

An Intervention to Reduce Alcohol Consumption in Undergraduate Students Using Implementation Intentions and Mental Simulations: A Cross-National Study

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Abstract

Background Excessive alcohol consumption has been linked to deleterious health consequences among undergraduate students. There is a need to develop theory-based and cost-effective brief interventions to attenuate alcohol consumption in this population.

Purpose The present study tested the effectiveness of an integrated theory-based intervention in reducing undergraduates' alcohol consumption in excess of guideline limits in national samples from Estonia, Finland, and the UK.

Method A 2 (volitional: implementation intention vs. no implementation intention) × 2 (motivational: mental simulation vs. no mental simulation) × 3 (nationality: Estonia vs. Finland vs. UK) randomized-controlled design was adopted.

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Participants completed baseline psychological measures and self-reported number of alcohol units consumed and binge-drinking frequency followed by the intervention manipulation. One month later, participants completed follow-up measures of the psychological variables and alcohol consumption.

Results Results revealed main effects for implementation intention and nationality on units of alcohol consumed at follow-up and an implementation intention × nationality interaction. Alcohol consumption was significantly reduced in the implementation intention condition for the Estonian and UK samples. There was a significant main effect for nationality and an implementation intention × nationality interaction on binge-drinking frequency. Follow-up tests revealed significant reductions in binge-drinking occasions in the implementation intention group for the UK sample only.

Conclusion Results support the implementation intention component of the intervention in reducing alcohol drinking in excess of guideline limits among Estonian and UK undergraduates. There was no support for the motivational intervention or the interaction between the strategies. Results are discussed with respect to intervention design based on motivational and volitional approaches.

Keywords Binge drinking · Implementation intention · Mental simulations · Planned behavior

Research has consistently shown high levels of alcohol consumption and frequency of high-risk single-session alcohol drinking, known as “binge drinking”, among undergraduate students [1–3]. This population is, therefore, vulnerable to the deleterious health consequences of excess alcohol consumption such as unplanned sexual intercourse, physical illness, accidents, and injuries [4–7]. In addition,

excessive alcohol consumption has been linked to maladaptive population-specific outcomes such as impaired academic performance [8] and attrition from university [9]. In response, organizations responsible for student health such as governments [10], university authorities [11], and student advice groups [12] have developed guidelines to reduce high-risk alcohol drinking among undergraduate students. There has also been a drive to develop effective brief interventions to attenuate alcohol consumption in this population [13, 14].

While interventions have had mixed success in reducing alcohol intake, few have been informed by a clear theoretical framework [15, 16]. Furthermore, those that have adopted such a framework have seldom reported the specific components of the intervention that give rise to behavior change [17, 18]. Isolating these “active” components has been identified as essential for the effective evaluation and replication of interventions in health psychology and behavioral medicine [19, 20]. In addition, many alcohol-reduction interventions have been tested in student populations within a single national group. There have been few attempts at replication and tests of generalizability of interventions across different universities and national groups. Such tests are essential if an intervention is to be implemented on a wide scale, nationally or internationally. A lack of confirmatory evidence for the effectiveness of interventions in different populations increases the potential for the wide-scale adoption of untested interventions that may have limited effectiveness on health outcomes and constitute a waste of resources [74].

The aim of the present study was to evaluate the effectiveness and generalizability of a theory-based intervention to reduce the consumption of drinking alcohol in excess of guideline limits among undergraduate students. The intervention was designed to change behavior by targeting the motivational and volitional stages of the decision-making process. We adopted a randomized-controlled design and replicated the intervention in samples of undergraduate students from universities in three countries: Estonia, Finland, and the UK. Our study adds to knowledge in two main ways. First, it contributes to theoretical development by testing the efficacy of an intervention strategy aimed at increasing motivation to act to reduce alcohol drinking and promoting plans to execute the intended action. This provides new insight into whether strategies intervening at both stages of the decision-making process lead to more effective behavior change than strategies intervening at each stage in isolation. Second, it tests whether the intervention is replicable in three samples from different national groups. This will provide evidence for the generalizability of the intervention to reduce alcohol consumption among undergraduate students and help evaluate whether it is feasible to expect universal success if it is adopted for use in the larger student population.

Action Phases, Motivation, and Implementation Intentions

Theories adopted to inform behavior-change interventions often make reference to two key processes that lead to behavioral engagement: motivation and volition. Heckhausen and Gollwitzer's [21] action-phase model integrates these two processes to provide a comprehensive account of goal-directed action. According to the model, the motivational phase accounts for the processes that lead to the formation of an intention to perform a specific behavior for the attainment of a goal or outcome (e.g., “I intend to do X to achieve goal Y”). Numerous theories have provided operationalizations of this motivational phase and identified the antecedents and mechanisms that lead to intention formation. At the forefront of these theories is the theory of planned behavior [22] in which behavior is viewed as a function of intentions that mediate the effect of personal (attitudes), social (subjective norms), and control (perceived behavioral control) beliefs on behavior. Research has demonstrated significant relations between these antecedent variables and intentions. However, the link between intentions and behavior is consistently weak [23, 24]. This so-called intention-behavior “gap” represents a limitation of the theory and illustrates that intended actions are not always enacted. A solution is apparent in the action-phase model through the volitional phase. This phase outlines how critical cues in the environment serve to initiate the enactment of intentions and lead to behavioral engagement. The identification of such cues promotes increased access and recall of the intended behavior and leads to efficient action initiation.

Strategies that highlight the critical cues in the environment (often a location or situation) will, therefore, be effective in increasing the enactment of intended behaviors by promoting strong links between intention and behavior. Gollwitzer [25] proposed a strategy in which people identified and wrote down a critical cue and linked it with an intended action, known as implementation intentions (e.g., “if situation Z occurs, then I will perform response X!”). These exercises increased the likelihood of intentions being enacted by promoting the accessibility of the critical cue [26] and developing a link in memory between the critical situation (Z) and the planned action (X) [27]. Behavioral enactment according to the action-phase model is, therefore, a function of a motivational phase and a volitional phase, such that intention alone is unlikely to be sufficient for behavioral enactment. The active identification of environmental cues and making a link between the cue and the intended action is much more likely to lead to behavioral engagement.

The action-phase model provides a blueprint for interventions designed to incorporate strategies that target both phases of action in order to maximize the enactment of

intentions. Interventions adopting theories of intention such as the theory of planned behavior as a framework to change health-related behavior have not always been successful [28] and are often more effective in changing intentions rather than behavior [23, 29]. The adoption of implementation intention as an intervention strategy to change behavior has been shown to be effective in increasing the intention-behavior link and increasing behavioral engagement in a variety of health-related behaviors [30, 31] including physical activity [32–34], dietary behaviors [35–37], cancer screening and self-examination, [38–40], and alcohol consumption [41, 42].

