

de Visser, R.O., Brown, C.E., Cooke, R., Cooper, G. & Memon, A. (in press) Using alcohol unit-marked glasses enhances capacity to monitor intake: evidence from a mixed-method intervention trial. Alcohol & Alcoholism.

note: authors' version of accepted manuscript: published version may vary

Aims: People tend to have poor knowledge of government guidelines for alcohol use, and lack the motivation and skills required to use them to monitor their drinking. The study aim was to determine whether using glasses marked with such guidelines would improve knowledge and attitudes, increase frequency of counting units, and lower alcohol intake.

Methods: 450 adults participated in an intervention-control study with 1-month follow-up. The intervention group was encouraged to use glasses supplied by the researchers that indicated the unit content of drinks of different strengths and volumes, and stated the intake guidelines. Interviews with 13 intervention group participants focused on their experiences of using the glasses and recommendations for their use.

Results: Analyses adjusted for baseline variables showed that the intervention improved: knowledge of unit-based guidelines; ability to estimate the unit content of drinks; attitudes toward the guidelines; and frequency of counting unit intake. However, there was no significant change in alcohol consumption. Interview data confirmed that the glasses provided useful information that encouraged people to think about their drinking and to discuss alcohol with other people. However, their design was not appealing to all, and their initial impact did not always persist.

Conclusions: Use of unit-marked glasses led to changes in people's use of unit-based guidelines to monitor their drinking. The qualitative data suggested that the glasses could have an impact at the individual level (on knowledge and attitudes) and at a broader level (by prompting discussion of alcohol use).

Keywords: intervention; guidelines; health education

To reduce alcohol-related harm, governments in many countries publicize alcohol consumption guidelines (Furtwängler & de Visser, 2013). In the UK, alcohol consumption is described in 10mL “units”: it is recommended that people not drink more than 14 units a week and not drink for 48 hours after a heavy drinking session (National Health Service [NHS], n.d.). The House of Commons Science and Technology Committee (2012) recommended that people should have two alcohol-free days per week.

If individuals are to adhere to such guidelines, they must possess accurate knowledge of them, as well as appropriate attitudes and skills. However, studies in the UK (de Visser, 2015; de Visser & Birch, 2012; Gill & O’May, 2006; Gill & O’May, 2007a; Office for National Statistics [ONS], 2010) and elsewhere (Devos-Comby & Lange, 2008; Hasking et al., 2005; Kerr & Stockwell, 2012) indicate that most people have poor knowledge of guidelines and tend not to use them to monitor their drinking.

The Information-Motivation-Behavioural Skills model (IMB: Fisher et al., 1994) proposes that healthy behaviour is the result of information (i.e., understanding of unit-based guidelines), motivation (i.e., desire to apply this knowledge) and behavioural skills (i.e., knowing how to apply the guidelines). According to the IMB, repeated exposure to the unit content of drinks and alcohol intake guidelines should improve knowledge of unit-based guidelines, and may enhance motivation to adhere to them, especially if people possess required behavioural skills such as being able to accurately estimate drinks’ unit content.

One way to promote awareness of unit-based guidelines is to display them on glasses. Some organizations - including local governments and non-government such as the Drinkaware trust - distribute plastic drinking vessels marked with the unit content of drinks and intake guidelines (referred to hereafter as “unit-marked glasses”). For example, Brighton & Hove City Council distributes several thousand glasses each year at public events and training for health professionals, and has anecdotal evidence that they are appealing and useful. However, there is a lack of research evidence as to their impact on people’s knowledge of units, capacity to monitor unit intake, or alcohol consumption. The potential for these glasses to improve knowledge and skills is important because labels on packaged alcohol products do not always contain the information needed to monitor unit intake (Petticrew et al., 2016).

One aim of our study was to examine whether using unit-marked glasses would lead to increased knowledge of the guidelines, more favourable attitudes toward them, more frequent counting of units, and lower alcohol intake. A second aim was to explore people’s experiences of using unit-marked glasses.

Methods

A mixed methods design was used. Phase 1 was an intervention study to measure the impact of using unit-marked glasses on alcohol consumption. Phase 2 used interviews with Phase 1 intervention group members to explore experiences of the intervention and how it could be improved. Combining qualitative and quantitative methods can aid the refinement of interventions (de Visser et al., 2015).

Phase 1 - Intervention study

Sample: Participants’ ages ranged from 18 to 74 ($M = 42.0$, $SD = 10.5$). Of the 543 people signed up to the follow-up study, 450 (83%) completed it. Those who completed the follow-up were significantly older than those who did not ($p < .01$), but did not differ in their knowledge, attitudes and behaviour related to the unit-based guidelines, or their patterns of alcohol use (Supplementary Table 1). The sample was comparable to the UK adult population in terms of white ethnicity (96% sample vs 92% UK: ONS, 2015a), and

proportion working full-time (67% sample vs 73% UK: ONS, 2015b). The high proportion of people who had completed university education (75% sample vs 27% UK: ONS, 2015c) may reflect sampling from predominantly “white-collar” employers.

