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A randomized controlled trial of a brief online intervention to reduce alcohol consumption in new university students: Combining self-affirmation, theory of planned behaviour messages, and implementation intentions

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Abstract

Objectives. Excessive alcohol consumption increases when students enter university. This study tests whether combining (i) messages that target key beliefs from the theory of planned behaviour (TPB) that underlie binge drinking, (ii) a self-affirmation manipulation to reduce defensive processing, and (iii) implementation intentions (if-then plans to avoid binge drinking) reduces alcohol consumption in the first six months at university. *Design.* A 2 (self-affirmation) × 2 (TPB messages) × 2 (implementation intention) between-participants randomised controlled trial with six-month follow-up. Methods. Before starting university, students (N = 2,951) completed measures of alcohol consumption and were randomly assigned to condition in a full factorial design. TPB cognitions about binge drinking were assessed immediately post-intervention (n = 2,682). Alcohol consumption was assessed after one week (n = 1,885), one month (n = 1,389) and six months (n = 892) at university. TPB cognitions were assessed again at one and six months. Results. Participants who received the TPB messages had significantly less favourable cognitions about binge drinking (except perceived control), consumed fewer units of alcohol, engaged in binge drinking less frequently and had less harmful patterns of alcohol consumption during their first six months at university. The other main effects were non-significant. Conclusions. The findings support the use of TPB-based interventions to reduce students' alcohol consumption, but question the use of self-affirmation and implementation intentions before starting university when the messages may not represent a threat to self-identity and when students may have limited knowledge and experience of the pressures to drink alcohol at university.

Keywords: binge drinking; heavy episodic drinking; college; online; intervention

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Alcohol consumption, including binge drinking, increases when young people enter

university (Cameron et al., 2015; Fromme, Corbin, & Kruse, 2008), and is higher among

students than their non-student peers (Gill, 2002; Naimi et al., 2003). Binge drinking is

associated with increased risk of various negative social and health consequences, including

anti-social behaviour, physical violence, sexual assaults, unsafe sex, accidents and injuries

(Miller, Plant, & Plant, 2005), as well as poorer academic performance (Wechsler et al.,

2002). Excessive alcohol consumption over a prolonged period of time is associated with

various long-term negative health outcomes, including cirrhosis of the liver, heart disease and

cancer (NHS, 2014a). The House of Commons Health Committee (2009, paragraph 32) has

recommended that "universities take a much more active role in discouraging irresponsible

drinking amongst students". The transition into university represents an ideal opportunity to

intervene to reduce alcohol consumption in students before drinking patterns become

established (Scott-Sheldon, Carey, Elliot, Garey, & Carey, 2014).

Research indicates that health behaviour interventions that are based on theory are

more effective than those that are not (Glanz & Bishop, 2010; Noar, Benac & Harris, 2007;

Webb, Joseph, Yardley & Michie, 2010), as they are more likely to target the key proximal,

and modifiable, determinants of behaviour. The theory of planned behaviour (TPB; Ajzen,

1988) provides one such theoretical framework to develop interventions. According the TPB,

intention is the proximal determinant of behaviour. Intention is, in turn, determined by

attitude (i.e., evaluations of the behaviour), subjective norms (i.e., the perceived views of

important referents) and perceived behaviour control (i.e., perceptions of control over, and the

ease of, performing the behaviour), which is also hypothesised to have a direct effect on

behaviour. Behavioural, normative and control beliefs underlie each of these constructs. Recent formulations of the TPB have distinguished between affective and cognitive attitudes, subjective and descriptive norms, and self-efficacy and perceived control (Fishbein & Ajzen, 2010).