Integrating both motivational and volitional strategies in a single intervention is an approach that has been adopted less frequently, even though it is consistent with the action-phase model. For example, researchers have adopted motivational components from Rogers' [43] protection motivation theory and Janis and Mann's [44] decision-making theory and included them alongside an implementation intention component using factorial designs [34, 37, 45]. Such designs permit the evaluation of the interaction between the components as well as each component in isolation. Findings indicate that an intervention adopting both motivational and volitional components was more effective in changing health-related behaviors such as physical activity [34, 45] and reducing dietary fat intake [37] than an intervention adopting either component alone. These findings not only demonstrate the advantage of integrating these strategies but also demonstrate the importance of isolating the components that lead to behavior change. This is an important endeavor in intervention designs if they are to be accurately replicated [46]. In the present study, we adopted an integrated approach using motivational and volitional strategies to reduce alcohol consumption in excess of guideline limits on single occasions among undergraduate students. We anticipated that a combination of strategies would be more effective in reducing alcohol consumption than each of the strategies in isolation.

Motivation, Intentions, and Mental Simulations

Many motivational interventions that seek to promote the formation of intentional behavior target changes in the belief-based constructs that underpin intentions, namely attitudes and perceived behavioral control [28, 47]. Traditionally, such strategies have used persuasive communications targeting the most frequently cited outcome expectations of performing the behavior and the means available to produce those outcomes [47]. Such interventions, therefore, target the attitude and perceived behavioral control components of the theory as these have been identified as the strongest

predictors of intention [24]. An important prerequisite for the development of such interventions is the conduct of formative research that identifies the *modal* (most frequently occurring) beliefs with respect to the target behavior. In the absence of normative data or formative research, this presents an additional step in the process of intervention development.

Recently, however, research has demonstrated that the antecedents of intentions, namely attitudes and perceived behavioral control, can be changed using a person-centered motivational intervention strategy known as *mental simulations* [48]. Mental simulations are defined as mental rehearsals of future events and have shown efficacy in increasing motivation and actual behavioral engagement [49, 50]. Two types of mental simulation exist. Rehearsing the achievement of a salient behavioral goal such as reducing fat intake or drinking alcohol within guideline limits is known as an *outcome* mental simulation. This strategy focuses on the actor's attainment of a desirable goal or outcome. In contrast, imagining the specific steps and actions required to attain the goal is termed a *process* mental simulation. This strategy attends to the means required to attain the goal or outcome. Research has supported the effectiveness of process mental simulations in promoting behavioral engagement such as studying for exams or purchasing products [49, 51]. In addition, planning and motivation have been shown to mediate these effects providing evidence that the mechanism is through enhanced motivation. There is also some evidence that outcome mental simulations induce positive emotions and, as a result, increase motivation to attain goals and engage in behavior [51–53]. Furthermore, it seems that imagining future outcomes has a positive effect on self-efficacy and motivation [53].

Armitage and Reidy's [48] research has demonstrated that process mental simulations are effective in increasing intentions and the mechanism is via the mediation of attitudes and perceived behavioral control. Visualizing the steps required to attain a goal promotes increased feelings of competence and self-efficacy regarding engaging in the behavior in future which, in turn, leads to stronger intentions to perform the behavior. In this case, the person becomes a "self-model" and probably represents a vicarious efficacy experience. Overall, this research suggests that mental simulations of both varieties are efficacious in promoting intentions. They have the added advantage of being self-administered and, because they are self-directed, it obviates the need for time-intensive formative surveys to identify modal beliefs. Instead, participants identify their own outcomes and process actions. In the present study, we aim to use outcome mental simulations as a means to increase motivation and, therefore, intentions to keep alcohol drinking within guideline limits. This strategy will be included alongside an implementation intention strategy

in full-factorial randomized design. This approach means that both the motivational and volitional components of the action-phase model will be targeted, and it will permit the identification of which of the intervention components, used in isolation or synergistically, are most effective in bringing about behavior change.

Cross-National Comparisons

A key premise of intervention strategies based on social cognitive models (e.g., mental simulations, implementation intentions) is that their effects are purportedly universal and should, therefore, generalize across contexts and in groups from different cultural backgrounds [54, 55]. In the present study, we aimed to test the generalizability of the intervention strategies to reduce alcohol consumption and binge drinking by sampling undergraduate student participants from universities in three nations with diverse cultural orientations, namely, Estonia, Finland, and the UK. Our rationale for selecting these national groups is twofold. First, these nations have been shown to have relatively high incidences of binge drinking among young people and such drinking patterns represent a considerable risk to this population in each of these countries [56, 57]. As a consequence, effective interventions to reduce alcohol consumption, particularly binge drinking, is likely to be of interest to health promoters and policy makers interested in preventive measures aimed at improving young people's health in these nations. Second, these nations differ in their cultural orientation, with Estonia and Finland characterized as more collectivist in cultural orientation relative to the UK, which is classified as a nation that tends to endorse individualist values [58]. Such cultural norms are likely to bias thought processes and affect behavior in a number of different domains. For example, people from collectivist nations may be more likely to conform to social norms, while people with an individualist cultural background tend to act on the basis of personal beliefs. Some features of the present interventions, such as the requests to engage in mental simulation exercises, are expected to appeal to people from a collectivist background while others like encouraging participants to write down their own cues to action in implementation intention exercises may appeal to people from an individualist culture. Notwithstanding these features, we hypothesized in the present study that the effects of the intervention would be universal, regardless of cultural background.

The Present Study

The aim of the present study was to evaluate the effectiveness and generalizability of a theory-based inter-

vention to reduce alcohol consumption in excess of guideline limits among undergraduate students. The intervention adopted a full-factorial randomized controlled design with two intervention strategies targeting the volitional (implementation intention) and motivational (outcome mental simulation) components of Heckhausen and Gollwitzer's [21] action-phase model. The intervention was replicated in three samples of undergraduate students from city-based universities in Estonia, Finland, and the UK. All participants in each sample were required to complete questionnaires containing psychological measures and self-report measures of alcohol consumption at an initial wave of data collection. Participants allocated to the implementation intention, mental simulation, or combined implementation intention, and mental simulation intervention conditions also received pen-and-paper versions of the intervention strategies. Participants assigned to the control group received baseline measures only. Follow-up psychological and behavioral measures were taken 4 weeks later. Primary dependent variables were self-reported number of units of alcohol consumed and frequency of binge-drinking occasions over the 4-week post-intervention period.

