Does the structure (tunneled vs. free-roam) and content (if-then plans vs. choosing strategies) of a brief online alcohol intervention effect engagement and effectiveness? A randomized controlled trial

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Does the structure (tunnelled vs. free-roam) and content (if-then plans vs. choosing

strategies) of a brief online alcohol intervention effect engagement and effectiveness?

A randomised controlled trial

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Abstract

Background. Despite the potential of brief online interventions for reducing alcohol consumption, their effectiveness may be compromised by low levels of engagement and the inclusion of ineffective behaviour change techniques.

Purpose. To test whether (i) a tunnelled version of an intervention (where the content is delivered in a pre-specified order) leads to greater engagement and greater reductions in alcohol consumption than a free-roam version (where the content can be viewed in any order) and (ii) forming if-then plans linking strategies to cut down with high-risk situations leads to greater reductions in alcohol consumption than only choosing strategies to cut down.

Methods: Participants ($N = 286$ university staff and students) were randomly allocated to one of four versions of a brief online alcohol intervention in a 2 (structure: tunnelled vs. free-roam) by 2 (planning: strategies vs. if-then plans) factorial design. Engagement (pages visited, time) was recorded automatically. Alcohol consumption (weekly units) was assessed at baseline and one- and six-month follow-up.

Results. Participants who received the tunnelled version viewed significantly more pages and spent significantly more time on the website than those who received the free-roam version. Significant reductions in alcohol consumption were observed at follow-up; however, neither the structure of the intervention or planning had a significant effect on reductions in alcohol consumption.

Conclusions. Tunnelled online interventions can increase engagement, but this may not translate into greater changes in behaviour. Further experimental research using factorial designs is needed to identify the key behaviour change techniques to include in brief online interventions.

Keywords. Alcohol; Digital intervention; Engagement; Randomized controlled trial.

Implications

Practice. Brief online interventions may be effective in encouraging and supporting people to reduce their alcohol consumption.

Policy. Even though brief online interventions typically have a small-sized effect on alcohol consumption, on a population-level, this may translate into substantial health benefits and health care cost savings.

Research. Further experimental work with factorial designs is needed to identify the active, and redundant, behaviour change techniques in brief online alcohol interventions in order to increase their effectiveness.

Introduction

Brief alcohol interventions typically comprise of a single session of between 5 and 25 minutes delivered by a health professional in a primary care setting [1]. Reviews have estimated that these brief interventions produce small but significant reductions in alcohol consumption ($d_+ = 0.26$) at 6-12 months follow-up [2], and an average reduction in weekly consumption of 20 grams of alcohol at one-year follow-up (i.e., 2.5 UK units of alcohol) [3]. The reach and potential of such interventions could be expanded considerably if delivered online, as online interventions are typically low-cost, easy to deliver, and convenient to use. Online interventions may also be more acceptable to risky drinkers who may not attend primary care or might prefer the relative anonymity of an online intervention [4]. However, online interventions have been found to have smaller, but still significant, effects on alcohol consumption ($d_+ = 0.15$) than those delivered in person [5]. Research is therefore needed to enhance the effectiveness of current online interventions to reduce alcohol consumption.

Engagement with online interventions is often low [6] which may reduce their effectiveness [7]. The way in which the content is delivered in an online intervention may influence levels of engagement. One key distinction is between free-roam structures that allow users to view the intervention content in any order and tunnelled structures that guide users through the intervention content in a specific, pre-determined, order [8,9]. Free-roam structures provide users with more control and autonomy over what content they view and in which order and may therefore increase engagement. In addition, users can focus on the most relevant material, which may increase intervention effectiveness. However, users may use the autonomy afforded by free-roam structures to not to view any (or very little) material and potentially skip the most important material. Tunnelled structures may help to ensure that users engage with material that would otherwise not be viewed, as there are fewer obvious exits points. However, the resultant lack of control and autonomy may lead to reactance (e.g.,

message derogation and drop-out), thereby reducing engagement and effectiveness.

Systematic reviews of online interventions have reported that the structure of the intervention has little or no effect on engagement or effectiveness [6,10]. For example, one review found no difference between tunnelled versus free-roam online health interventions on measures of engagement or effectiveness, although many of the interventions included in the review were modular rather than brief interventions [6]. In addition, a systematic review of online educational interventions for self-care behaviours following cardiac surgery concluded that most tunnelled interventions were only minimal effective. In contrast, free-roam interventions were associated with increases in self-care behaviours, although only three such interventions were included in the review [10]. Very few studies have directly compared free-roam versus tunnelled versions of the same intervention using a factorial design [9]. In one study, participants who viewed a tunnelled version of a website about hepatitis visited more pages, spent more time on the website, and had greater knowledge about hepatitis at one-month follow-up than participants who viewed a free-roam version [11]. In another study, participants who viewed a tunnelled version of an online smoking cessation intervention visited more pages and spent more time online than those who viewed a free-roam version [12], although the structure of the intervention had a non-significant effect on cessation rates at 12-month follow-up [13]. To date, no studies have tested the effect of a tunnelled versus free-roam structure of a brief online alcohol intervention on engagement or effectiveness.

To be effective, online interventions need to include behaviour change techniques that have been found to lead to significant changes in the targeted behaviour. Brief alcohol interventions that are delivered in primary care typically involve screening for harmful or hazardous drinking, providing personalised feedback and information on the risks of excessive alcohol consumption, and giving tips on ways to cut down [1]. These tips typically take the form of lists of behavioural strategies (e.g., avoid drinking in rounds), taken from the

Australian "Drink-Less" programme [14], that are routinely incorporated into educational material on alcohol (e.g., Simple Structured Advice Intervention Tool). However, research suggests that such strategies may only be effective when they are linked to specific high-risk situations (e.g., when out with heavy drinking friends). A meta-analytic review reported that instructing people to form if-then plans that explicitly link specific high-risk situations with appropriate strategies (e.g., If I am out with heavy drinking friends, then I will avoid drinking in rounds) has a medium sized effect ($d_+ = 0.59$) on health-related behaviour [15] and a small sized effect ($d_+ = 0.25$) on alcohol consumption in online interventions [16].