The TPB has been found to explain large amounts of variance in intention (44.3%) and health behaviour (19.3%) in prospective tests (McEachan, Conner, Taylor, & Lawton, 2011), including alcohol consumption (Cooke, Dahdah, Norman, & French, 2016), and has been applied to explain alcohol intentions and behaviour in students (Cooke, Sniehotta, & Schüz, 2007; Hagger, Anderson, Kyriakaki, & Darkings, 2007; Johnson & White, 2003; McMillan & Conner, 2003; Norman, 2011; Norman, Armitage, & Quigley, 2007; Norman & Conner, 2006). The TPB therefore provides a strong theoretical basis for the development of interventions to change health behaviour. In support of this idea, Webb et al. (2010) reported that online interventions based on the TPB had a small-to-medium sized effect on health behaviour ($d_+ = 0.36$), which was larger than the average effect size found for all online health behaviour interventions included in their review ($d_+ = 0.16$).

In order to develop an intervention based on the TPB, Ajzen (1988) recommended that researchers undertake two phases of formative research; first, to identify the modal salient behavioural, normative and control beliefs held by the target population and second to assess the extent to which these beliefs are associated with intention and/or behaviour. Accordingly, Epton et al. (2015) identified a small number of beliefs that were associated with new university students' binge drinking intentions and behaviour including behavioural beliefs that binge drinking would be fun, but would have a negative impact on studying, normative beliefs about the views of friends, and control beliefs about the influence of having friends who binge drink. Epton et al. (2015) conducted an additional phase of formative research in

which current students were surveyed to provide arguments to target each of the chosen beliefs that could be included in an intervention.

Interventions that attempt to change health-risk behaviour can fail, however, because recipients derogate or dismiss the health message. Leffingwell, Neuman, Leedy, and Babitzke (2007) found that students who drank alcohol were more critical of a health message about the risks of alcohol and rated the problem as less important than students who did not drink alcohol. According to self-affirmation theory (Steele, 1988), such messages may not only threaten a person's physical integrity (by highlighting the potential negative effect of their behaviour on their health), but also their self-integrity (i.e., their sense of being a sensible, rational, adaptive and morally adequate individual). People may therefore derogate or dismiss the message in order to protect their self-integrity. Self-affirmation, which typically involves reflecting on a cherished value or attribute in an unrelated domain, is a simple technique that can be used to protect against threats to self-integrity and encourage more open or unbiased processing of health messages, which should lead to greater message acceptance and associated changes in behaviour. Epton, Harris, Kane, van Koningsbruggen and Sheeran (2015) reported that, on average, self-affirmation manipulations have small but significant effects on message acceptance ($d_+ = 0.17$), intention ($d_+ = 0.14$) and behaviour ($d_+ = 0.32$). In studies with university students, self-affirmation manipulations have been found to reduce defensive processing of messages about the risks of alcohol (Norman & Wrona-Clarke, 2016; Scott, Brown, Phair, Westland, & Schüz, 2013) and intentions to consume alcohol (Harris & Happer, 2005; Scott et al., 2013), but not alcohol consumption (Harris & Napper, 2005; Kamboj et al., 2016; Knight & Norman, 2016; Meier et al., 2015; Norman & Wrona-Clarke, 2016; Scott et al., 2013).

Self-affirmation can be characterised as a motivational intervention that serves to reduce defensive processing of health messages and promote message acceptance (Harris &

Epton, 2009). Additional volitional techniques may be required to translate good intentions (e.g., to drink less alcohol) into behaviour (e.g., reduced alcohol consumption) (Gollwitzer & Sheeran, 2006). Gollwitzer (1999) made the distinction between goal intentions (e.g., to reduce alcohol consumption) and implementation intentions that specify how the goal is to be achieved (e.g., by drinking water instead of wine at dinner). Implementation intentions are specific if-then plans that identify a critical situation (the "if" part of the plan) and link it to an appropriate behavioural response (the "then" part of the plan). Forming implementation intentions has been found to have a medium-to-large sized effect on health behaviour ($d_+ =$ 0.59; Gollwitzer & Sheeran, 2006) and has been used to reduce alcohol consumption in university students (Hagger et al., 2012; Murgraff, Abraham, & McDermot, 2007; Murgraff, White, & Phillips, 1996; Norman & Wrona-Clarke, 2016).

