did not fill in the baseline questionnaire and were therefore excluded ($n = 6$). Overall, 456 students were allocated to the experimental condition and 451 to the control condition. The follow-up rates were high: 93.5 and 91.3% at 1 and 6 months, respectively. A total of 821 students (90.5%) completed data at baseline, 1- and 6-month follow-up.

Baseline characteristics

Table 1 presents baseline characteristics of 907 participants, of whom 60.2% was male, 73.5% received university training, 21.3% was freshmen and 51.4% affiliated with fraternities or sororities. The average age was 20.8 (SD = 1.7).

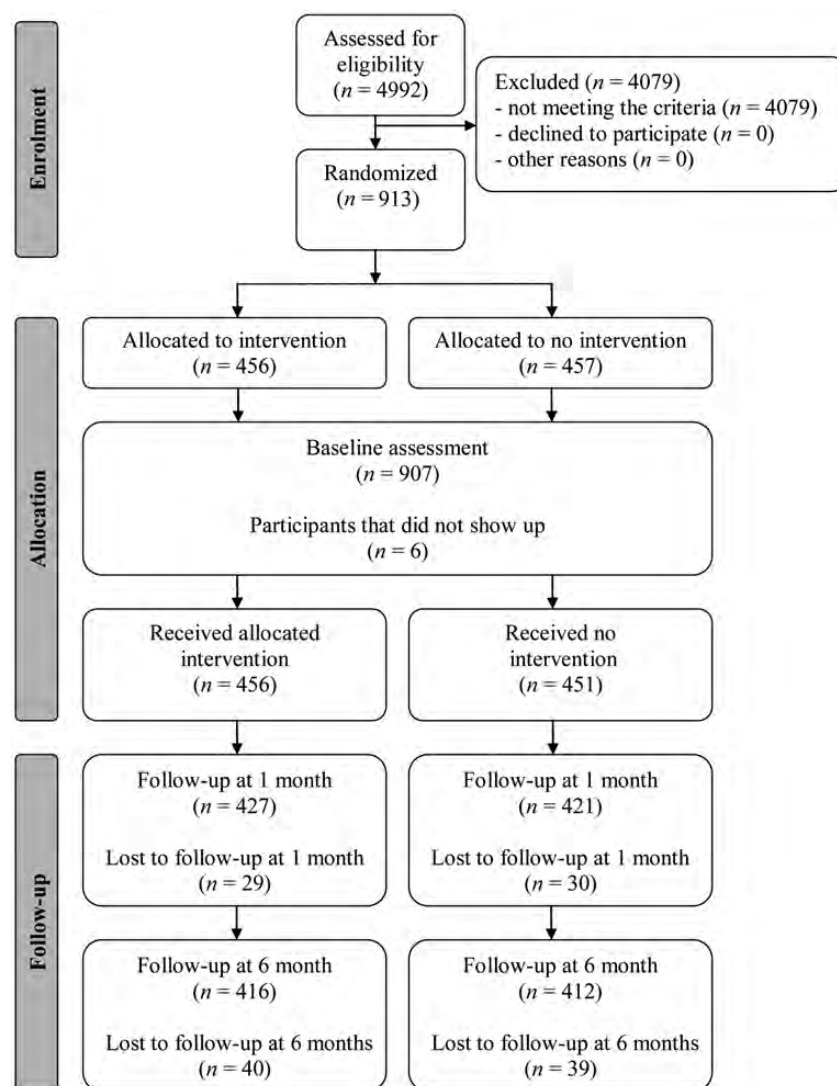


Fig. 1. Participant flow chart.

Slightly more than one fifth of the participants (21.4%) were considered to be in the contemplation stage of change, meaning that they were motivated to reduce their alcohol consumption in the near future (The screening survey was administered between September and December 2010, whereas the baseline assessment was administered in January 2011, which might explain the reduction in participant's motivation to reduce their alcohol consumption in the near future.). Additionally, more than one third (39.0%) of the participants reported symptoms of problem drinking. Moreover, nearly half of participants (44.7%) celebrated carnival. At baseline, 746 (82.2%) participants were heavy drinkers and 741 (81.7%) participants had drunk five or more glasses of standard alcohol units in the previous week on one drinking occasion. Mean weekly alcohol consumption was 21.8 (SD = 15.9) standard units. There were no significant differences ($P > 0.05$) between conditions on any of the baseline variables.