To date, however, only a few studies have directly compared the effects of forming if-then plans versus simply considering different strategies for reducing alcohol consumption. In a series of studies [17-19], participants were presented with a list of high-risk situations for heavy episodic drinking and potential strategies for reducing alcohol consumption. Greater reductions in alcohol consumption were found among those who were instructed to link situations and strategies than among those who were instructed to simply tick relevant situations and strategies (without explicitly linking them). Despite some encouraging findings, these studies suffer from a number of limitations. First, whereas the situations were taken from a scale designed to identify high-risk situations for heavy episodic drinking [20], the strategies were based on processes of change that are proposed to be important in treating alcohol dependency [21]. These strategies may be less relevant for non-dependent and/or non-treatment samples. Second, the interventions were embedded in questionnaires assessing beliefs about alcohol or binge drinking, so the findings may not generalise to interventions that explicitly seek to reduce alcohol consumption. Third, the questionnaires were delivered in person rather than online. Again, the findings may not generalise to an online intervention. The present study sought to overcome these three limitations.

The Present Study

The present study assessed (i) the effect of the structure (i.e., tunnelled versus free-roam) of a brief online intervention on engagement with the intervention and alcohol consumption and (ii) the effect of planning (i.e., forming if-then plans versus choosing strategies to cut down) on alcohol consumption. In line with previous studies that have directly compared tunnelled versus free-roam structures [11,12], it was hypothesised that the tunnelled version of the intervention would lead to greater engagement and greater reductions in alcohol consumption at follow-up than the free-roam version. In line with previous studies that have assessed the effect of forming if-then plans on alcohol consumption [17-19], it was further hypothesised that forming if-then plans would lead to greater reductions in alcohol consumption at follow-up than choosing strategies to cut down.

The brief online alcohol intervention tested in the present study – DontBottleItUp (DBIU) – was developed by a social action charity in the UK that provides advice, support and treatment for drug and alcohol use. DBIU incorporates a screening test, feedback on risk level, information on units, comparisons with national data, and tailored risk information. Drinkers categorised as being at increasing and higher risk are also provided with tips on how to cut down on their drinking. The intervention is publicly available and is currently commissioned in 12 local authorities in the UK. Almost 60,000 people screened themselves using the DBIU website in 2017-18.

Method

Procedure and Design

A meta-analysis of online health behaviour interventions reported that interventions that included action planning had an average effect size of $d = 0.25$ [16]. An a priori power analysis indicated that 506 participants would be needed to detect a similarly sized effect on alcohol consumption in the current study with 80% power and alpha = 0.05.

Emails were sent to volunteers lists of staff and students at a university in the UK

with information about an online study on alcohol feedback and advice. The email contained a link to the baseline questionnaire hosted on Qualtrics. After providing informed consent, participants completed baseline measures of demographics and alcohol consumption. At the end of the questionnaire, participants were instructed to click on a link to the DBIU website, at which point they were randomly allocated to one of four versions of the website (using the randomisation function on Qualtrics) in a 2 (structure: tunnelled vs. free-roam) by 2 (planning: strategies vs. if-then plans) between-participants factorial design. Within the DBIU website, participants completed the Alcohol Use Disorders Identification Test (AUDIT) [22], were provided with feedback on their risk level (i.e., lower risk, increasing risk, higher risk, high risk/possibly dependent), and were directed to 4 to 5 pages of information on alcohol tailored to their risk level (see Electronic Supplementary Material).

Information on engagement with the website (e.g., pages visited, time spent on the website) was automatically recorded by a back-end data log and linked to the baseline survey data using unique ID codes. An email with a link to a follow-up questionnaire to assess alcohol consumption was sent to participants one and six months later. Up to two reminder emails were sent to participants who did not respond to the original request.

Potential participants needed to be aged 18 years or over to participate. We did not screen out participants who were categorised as lower risk drinkers for two reasons. First, the DBIU website provides (tailored) feedback and information all drinkers, regardless of risk level. Second, current evidence suggests that any level of drinking is not without risk [23]. Participation in the study was voluntary but was incentivised by the opportunity to enter a prize draw to win one of three £50 gift vouchers at each time point. The study was approved by the Department of Psychology's Research Ethics Committee in line with the institution's research ethics approval procedure, registered with Current Controlled Trials [redacted], and reported using CONSORT guidelines (see Electronic Supplementary Material).

Conditions

Structure: Tunnelled versus free-roam. After receiving feedback on their alcohol

risk score, participants in both conditions had the opportunity to view 4 to 5 pages of

information about alcohol tailored to their risk level. All participants could view pages

providing information on the meaning of units, how their drinking compared to national

figures, and the risks associated with their level of drinking. The layout and amount of

material of these pages were similar for each drinker category, although the content was

tailored by risk level. Lower risk drinkers could view an additional page with brief advice to

keep their drinking within recommended limits. Increasing risk drinkers could view an

additional page on how to cut down on their drinking. Higher risk drinkers could view two

additional pages on how to cut down on their drinking and on alcoholism. High risk/possibly

dependent drinkers could view two additional pages on alcoholism and on how to obtain

further support to reduce their drinking that included an advice video. Participants allocated

to the tunnelled version of the DBIU website were instructed to click on an arrow to move to

the next page (and so on) so that they moved sequentially through the pages on the website.

Participants allocated to the free-roam version were presented with a table of options and

could click on and read as many or as few pages as they wished, in any order.

Planning: Strategies versus if-then plans. Increasing risk and higher risk drinkers

allocated to the strategies condition were presented with the list of ten strategies for cutting

down on drinking (e.g., avoid drinking in rounds or in large groups) taken from the

Australian "Drink-Less" programme [14]. Participants were instructed to drag up to three

strategies (and/or write their own strategies) into three boxes to form strategies to cut down.

Increasing risk and higher risk drinkers allocated to the if-then planning condition were

presented with a list of ten high-risk situations taken from research on the situations in which

people are tempted to engage in heavy episodic drinking (e.g., If I am out with others who are

drinking a lot) [20], as well as the ten strategies for cutting down on drinking. Participants were instructed to form up to three if-then plans to cut down by dragging the situations and strategies into adjacent boxes (e.g. If I am out with others who are drinking a lot, then I will set myself a limit and stick to it) and/or by writing their own if-then plans.