The Present Research

Combining self-affirmation, messages based on the TPB, and implementation intentions should ensure that the messages (i) are not derogated and (ii) target the key beliefs underlying students' alcohol consumption, and (iii) that positive intentions are translated into behaviour. The present study targeted students during a significant life transition, i.e., starting university, when their social and physical environments may be in a state of flux and their beliefs more amenable to change (Heatherton & Nichols, 1994; Wood, Tam, & Witt, 2005). Such significant life transitions represent potential "teachable" moments (Lawson & Flocke, 2009). It was hypothesised that (i) the messages based on the TPB would lead to less favourable cognitions about binge drinking and reduced alcohol consumption, and that the effects of the messages on alcohol consumption would be mediated by changes in cognitions about binge drinking, (ii) self-affirmation would augment the effect of the messages on cognitions about binge drinking, and (iii) forming implementation intentions would augment the effect of the messages on alcohol consumption over the first six months at university.

Method

Procedure and Design

Three weeks before starting university, all undergraduate students entering university in a large UK city were sent an email inviting them to take part in the study, with a link to the baseline questionnaire. After completing measures of demographics and alcohol consumption, participants were randomly assigned to condition in a 2 (self-affirmation) × 2 (TPB-based messages) × 2 (implementation intention) between-participants factorial design. Thus, participants completed a self-affirmation task (i.e., a questionnaire about important values and attributes) or not; viewed information (i.e., text and videos) that targeted key beliefs about binge drinking at university or not; and completed an implementation intentions task (i.e., if-then plans to avoid binge drinking) or not. All participants then completed measures of TPB cognitions with respect to binge drinking. Participants were contacted again by email one week, one month and six months after starting university with a link to follow-up questionnaires that assessed their alcohol consumption at university. They also repeated the TPB measures at one and six months.

Participation in the study was voluntary, but was incentivised by a £100 prize draw at each time point. Participants who completed all of the questionnaires could also win an iPad mini. Up to three reminder emails were sent at each time point to increase response rates. The study was approved by the Department of Psychology Research Ethics Committee in accordance with the University's Research Ethics Approval Procedure, and was registered with Current Controlled Trials (ISRCTN84252967).

Participants

Of the students (N = 5,832) who were sent an invitation email, 3,215 (55.1%) clicked on the link and 2,951 (91.8%) completed the baseline demographic and alcohol consumption measures and were randomised to condition. Of these, 2,682 (90.1%) completed the

experimental procedures and the immediate post-intervention measures. The baseline sample

comprised 1,214 males (45.3%) and 1,444 females (53.8%) (other n = 8, missing n = 16) with

a mean age of 18.76 years (SD = 1.94). Most of the sample (74.5%) described their ethnicity

as 'White". The sample consumed a mean of 8.16 units of alcohol per week (SD = 10.91) and

engaged in binge drinking a mean of 0.39 times per week (SD = 0.73), and comprised 1714

(64.6%) drinkers and 940 (35.4%) non-drinkers (missing n = 28). Of the baseline sample,

1,885 (70.3%) completed a follow-up questionnaire after one week, 1,389 (51.8%) one month

and 892 (33.2%) six months at university. Figure 1 summarises the flow of participants

through the experiment.

Interventions

Self-affirmation manipulation. The self-affirmation manipulation comprised an

adapted version of the Values in Action Strength Scale (Peterson & Seligman, 2004), as

developed by Napper, Harris, and Epton (2009). Participants rated the extent to which 32

positive traits, characteristics or qualities (e.g., *I always try to keep my word*) applied to

themselves on five-point response scales (Very much like me – Very much unlike me).