Loss to follow-up

Retention rates were 93.5% ($n = 848$) at the 1-month follow-up and 91.3% ($n = 828$) at the 6-month follow-up and

unrelated to conditions ($\chi^2 = 0.032$ [df = 1], $P = 0.86$ and $\chi^2 = 0.004$ [df = 1], $P = 0.95$). Non-completers did not differ from the follow-up respondents ($P > 0.05$) in terms of the characteristics assessed at baseline (analyses not shown here).

Effect of the intervention

Heavy drinking and frequency of binge drinking

Table 2 displays the effect of the intervention on heavy drinking and frequency of binge drinking at the 1- and 6-month follow-up for the experimental and control conditions. At both the follow-up assessments, there were no significant differences between conditions in heavy drinking and frequency of binge drinking. All findings were replicated under completers-only analyses.

Weekly alcohol consumption

Table 3 shows means and standard deviations of weekly alcohol consumption by condition at the follow-up assessments. There were no significant differences between the experimental and control conditions in weekly alcohol

Table 2. Percentage of heavy drinking and frequency of binge drinking at the 1- and 6-month follow-up by condition (WDYD intervention versus control): intention-to-treat (multiple imputation) and completers-only analyses

	Intervention		Control		OR	95% CI	P
	n	%	n	%			
<i>Heavy drinking</i>							
1-month follow-up							
Intention-to-treat	456	81.5	451	82.8	0.92	[0.64–1.31]	0.63
Completers-only	412	81.6	409	83.1	0.90	[0.62–1.29]	0.55
6-month follow-up							
Intention-to-treat	456	68.0	451	66.0	1.10	[0.83–1.46]	0.52
Completers-only	412	67.5	409	65.5	1.09	[0.82–1.46]	0.55
<i>Frequency of binge drinking</i>							
1-month follow-up							
Intention-to-treat	456	80.2	451	82.3	0.88	[0.61–1.25]	0.46
Completers-only	412	80.6	409	82.9	0.86	[0.60–1.22]	0.39
6-month follow-up							
Intention-to-treat	456	67.0	451	65.2	1.09	[0.82–1.44]	0.56
Completers-only	412	66.7	409	65.0	1.08	[0.81–1.44]	0.61

Table 3. Weekly alcohol consumption SDs at the 1- and 6-month follow-up by condition (WDYD intervention versus control): intention-to-treat (multiple imputation) and completers-only analyses

	Intervention		Control		β	95% CI	P
	M	SD	M	SD			
1-month follow-up							
Intention-to-treat	28.6	22.6	31.0	26.9	−0.06	[−6.11 to 0.45]	0.09
Completers-only	28.4	22.9	31.7	27.5	−0.07	[−6.74 to 0.20]	0.07
6-month follow-up							
Intention-to-treat	21.5	20.6	22.4	20.5	−0.02	[−3.61 to 1.88]	0.54
Completers-only	21.2	20.7	22.3	20.6	−0.03	[−3.94 to 1.72]	0.44

Table 4. Moderating effects on heavy drinking and frequency of binge drinking using logistic regression (intention-to-treat analysis) at the 1- and 6-month follow-up