Procedure: Online surveys were used at enrolment and 1-month follow-up. Adult drinkers were recruited in mid-2015 in and near two cities in England via contacts with public- and private-sector employers. Ethical approval was granted by the host University research governance committees. Potential participants were advised that completing the first questionnaire indicated consent to participate in the follow-up study.

Allocation of participants to control or intervention condition was made per employer/contact - i.e., all participants at the 6 control workplaces were allocated to the control condition, and all participants at the 8 intervention workplaces were allocated to the intervention condition. Intervention group members received three 350 mL plastic unit-marked glasses indicating the content of spirits, wine and beer of different strengths and volumes, and stating the intake guidelines (see Supplementary Figure 1). These were sent to residential addresses. Recipients were instructed: “[To] use the glasses for all drinks containing alcohol in the next month. If you prefer to drink from other glasses, then please pour drinks into the unit-marked glass before transferring the contents into your preferred glass (e.g., pour wine into the unit-marked glass and then into a wine glass). We would like you to use the glasses as much as possible for drinks that do not contain alcohol. We have provided you with three unit-marked glasses to make it easier for you to use them at home, work, or elsewhere”. Two weeks later, they received an email reminder to use the glasses as described above. Participants were asked to use the glasses for alcoholic and non-alcoholic drinks in order to maximise their exposure to the information conveyed by them.

After one calendar month, all participants received a link for the follow-up questionnaire. The control group completed baseline and follow-up questionnaires, but did not receive the glasses. They received a unit-marked glass on completion of the follow-up. If required, reminders to complete the follow-up were sent 3 days and 6 days after the initial request. All participants who completed the follow-up received a £5 (USD7) shopping voucher.

Baseline questionnaire: Age, employment status (recoded as “working full-time” or “other”), ethnicity (recoded as “White” or “other”), and highest completed level of education (recoded as “University” or “less than University”) were assessed.

Four items assessed knowledge of the recommended daily unit intake maxima current at the time of the study (i.e., men should not regularly consume more than 3-4 units per day, women should not regularly consume more than 2-3 units per day) and the recommended number of dry days per week for men and for women (de Visser, 2015). Correct responses were summed to give knowledge scores between 0 and 4.

Knowledge of the unit content of drinks was assessed with 10 items (de Visser, 2015). Colour pictures of each drink were accompanied by brief descriptions: pint (568mL) of regular strength beer; pint (568mL) of cider; large glass (250mL) of wine; bottle (750mL) of wine; glass (150mL) of sparkling wine; single measure (25mL shot) of a spirit; single measure mixed drink; alcopop (275mL bottle); single (50mL) cream liqueur; and a cocktail. Estimates were considered to be correct if they were within $\pm 10\%$ of the actual unit content (de Visser & Birch, 2012; Gill & O’May, 2007b), and summed to give scores from 0 to 10.

Novel items were used to assess beliefs and behaviour related to unit-based guidelines. Participants used 10-point scales (1 = “not at all” - 10 = “extremely”) to answer two questions: “How familiar are you with the concept of units?” and “How useful to you is the concept of units?” Respondents used another 10-point scale (1 = “never” - 10 = “always”) to answer “How often do you count the number of units of alcohol that you drink?”

Participants used a 10-point scale (1 = "not at all" - 10 = "extremely") to answer "How concerned are you about the effect of your alcohol intake on your health?" This was converted by median split into a dichotomous measure of more and less concerned people.

Participants viewed a pictorial guide to the unit content of various drinks to report how many units they consumed on each day in the previous week (de Visser, 2015). Knowledge questions were presented before intake questions, and back-tracking was not permitted: the guide could not be used to amend earlier responses. Responses were used to create three variables: days in the last week when intake was over the recommended maximum; dry days during the last week; total number of units in the last week. The latter was also converted into a dichotomous variable that identified heavier and lighter drinkers based on a median split.

Follow-up questionnaire: The follow-up questionnaire used the measures described above to assess: knowledge of guidelines; knowledge of the unit content of drinks; familiarity with the concept of units; perceived utility of units; frequency of counting units; number of days in the last week when intake was over the recommended maximum; number of dry days during the last week; and total number of units in the last week.

The intervention group reported their frequency of use of the unit-marked glasses in three locations: at home, at work; and elsewhere (1 = "never" - 10 = "always"). They used another 10-point scale (1 = "not at all" and 10 = "extremely") to answer three questions about the glasses: How helpful were they for understanding government guidelines for alcohol use?; How easy were they to use?; How much did they make you think about your alcohol intake?