Messages about binge drinking. The TPB-based messages were developed on the

basis on the three phases of formative research conducted by Epton et al. (2015). The

messages targeted three key beliefs about binge drinking; namely, that engaging in binge

drinking at university is fun, that engaging in binge drinking at university has a negative

impact on studies, and that having friends who binge drink increases the likelihood of binge

drinking at university. The first message ("You can have fun at university without binge

drinking") outlined various ways to meet new people and have fun without binge drinking,

such as joining societies (259 words). The second message ("*Binge drinking is not good for

your studies*") provided information about the impact of binge drinking on academic

outcomes, and outlined different ways by which this may occur, including missing lectures

and reduced cognitive functioning (208 words). The third message ("*Resisting social pressures to binge drink*") highlighted the fact that most students do not binge drink on a regular basis and that there are many reasons not to, even if friends are, including remembering that it is "your decision", the financial cost of binge drinking and being able to look after one's friends (216 words). Each message was followed by a brief video (approx. 1 minute) of students talking about the respective issues.

Implementation intentions. Following Hagger et al. (2012), participants were asked to form up to three if-then plans to avoid binge drinking at university. Participants were presented with brief text highlighting the importance of making plans to avoid binge drinking at university that included two example plans (e.g., If I feel under social pressure to binge drink, then I will say that I have something important to do and leave). Next, participants completed a table with text boxes for the "if" and "then" components of up to three plans. They were instructed to pay particular attention to the specific situations in which the plans would be implemented.

Measures

Alcohol consumption. At baseline, participants were asked to "think of a typical week and what you would have to drink on each day of the week". They were then presented with a table and asked to write the type and amount of each drink that they typically consumed on each day of the week (e.g., 1 shot of vodka, 2 pints of cider). Responses were converted into units (= 8 grams of pure alcohol) using an online calculator (NHS, 2014b). Both the total number of units consumed and the number of binge drinking sessions (i.e., 8 or more units of alcohol in a single session for men, and 6 or more units for women) in a typical week were calculated, and comprised the primary outcomes. The same procedure was used to assess alcohol consumption at university, except that at one-week after starting university participants were asked to "think about what you had to drink on each day during Intro

Week", and at one- and six-month follow-up participants were asked to think about a typical week during their first month and six months at university.

At six-month follow-up, participants also completed the 10-item Alcohol Use Disorders Identification Test (AUDIT; Babor, Higgins-Biddle, Suanders & Nonteiro, 2001), which is a widely used screening tool for identifying hazardous and harmful patterns of alcohol consumption. Scores on the AUDIT can range between 0 and 40 with scores of 8 or more being indicative of possible harmful alcohol use.

Cognitions about binge drinking. Participants completed two-item direct measures of TPB constructs, using seven-point response scales, immediately after the intervention and one and six months after starting university: intention (e.g., Do you intend to engage in binge drinking at university? Definitely do not– Definitely do, αs = .91, .90, .90), affective attitude (e.g., Engaging in binge drinking at university would be... *Unpleasant*–Pleasant, αs = .93, .93, .93), cognitive attitude (e.g., Engaging in binge drinking at university would be... Harmful–Beneficial, αs = .83, .85, .86), subjective norms (e.g., People who are important to me would disapprove/approve of me engaging in binge drinking at university, Disapprove–Approve αs = .76, .77, .75), descriptive norms (e.g., Most students engage in binge drinking at university, Unlikely–Likely, αs = .85, .84, .80), self-efficacy (e.g., If I wanted to, engaging in binge drinking at university *would be... Difficult*–Easy, αs = .87, .88, .85), and perceived control (e.g., How much control do you have over whether or not you engage in binge drinking at university, No control–Complete control, αs = .69, .78, .81).

Single items assessed the extent to which participants endorsed each of the three beliefs targeted by the messages (i.e., Engaging in binge drinking at university would be fun, Engaging in binge drinking at university would have a negative impact on my studies, My friends engaging in binge drinking would make my binge drinking at university more likely) on seven-point response scales (Unlikely–Likely).

Results

Randomisation Checks

There were no significant differences between the conditions in demographics (i.e., age, gender, ethnicity) or alcohol consumption at baseline (i.e., units consumed, frequency of binge drinking).