Measures

Demographics

The baseline questionnaire contained questions assessing age, gender (i.e., Male, Female, Other), ethnicity (i.e., White, Asian/Asian British, Black/Black British, Mixed, Other), nationality and staff/student status.

Engagement

The primary outcome measures for engagement were the total number of pages that each user viewed and the total time spent on the DBIU website (from completing the AUDIT measure to their last click on the website). Secondary outcome variables were the number of plans that were made by increasing and higher risk drinkers and whether or not high risk/possibly dependent drinkers viewed the advice video.

Alcohol consumption

Alcohol consumption was assessed by asking participants to report what they typically drank on each day of the week. In line with an alcohol timeline follow-back method [24], participants were presented with a table containing days of the week (as columns) and a list of 15 common drinks taken from the Alcohol Outcomes Record of the Treatment Outcomes Profile [25] (e.g., large glass of wine (250ml); single measure (shot) of spirits (25ml); pint of ordinary strength lager, beer or cider) along with three spaces for additional drinks not listed in the table (as rows). Participants were asked to type in how many of each drink they typically drank on each day of the week. The table also contained three rows for participants to type in other drinks not listed in the table. The drinks were converted into units

of alcohol using values listed on the Alcohol Outcomes Record form. Other drinks were coded and converted into units using an online unit calculator [26]. Participants reported on their typical alcohol consumption at baseline, and on what they typically drank on each day of the week over the previous month at one- and six-month follow-up.

Participants also completed the 10-item AUDIT [22] at baseline, as part of the DBIU website, and at six-month follow-up. The AUDIT is a widely used screening tool for identifying hazardous and harmful patterns of alcohol consumption. Scores on the AUDIT can range between 0 and 40. Respondents with scores between 0 and 7 are categorised as lower risk drinkers, between 8 and 15 as increasing risk drinkers, between 16 and 19 as higher risk drinkers and 20 or above as high risk/possibly dependent drinkers.

The primary outcome measure for alcohol consumption was the number of units of alcohol consumed per week. Secondary outcome measures included frequency of binge drinking (defined as the number of days when females/males consumed 6/8 or more units of alcohol, respectively), the number of drinking days, the number of units consumed on a drinking day, and peak daily consumption per week, as well as AUDIT scores.

Analytic Plan

The data were analysed using SPSS 23.0. First, the data were screened for outliers. Participants who reported weekly alcohol consumption (units) > 3 *SD* from the mean were removed from the dataset. In addition, participants who had website visit times > 3 *SD* from the mean were excluded from the analysis examining time spent on the website. Second, descriptive statistics were used to describe the characteristics of participants at baseline, and randomisation checks compared the four conditions using chi-square tests and ANOVAs as appropriate. Third, attrition analyses compared participants who were lost to follow-up to those who completed the follow-up questionnaires by condition and on baseline measures using chi-square tests and independent samples t-tests as appropriate. Fourth, the effect of

structure on the number of pages viewed and time spent on the website was assessed using two-way between-participants ANOVAs with structure and risk level as fixed factors (to control for the fact that the different risk groups could view different numbers of pages). In addition, the effect of structure on the number of plans made by increasing and higher risk drinkers was tested using an independent t-test, and a chi-square test was used to test the effect of structure on whether or not high/possibly dependent drinks viewed the advice video. Fifth, to test the effect of structure on alcohol consumption, a mixed-measures MANOVA was conducted with structure as the between-participants factor and the measures of alcohol consumption at baseline and one- and six-month follow-up as repeated-measures dependent variables. Significant multivariate effects were followed-up with univariate analyses. Similarly, a mixed-measures ANOVA was conducted with structure as the between-participants factor and AUDIT scores at baseline and six-month follow-up as the repeated-measures dependent variable. Sixth, given that only increasing and higher risk drinkers were able to the view the page on making plans to cut down in the DBIU website, further analyses were conducted to test the effect of planning on alcohol consumption in increasing and higher risk drinkers. Thus, a mixed-measures MANOVA was conducted with structure and planning as between-participants factors and the measures of alcohol consumption at baseline and one- and six-month follow-up as repeated-measures dependent variables. Significant multivariate effects were followed-up with univariate analyses. Similarly, a mixed-measures ANOVA was conducted with structure and planning as the between-participants factors and AUDIT scores at baseline and six-month follow-up as the repeated-measures dependent variable. See the Electronic Supplementary Material for descriptive statistics for all analyses.

Results

Participants

Participants were recruited between March-November 2017. In total, 580 staff and

students clicked the link to further information about the study (see Figure 1). Of these, 10 (6%) did not consent to take part in the study, 137 (24%) did not complete the baseline measures and 143 (25%) did not complete the AUDIT and so received no feedback or information on their alcohol consumption. Four additional (1%) participants were excluded due to extreme weekly alcohol consumption (> 3 SDs above the mean), resulting in a baseline sample of 286 participants (i.e., 49% of those who clicked on the original link). The baseline sample comprised 105 university staff and 181 university students, and 102 males and 180 females (other $n = 4$) with a mean age of 27.63 years ($SD = 10.00$). The majority were UK nationals (76.9%) and described their ethnicity as White (85.7%). The sample included 106 (37.1%) lower risk drinkers, 133 (46.5%) increasing risk drinkers, 26 (9.1%) higher risk drinkers and 21 (7.3%) high risk/possibly dependent drinkers. Of the baseline sample, 241 (84%) participants completed the one-month follow-up questionnaire and 228 (80%) completed the six-month follow-up questionnaire. A further nine participants were excluded due to extreme weekly alcohol consumption at one-month ($n = 5$) and six-month ($n = 4$) follow-up resulting final samples sizes of 236 and 224 at one- and six-month follow-up.

Randomisation Checks and Attrition Analyses

Randomisation checks revealed no significant differences between the conditions in terms of demographics or baseline alcohol consumption. In addition, attrition analyses indicated no significant differences in retention rates between conditions or in terms of demographics and all baseline measures of alcohol consumption, except for weekly units, $t(275) = 2.38$, $p = .018$; participants lost to follow-up consumed more units at baseline ($M = 19.25$, $SD = 20.78$) than those who completed the follow-ups ($M = 14.05$, $SD = 13.72$).