Analytic plan: Intention to treat analyses were conducted to identify simple intervention effects (Gupta, 2011). Modified per-protocol analyses were also conducted with respondents split into three groups according to frequency of use of the glasses (Sedgwick, 2015). Control and intervention groups were compared at baseline to check that the non-random allocation to conditions did not introduce systematic bias, and to identify any baseline differences to be accounted for in subsequent analyses. ANCOVAs were planned for each follow-up variable with the corresponding baseline measure used as a covariate along with variables for which there were significant between-group baseline differences (Table 1). Given the interest in 8 outcome variables, the significance level was set at $p < .01$ (Benjamini & Hochberg, 1995).

Phase 2 - Qualitative study

Sample: All Phase 1 intervention group participants were invited to be interviewed about their experiences of using the glasses: 83 out of 229 volunteered and 14 were selected to give a balance of male and female participants who were more- and less-frequent users of their glasses. Volunteers did not differ from non-volunteers in terms of demographics, beliefs, alcohol intake, or frequency of use of the glasses (Supplementary Table 2). Telephone interviews were conducted with 7 women and 6 men aged 27-60 (one male interviewee was unavailable for interview). They focused on initial and later reactions to the glasses, the experience of using them, the perceived impact of using them on alcohol consumption, and suggestions for how to improve the intervention.

Analytic plan: Interview recordings were transcribed verbatim. Transcripts underwent thematic analysis which is a flexible method for identifying patterns within data (Braun & Clarke, 2006). They were read repeatedly and annotated to identify pre-determined themes related to: initial impression of the glasses; impact of information on the glasses; experience of using the glasses; impact of using the glasses on drinking behaviour. The first and second authors independently coded the first two transcripts and compared notes to agree a consistent approach to analysis of the remainder of the transcripts.

Results

Phase 1

Control and intervention groups were comparable at baseline (Table 1). The only significant difference was that intervention group participants were more likely to be employed full-time. Analyses of intervention effects controlled for this difference. The mean knowledge score was just above the scale midpoint, and participants tended not to give correct estimates of the unit content drinks. Mean ratings suggested that participants were moderately familiar with the guidelines, and perceived moderate usefulness of units, but did not count units frequently. Respondents were moderately concerned about the health effects of alcohol.

> Table 1 <

On a 10-point scale (1 = never, 10 = always), the mean frequency of use of glasses at home was 5.56 ($SD = 3.01$); at work was 1.77 ($SD = 2.13$); and in other locations was 1.75 ($SD = 1.89$). When frequency of use scores were summed, the mean frequency of use was 9.06 ($SD = 4.586$). Participants found that the glasses: were helpful for understanding the government guidelines ($M = 7.51$, $SD = 2.52$); were easy to use ($M = 7.58$, $SD = 2.73$); and made them think a lot about their alcohol intake ($M = 6.85$, $SD = 2.92$).

Table 2 shows the results of intention-to-treat analyses. After adjusting for employment status and the corresponding baseline measure, the intervention group had significantly better knowledge of unit-based guidelines, and were significantly better at estimating the unit content of different drinks at follow-up. They also reported significantly greater familiarity with unit-based guidelines, perceived that the guidelines were more useful, and reported counting their unit intake more frequently. At follow-up there were no significant differences in alcohol consumption. When these analyses were re-run including the dichotomous measures of concern about the health effects of alcohol and weekly unit intake, all of the intervention effects remained significant and were of comparable magnitude. Only one significant interaction effect was found: heavier drinkers in the intervention condition reported counting units more frequently ($F_{(1,439)} = 6.13$, $p = .01$).

> Table 2 <

Among the 229 respondents in the intervention group, 35 reported not using the glasses at all. Therefore, the analyses were re-run using a 3-category variable in a modified per-protocol analysis. Participants in the control group and participants in the intervention group who did not use their glasses were allocated to the “non-use” group. The remaining participants in the intervention group were coded as “low use” or “high use” according to a median split of frequency of use summed across the three settings. These three groups did not differ on any baseline variables (Supplementary Table 3). Table 3 shows similar results to Table 2. However, whereas any use of the glasses was associated with greater knowledge of UK guidelines, greater accuracy of estimate of unit content of drink, and greater familiarity with units, only high use of the unit-marked glasses was associated with significantly greater perceived utility of units and more frequent counting of units at follow-up. When these analyses were re-run including the dichotomous measures of concern about the health effects of alcohol and weekly unit intake, all intervention effects remained significant and were of comparable magnitude. No significant interaction effects were found.

> Table 3 <

Phase 2

Four key themes are described below and illustrated with quotes (Table 4).