Attrition Analyses

Levels of attrition between randomisation and completion of the immediate post-intervention measures differed between conditions, $\chi^2(7, N = 2951) = 149.28$, $p < .001$; attrition was higher among participants allocated to form implementation intentions (14.4%) than among those who were not (3.8%). Participants lost to follow-up were more likely to be male (80.1%) than female (71.5%), $\chi^2(1, N = 2658) = 25.89$, $p < 001$, non-White (84.0%) than White (72.6%), $\chi^2(1, N = 2676) = 36.00$, $p < 001$, and to consume more units of alcohol at baseline (M = 8.42, SD = 11.10) than those who completed the follow-up questionnaires (M = 7.36, SD = 10.25), $t(2652) = 2.16$, $p = .03$. All other comparisons were non-significant.

Alcohol Consumption at University

Two 2 (self-affirmation: yes, no) × 2 (messages: yes, no) × 2 (implementation intention: yes, no) × 3 (time: one week, one month, six months) mixed-measures ANCOVAs were conducted, with units of alcohol and frequency of binge drinking assessed after one week, one month, and six months at university as the (repeated-measures) dependent variables, and corresponding baseline measures entered as covariates. Table 1 reports the descriptive statistics at each follow-up time point by condition.

Units of alcohol consumed. Time had a significant effect on the number of units of alcohol consumed, $F(2, 1232) = 24.69$, $p < .001$, which peaked during the first week at university and then declined and remained stable at one and six months (see Table 2). Message condition had a significant main effect on the number of units of alcohol consumed,

$F(1, 616) = 6.32$, $p = .01$, $d = 0.20$, which was lower in those who viewed the messages (see Table 2). No other main effects or interactions were significant.

Frequency of binge drinking. Time also had a significant effect on the frequency of binge drinking, $F(2, 1232) = 35.96$, $p < .001$, which peaked during the first week at university and then declined and remained stable at one and six months (see Table 2). Message condition had a significant main effect on the frequency of binge drinking, $F(1, 616) = 4.25$, $p = .04$, $d = 0.17$, which was lower among participants who viewed the messages (see Table 2). The main effect of message condition was qualified by a significant interaction with the self-affirmation condition, $F(1, 616) = 4.01$, $p = .046$, such that the effect of message condition was significant among non-affirmed participants ($M_{MESS} = 0.88$, $SE = 0.08$; $M_{NoMESS} = 1.19$, $SE = 0.08$), $F(1, 302) = 8.52$, $p = .004$, but non-significant among self-affirmed participants ($M_{MESS} = 1.11$, $SE = 0.08$; $M_{NoMESS} = 1.11$, $SE = 0.08$), $F(1, 317) = 0.01$, $p = .92$. There was also a significant 3-way interaction between self-affirmation, implementation intentions, and time, $F(2, 1232) = 2.38$, $p = .03$. The interaction between self-affirmation and time was non-significant among participants who formed implementation intentions, $F(2, 592) = 0.99$, $p = .32$, but significant among participants who did not form implementation intentions, $F(2, 646) = 3.82$, $p = .02$, such that self-affirmed participants who did not form implementation intentions engaged in binge drinking more frequently than non-affirmed participants at one-week follow-up ($M_{SA} = 1.57$, $SE = 0.11$; $M_{NA} = 1.26$, $SE = 0.12$). No other main effects or interactions were significant.

AUDIT scores. A 2 x 2 x 2 between-participants ANOVA revealed that message condition had a significant main effect on AUDIT scores at six-month follow-up, $F(1, 875) = 4.43$, $p = .04$, $d = 0.14$, which were lower among those who viewed the messages ($M_{MESS} = 7.77$, $SD = 6.21$) than those who did not ($M_{NoMESS} = 8.71$, $SD = 6.50$). No other main effects or interactions were significant. In support of these findings, chi-square analysis revealed that

fewer participants exceeded the cut-off score for possible harmful patterns of alcohol use in

the message condition (48.1%) than in the no message condition (55.5%) at six-month follow-

up, χ^2 (1, N = 882) = 4.92, p = .03.