Engagement

Participants who received the tunnelled version of the intervention viewed significantly more pages ($M = 3.49$, $SD = 1.52$) than participants who received the free-roam

version ($M = 1.37$, $SD = 1.59$), $F(1,278) = 75.80$, $p < .001$, $p\eta^2 = .214$. The main effect of risk level, $F(3,278) = 0.27$, $p = .85$, $p\eta^2 = .003$, and the structure $\times$ risk level interaction, $F(3,278) = 0.56$, $p = .64$, $p\eta^2 = .006$, were non-significant. Participants who received the tunnelled version also spent significantly more time (seconds) on the website ($M = 200.48$, $SD = 123.31$) than participants who received the free-roam version ($M = 173.49$, $SD = 119.28$), $F(1,275) = 4.63$, $p = .03$, $p\eta^2 = .017$. The main effect of risk level on time spent on the website was also significant, $F(3,275) = 3.15$, $p = .02$, $p\eta^2 = .033$; post-hoc tests indicated that lower risk drinkers spent less time on the website ($M = 158.69$, $SD = 114.20$) than increasing risk ($M = 197.85$, $SD = 121.31$), higher risk ($M = 215.54$, $SD = 118.72$) and high risk/possibly dependent ($M = 230.65$, $SD = 143.99$) drinkers. The structure $\times$ risk level interaction was non-significant, $F(3,275) = 0.90$, $p = .44$, $p\eta^2 = .010$.

Increasing and higher risk drinkers who received the tunnelled version of the intervention made more plans to cut down ($M = 0.99$, $SD = 1.40$) than those who received the free-roam version ($M = 0.31$, $SD = 0.87$), $t(157) = 3.68$, p < .001, $d = 0.59$.

Only one high risk/possibly dependent drinker (in the tunnelled version) watched the advice video. As a result, it was not possible to formally test whether the structure of the intervention influenced this measure of engagement. However, additional exploratory analyses revealed that high risk/possibly dependent drinkers who received the tunnelled version were significantly more likely to view the advice page containing the video (10/14) than those who received the free-roam version (1/7), *Fisher's Exact Test*, $p = .02$.

Alcohol Consumption [1]

All participants

A significant multivariate effect of time was found on the measures of alcohol consumption, $F(10,196) = 2.46$, $p = .009$, $p\eta^2 = .111$, in the full sample. Significant univariate effects of time were found on weekly units, $F(2,410) = 8.51$, $p < .001$, $p\eta^2 = .040$, frequency

of binge drinking, $F(2,410) = 3.20$, $p = .042$, $p\eta^2 = .015$, and number of days drinking, $F(2,410) = 5.30$, $p = .005$, $p\eta^2 = .025$. Post-hoc analyses indicated significant reductions in weekly units between baseline ($M = 14.05$, $SD = 13.72$) and both one-month ($M = 11.76$, $SD = 11.18$), $t(206) = 4.23$, $p < .001$, $d_z = 0.29$, and six-month ($M = 12.09$, $SD = 12.28$), $t(206) = 3.10$, $p = .002$, $d_z = 0.22$, follow-up. Significant reductions were also observed in the frequency of binge drinking between baseline ($M = 0.82$, $SD = 1.18$) and six-month follow-up ($M = 0.65$, $SD = 0.99$), $t(206) = 2.44$, $p = .015$, $d_z = 0.17$, and in the number of drinking days between baseline ($M = 2.47$, $SD = 1.71$) and one-month follow-up ($M = 2.19$, $SD = 1.58$), $t(206) = 3.80$, $p < .001$, $d_z = 0.26$. The structure of the intervention had a non-significant multivariate effect on alcohol consumption, $F(5,201) = 0.67$, $p = .649$, $p\eta^2 = .016$, as did the multivariate time × structure interaction, $F(10,196) = 1.37$, $p = .198$, $p\eta^2 = .065$).

There was a significant effect of time on AUDIT scores, $F(1,218) = 76.46$, $p < .001$, $p\eta^2 = .260$, which declined between baseline ($M = 8.85$, $SD = 5.28$) and six-month follow-up ($M = 6.68$, $SD = 4.57$). The effect of structure, $F(1,218) = 1.06$, $p = .304$, $p\eta^2 = .005$, and the time × structure interaction, $F(1,216) = 2.67$, $p = .103$, $p\eta^2 = .012$, were non-significant.

Increasing and higher risk drinkers

A significant multivariate effect of time was found on the measures of alcohol consumption, $F(10,105) = 3.60$, $p < .001$, $p\eta^2 = .255$, in increasing and higher risk drinkers. Significant univariate effects of time were found on weekly units, $F(2,228) = 8.78$, $p < .001$, $p\eta^2 = .072$, frequency of binge drinking, $F(2,228) = 4.47$, $p = .013$, $p\eta^2 = .038$, number of days drinking, $F(2,228) = 7.37$, $p = .001$, $p\eta^2 = .061$, units on drinking days, $F(2,228) = 3.84$, $p = .023$, $p\eta^2 = .033$, and peak daily consumption, $F(2,228) = 3.15$, $p = .045$, $p\eta^2 = .027$. Post-hoc analyses indicated significant reductions in weekly units between baseline ($M = 17.87$, $SD = 12.80$) and both one-month ($M = 14.57$, $SD = 10.67$), $t(117) = 4.24$, $p < .001$, $d_z = 0.39$, and six-month ($M = 15.17$, $SD = 12.64$), $t(117) = 3.08$, $p = .003$, $d_z = 0.28$, follow-up, as well

as in the frequency of binge drinking between baseline ($M = 1.10$, $SD = 1.65$) and both one-month ($M = 0.89$, $SD = 0.96$), $t(117) = 2.22$, $p = .028$, $d_z = 0.20$, and six-month ($M = 0.83$, $SD = 1.10$), $t(117) = 3.23$, $p = .002$, $d_z = 0.30$, follow-up. In addition, a significant reduction was observed in the number of drinking days between baseline ($M = 2.91$, $SD = 1.57$) and one-month follow-up ($M = 2.47$, $SD = 1.38$), $t(117) = 4.51$, $p < .001$, $d_z = 0.42$, as well as in the number of units consumed on drinking days between baseline ($M = 6.54$, $SD = 4.63$) and six-month follow-up ($M = 5.48$, $SD = 4.22$), $t(117) = 2.54$, $p = .012$, $d_z = 0.23$, and in peak daily consumption between baseline ($M = 9.55$, $SD = 10.27$) and six-month follow-up ($M = 7.41$, $SD = 6.43$), $t(117) = 2.16$, $p = .033$, $d_z = 0.20$.