First impressions: Participants generally had positive opinions of the glasses. They thought that they: were useful for informing them about government guidelines; clarified their understanding of units; and made them more aware of what they were pouring and drinking (Quote 1). Design aspects that participants praised included the glasses being clear and clean looking: they had a clear message which imparted the necessary information well. However, some participants felt the glasses were cluttered with too much information, and that the design looked medical and hence not appealing (Quote 2)

Influence of unit-marked glasses on thinking: Participants noted that the information on the glasses made them more aware of guidelines and the amounts that they were pouring and drinking. Having the glasses made them reflect more on such issues as how much alcohol constituted a unit, the size of the glasses they normally drank out of, and the strengths of different drinks (Quote 3).

Participants reported self-pouring larger measures of spirits than licensed premises’ single unit servings, and were surprised that their wine glasses constituted more units than they had imagined. This made some realise that they drank more than they had estimated (Quote 4): one participant described the unit information as “eye-opening”. For other participants, the information on the glasses confirmed their knowledge of units. Most participants agreed that the glasses were a helpful reference point, increasing their awareness and leading them to think more about their alcohol intake.

Experience of using unit-marked glasses: Several participants noted that it was not aesthetically appealing for them to drink from half-pint plastic glasses. Although this might suggest limited utility of the glasses, some participants noted that they did (or would) use the glasses for non-alcoholic drinks (Quote 5). Concerns about the glasses’ shape, size and material led some participants to suggest that having tailored vessels (e.g., pint glasses for beer, and glasses with stems for wine) made of glass (rather than plastic) would be beneficial (Quote 6).

Among participants who were willing to use the unit-marked glasses, some found it embarrassing to use them, and some noted that measuring out drinks reduced their enjoyment (Quote 7). Participants also noted that their use of unit-marked glasses could affect others’ enjoyment of drinking. One participant related how she was told by her daughter to “put that

away mum, you're spoiling the party".

Impact of using unit-marked glasses on own (and others') drinking: Although the glasses increased participants' awareness of units and recommended drinking guidelines, this did not necessarily translate into behaviour change (Quote 8). Several participants reported that using the glasses encouraged them to think about their alcohol consumption in ways that led to reductions in intake. However, some noted that initial changes to behaviour were not always maintained (Quote 9). Other participants reported that although using the glasses made them more aware of their consumption, it did not affect their alcohol intake, because they were not concerned about the health effects of alcohol consumption on their health nor open to change (Quote 10). One participant suggested that using the unit-marked glasses for non-alcoholic drinks had a paradoxical effect of making him think about (and want) alcohol more than usual (Quote 11).

Several participants noted that their use of the glasses sparked conversations with friends, family members and work colleagues about drinking and alcohol consumption (Quote 12, Quote 13).

Participants generally thought that the clear markings on the glasses were a positive factor, and that discussion of drinking could be a good thing, but some noted that they would have preferred more discrete markings, especially for use outside of the home (Quote 14, Quote 15).

Discussion

Phase 1 findings revealed that use of glasses marked with UK units and recommendations for alcohol intake resulted in significant improvements in knowledge of intake guidelines and the unit content of various drinks, more positive attitudes toward the guidelines, and more frequent counting of unit intake. The glasses were found to be easy to use and helpful for understanding the guidelines, and they also prompted participants to think about their alcohol intake. However, there were no significant reductions in alcohol consumption. The analyses also indicated relatively low rates of use of the glasses. However, as expected from applying the IMB (Fisher et al., 1994), greater use of the glasses was associated with significantly better knowledge, motivation, and behavioural skills at follow-up.

Given the evidence that greater use of the unit-marked glasses led to bigger changes in knowledge, skills, and behaviour, Phase 2 provided useful insights into why people did or did not use them, and how their impact could be enhanced. Participants noted that although the glasses conveyed useful information that encouraged them to think about their drinking, the initial impact of the information did not always persist, measuring took some of the pleasure out of drinking, and the plastic glasses were less appealing to drink from than "real" glasses - especially for beer and wine. Further research could examine whether making the glasses more appealing - e.g., by providing them in different shapes and sizes for wine and beer, and by making them out of glass rather than plastic - would enhance their appeal and their impact.

Although this was an individual-focused intervention, there was evidence that it could have an effect on others via social contagion or diffusion - especially because drinking is usually a social activity (de Visser et al., 2013; Jayne et al., 2010). Many interviewees noted that their use of the glasses prompted discussions of alcohol use with other people (but in contexts such as work this was not always desired). The terms "social contagion" and "diffusion" refer to processes by which new ideas or practice spread through social systems (Christakiz & Fowler, 2013; Rogers, 2003). Thus, use of unit-marked glasses by some individuals may prompt discussion of alcohol use with others, which may lead to behaviour change in people other than the initial recipients of the intervention.