Cognitions about Binge Drinking

A series of 2 (self-affirmation: yes, no) × 2 (messages: yes, no) × 2 (implementation

intention: yes, no) × 3 (time: immediate, one month, six months) mixed-measures ANOVAs

was conducted, with measures of cognitions about binge drinking assessed immediately after

the intervention, and after one and six months at university as the (repeated-measures)

dependent variables. Table 3 reports the descriptive statistics at each follow-up time point by

condition.

Time had a significant effect on all cognitions (see Table 4). Intentions to binge drink,

F(2, 1330) = 10.55, p < .001, affective attitude, F(2, 1326) = 17.48, p < .001, cognitive

attitude, F(2, 1328) = 19.47, p < .001, subjective norms, F(2, 1328) = 6.02, p = .002,

descriptive norms, F(2, 1330) = 10.66, p < .001, self-efficacy, F(2, 1328) = 13.22, p < .001,

and perceived control, F(2, 1330) = 4.58, p = .01, all increased over time indicating more

favourable cognitions about binge drinking. Post-hoc analyses revealed that the differences

between all the time points were significant, with the exception of the difference between

immediate and one-month follow-up scores for intention and between the one- and six-month

follow-up scores for subjective norms and perceived control. The belief that binge drinking at

university would be fun also increased over time, F(2, 1318) = 16.83, p < .001, whereas the

belief that binge drinking would have a negative impact on their studies decreased over time,

F(2, 1312) = 9.75, p < .001. Differences between the immediate and one-month follow-up

scores for both beliefs were non-significant, but all other differences were significant.

Message condition had a significant main effect on all of the cognitions about binge

drinking, with the exception of perceived control (see Table 4). Participants who viewed the

messages reported weaker intentions to binge drink at university, $F(1, 665) = 12.43$, $p < .001$, $d = 0.27$, less positive affective attitudes, $F(1, 663) = 9.84$, $p = .002$, $d = 0.24$, less positive cognitive attitudes, $F(1, 664) = 12.69$, $p < .001$, $d = 0.28$, lower subjective norms, $F(1, 664) = 8.22$, $p = .004$, $d = 0.22$, lower descriptive norms, $F(1, 665) = 53.29$, $p < .001$, $d = 0.56$, and lower self-efficacy, $F(1, 664) = 5.38$, $p = .02$, $d = 0.18$, than participants who did not view the messages. Participants who viewed the messages were also less likely to believe that binge drinking at university would be fun, $F(1, 659) = 8.17$, $p = .04$, $d = 0.22$, and more likely to believe that it would have a negative impact on their studies, $F(1, 656) = 26.19$, $p < .001$, $d = 0.40$, than participants who did not view the messages.

The significant effects of message condition on intention, $F(2, 1330) = 3.09$, $p = .046$, affective attitude, $F(2, 1326) = 5.45$, $p = .004$, cognitive attitude, $F(2, 1328) = 7.41$, $p = .001$, subjective norms, $F(2, 1328) = 3.39$, $p = .03$, descriptive norms, $F(2, 1330) = 11.72$, $p < .001$, and the belief that binge drinking would impact on studies, $F(2, 1312) = 13.61$, $p < .001$, were qualified by significant interactions with time. Post-hoc analyses indicated that the effects of the messages weakened over time, although the effects on intention, affective attitude and descriptive norms remained significant at six-month follow-up. No other main effects or interactions were significant.

Mediation Analyses

Mediation analyses assessed whether the effects of the message condition on alcohol consumption were mediated by changes in cognitions about binge drinking (Preacher & Hayes, 2008). Message condition was entered as an independent variable along with the measures of the TPB assessed immediately post-intervention as potential mediators and alcohol consumption at baseline as a covariate. Alcohol consumption at six-month follow-up was the dependent variable.