In accordance with previous research, we hypothesized that both motivational and volitional components would have main effects on alcohol consumption and binge-drinking occasions over the 4-week follow-up period. We also expected a significant implementation intention $\times$ mental simulation interaction effect such that the combined intervention was more effective in reducing alcohol consumption than each of the intervention strategies alone. It was also hypothesized that the mental simulation strategy would lead to significant increases in the antecedents of intention, like attitudes and perceived behavioral control, as demonstrated previously [48]. Furthermore, it was hypothesized that motivation and intentions would mediate the effects of the mental simulation strategy on the alcohol-dependent variables, in accordance with previous research [49]. However, we also expected no effect for implementation intentions on intentions or motivation [30]. Finally, we hypothesized that the effects of the intervention would generalize to the three national samples and, therefore, no main effect for nationality or interaction effect between nationality and the intervention variables was expected.

Method

Participants

Participants were undergraduate students studying psychology from city-based universities in Estonia, Finland, and the UK (locations withheld for masked review). Four hundred questionnaires were distributed to eligible partic-

ipants in each location with 240, 194, and 284 completed questionnaires received at baseline for the universities in Estonia, Finland, and the UK, respectively. Follow-up data were obtained from 191 (response rate=78.75%), 121 (61.34%), and 175 (61.62%) participants in the Estonian, Finnish, and the UK universities, respectively. Attrition was attributed to absences and participants' voluntary withdrawal. Elimination of cases due to missing data or spoiled questionnaires resulted in final samples of 185, 119, and 163 for the Estonian, Finnish, and the UK universities, respectively. Participant characteristics at baseline and follow-up are provided in Table 1. The flow of participants through study including allocation to each intervention condition is illustrated in Fig. 1. The relatively large percentage of females is typical of the undergraduate psychology populations in each national group.

Design and Procedure

A 2 (implementation intention: present vs. absent) $\times$ 2 (mental simulation: present vs. absent) $\times$ (nationality: Estonia vs. Finland vs. UK) between-participants randomized controlled design was adopted. All participants received questionnaire packets containing behavioral and psychological measures at baseline with follow-up measures collected 1 month later. Participants allocated to the intervention conditions also received pen-and-paper format intervention manipulations following the baseline measures. The randomization sequence was generated by the lead researcher using a computerized sequencing tool [59]. Questionnaires were distributed to eligible participants in sealed envelopes according to the randomization sequence upon entry to a psychology lecture. Distribution was conducted by research assistants blind to the allocation sequence. Data for intervention conditions were collected simultaneously consistent with the randomization protocol. Participants were verbally instructed by the

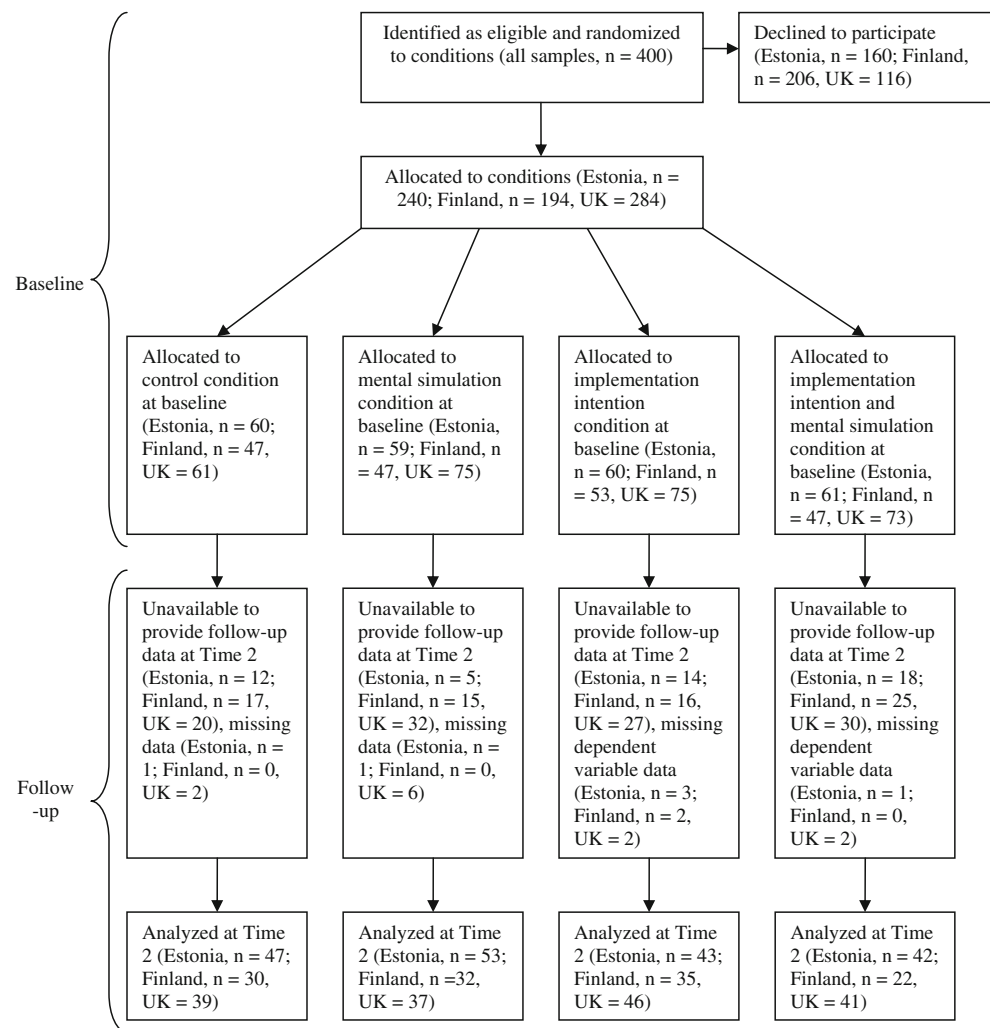
research assistants to sit in the lecture theater with at least one empty seat in all directions between themselves and other participants to avoid any cross-contamination of the different intervention protocols. Next, participants were instructed to read the instruction sheet on the front of the questionnaire under quiet conditions. The instruction sheet informed participants that they were participating in a health survey and would be asked questions relating to their health behavior. They were also informed that they would be invited to participate in a second survey 4 weeks later and that they would be entered into a prize draw if they completed both surveys. Participants were required to sign a form affirming that they had read the information and consented to participate. The questionnaires comprised scaled questions and, if allocated to one of the intervention conditions, open-ended response boxes for written responses to the intervention manipulations. The lecture was suspended until consenting participants had completed their questionnaires. Participants opting not to participate were asked to sit quietly and not disrupt others. Four weeks later, participants completed the psychological and behavioral measures in the same lecture slot. The study protocol was approved by the ethical review boards of the participating institutions.