As in previous research, this study found that people have poor knowledge of alcohol intake guidelines and tend not to use them to monitor their drinking (de Visser, 2015; de Visser & Birch, 2012; Devos-Comby & Lange, 2008; Gill & O'May, 2006; Gill & O'May, 2007a; Hasking et al., 2005; Kerr & Stockwell, 2012; ONS, 2010). It is therefore noteworthy that use of the unit-marked glasses had a significant positive impact on guideline-related knowledge and attitudes. One reason for the modest effect sizes may be that the glasses were used relatively infrequently by members of the intervention group. However, intervention effects were larger with greater use of glasses. It should also be noted that participants were only moderately concerned about the health effects of alcohol (see also de Visser et al., 2013; Jayne et al., 2010). It would be helpful for future research to determine whether the intervention would be more effective among groups with greater motivation to change their behaviour and/or for whom the health effects of their drinking were more salient (Fisher et al., 1994; Prochaska & Velicer, 1997): such groups may include people voluntarily seeking help to reduce their alcohol intake, and those advised by health professionals to do so. It would also be helpful for future research to determine whether making the glasses more appealing would lead to more frequent use and greater intervention effects.

There would be value in replicating this study with broader groups of drinkers. Data collection was focused on two cities that may not represent the British population (Public Health England, 2014) and people with predominantly "white collar" occupations. However, it has been noted that higher socioeconomic status adults are a group worthy of more research attention because they may be more likely to drink in harmful ways than other adults (Iparraguirre, 2015). Replication of the study in younger adults and teenagers would also be informative for evaluation of the likely impact of preventative implementation of the intervention. The reliance on self-report measures of alcohol intake without validation via an objective measure could be considered a study limitation. However, the within-subjects analyses would not have been affected by the use of self-reports unless there were systematic differences over time in accuracy of self-reports between the intervention and control groups. One methodological limitation of the study was the non-random allocation of participants and/or workplaces to the control or intervention condition. However, the allocation process did not introduce systematic differences between the two conditions. A stronger study design would have been a randomised cluster RCT, but the funding and resources available for this study did not permit this. A second limitation was that there was no condition in which participant received unmarked glasses. It is therefore not possible to conclude whether intervention effects were due to using the plastic glasses or whether they were due to the specific markings on the glasses. However, the study was designed to test a currently-used intervention (i.e., distribution of unit/guideline-marked glasses) against no such intervention, and we cannot conceive of any organisation deciding to distribute plastic glasses that contain no information at all.

The impact of this intervention was significant, but small. However, it was not particularly expensive: each glass costs around 70p (USD1). It is unlikely that any single short-term intervention will have a large immediate impact on alcohol use, especially among people who are not strongly motivated to change their behaviour. It should also be noted that the interventions only focused on some of the skills required to drink in line with government guidelines - i.e., the capacity to accurately monitor unit intake. People who want to reduce their alcohol consumption may also need help to capacity to resist temptation and/or pressure to drink (de Visser et al., 2015).

Acknowledgments

Thanks are due to: all participants; employers who assisted with recruitment; Tess Langfield for aiding data management; colleagues who provided constructive comments at the 42nd Kettil Bruun Society Conference. This research was supported by the European Foundation for Alcohol Research (EA 14 25).

References

- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, *3*, 77-101. doi: 10.1191/1478088706qp063oa
- Benjamini, Y. & Hochberg, Y. (1995). "Controlling the false discovery rate: a practical and powerful approach to multiple testing" (PDF). *Journal of the Royal Statistical Society - Series B*, *57*, 289-300. doi: 10.2307/2346101.
- Christakis, N.A., & Fowler, J.H. (2013). Social contagion theory: examining dynamic social networks and human behaviour. Statistics in Medicine, *32*, 556–577. doi: 10.1002/sim.5408
- de Visser, R.O. (2015) . Personalized feedback based on a drink-pouring exercise may improve knowledge of, and adherence to, government guidelines for alcohol consumption. Alcoholism: Clinical & Experimental Research, *31*, 206-212. doi: 10.1111/acer.12623
- de Visser, R.O., & Birch, J.D. (2012). My cup runneth over: young people's lack of knowledge of low-risk drinking guidelines. Drug & Alcohol Review, *31*, 206-212. doi: 10.1111/j.1465-3362.2011.00371.x
- de Visser, R.O., Wheeler, Z., Abraham, C., & Smith, J.A. (2013) “Drinking is our modern way of bonding”: Young people's beliefs about interventions to encourage moderate drinking. Psychology & Health, *28*, 1460-1480. doi: 10.1080/08870446.2013.828293
- de Visser, R.O., Graber, R., Hart, A., Abraham, C., Scanlon, T., Watten, P., & Memon, A. (2015). Using qualitative methods within a mixed-methods approach to developing and evaluating interventions to address harmful alcohol use among young people. Health Psychology, *34*, 349-360. doi: 10.1037/hea0000163
- Devos-Comby, L., & Lange, J.E. (2008). “My drink is larger than yours”? A literature review of self-defined drink sizes and standard drinks. Current Drug Abuse Reviews, *1*, 162-176.
- Fisher, J.D., Fisher, W.A., Williams, S.S. & Malloy, T.E. (1994). Empirical tests of an information-motivation-behavioural skills model of AIDS-preventive behaviour with gay men and heterosexual university students. Health Psychology, *13*, 238–250. doi: 10.1037/0278-6133.13.3.238
- Furtwängler, N.A.F.F., & de Visser, R.O. (2013). Lack of international consensus in low risk drinking guidelines. Drug & Alcohol Review, *32*, 11-18. doi: 10.1111/j.1465-3362.2012.00475.x
- Gill, J.S., & O’May, F. (2006). People seem confused about sensible drinking messages. British Medical Journal, *332*, 302-303. doi: 10.1136/bmj.332.7536.302-a
- Gill, J.S., & O’May, F. (2007a). How ‘sensible’ is the UK Sensible drinking message? Factors which impact on levels of alcohol consumption among newly matriculated female university students. Journal of Public Health, *29*, 13-16. doi: 10.1093/pubmed/fdl080
- Gill, J.S., & O’May, F. (2007b). Practical demonstration of personal daily consumption: a useful intervention tool to promote responsible drinking among UK adults? Alcohol &