The multivariate effects of structure, $F(5,110) = 0.71$, $p = .621$, $p\eta^2 = .031$, and planning, $F(5,110) = 0.20$, $p = .963$, $p\eta^2 = .009$, were non-significant, as were the structure × planning, $F(5,110) = 1.86$, $p = .108$, $p\eta^2 = .078$, time × structure, $F(10,105) = 1.69$, $p = .321$, $p\eta^2 = .100$, time × planning, $F(10,105) = 1.05$, $p = .410$, $p\eta^2 = .091$, and time × structure × planning, $F(10,105) = 0.68$, $p = .741$, $p\eta^2 = .061$, interactions.

There was a significant effect of time on AUDIT scores, $F(1,121) = 79.02$, $p < .001$, $p\eta^2 = .395$, which declined between baseline ($M = 10.96$, $SD = 3.04$) and six-month follow-up ($M = 8.25$, $SD = 4.04$). The effects of structure, $F(1,121) = 1.07$, $p = .302$, $p\eta^2 = .009$, and planning, $F(1,121) = 0.30$, $p = .585$, $p\eta^2 = .002$, were non-significant, as were the structure × planning, $F(1,121) = 0.87$, $p = .353$, $p\eta^2 = .007$, , time × structure, $F(1,121) = 1.75$, $p = .189$, $p\eta^2 = .014$, time × planning, $F(1,121) = 1.35$, $p = .247$, $p\eta^2 = .011$, and time × structure × planning, $F(1,121) = 0.02$, $p = .904$, $p\eta^2 < .001$, interactions.

Discussion

The present research tested whether the structure and content of a brief online alcohol intervention influenced engagement and effectiveness. The structure of the online intervention had a significant effect on all measures of engagement. Participants who

received the tunnelled version of the intervention viewed more pages and spent more time on the website than those who received the free-roam version. In addition, increasing and higher risk drinkers made more plans reduce their alcohol consumption and high risk/possibly dependent drinkers were more likely to view a page providing advice on cutting down when they received the tunnelled versus the free-roam version of the intervention. These findings are in line with the few previous studies that have directly compared tunnelled and free-roam versions of the same online intervention in randomised controlled trials [11,12]. Taken together, these findings suggest that many participants who are given autonomy over which pages to view, and in which order, in free-roam interventions use this autonomy to view few, or no, pages. In contrast, tunnelling may encourage participants to continue to click through the pages as there are no obvious exit points [8].

In contrast to the effects on engagement, the structure of the intervention had a non-significant effect on alcohol consumption. This finding is consistent with an earlier study that found a non-significant difference in cessation rates between participants who had access to a tunnelled version versus a free-roam version of an online smoking cessation intervention [13]. There are a number of possible explanations for the contrasting effects of structure on engagement and effectiveness. First, despite viewing fewer pages, participants who received the free-roam version may nonetheless have chosen to view information that encouraged or helped them to change their behaviour. Second, it is possible that participants who received the tunnelled version of the intervention may have paid less attention to the material despite having viewed more pages and spent more time on the website than those who received the free-roam version. In short, the increased engagement that was observed in the current study may have been relatively superficial. A previous study [11] found that that a tunnelled intervention led to greater knowledge about hepatitis at one-month follow-up than a free-roam intervention, suggesting that participants who received the tunnelled version had

actively processed the information that they viewed. However, in the current study no data were collected on knowledge about excessive alcohol consumption or other measures of engagement [27] including subjective experiences (e.g., perceived ease of use, liking) and physiological (e.g., electrodermal activity) and psychophysical (e.g., eye tracking) reactions. Indeed, recent research has sought to develop a self-report measure of engagement with digital behaviour change interventions that encompass both the extent (i.e., amount and depth of use) and the subjective (cognitive and emotional) experience of online interventions [28]. Such a measure may prove helpful in future research on the factors influencing engagement.

It is also worth noting that the distinction between free-roam and tunnelled structures may be an artificial dichotomy as there may be benefits in hybrid designs that combine elements of both [9]. For example, users could be presented with a table of options, or modules, to explore (i.e., free-roam structure), but within each option they may be directed through the material in a pre-determined order (i.e., tunnelled structure). Future research could explore other aspects of the "information architecture" of websites [29] in addition to the navigation system, such as organising designs (e.g., hierarchical versus matrix/flat organisation of information) and labelling systems (e.g., that alter amount of information presented to users).

Planning had a non-significant effect on reductions in alcohol consumption in increasing and higher risk drinkers, indicating that simply providing and choosing strategies may have been sufficient to engender reductions in alcohol consumption, without the need to form detailed if-then plans linking the use of these strategies to specific high-risk situations. This finding contrasts with previous research which has found that instructing participants to explicitly link situations and strategies leads to greater reductions in alcohol consumption than instructing participants to merely consider the situations and strategies, but not to link them [17-19]. Similarly, studies that have tested the effect of forming if-then plans versus (no

planning) control conditions have found that if-then planning has significant effects on alcohol consumption [30,31], although there are some null findings [32].

One explanation for finding that if-then planning did not confer additional benefit is that the intervention may have contained other information that was sufficient to produce changes in alcohol consumption without the need for planning. In particular, all participants in the present study received feedback on their risk level. Feedback on performance was identified as one of a small number of behaviour change techniques that were associated with greater reductions in alcohol consumption in a meta-analysis of online alcohol interventions [5]. Other key behaviour change techniques included the provision of normative information, prompting goal commitment and prompting review of goals. Further experimental research is needed to test the different combinations of these behaviour change techniques using factorial designs that can identify the effective (and ineffective) components of brief online alcohol interventions. For example, a factorial trial of an alcohol reduction app only found a significant effect of action planning when used in combination with self-monitoring [33].