Intervention Manipulations

Participants randomly allocated to the implementation intention only, mental simulation only, or combined implementation intention and mental simulation conditions were presented with an introductory passage of text. The passage was based on previous research [60] and requested participants set themselves a goal of keeping their alcohol intake within weekly guideline limits based on World Health Organization recommendations (see Appendix 1). Participants receiving the mental simulation manipulation were presented with an adapted

Table 1 Participant characteristics

Participant characteristics	Sample	Full sample		Females			Males			
		Number	Age		Number	Age		Number	Age	
			Mean	SD		Mean	SD		Mean	SD
	Baseline									
	Estonia	240	20.94	2.94	162	20.72	2.43	78	21.41	3.75
	Finland	194	23.40	4.28	123	23.40	5.01	71	23.41	2.59
	UK	284	19.77	2.70	246	19.76	2.85	38	19.79	1.36
	Follow-up									
Baseline participants completing questionnaires at baseline, follow-up participants with complete data at 1-month follow-up	Estonia	185	20.83	3.02	129	20.60	2.48	56	21.39	3.96
	Finland	119	23.66	4.99	76	23.76	5.93	43	23.49	2.63
	UK	163	19.72	2.87	144	19.75	3.04	19	19.47	0.84

Fig. 1 Participant flow diagram for the Estonian, Finnish, and UK samples

version of Pham and Taylor's [49] outcome simulation script (Appendix 1). The script was modified to make reference to the target behavior of keeping alcohol drinking within safe limits. The instructions were followed by a series of blank, ruled lines for participants to write down their responses. Responses were used as a manipulation check to evaluate compliance with the intervention. Participants receiving the implementation intention manipulation were presented with a script asking them to identify a situation in which they might drink alcohol over guideline limits and develop a course of action that will help them manage that situation (Appendix 1). The manipulation followed an "if...then..." format which has been shown to be optimal in promoting behavior change [36]. Participants were given the freedom to develop their own contingencies and plans, but constrained to write their plans so as to make a clear link between the situation and desired action. Participants were also provided with an example situation and behavioral alternative in the "if...then..." format as a guide. The instructions were followed by two

sets of blank, ruled lines with the word "If..." printed before the first set of lines and the phrase "then I will..." printed before the second set of lines. Again, responses to the open-ended questions served as a manipulation check and an indicator of whether participants had formed an implementation intention.

Measures

Self-reported alcohol behavior Self-report measures of the primary dependent variables of average number of units (U) of alcohol consumed per week and average number of binge-drinking occasions per week in the past month were taken at baseline and follow-up. Participants were asked to write down the number of units of alcohol they had consumed and the number of occasions they exceeded 10 U for men or 7 U for women each week over the previous 4 weeks. These values were adopted as they reflect the definition of risky, single-session ("binge") alcohol drinking published by the UK government [61].

Separate response boxes were provided for each week and responses were averaged for the 4-week period. As a guide, participants were presented with a chart that listed the volumes of common alcoholic beverages that equated to 1 U of alcohol. The chart was printed as a header on each page of the questionnaire to remind participants of unit equivalence. Participants also completed the four-item Fast Alcohol Screening Test (FAST) at baseline to assess extent of alcohol misuse [62].

Psychological measures Items developed to measure the theory of planned behavior variables adhered to the boundary condition of correspondence in terms of the target behavior (“keeping alcohol drinking within safe limits”), time (“one month”), and context (“on each individual occasion or session”). The target behavior was defined for participants in an initial set of instructions preceding the measures: “The World Health Organization has published guidelines for the amount of alcohol considered safe to drink on a single occasion. Guideline safe limits are four units of alcohol per day for males and three units per day for females”. Intentions were measured via three items using six-point scales (e.g., “I intend to participate keep my alcohol drinking within safe limits on each individual occasion or session over the next month”) with scale anchors 1 (*extremely unlikely*) and 6 (*extremely likely*) (Estonian sample, $\alpha=0.93$; Finnish sample, $\alpha=0.94$; UK sample, $\alpha=0.95$). Attitudes were measured on five six-point semantic differential items in response to the stem: “For me, keeping my alcohol drinking within safe limits on each individual occasion or session over the next month is...” Responses were made on the enjoyable–unpleasant, worthwhile–not worthwhile, useful–of no use, good–bad, and important–unimportant bipolar adjectives (Estonian sample, $\alpha=0.88$; Finnish sample, $\alpha=0.91$; UK sample, $\alpha=0.83$). Subjective norms were measures on three items (e.g., “Most people who are important to me (e.g., friends, family) would want me to keep my alcohol drinking within safe limits on each individual occasion or session over the next month”) on six-point scales anchored by 1 (*disagree*) and 6 (*agree*) (Estonian sample, $\alpha=0.82$; Finnish sample, $\alpha=0.62$; UK sample, $\alpha=0.85$). Perceived behavioral control was assessed via three items using six-point scales (e.g., “How much personal control do you think you have in keeping your alcohol drinking within safe limits on each individual occasion or session over the next month?”) with scale anchors 1 (*no control at all*) and 6 (*complete control*) (Estonian sample, $\alpha=0.86$; Finnish sample, $\alpha=0.70$; UK sample, $\alpha=0.81$).

Participants were also asked to report their motivation to engage in the target behavior on three items (e.g., “How motivated are you to keep your alcohol drinking

within safe limits on each individual occasion or session over the next month”) with scale anchors 1 (*not at all motivated*) and 6 (*extremely motivated*) (Estonian sample, $\alpha=0.89$; Finnish sample, $\alpha=0.93$; UK sample, $\alpha=0.93$)¹. Finally, participants allocated to the implementation intention condition were asked to rate the extent to which they had planned to keep their alcohol drinking with safe limits on three items (e.g., “To what extent have you figured out exactly how you might keep your alcohol drinking to within safe limits on each individual occasion or session over the next month”) with scale anchors 1 (*I have no idea*) and 6 (*I have figured out exactly*) (Estonian sample, $\alpha=0.77$; Finnish sample, $\alpha=0.90$; UK sample, $\alpha=0.91$).