- Alcoholism, 42, 436-441. doi: 10.1093/alcalc/agm049
- Gupta, S.K. (2011). Intention-to-treat concept: A review. Perspectives in Clinical Research, 2, 109–112. doi: 10.4103/2229-3485.83221
- House of Commons Science and Technology Committee (2012). Science and Technology Committee 11th Report: Alcohol Guidelines. Downloaded on 26/11/15 from www.publications.parliament.uk/pa/cm201012/cmselect/cmsctech/1536/153602.htm
- Hasking, P., Shortell, C., & Machalek, M. (2005) University students' knowledge of alcoholic drinks and their perception of alcohol-related harm. Journal of Drug Education, 35, 95-109. doi: 10.2190/9Y34-F5XR-AQV5-KEL8
- Iparraguirre, J. (2015). Socioeconomic determinants of risk of harmful alcohol drinking among people aged 50 or over in England. BMJ Open, 5, e007684 doi:10.1136/bmjopen-2015-007684
- Jayne, M., Valentine, G., & Holloway, S. L. (2010). Emotional, embodied and affective geographies of alcohol, drinking and drunkenness. Transactions of the Institute of British Geographers, 35, 540–554. doi:10.1111/j.1475-5661.2010.00401.x
- Kerr, W.C., & Stockwell, T. (2012). Understanding standard drinks and drinking guidelines. Drug & Alcohol Review, 31, 200-205. doi: 10.1111/j.1465-3362.2011.00374.x
- National Health Service (2016). Alcohol units and guidelines. website visited 07/01/16: www.nhs.uk/change4life/Pages/alcohol-lower-risk-guidelines-units.aspx
- Office for National Statistics (2010) Drinking: Adults' Behaviour and Knowledge in 2009. Newport: ONS.
- Office for National Statistics (2015a). Statistical bulletin: UK Labour Market, December 2015. website visited 07/01/16: www.ons.gov.uk/ons/rel/lms/labour-market-statistics/december-2015/statistical-bulletin.html
- Office for National Statistics (2015b). Census 2011 Table Links. KS201EW: Ethnic Group. website visited 07/01/16: www.nomisweb.co.uk/census/2011/key_statistics
- Office for National Statistics (2015c). Highest levels of qualification across England and Wales. website visited on 07/01/16: www.ons.gov.uk/ons/rel/census/2011-census-analysis/local-area-analysis-of-qualifications-across-england-and-wales/info-highest-qualifications.html
- Petticrew, M., Douglas, N., Knai, C., Durand, M.A., Eastmure, E., & Mays, N. (2016). Health information on alcoholic beverage containers: has the alcohol industry's pledge in England to improve labelling been met? Addiction, 111, 51-55. doi: 10.1111/add.13094
- Prochaska, J.O., & Velicer, W.F. (1997) Transtheoretical model of health behaviour change. American Journal of Health Promotion, 12, 38-48. doi: 10.4278/0890-1171-12.1.38
- Public Health England (2014). Local Alcohol Profiles. downloaded 14/09/14 from www.lape.org.uk/
- Rogers E. (2003). Diffusion of Innovations (5th edition). London: Free Press.
- Sedgwick, P. (2015). Intention to treat analysis versus per protocol analysis of trial data. British Medical Journal, 350, h681. doi: 10.1136/bmj.h681