There was some evidence that the DBIU intervention as a whole had a beneficial effect on alcohol consumption at follow-up. Specifically, weekly alcohol consumption declined by 2.3 units ($d_z = 0.29$) at one-month follow-up and by 2.0 units ($d_z = 0.22$) at six-month follow-up among all participants, and by 3.3 units ($d_z = 0.39$) at one-month follow-up and by 2.7 units ($d_z = 0.28$) at six-month follow-up among increasing risk and higher risk drinkers. These effect sizes compare favourably with the average effect sizes for online alcohol interventions with follow-ups of one month or less ($d = 0.31$) and greater than one month ($d = 0.12$) [5]. Similarly, the reductions in alcohol consumption observed in increasing risk and higher risk drinkers compare favourably with the average reductions reported for digital alcohol interventions for hazardous and harmful drinkers with follow-ups at one-month (20.3 grams/week ≈ 2.5 units) and more than three to six months (11.5 grams/week ≈

1.5 units) [34]. Although relatively small, from a public health perspective, these reductions may have an important effect on alcohol-related diseases and health care costs given the prevalence of hazardous and harmful drinking in the UK and the low cost/wide reach of online alcohol interventions. For example, cost-effectiveness studies of alcohol harm reduction policies have demonstrated that even small reductions in alcohol consumption can result in substantial health benefits and health care cost savings [35].

Limitations

The present study has a number of limitations that should be noted. First, although the observed reductions in alcohol consumption were in line with the average effect sizes for online alcohol interventions, it should be noted that the present study did not include a no-intervention control group. It is possible that some of the change over time may reflect regression to the mean or a question-behaviour effect [36]. Second, the use of self-report measures of alcohol consumption may have introduced self-presentation biases, although reviews have concluded that self-report measures can provide accurate estimates of alcohol consumption [37] and that the AUDIT, which also focuses on harmful-related harms and risk of dependency, has very good sensitivity and specificity when compared against various diagnostic gold standards (e.g., DSM criteria for alcohol abuse and dependence) [38]. It should be noted, however, that in the present study, the measure of alcohol consumption and the AUDIT both assessed typical, rather than specific (e.g., over the past seven days), alcohol consumption and therefore may be less sensitive to change. Third, the number of drinkers recruited into the study was lower than target number indicated by the a priori power analysis. It is likely that some of the analyses were underpowered to detect smaller effects, especially those focusing on the effect of the conditions on the alcohol consumption of increasing and higher risk drinkers. Fourth, although attrition was relatively low in this study compared with other studies of digital alcohol interventions [30,32,33], participants lost to

follow-up reported consuming more units of alcohol at baseline than those who completed the follow-up measures (although they did not differ on other baseline characteristics). This may indicate that it is more difficult to retain risky drinkers and therefore limits the generalisability of the findings, although intention-to-treat analyses confirmed the original findings with completers.

Conclusions

The present findings suggest that brief online interventions may be used to encourage and support people to reduce their alcohol consumption, as evidenced by significant reductions in alcohol consumption over time. The tunnelled version of the intervention led to participants spending more time and viewing more pages on the website than the free-roam version; however, neither the structure of the intervention or planning had a significant effect on alcohol consumption. The findings therefore indicate that using a tunnelled structure can increase levels of engagement with brief online interventions; however, further experimental work is needed to identify the active, redundant and/or detrimental ingredients of brief online interventions to ensure that increased engagement is translated into increased effectiveness.

Footnote

1.   Given the amount of missing data at one- and six-month follow-up, the effects of the conditions on the primary outcome variable (weekly units) were also tested using intention-to-treat analyses. Missing values analysis indicated that the data for weekly units were not missing at random, Little's MCAR test $\chi^2 = 30.09$, $p < .001$. The multiple imputation method was therefore used to generate five imputed datasets for analysis. The findings remained unchanged. For the full sample, the main effect of time was significant in all five of the imputed datasets whereas the time $\times$ structure interaction was non-significant in all five of the imputed datasets. For increasing and higher risk drinkers, the main effect of time was significant in all five of the imputed datasets, whereas the time $\times$ structure and the time $\times$

structure × planning interactions were non-significant in all five of the imputed datasets, and the time × planning interaction was non-significant in four out of five of the imputed datasets.

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Figure 1. *Flow of participants through the study*

Clicked on link to the study
$N = 580$

Not Randomised $n = 147$
Did not consent $n = 10$
Did not completed baseline survey $n = 137$

Randomised to Condition
$n = 433$

Tunneled + Strategies $n = 108$	Tunneled + Plans $n = 109$	Free-Roam + Strategies $n = 108$	Free-Roam + Plans $n = 108$
Did not complete AUDIT $n = 34$ Extreme alcohol value $n = 2$	Did not complete AUDIT $n = 37$ Extreme alcohol value $n = 0$	Did not complete AUDIT $n = 39$ Extreme alcohol value $n = 2$	Did not complete AUDIT $n = 33$ Extreme alcohol value $n = 20$

Engagement

Analysed $n = 72$	Analysed $n = 72$	Analysed $n = 67$	Analysed $n = 75$

One-Month Follow-Up

Completed Q $n = 57$ Extreme alcohol value $n = 1$ Not followed-up $n = 15$ Analysed $n = 56$	Completed Q $n = 59$ Extreme alcohol value $n = 2$ Not followed-up $n = 13$ Analysed $n = 57$	Completed Q $n = 60$ Extreme alcohol value $n = 1$ Not followed-up $n = 7$ Analysed $n = 59$	Completed Q $n = 65$ Extreme alcohol value $n = 1$ Not followed-up $n = 10$ Analysed $n = 64$

Six-Month Follow-Up

Completed Q $n = 55$ Extreme alcohol value $n = 1$ Not followed-up $n = 17$ Analysed $n = 54$	Completed Q $n = 59$ Extreme alcohol value $n = 0$ Not followed-up $n = 13$ Analysed $n = 59$	Completed Q $n = 54$ Extreme alcohol value $n = 1$ Not followed-up $n = 13$ Analysed $n = 53$	Completed Q $n = 60$ Extreme alcohol value $n = 2$ Not followed-up $n = 15$ Analysed $n = 58$