Results

Preliminary Analyses

Baseline alcohol consumption A 2 (gender) $\times$ 3 (nationality: Estonia vs. Finland vs. UK) ANOVA with baseline average number of alcohol units consumed over the previous 4 weeks as the dependent variable revealed significant main effects for gender ($F(1, 711)=62.47, p<0.01, \eta_p^2=0.08$) and nationality ($F(1, 711)=54.44, p<0.01, \eta_p^2=0.13$), but no gender $\times$ nationality interaction effect. Males ($M=9.64, SD=11.66$) consumed significantly more units of alcohol per week than females ($M=6.19, SD=8.90$), corroborating previous research findings [63]. Univariate follow-up tests for the main effect of nationality revealed that participants in the UK sample ($M=11.07, SD=9.67$) consumed significantly more units of alcohol than their Estonian ($M=4.94, SD=8.90; F(1, 522)=56.17, p<0.01, \eta_p^2=0.10$) and Finnish ($M=3.92, SD=4.40; F(1, 475)=92.32, p<0.01, \eta_p^2=0.16$) counterparts. The percentage of male (Estonian sample, 16.67%; Finnish sample, 19.72%; UK sample, 60.52%) and female (Estonian sample, 6.79%; Finnish sample, 4.07%; UK sample, 49.19%) participants who exceeded recommended daily guidelines for alcohol (10 U for men, 7 U for women) on more than three occasions in the 4-week period were lower than those reported in a recent cross-national survey of undergraduate

¹ The measure of motivation correlated significantly with the Theory of Planned Behaviour variables. Correlations between motivation and intention were particularly strong (r range=0.65 to 0.80), an unsurprising finding given that intention is a motivational variable and reflects the degree of planning and effort an individual is prepared to invest in pursuing the behavior in the future. Taking into consideration the strength of these relations, we exercised care not to include intentions and motivation together as covariates in subsequent analyses in order to avoid potential problems of multi-collinearity.

students [3] in Estonia (male, 26%; female, 15%) and Finland (male, 18%; female, 15%), but substantially greater than the statistics for UK students (male, 22%; female, 15%). These data provide some brief descriptive evidence that participants in the UK sample represented a high-risk group with respect to alcohol consumption relative to national averages and a much larger percentage engaged in binge drinking relative to normative data for undergraduate students in the UK. By comparison, the descriptive comparison data suggests that samples from the Estonian and Finnish universities represented comparatively lower risk and did not have levels of alcohol consumption or percentages of binge drinking higher than normative data from Estonia and Finland. However, these comparisons should be treated as tentative as they were based on observation rather than formal analysis and males were underrepresented in the Finnish and UK samples. A degree of caution should, therefore, be exercised when interpreting these comparisons.

Randomization checks Randomization checks were conducted on baseline demographic, behavioral, and psychological measures in the three national samples. We conducted a MANOVA with age, average units of alcohol consumed, number of binge-drinking sessions, intentions, motivation, attitude, subjective norms, perceived behavioral control, and motivation as the dependent variables and the intervention condition (control, implementation intention only, mental simulation only, and combined implementation intention and mental simulation groups) as the independent variable in each sample. There was no significant multivariate effect for intervention condition in the Estonian and Finnish samples. For the UK sample, there was a significant multivariate effect for intervention condition, Wilks' $\Lambda=0.90$, $F(24, 792)=1.23$, $p<0.05$, $\eta_p^2=0.03$. Univariate follow-up tests revealed a significant effect for condition on attitude ($F(3, 280)=2.95$, $p<0.05$, $\eta_p^2=0.03$) with LSD post-hoc comparisons indicating that attitudes were significantly higher in the combined implementation intention and mental simulation group ($M=4.53$, $SD=0.82$) compared to the mental simulation only ($M=4.14$, $SD=0.91$; $p<0.01$) and implementation intention only ($M=4.24$, $SD=0.80$; $p<0.05$) groups. There were no other significant differences. On the basis of these findings, we included baseline attitudes as a covariate in subsequent analyses.

Attrition checks In order to check whether key baseline variables differed between the sample that remained in the study after 1 month and those lost to follow-up, we conducted a MANOVA with age, number of units of

alcohol consumed, number of binge-drinking occasions, intentions, attitudes, subjective norms, perceived behavioral control, and motivation as dependent variables and follow-up status as the independent variable in each sample. The analyses revealed no significant multivariate effect in any of the three samples.

Manipulation checks We content-analyzed participants' written responses to the implementation intention and mental simulation manipulations to evaluate whether they had sufficiently attended to the exercises. Participants allocated to the implementation intention condition were considered compliant if they provided a relevant contingency in response to the "If..." prompt and a suitable course of action in response to the "then I will..." prompt. Responses to the "If..." prompt included relevant locations or situations such as parties, bars, or nightclubs and responses to the "then I will..." prompt included strategies such as switching to non-alcoholic alternatives such as softdrinks, providing reasons for abstaining from drinking, pacing oneself and taking longer to consume drinks, or limiting expenditure on drinks. Similar behaviors to those listed in response to this prompt have been put forward in previous surveys as means to manage alcohol intake [64]. The vast majority of participants allocated to this condition cited responses that conformed to the required if-then format and provided cues and alternative courses of action that were considered appropriate. However, a minority of participants did not provide any written response to the prompts (Estonian sample, $n=14$, Finnish sample, $n=14$, UK sample, $n=12$) or wrote down inappropriate responses (Estonian sample, $n=12$, Finnish sample, $n=2$, UK sample, $n=4$). This constitutes a test of intervention fidelity (see 65), which is important for a participant-administered intervention protocol such as this. The relatively low level of non-compliance leads us to expect that the vast majority of participants will comply with the intervention if it were administered elsewhere. Few of these non-compliant participants provided follow-up data (Estonian sample, $n=17$, Finnish sample, $n=6$, UK sample, $n=5$). Notwithstanding the non-compliance, we included data from these participants in subsequent analyses and they remained the intervention groups to which they were originally randomized. The non-compliant participants remained in the analysis to ensure that our evaluation of the intervention was a conservative estimate of its effectiveness regardless of naturally occurring non-compliance.

Participants also reported the extent to which they had planned to keep their alcohol intake to within safe limits. Mean planning scores were significantly higher

than the mid-point of the scale in the Estonian sample ($M=4.41$, $SD=1.19$; $t(1,121)=9.06$, $p<0.01$, $d=1.64$) and borderline significant for the UK sample ($M=3.72$, $SD=1.46$; $t(1,143)=1.84$, $p=0.06$, $d=0.31$). However, there was no significant difference for the Finnish sample ($M=3.48$, $SD=1.62$). We also compared levels of planning in the implementation intention only and combined implementation intention and mental simulation conditions in each sample as a check on whether the inclusion of additional instructions alongside the implementation-intention manipulation affected responses. No significant differences in planning scores were found between participants in the implementation intention only and combined conditions.

For the mental simulation manipulation, participants reporting positive outcomes and feelings of satisfaction as a result of keeping their alcohol intake within safe limits were coded as compliant. As with the implementation intention manipulation, the majority of participants in all samples reported positive outcomes and feelings and were considered compliant with the manipulation. However, a minority of participants did not provide a response (Estonian sample, $n=6$, Finnish sample, $n=1$, UK sample, $n=4$) or reported an inappropriate outcome (Estonian sample, $n=17$, Finnish sample, $n=9$, UK sample, $n=2$). Of these, a relatively small number of participants provided follow-up data (Estonian sample, $n=9$, Finnish sample, $n=4$, UK sample, $n=0$). As before, these participants were classified as non-compliers and remained in the analysis in the groups to which they were originally randomized.