	1-month follow-up			6-month follow-up		
	OR	95% CI	P	OR	95% CI	P
<i>Heavy drinking by</i>						
Gender	0.72	[0.35–1.44]	0.35	1.39	[0.78–2.49]	0.27
Readiness to change T0	0.61	[0.26–1.48]	0.28	1.28	[0.64–2.55]	0.49
Problem drinking T0	0.75	[0.35–1.65]	0.48	0.74	[0.41–1.33]	0.31
Freshmen T0	1.04	[0.45–2.38]	0.93	1.15	[0.57–2.33]	0.69
Fraternity or sorority membership T0	1.07	[0.53–2.18]	0.85	0.87	[0.48–1.56]	0.63
Carnival participation T1	0.78	[0.31–1.94]	0.59	0.99	[0.55–1.80]	0.99
<i>Frequency of binge drinking by</i>						
Gender	0.75	[0.37–1.52]	0.43	1.38	[0.78–2.44]	0.27
Readiness to change T0	0.67	[0.28–1.61]	0.37	1.30	[0.65–2.59]	0.45
Problem drinking T0	0.70	[0.32–1.49]	0.35	0.75	[0.41–1.36]	0.33
Freshmen T0	1.00	[0.45–2.24]	0.99	1.14	[0.57–2.32]	0.71
Fraternity or sorority membership T0	1.08	[0.54–2.18]	0.83	0.90	[0.50–1.61]	0.72
Carnival participation T1	0.83	[0.33–2.09]	0.69	1.06	[0.59–1.91]	0.84

Note. T0, baseline assessment; T1, 1-month follow-up.

consumption at both the follow-up assessments. These results were replicated in the completers-only analyses.

Moderating intervention effects

Heavy drinking and frequency of binge drinking

Moderation analyses in terms of heavy drinking and frequency of binge drinking revealed no significant effects at

1- and 6-month after the intervention for any of the moderators (Table 4).

Weekly alcohol consumption

Moderation analyses with respect to weekly alcohol consumption found significant effects for problem drinking ($\beta = -0.12$; $CI = -14.09$ to -1.24 ; $P = 0.02$) and carnival

Table 5. Moderating effects on weekly alcohol consumption using linear regression (intention-to-treat analysis) at the 1- and 6-month follow-up

	1-month follow-up			6-month follow-up		
	β	95% CI	<i>P</i>	β	95% CI	<i>P</i>
Weekly alcohol consumption by						
Gender	0.10	[-3.12 to 9.67]	0.32	0.05	[-4.14 to 6.69]	0.64
Readiness to change T0	-0.10	[-15.89 to 0.06]	0.05	-0.02	[-8.01 to 5.27]	0.69
Problem drinking T0	-0.12	[-14.09 to -1.24]	0.02	-0.02	[-6.69 to 4.37]	0.68
Freshmen T0	-0.01	[-8.65 to 7.50]	0.89	0.04	[-3.78 to 9.58]	0.40
Fraternity or sorority membership T0	0.12	[-3.16 to 10.06]	0.31	0.00	[-5.36 to 5.45]	0.99
Carnival participation T1	-0.12	[-13.52 to -1.74]	0.01	-0.05	[-7.84 to 3.21]	0.41

Note. T0, baseline assessment; T1, 1-month follow-up.