Supplementary Material

Table 1. *Alcohol Information Pages in the Intervention by Risk Level*

Title of page	Risk Level			
	Lower	Increasing	Higher	High/Possibly Dependent
What do units mean?	X	X	X	X
How does my drinking compare?	X	X	X	X
What are the risks?	X	X	X	X
What can I do next?	X			
Am I an alcoholic?			X	X
Create a plan		X	X	
Plan your next step				X

Table 2. *Baseline Characteristics of Participants by Condition*

		Condition				
		Tunnelled + Strategies	Tunnelled + Plans	Free-Roam + Strategies	Free-Roam + Plans	All
		n	*n*	*n*	*n*	*n*
Staff/Student Status	Staff	26	27	28	28	105
	Student	41	45	43	47	181
Gender	Male	24	24	24	27	102
	Female	47	45	40	48	180
	Other	0	1	3	0	4
Ethnicity	White	60	63	56	66	245
	Non-White	12	8	12	9	41
Nationality	UK	54	60	49	57	220
	Non-UK	18	18	12	18	66
		M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Age		18.43 (10.38)	26.99 (10.45)	28.10 (9.51)	27.07 (9.72)	27.63 (10.00)
Weekly Units		14.58 (16.22)	18.32 (19.22)	19.11 (20.23)	14.14 (14.55)	16.47 (17.67)
Frequency of Binge Drinking		0.81 (1.17)	1.03 (1.44)	1.12 (1.43)	0.75 (0.95)	0.92 (1.26)
Number of Drinking Days		2.51 (1.78)	2.65 (1.83)	2.82 (1.65)	2.45 (1.76)	2.60 (1.76)
Units on Drinking Days		4.63 (3.85)	6.51 (4.84)	5.83 (6.82)	5.61 (5.51)	5.64 (5.39)
Peak Daily Consumption		6.79 (7.70)	8.53 (7.98)	8.26 (7.03)	8.69 (13.23)	8.07 (9.39)
AUDIT Score		9.22 (5.96)	10.24 (6.64)	9.27 (5.42)	9.07 (5.76)	9.45 (5.96)

Table 3. *Number of Pages Viewed by Structure Condition and Risk Level (Full Sample, N = 286)*

| Risk Level | Structure Condition | | Total |
| | Tunnelled | Free-Roam | |
	M (SD)	*M (SD)*	*M (SD)*
Lower risk	3.44 (1.33)	1.61 (1.71)	2.51 (1.78)
Increasing risk	3.46 (1.28)	1.23 (1.52)	2.29 (1.80)
Higher risk	3.67 (2.29)	1.18 (1.17)	2.62 (2.25)
High risk/possible dependent	3.64 (2.24)	1.14 (1.95)	2.81 (2.42)
Total	3.49 (1.52)	1.37 (1.59)	2.43 (1.88)

Table 4. *Time Spent on the Website by Structure Condition and Risk Level (Full Sample, N = 283)*

	Structure Condition		
	Tunnelled	Free-Roam	Total
Risk Level	*M (SD)*	*M (SD)*	*M (SD)*
Lower risk	161.35 (158.69)	156.13 (106.81)	158.69 (114.20)
Increasing risk	210.35 (197.85)	186.44 (136.45)	197.85 (121.31)
Higher risk	252.13 (215.54)	165.64 (67.30)	215.54 (118.72)
High risk/possible dependent	250.46 (230.65)	193.86 (90.55)	250.65 (143.99)
Total	200.48 (123.31)	173.49 (119.28)	187.13 (121.87)

Table 5. *Number of Pages Viewed by Condition and Risk Level (Increasing and Higher Risk Drinkers, N = 159)*

	Condition			
	Tunnelled + Strategies	Tunnelled + Plans	Free-Roam + Strategies	Free-Roam + Plans
Risk Level	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Increasing risk	3.21 (1.50)	3.66 (1.06)	1.16 (1.53)	1.29 (1.54)
Higher risk	4.38 (1.77)	2.86 (2.67)	1.69 (1.51)	0.83 (0.75)

Table 6. *Time Spent on the Website by Condition and Risk Level (Increasing and Higher Risk Drinkers, N = 157)*

	Condition			
	Tunnelled + Strategies	Tunnelled + Plans	Free-Roam + Strategies	Free-Roam + Plans
Risk Level	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Increasing risk	201.00 (86.51)	217.51 (113.90)	208.44 (151.28)	166.89 (120.56)
Higher risk	280.24 (153.50)	220.00 (116.28)	178.40 (74.74)	155.00 (65.50)

Table 7. *Number of Plans Made by Structure and Planning Condition (Increasing and Higher Risk Drinkers, N = 159)*

	Structure Condition		
	Tunnelled	Free-Roam	Total
Planning Condition	*M (SD)*	*M (SD)*	*M (SD)*
Strategies	1.28 (1.49)	0.27 (0.83)	0.77 (1.30)
If-then plans	0.73 (1.29)	0.34 (0.91)	0.53 (1.12)
Total	0.99 (1.40)	0.31 (0.88)	0.64 (1.21)

Table 8. *Weekly Units by Structure Condition and Time (Full Sample, N = 207)*

	Structure Condition		
	Tunnelled	Free-Roam	Total
Timepoint	*M (SD)*	*M (SD)*	*M (SD)*
Baseline	13.80 (14.36)	14.28 (13.14)	14.05 (13.72)
One-month follow-up	12.38 (12.02)	11.16 (10.32)	11.76 (11.18)
Six-month follow-up	13.07 (12.09)	11.14 (12.03)	12.09 (12.28)

Table 9. *Frequency of Binge Drinking by Structure Condition and Time (Full Sample, N = 207)*

	Structure Condition		Total
	Tunnelled	Free-Roam	
Timepoint	*M (SD)*	*M (SD)*	*M (SD)*
Baseline	0.84 (1.38)	0.79 (0.96)	0.82 (1.18)
One-month follow-up	0.78 (0.97)	0.61 (0.88)	0.70 (0.93)
Six-month follow-up	0.75 (1.09)	0.56 (0.88)	0.65 (0.99)