Main Analysis

Effect of intervention on alcohol intake Two 2 (implementation intention: present vs. absent) $\times$ 2 (mental simulation: present vs. absent) $\times$ 3 (nationality: Estonia vs. Finland vs. UK) ANCOVAs were conducted on the primary dependent variables of average number of units of alcohol and number of binge-drinking occasions in the month following the intervention. Three covariates were included in the model: baseline FAST scores, baseline units of alcohol or number of binge-drinking occasions, and attitudes. For the analysis with units of alcohol consumed as the dependent variable, significant main effects for implementation intentions ($F(1, 452)=5.42$, $p<0.05$, $\eta_p^2=0.01$) and nationality ($F(2, 452)=7.94$, $p<0.01$, $\eta_p^2=0.03$), and a significant implementation intention $\times$ nationality interaction ($F(2, 452)=3.15$, $p<0.05$, $\eta_p^2=0.01$), were found. There were no other

main or interaction effects². We probed the interaction by conducting univariate ANCOVAs with implementation intention as the independent variable within each national sample. In each analysis, units of alcohol consumed were the dependent variable and implementation intentions the independent variable while controlling for baseline FAST scores, units of alcohol, and attitudes. Participants receiving the implementation intention intervention reported drinking significantly fewer units of alcohol (Estonian sample, $M=2.69$, $SD=3.42$; UK sample, $M=7.86$, $SD=7.04$) relative to those that did not receive the implementation intention intervention (Estonian sample, $M=4.11$, $SD=5.09$; UK sample, $M=10.11$, $SD=7.10$) for the Estonian ($F(1, 185)=4.09$, $p<0.05$, $\eta_p^2=0.02$), and UK ($F(1, 163)=11.06$, $p<0.01$, $\eta_p^2=0.07$) samples. There was no effect for implementation intentions in the Finnish sample.

For the analysis with number of binge-drinking occasions as the dependent variable, a significant main effect for nationality ($F(1, 452)=6.15$, $p<0.01$, $\eta_p^2=0.03$) and a significant implementation intention $\times$ nationality interaction effect ($F(2, 452)=4.68$, $p<0.01$, $\eta_p^2=0.02$) was found.

² Previous intervention studies have shown that the significant effects of implementation intention and planning manipulations on alcohol consumption are confined to female samples [41]. This differential effectiveness was a concern in the present study given the variation in gender profiles across the three national samples. One possibility was that the higher proportion of female participants in the UK sample and, to a lesser extent, the Estonian sample, may have accounted for the significant findings for the implementation intention manipulation on the alcohol behavior variables in these samples, relative to the Finnish sample which had the closest ratio of males to females and showed no effects. As a consequence, we conducted supplementary ANCOVAs with gender as an additional independent factor to test the hypothesis that gender moderated the effect of the interventions. Specifically, we conducted two 2 (implementation intention: present vs. absent) $\times$ 2 (mental simulation: present vs. absent) $\times$ 3 (nationality: Estonia vs. Finland vs. UK) $\times$ 2 (gender: male vs. female) ANCOVAs on the dependent variables of average number of units of alcohol and number of binge-drinking occasions in the month following the intervention. The analyses revealed an identical pattern of effects as the main analyses. Specifically, the analysis with number of units consumed as the dependent variable revealed significant main effects for implementation intentions ($F(1, 440)=6.36$, $p<0.05$, $\eta_p^2=0.01$) and nationality ($F(2, 440)=5.42$, $p<0.01$, $\eta_p^2=0.02$), and a significant implementation intention $\times$ nationality interaction ($F(2, 440)=5.73$, $p<0.01$, $\eta_p^2=0.03$). The analysis with number of binge-drinking occasions as the dependent variable revealed a significant main effect for nationality ($F(1, 440)=3.60$, $p<0.05$, $\eta_p^2=0.02$) and a significant implementation intention $\times$ nationality interaction effect ($F(2, 440)=4.26$, $p<0.05$, $\eta_p^2=0.02$). In both analyses, there was no significant main effect for gender or any effect of the two-, three-, or four-way interactions between gender and the other independent variables on alcohol behavior. These data led us to reject the hypothesis that gender moderated the effects of the intervention components, specifically, implementation intentions, on alcohol behavior.

Follow-up univariate ANCOVAs in each national sample revealed a main effect for implementation intention in the UK sample (implementation intention, $M=2.30$, $SD=2.93$; no implementation intention, $M=3.13$, $SD=3.07$; $F(1, 158)=6.66$, $p=0.01$, $\eta_p^2=0.04$), but no effects in the Estonian or Finnish samples³.

Effects of intervention on psychological variables The effects of the intervention conditions and nationality on the psychological variables was tested using a 2 (implementation intention: present vs. absent) $\times$ 2 (mental simulation: present vs. absent) $\times$ 3 (nationality: Estonia vs. Finland vs. UK) MANCOVA with intention, attitude, subjective norms, perceived behavioral control, and motivation as the dependent variables and their respective baseline measures and FAST scores as covariates. The analysis revealed a significant multivariate main effect for nationality, Wilks' $\Lambda=.88$, $F(10, 890)=5.83$, $p<.01$, $\eta_p^2=.06$. There were no significant main or interaction effects for the intervention conditions. Univariate ANOVAs revealed significant effects of nationality on the intention ($F(1, 449)=13.86$, $p<.01$, $\eta_p^2=.06$) and perceived behavioral control ($F(1, 449)=7.64$, $p<.01$, $\eta_p^2=.03$) variables. LSD post-hoc comparisons indicated that post-intervention intentions were significantly higher in the Estonian sample ($M=4.34$, $SD=1.16$) compared to the Finnish ($M=3.71$, $SD=1.72$; $p<.01$) and UK ($M=4.09$, $SD=1.34$; $p<.05$) samples. Intentions were also significantly higher in the UK sample relative to the Finnish

sample ($p<.05$). Mean levels of perceived behavioral control were significantly higher in the Finnish sample ($M=5.26$, $SD=0.52$) compared to the Estonian ($M=4.97$, $SD=0.85$; $p<.01$) and UK ($M=4.93$, $SD=0.88$; $p<.01$) samples.

Discussion

The aim of the present study was to evaluate the effectiveness and generalizability of a theory-based intervention using volitional (implementation intentions) and motivational (mental simulations) strategies to reduce the consumption of alcohol in excess of guideline limits among undergraduate students from universities in three national groups. The intervention utilized an identical full-factorial randomized-controlled design in each sample. Primary dependent variables were number of units of alcohol consumed and frequency of binge-drinking occasions over the 4 weeks following the intervention. It was hypothesized that the combined implementation intention and mental simulation intervention would lead to greater reductions in the dependent variables than either strategy alone. In addition, we expected an identical pattern of effects of the intervention on alcohol consumption across the national samples. Results indicated a significant main effect for implementation intentions and an implementation intention $\times$ nationality interaction effect on the number of units of alcohol consumed and number of binge-drinking occasions in the 4-week follow-up period. There were no effects for the mental simulation component of the intervention. Follow-up tests for the interactions revealed that the implementation intention intervention component was successful in reducing number of units of alcohol consumed in the Estonian and UK samples but not in the Finnish sample. Similarly, follow-up tests indicated that implementation intentions were effective in reducing the number of binge drinking occasions in the UK sample only. The interventions had no effects on the motivation or theory of planned behavior variables.