Table 1 Comparison of control and intervention groups at baseline

		Whole sample N=450	Control N=221	Intervention N=229	difference
Sex	Female	67.3%	67.9%	66.8%	$\chi^2_{(1)} = 0.06, p = .81$
	Male	32.7%	32.1%	33.2%	
Ethnicity	White	95.4%	94.9%	95.9%	$\chi^2_{(1)} = 0.26, p = .61$
	Other	4.6%	5.1%	4.1%	
Occupation	Full-time employment	67.1%	61.2%	72.8%	$\chi^2_{(1)} = 11.38, p < .01$
	Other	32.9%	38.8%	27.2%	
Education	University	75.1%	78.2%	72.1%	$\chi^2_{(1)} = 2.11, p = .12$
	Less than university	24.9%	21.8%	27.9%	
Age		42.0 (10.5)	41.7 (10.9)	42.3 (10.2)	$t_{(1, 448)} = 0.62, p = .54$
Age at first alcoholic drink		15.8 (2.9)	16.0 (3.0)	15.7 (2.9)	$t_{(1, 448)} = -0.96, p = .34$
Accuracy of knowledge of UK guidelines [*]		2.43 (1.27)	2.34 (1.30)	2.52 (1.23)	$t_{(1, 448)} = 1.51, p = .13$
Accuracy of estimates of unit content of drinks ^{2**}		3.10 (1.86)	2.90 (1.84)	3.28 (1.87)	$t_{(1, 446)} = 2.19, p = .03$
Familiarity with units ^{***}		6.35 (2.34)	6.31 (2.28)	6.39 (2.41)	$t_{(1, 446)} = 0.39, p = .70$
Perceived utility of units ^{***}		5.88 (2.58)	5.80 (2.75)	6.00 (2.39)	$t_{(1, 432)} = 0.84, p = .40$
Frequency of counting units ^{***}		2.87 (2.55)	3.02 (2.74)	2.73 (2.34)	$t_{(1, 432)} = -1.22, p = .22$
Days over daily guideline maximum		2.03 (1.79)	1.95 (1.85)	2.11 (1.73)	$t_{(1, 448)} = 0.92, p = .36$
Dry days in last week		3.83 (1.88)	3.88 (1.91)	3.78 (1.86)	$t_{(1, 448)} = -0.57, p = .57$
Units consumed in last week		17.77 (16.41)	16.85 (16.64)	18.66 (16.18)	$t_{(1, 448)} = 1.37, p = .24$
Concern about effect of alcohol intake on health ^{***}		5.08 (2.95)	4.97 (2.93)	5.19 (2.96)	$t_{(1, 448)} = 0.78, p = .44$

notes:

* range = 0-4

** range = 0-10

*** range = 1-10

Table 2 Follow-up measures of knowledge, attitudes, and behaviour according to intervention group - intention to treat analysis

	Control N=221	Intervention N=229	intervention effect*	effect size
Accuracy of knowledge of UK guidelines**	2.53 (1.16)	3.08 (1.12)	$F_{(1,446)} = 24.14, p < .01$	partial $\eta^2 = .05$
Accuracy of estimates of unit content of drinks***	3.08 (1.94)	3.86 (2.07)	$F_{(1,446)} = 12.47, p < .01$	partial $\eta^2 = .03$
Familiarity with units†	5.96 (2.50)	7.14 (2.32)	$F_{(1,446)} = 32.62, p < .01$	partial $\eta^2 = .07$
Perceived utility of units†	5.42 (2.68)	6.36 (2.40)	$F_{(1,446)} = 20.42, p < .01$	partial $\eta^2 = .04$
Frequency of counting units†	3.33 (2.51)	4.07 (2.59)	$F_{(1,446)} = 20.01, p < .01$	partial $\eta^2 = .04$
Days over daily guideline maximum	2.03 (1.91)	2.03 (1.77)	$F_{(1,446)} = 0.35, p = .55$	partial $\eta^2 < .01$
Dry days in last week	3.92 (1.99)	3.78 (1.87)	$F_{(1,446)} = 0.29, p = .59$	partial $\eta^2 < .01$
Units consumed in last week	16.60 (15.48)	17.71 (15.51)	$F_{(1,446)} = 0.01, p = .92$	partial $\eta^2 < .01$

notes:

* - adjusted for baseline measure of outcome variable, and occupation status

** - range 0-4

*** - range 0-10

† - range 1-10

Table 3 Follow-up measures of knowledge, attitudes, and behaviour - modified per-protocol treat analysis

	use of glasses			intervention effect **	effect size
	Non-use N=256	Low N=96	High N=98		
Accuracy of knowledge of UK guidelines***	2.55 (1.18) ^a	3.16 (1.13) ^b	3.17 (1.02) ^b	$F_{(2,447)} = 15.61, p < .01$	partial $\eta^2 = .06$
Accuracy of estimates of unit content of drinks [†]	3.07 (1.98) ^a	3.86 (2.01) ^b	4.14 (1.99) ^b	$F_{(2,447)} = 11.48, p < .01$	partial $\eta^2 = .04$
Familiarity with units ^{††}	6.09 (2.55) ^a	7.22 (1.92) ^b	7.16 (2.51) ^b	$F_{(2,447)} = 16.50, p < .01$	partial $\eta^2 = .05$
Perceived utility of units ^{††}	5.44 (2.69) ^a	6.20 (2.09) ^a	6.81 (2.46) ^b	$F_{(2,447)} = 12.45, p < .01$	partial $\eta^2 = .04$
Frequency of counting units ^{††}	3.37 (2.57) ^a	3.86 (2.24) ^a	4.40 (2.76) ^b	$F_{(2,447)} = 9.62, p < .01$	partial $\eta^2 = .03$
Days over daily guideline maximum	1.95 (1.92)	2.40 (1.70)	1.87 (1.71)	$F_{(2,447)} = 0.73, p = .48$	partial $\eta^2 < .01$
Dry days in last week	3.95 (2.03)	3.48 (1.87)	3.90 (1.71)	$F_{(2,447)} = 0.54, p = .58$	partial $\eta^2 < .01$
Units consumed in last week	16.31 (15.99)	21.00 (14.96)	15.47 (14.15)	$F_{(2,447)} = 1.15, p = .32$	partial $\eta^2 < .01$

notes:

* - 221 in control condition plus 35 in intervention condition who did not use glasses

** - adjusted for baseline measure of outcome variable, and occupation status

*** - range 0-4

† - range 0-10

†† - range 1-10

means with different superscripts are significantly different at $p < .01$

Table 4 Indicative quotes for each theme

<p>First impressions</p> <p>Quote 1: When you buy a wine glass you think it's small, medium or large, but even our medium ones were - according to your, you know, your measures - a large, you know, a large, er, number of units. So, you know, I have to say it has moderated my drinking (F60)</p> <p>Quote 2: It's not a cool design, but it's not about design, it's about the message isn't it? (M52)</p>
<p>Influence of unit-marked glasses on thinking</p> <p>Quote 3: I was vaguely aware that I drank somewhat too much and now I'm more aware of exactly how much (F57)</p> <p>Quote 4: I think previously I might have poured units and thought "OK, so I've had three single vodkas and coke", whereas now I'd know I'd actually had more like six (F28)</p>
<p>Experience of using unit-marked glasses</p> <p>Quote 5: It was unusual because they're plastic. I'm used to drinking alcohol out of a glass (M43)</p> <p>Quote 6: It would be a really good design project for kids or students to design measure, measurable glasses that were actually desirable. One you would buy that you'd go "Oh yeah I'd drink out of that" (F39)</p> <p>Quote 7: The first time I used them it was for wine, and it just felt a bit weird. Like we poured them into another glass, but it somehow seemed to take away the pleasure of the wine by pouring it into this plastic cup rather than pouring it straight from the bottle into a nice glass. (F28)</p>
<p>Impact of using unit-marked glasses on own (and others') drinking</p> <p>Quote 8: I think as soon as you see them you think "Oh these are quite good. They're quite useful", but after a short amount of time you become a little bit blind to the outside of the design. (F28)</p> <p>Quote 9: Prior to the study, um, probably I was drinking three, three or four nights during the week, and then at weekends. And now it's more like once, once during the week, and then kind of drinking at weekends. Yeah it's had a significant impact on the amount that I drink, yeah. They've had a sort of positive influence on, um, the amount that I drink during the week [...] and consequently feel quite a bit healthier as a result. (M43)</p> <p>Quote 10: It made me more mindful, but you know it, it hasn't lowered it, and it hasn't increased it, so ... I'm, I'm at that age now where I know what I'm doing, and, and that's it. I'm set in my ways. (M41)</p> <p>Quote 11: I kept thinking about alcohol which I wouldn't normally. I felt it increased my consumption slightly I think. (M58)</p> <p>Quote 12: If anyone saw the glass they were like "Ooh, what's that?" And of course everyone gets a bit like "Ooh!", and wants to, you know, talk about themselves. (F36)</p> <p>Quote 13: I have a teenage daughter, and the unit-marked cups were very useful to show her what an alcohol unit is for various types of alcohol. It also highlighted how different our perceptions were. (F52)</p> <p>Quote 14: I was reluctant to use the unit-marked glasses out, as I didn't want to draw attention to myself. (M46)</p> <p>Quote 15: At work I wouldn't particularly want to, like, engage in discussions about my drinking (F36)</p>