Table 10. *Number of Drinking Days by Structure Condition and Time (Full Sample, N = 207)*

	Structure Condition		
	Tunnelled	Free-Roam	Total
Timepoint	*M (SD)*	*M (SD)*	*M (SD)*
Baseline	2.44 (1.84)	2.50 (1.58)	2.47 (1.71)
One-month follow-up	2.21 (1.63)	2.17 (1.53)	2.19 (1.58)
Six-month follow-up	2.47 (1.77)	2.16 (1.70)	2.31 (1.74)

Table 11. *Units Consumed on Drinking Days by Structure Condition and Time (Full Sample, N = 207)*

| Timepoint | Structure Condition | | Total |
| | Tunnelled | Free-Roam | |
	M (SD)	*M (SD)*	*M (SD)*
Baseline	5.84 (4.51)	5.41 (4.59)	5.13 (4.55)
One-month follow-up	5.04 (4.49)	4.61 (4.36)	4.82 (4.42)
Six-month follow-up	4.80 (4.37)	4.48 (4.22)	4.64 (4.29)

Table 12. *Peak Daily Consumption by Structure Condition and Time (Full Sample, N = 207)*

	Structure Condition		
	Tunnelled	Free-Roam	Total
Timepoint	*M (SD)*	*M (SD)*	*M (SD)*
Baseline	6.39 (5.79)	8.01 (10.93)	7.21 (8.80)
One-month follow-up	6.34 (5.26)	6.05 (5.62)	6.20 (5.43)
Six-month follow-up	6.47 (6.47)	5.78 (5.88)	6.12 (6.07)

Table 13. *AUDIT Scores by Structure Condition and Time (Full Sample, N = 220)*

	Structure Condition		
	Tunnelled	Free-Roam	Total
Timepoint	*M (SD)*	*M (SD)*	*M (SD)*
Baseline	8.96 (5.74)	8.73 (4.78)	8.85 (5.28)
Six-month follow-up	7.20 (5.07)	6.16 (3.96)	6.68 (4.57)

Table 14. *Weekly Units by Condition and Time (Increasing and Higher Risk Drinkers, N = 118)*

	Condition				
	Tunnelled + Strategies	Tunnelled + Plans	Free-Roam + Strategies	Free-Roam + Plans	Total
Timepoint	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Baseline	16.06 (12.21)	18.55 (13.87)	21.26 (13.79)	15.59 (11.07)	17.87 (12.80)
One-month follow-up	12.40 (6.23)	17.31 (13.99)	15.99 (10.74)	12.24 (8.71)	14.57 (10.67)
Six-month follow-up	11.70 (8.39)	19.99 (14.27)	15.97 (12.49)	12.27 (12.29)	15.17 (12.64)

Table 15. *Frequency of Binge Drinking by Condition and Time (Increasing and Higher Risk Drinkers, N = 118)*

	Condition				
	Tunnelled + Strategies	Tunnelled + Plans	Free-Roam + Strategies	Free-Roam + Plans	Total
Timepoint	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Baseline	0.95 (1.32)	1.25 (1.41)	1.24 (1.02)	0.94 (0.92)	1.10 (1.65)
One-month follow-up	0.81 (0.87)	1.13 (1.04)	1.00 (1.07)	0.64 (0.80)	0.89 (0.96)
Six-month follow-up	0.67 (1.15)	1.13 (1.26)	0.83 (1.00)	0.67 (0.96)	0.83 (1.10)

Table 16. *Number of Drinking Days by Condition and Time (Increasing and Higher Risk Drinkers, N = 118)*

	Condition				
	Tunnelled + Strategies	Tunnelled + Plans	Free-Roam + Strategies	Free-Roam + Plans	Total
Timepoint	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Baseline	3.19 (1.75)	2.84 (1.69)	2.97 (1.27)	2.75 (1.63)	2.91 (1.57)
One-month follow-up	2.57 (1.33)	2.44 (1.72)	2.45 (1.06)	2.47 (1.36)	2.47 (1.38)
Six-month follow-up	2.95 (1.72)	3.19 (1.86)	2.62 (1.52)	2.17 (1.80)	2.69 (1.76)

Table 17. *Units Consumed on Drinking Days by Condition and Time (Increasing and Higher Risk Drinkers, N = 118)*

Timepoint	Condition				Total
	Tunnelled + Strategies	Tunnelled + Plans	Free-Roam + Strategies	Free-Roam + Plans	
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Baseline	4.73 (2.75)	6.98 (5.63)	7.74 (4.33)	6.21 (4.50)	6.54 (4.63)
One-month follow-up	4.89 (1.96)	7.13 (5.40)	6.74 (4.53)	5.03 (3.99)	6.00 (4.36)
Six-month follow-up	3.59 (1.96)	6.57 (4.69)	6.26 (3.82)	4.98 (4.73)	5.48 (4.22)

Table 18. *Peak Daily Consumption by Condition and Time (Increasing and Higher Risk Drinkers, N = 118)*

	Condition				
	Tunnelled + Strategies	Tunnelled + Plans	Free-Roam + Strategies	Free-Roam + Plans	Total
Timepoint	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Baseline	6.71 (4.50)	9.33 (6.61)	10.97 (6.04)	10.26 (16.31)	9.55 (10.27)
One-month follow-up	6.50 (2.68)	8.95 (6.06)	9.03 (6.20)	6.56 (4.80)	7.81 (5.34)
Six-month follow-up	4.78 (2.66)	9.52 (8.06)	8.61 (6.16)	6.11 (5.92)	7.41 (6.43)

Table 19. *AUDIT Scores by Condition and Time (Increasing and Higher Risk Drinkers, N = 125)*

| | Condition | | | | |
| Timepoint | Tunnelled + Strategies | Tunnelled + Plans | Free-Roam + Strategies | Free-Roam + Plans | Total |
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Baseline	10.83 (3.20)	11.28 (3.49)	11.14 (2.40)	10.59 (3.01)	10.96 (3.04)
Six-month follow-up	8.09 (3.90)	9.33 (4.85)	7.65 (3.36)	7.76 (3.68)	8.25 (4.04)