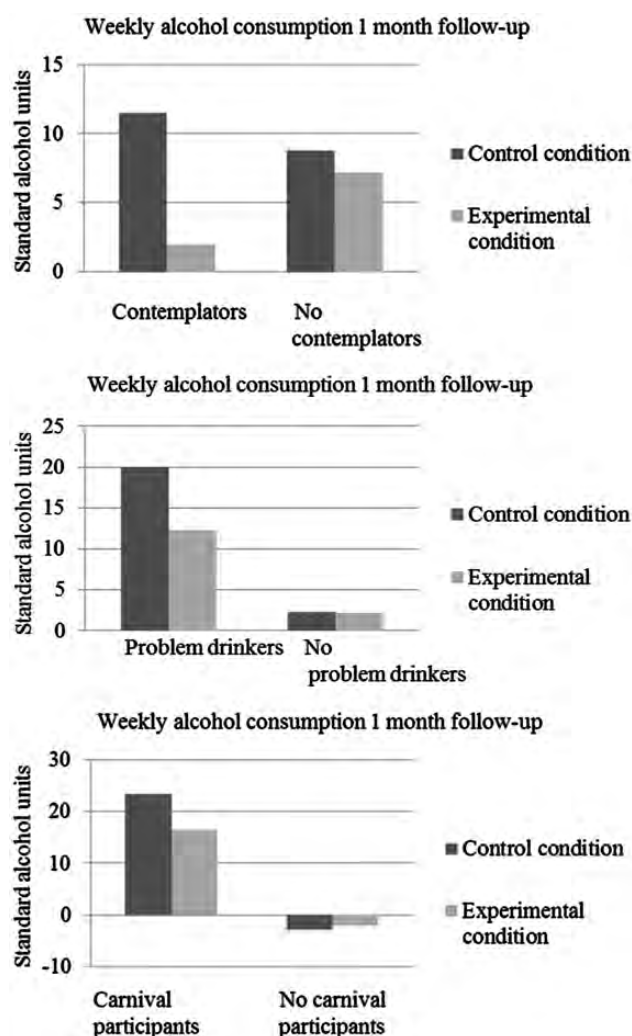


Fig. 2. Increases in weekly alcohol consumption (in standard alcohol units) in the experimental and control condition 1 month after baseline assessment, by readiness to change, problem drinking and carnival participation.

participation ($\beta = -0.12$; CI = -13.52 to -1.74; $P = 0.01$) at the 1-month follow-up. For readiness to change, a marginally significant effect was found ($\beta = -0.10$; CI = -15.89 to 0.06; $P = 0.05$). Contemplators, problem drinkers and carnival participants in the experimental condition increased their mean weekly alcohol consumption at the 1-month follow-up with 2.0, 12.3 and 16.4 alcohol units compared with 11.5, 20.0,

and 23.3 alcohol units in the control condition, respectively, indicating that those in the control condition had increased their intake by a significantly larger amount in absolute terms than those exposed to the WDYD intervention. These effects were not found at 6-month follow-up. In addition, gender, freshmen and fraternity or sorority membership did not moderate the effect of the WDYD intervention at both the follow-up assessments (Table 5 and Fig. 2).

DISCUSSION

The aim of the current study was to evaluate the effectiveness of the web-based brief alcohol intervention WDYD. It was hypothesized that exposure to the WDYD intervention would reduce heavy drinking, frequency of binge drinking and weekly alcohol consumption among heavy drinking students compared with no intervention at the 1- and 6-month follow-up. Contrary to the hypothesis, there were no significant main effects of the WDYD intervention on any of the alcohol measures at the follow-up assessments. This is in contrast with previous studies showing that web-based brief alcohol interventions are successful (small to medium effect sizes) in reducing heavy drinking, frequency of binge drinking and/or weekly alcohol consumption in a student population at the 1-month follow-up (e.g. Dumas and Andersen, 2009; Hustad *et al.*, 2010) and 6-month follow-up (e.g. Kypri *et al.*, 2008).

Several explanations can be proposed for the absence of main effects of the WDYD intervention on the alcohol measures at the follow-up assessments. First, the 20-min and single-session exposure to the WDYD intervention might not have been intensive enough to reduce alcohol consumption at the follow-up assessments. Booster sessions might have increased participants' exposure to the WDYD intervention and thereby strengthen and/or extending intervention effects (Portnoy *et al.*, 2008; Riper *et al.*, 2011). Secondly, participants in both conditions might have been exposed to alcohol intervention programs, such as mass media campaigns (e.g. national campaigns aiming at increasing awareness of dangers of drunk driving). Exposure to other alcohol intervention programs on the alcohol measures can therefore not be ruled out for participants in both conditions. Thirdly, it is unclear to what extent the participants in the experimental condition have read and remembered the personalized feedback and normative comparisons and utilized the tips to resist alcohol in high-risk drinking situations provided by the WDYD intervention. Participants might have exhibited less engagement in

the content and presentation of the WDYD intervention than envisioned beforehand (Danaher and Seeley, 2009).