Present results support the efficacy of implementation intentions as a theory-based strategy to reduce alcohol consumption among undergraduate students in Estonia and the UK. Implementation intentions lead to 1.42 and 2.25 unit reductions in monthly alcohol consumption in the Estonia and UK samples, respectively, which represent 35.55% and 22.26% reductions on baseline levels. Implementation intentions also reduced binge-drinking frequency by nearly a full session (mean reduction=0.83) in the UK sample. This finding corroborates the wealth of research that has demonstrated the effectiveness of volitional plans in promoting behavioral engagement in other health-related

³ We also tested whether the inclusion of participants who consumed no alcohol at baseline affected results. Specifically, we conducted analyses on participants reporting drinking at least 1 U of alcohol in the previous 4 weeks at baseline. We conducted two additional 2 (implementation intention: present vs. absent) $\times$ 2 (mental simulation: present vs. absent) $\times$ 3 (nationality: Estonia vs. Finland vs. UK) ANCOVAs with number of units of alcohol consumed and number of binge-drinking occasions as dependent variables and controlling for baseline FAST scores, alcohol consumption, and attitudes. For the analysis with number of units consumed as the dependent variable, the analysis revealed significant main effects for implementation intention ($F(1, 399)=3.72$, $p<0.05$, $\eta_p^2=0.01$) and nationality ($F(2, 399)=8.21$, $p<0.01$, $\eta_p^2=0.04$), and a significant two-way interaction for implementation intentions and nationality ($F(2, 399)=3.19$, $p<0.05$, $\eta_p^2=0.02$). This interaction was probed with separate univariate ANCOVAs for each national group. The analyses revealed significant main effects for implementation intentions in the Estonia ($F(1, 155)=4.41$, $p<0.05$, $\eta_p^2=0.03$), and UK ($F(1, 158)=10.58$, $p<0.01$, $\eta_p^2=0.07$) samples. For the analysis with number of binge-drinking occasions as the dependent variable, a significant main effect for nationality ($F(1, 399)=6.01$, $p<0.01$, $\eta_p^2=0.03$) and a significant two-way interaction for implementation intentions and nationality ($F(2, 399)=4.27$, $p<0.05$, $\eta_p^2=0.02$) was found. Separate univariate ANCOVAs revealed a similar main effect for implementation intentions as that found previously for the UK sample ($F(1, 158)=6.50$, $p<0.05$, $\eta_p^2=0.04$). There were no other significant effects. These results, therefore, follow a similar pattern to those found in the overall sample.

contexts [30, 31]. Present results, however, provided no support for an interaction between motivational and volitional strategies. According to Heckhausen and Gollwitzer's [21] action-phase model, interventions targeting both the motivational and volitional phases of the decision-making process would be optimally effective in producing changes in alcohol intake relative to interventions targeting one of the phases in isolation. This is because people need to have sufficient motivation to change their behavior from the outset. Cues and contingencies stated in action plans during the volitional phase would only be relevant if an individual intended to attain their goal [45]. However, motivation alone is often not sufficient for actual behavioral engagement. People with high motivation often do not enact their intentions because their intentions are held insufficiently in memory [40], or their intentions are vaguely stated [31]. Implementation intentions were, therefore, proposed to compliment the motivational intervention by catalyzing the enactment of intentions. Given that implementation intentions were the only effective intervention component in the present study, it would seem that a synergistic approach was not effective and current results are in contrast to previous research that has used such approaches [34, 37, 45].

Possible reasons for the lack of efficacy of the motivational intervention are that participants' baseline intentions to reduce their alcohol intake were already relatively strong or that the outcome mental simulation component of the intervention was not effective in changing intentions. There is evidence that both of these explanations might have been the case in the present study. Focusing first on the strength of intentions, a post-hoc analysis of pre-intervention intentions to reduce alcohol consumption in excess of guideline limits revealed that average intention levels were significantly higher than midpoint on the scale in each sample⁴. Although this is not indicative of a ceiling effect for intention scores and there was scope for improvement in all cases, it does provide some evidence that levels of motivation were already relatively high which may have diluted the effectiveness of the mental simulation component of the intervention, or meant that it was not needed.

Turning to the effectiveness of the mental simulation strategy, large, consistent effects for process mental simulations have been found in the literature [48, 49] with less ubiquitous findings for outcome mental simulations [52, 53]. Reasons for these differences in effectiveness stem from the fact that process simulations focus on the rehearsal

of the actual behavioral steps required to attain an outcome. This process promotes motivation to engage in the target behavior in future by increasing competence and self-efficacy to perform the behaviors required [48]. Outcome simulations are proposed to be less effective because they focus only on outcomes rather than means to produce those outcomes. However, there is literature demonstrating that the visualization of future outcome attainment increases motivation and behavioral engagement, and the mechanism behind this is likely via the induction of a positive affective state [52, 53]. Outcome simulations may, therefore, be of limited effectiveness, particularly among those with relatively strong intentions already. In addition, it may be that the outcome simulation manipulation needs modification. There is evidence that visualizing goal attainment in the third person rather than the first person (as in outcome mental simulations) is considerably more effective in producing behavior change [53]. It may, therefore, be premature to dismiss outcome mental simulations as a means to promote intentions as part of integrated interventions to reduce alcohol intake. Future research should examine the effectiveness of outcome simulations practiced in the third person as part of this intervention protocol as well as including process mental simulations for comparison. A further avenue of research would be to examine the effectiveness of the mental simulation intervention among individuals with relatively low baseline levels of motivation. In fact, this could lead to two-stage intervention protocols in which an initial motivational component, perhaps using mental simulations, was initially introduced to promote increased intention to reduce alcohol intake or binge drinking. This would be followed by an implementation intention component to convert the expected elevated intentions into actual behavior.