The present study further explored whether subgroups would benefit more than others from the WDYD intervention. The moderating effect of gender could not be demonstrated. If ambiguity remains concerning differential effectiveness of web-based brief alcohol interventions between genders, it reasonable to target both male and female students in future web-based delivered interventions. In addition, freshmen and fraternity and sorority members, both at elevated risk of developing and engaging in heavy drinking patterns (Turrisi *et al.*, 2006; Hustad *et al.*, 2010), were not found to benefit more than others from the WDYD intervention. Heavy drinking students who derived more benefit than others from the WDYD intervention tended to be contemplators, problem drinkers and carnival participants. The observed moderating effects were evident with respect to weekly alcohol consumption at the 1-month follow-up. Contemplators, problem drinkers and carnival participants increased their weekly alcohol consumption in both conditions, probably due to the carnival event that coincided with the 1-month follow-up assessment. However, those who were exposed to the WDYD intervention increased their weekly alcohol consumption less steeply than controls did, indicating the protective role of the WDYD intervention. Contemplators might have been better in operationalizing action plans postulated by the WDYD intervention about the maximum intake of alcoholic beverages per day and week compared with those who are not contemplators since they are found to be more likely to pursue their drinking goals, feel strongly committed to them, and consider that the drinking goals are attainable (Cox *et al.*, 2007). Additionally, problem drinkers might be more interested in, explored, and took advantage of the personalized feedback and normative comparisons with alarming content than non-problem drinkers (White *et al.*, 2010; Fraeyman *et al.*, 2012). Moreover, carnival participants might have perceived the personalized normative feedback and tips to resist alcohol in high-risk drinking situations to a greater relevance during the carnival event leading to more active processing of the feedback and information. Early intervening might be especially relevant to target carnival participants due to the extensive access to alcohol and peer pressure to drink large amounts of alcohol during this high-risk drinking event. The accurate timing of intervention exposure might also explain why carnival participants benefited more than others from the WDYD intervention.

The moderating intervention effects indicated that the WDYD intervention can be meaningful for subgroups of heavy drinking students who are motivated to change and who are most at risk. Moreover, the WDYD intervention can be valuable prior to specific high-risk drinking events (e.g. carnival) and might assist as a promising event-specific prevention strategy.

Strengths and limitations

The current study was adequately powered and had a high retention rate, especially when compared with other web-based alcohol interventions (Carey *et al.*, 2009). In addition, the trial design was conducted in a real-life context rather than in an artificial setting and thus provided accurate tests of hypotheses. Moreover, the WDYD intervention is based on

theory and evidence by using the IM protocol and includes components (e.g. personalized normative feedback) that have been identified as successful in reducing heavy drinking in student populations (Carey *et al.*, 2007b).

The study has several limitations that are worth mentioning. First, the convenience sampling strategy might have affected the representativeness of the study sample. Nonetheless, the majority of web-based brief alcohol interventions conducted with young adult or student populations have used this type of sampling strategy (e.g. Spijkerman *et al.*, 2010). Secondly, contamination between conditions might have occurred when participants in the control condition had friends in the experimental condition who shared the link of the WDYD intervention. Yet, the number of participants in the control condition that could have been exposed to the WDYD intervention is expected to be small because the intervention is not yet available online. A third limitation is the self-reported nature of the data. However, self-reports on alcohol measures have been found to be reliable and valid (Del Boca and Darkes, 2003; Engels *et al.*, 2007). Fourth, the results from this study cannot be generalized to individuals younger than 18 and those who have not attended a college or university. Finally, the current study used only two follow-up assessments (i.e. 1- and 6-month) and did not take into account the fluctuating nature of heavy drinking among college students (Del Boca *et al.*, 2004). Therefore, the effectiveness of the WDYD intervention should be further examined by using ecological momentary assessment as methodology for the assessment of drinking behavior.

CONCLUSIONS

The WDYD intervention was not effective in reducing heavy drinking, frequency of binge and weekly alcohol consumption among heavy drinking students at 1- and 6-month post-intervention. However, there is preliminary evidence that the WDYD intervention is effective in lowering drinking levels for subgroups of heavy drinking students in the short term.

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