An original feature of the present intervention is its replication in three samples from universities in different countries. This is important as it provided the opportunity to evaluate whether the adoption of this intervention strategy would result in universal reductions in alcohol consumption. Theoretically, this is a sound expectation as the action-phase model on which the present intervention is based was developed in the social cognitive tradition. Such models propose that given the same environmental conditions, all people process social information in the same way and make behavioral decisions accordingly. Therefore, we hypothesized that the intervention techniques would result in generalizable behavior change across samples. As a consequence, the significant interaction between nationality and the implementation intention component of the intervention went against expectations. There was evidence that the intervention was effective in reducing alcohol consumption in two of the three samples, providing tentative support for the generalizability hypothesis, but

⁴ Mean levels of intentions were significantly higher than the midpoint of the six-point scale for the Estonian ($M=4.74$, $SD=1.19$; $t(1,184)=14.19$, $p<0.01$, $d=2.09$), Finnish ($M=4.03$, $SD=1.73$; $t(1,118)=3.37$, $p<0.01$, $d=0.62$), and UK samples ($M=3.96$, $SD=1.33$; $t(1,162)=4.42$, $p<0.01$, $d=0.69$).

the lack of a significant effect in the Finnish sample means that unequivocal conclusions cannot be drawn on the generalizability of the intervention from these data.

A possible mitigating factor for the lack of an intervention effect in the Finnish population was the relatively low levels of alcohol intake among this group at baseline relative to the Estonian and UK students. This means that there was less scope for decreases in alcohol intake compared with the other samples. Indeed, it appears that the implementation intention intervention had the largest effect on number of units consumed at follow-up in the sample with the highest baseline alcohol consumption (UK sample effect size, $\eta_p^2=0.07$, $p<0.01$), a significant but smaller effect in the sample with the next highest baseline alcohol intake (Estonian sample effect size, $\eta_p^2=0.02$, $p<0.05$), and the smallest effect among those with the lowest (Finnish sample effect size, $\eta_p^2=0.01$, non-significant). However, the same pattern of effects emerged when we conducted the analysis on participants with high baseline levels of binge-drinking occasions, which seems to indicate that the intervention was less effective in participants from the Finnish university. However, extrapolating the efficacy of this intervention to all undergraduates in each national group would be speculative and go beyond the scope of the present data. The current samples represent only a small segment of the overall university population in each nation, and a randomized, stratified sampling procedure from all undergraduates in each nationality would be the most effective means to generalize with confidence.

Strengths, Limitations and Future Directions

The present study had a number of strengths. The intervention was based on a leading social psychological approach with a strong evidence base, namely the action-phase model. In addition, we used a full-factorial model within a randomized-controlled design. These features provided a hypothesis-testing framework and permitted the identification of the exact components responsible for the proposed effects on alcohol consumption. The generalizability of the intervention components in changing alcohol consumption was also tested in three independent samples of university students from different national groups. Careful attention was paid to maintaining identical content and design features in each national group so that the intervention components were the only sources of variation across the samples. Furthermore, our inclusion of non-compliant participants in follow-up analysis and retaining their allocation to their randomized intervention group provided conservative estimates of the power of the intervention. These design features ensure that the present study has sufficient quality to evaluate the efficacy of the intervention to reduce alcohol consumption in excess of

guideline limits among undergraduate students and its generalizability across these national samples.

However, the study is not without limitations. First, the 1-month follow-up period represents a relatively short-range behavioral prediction. Short-range follow-up periods of less than 1 month in duration are relatively common in psychosocial interventions adopting motivational and volitional interventions [35–37]. By comparison, interventions that have reported a long-range follow-up have been successful in changing health-related behavior [33, 66], including reducing alcohol consumption [41]. Longer-range follow-up periods are required so that the longitudinal effectiveness of the intervention components adopted the present study in changing alcohol consumption can be fully evaluated.

Second, the control group in the present study was a “mere-measurement” control because participants allocated to this group received baseline and follow-up psychological and behavioral measures. A “no-measurement control” group that received behavioral measures only was not included. There is considerable debate in the health psychology and behavioral medicine literature as to whether psychological measures serve as interventions in themselves and affect behavior change independent of any formal intervention strategy [67–69]. Suffice to say a “no-measurement” control group provides the opportunity to rule out “mere-measurement” effects and should be included as an additional control group in future intervention designs.

Third, we adopted self-report dependent measures of alcohol consumption and binge-drinking frequency in the present study. Self-reports of behavior have been criticized as they have the potential to introduce systematic measurement bias into data sets [70]. Although the behavioral measures adopted in the present study were previously developed and validated in behavioral studies on alcohol [71, 72], the exclusive reliance on self-report measures should be considered a limitation. The health psychology and behavioral medicine literature is replete with studies adopting self-reports of behavior, particularly research on alcohol consumption. One of the reasons for this is that alcohol tends to be metabolized relatively quickly and finding an objective measure of long-term alcohol use is challenging. Breathalyzers, for example, are useful and inexpensive tools to accurately establish recent alcohol consumption, but these do not provide an objective measure of long-term alcohol use. Other objective measures to establish long-term alcohol use such as biochemical methods using blood and liver markers are relatively costly in terms of the equipment, invasiveness, and time required for administration [73]. The development of accurate, easily administered objective measures of alcohol consumption similar to expired carbon monoxide for smoking or

pedometers for walking might reduce dependence on self-reported measures in research on alcohol.

Appendix 1

Introductory Passage

Initial introductory passage provided to participants allocated to the implementation intention and mental simulation conditions:

“The World Health Organization (WHO) recommends that safe limits for drinking alcoholic drinks are 4 U per day for men and 3 U per day for women. Drinking above these safe limits could lead to some health conditions in the long run. Considering these health messages, we would like you to try to keep your regular alcohol intake so that it is within recommended limits on each individual occasion or session over the next month. To help you do this, we ask you to take 5 min of your time to complete the next very simple mental exercise(s)”.

Implementation Intention Manipulation

“You are more likely to carry out your intention to keep your alcohol intake to within safe limits on each occasion or session if you make a decision about the time and place you will do so and how you plan to do it. Decide now when and where you will need to keep your alcohol intake to within safe limits and how you will do it. We want you to plan to keep your alcohol drinking to within safe limits on each occasion or session over the next month, paying particular attention to the specific situations in which you will implement these plans. For example, you may find it useful to say to yourself, ‘If I am in a bar/pub drinking with my friends and I am likely to drink over the daily safe limits for alcohol, then I will opt for a soft drink instead of an alcoholic drink to keep within the recommended safe limits.’ Please write your plans on the lines below, following the format shown in the previous example (‘if... then...’).”

Mental Simulation Manipulation

“You are now asked to visualize yourself having achieved your goal of keeping your alcohol intake to

within safe limits on each individual occasion or session over the next month, and imagine how you would feel. Imagine how much effort and willpower it has taken to achieve your goal of keeping your alcohol intake to within safe limits on each occasion or session and that you have successfully managed to do it. Imagine how satisfied you will feel. It is very important that you see yourself actually keeping your alcohol intake to within safe limits on each occasion or session over the next month and keep that picture on your mind. Please write on the lines below how you imagine will feel if you achieve your goal of keeping your alcohol intake within safe limits on each individual occasion or session over the next month.”

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