The direct effect of message condition on the number of units of alcohol consumed at six-month follow-up, $B = -3.12$, $SE = 0.83$, $p < .001$, was reduced to non-significance when the TPB variables were controlled, $B = -1.52$, $SE = 0.83$, $p = .07$, thereby suggesting mediation. Using bootstrapping procedures, the total indirect effect was found to be significant, $B = -1.50$, $SE = 0.42$, $CI = -2.39$ to -0.75. Only the individual indirect effects via self-efficacy, $B = -0.19$, $SE = 0.10$, $CI = -0.45$ to -0.05, and intention, $B = -1.10$, $SE = 0.38$, $CI = -2.11$ to -0.52, were significant.

The direct effect of the message condition on the frequency of binge drinking at six-month follow-up, $B = -0.20$, $SE = 0.07$, $p = .004$, was reduced to non-significance when the TPB variables were controlled, $B = -0.06$, $SE = 0.07$, $p = .37$. Using bootstrapping procedures, the total indirect effect was found to be significant, $B = -0.14$, $SE = 0.04$, $CI = -0.21$ to -0.07. Again, only the individual indirect effects via self-efficacy, $B = -0.02$, $SE = 0.01$, $CI = -0.05$ to -0.01, and intention, $B = -0.08$, $SE = 0.03$, $CI = -0.15$ to -0.04, were significant.

Discussion

The present study employed a full factorial design to test the effect of combining self-affirmation, messages based on the theory of planned behaviour (TPB) and implementation intentions on alcohol consumption in new university students. The messages had significant effects on the quantity of alcohol consumed, reducing the frequency of binge drinking and harmful patterns of alcohol use over students' first six months at university. Moreover, these effects of the messages on alcohol consumption did not diminish over time. The messages also had significant effects on (reducing) intentions to binge drink, cognitive attitudes, subjective norms, descriptive norms and self-efficacy, although some of these effects weakened over time. The effects of the messages on both the quantity of alcohol consumed and the frequency of binge drinking were mediated by TPB variables with significant indirect

effects through intention and self-efficacy which, according to the TPB, are proximal determinants of behaviour.

The effect sizes for the TPB-based messages on the quantity of alcohol consumed ($d = 0.20$) and the frequency of binge drinking ($d = 0.17$) although small, are larger than the average effect sizes reported by interventions targeting alcohol consumption in first year university students (d_+s = 0.13, 0.07; Scott-Sheldon et al., 2014) and for online alcohol interventions (d_+s = 0.15, 0.07; Black, Mullan & Sharpe, 2016). Furthermore, the finding that the effects of the messages were mediated by cognitions about binge drinking (i.e., intention and self-efficacy) provides strong support for the TPB (Norman & Conner, 2015). The significant effects of the messages contrast with the non-significant effects found for self-affirmation and implementation intentions. This may indicate that the messages were (i) sufficiently relevant to students not to be dismissed or derogated and (ii) sufficiently persuasive to produce changes in behaviour without the need to form if-then plans. Extensive formative research was conducted to identify the key beliefs underlying binge drinking at university and to develop of messages to target them (Epton et al., 2015), which is likely to have increased their relevance and effectiveness. In addition, the messages were presented to students just before a significant life transition when their beliefs may have been more malleable (Lawson & Flocke, 2009; Heatherton & Nichols, 1994).

Non-significant effects of self-affirmation on measures of message acceptance (Kamboj et al., 2016; Knight & Norman, 2016; Meier et al., 2015) and alcohol consumption (Harris & Napper, 2005; Kamboj et al., 2016; Knight & Norman, 2016; Meier et al., 2015; Norman & Wrona-Clarke, 2016; Scott et al., 2013) have been reported in other studies with university students, although significant effects have been reported with retail workers (Armitage, Harris, & Arden, 2011). The non-significant effects of self-affirmation in the present study may, in part, be due to the fact that participants completed the self-affirmation

manipulation before they entered university. It is possible that the messages were not perceived as a threat to self-integrity given that they targeted a future, rather than a current, behaviour (i.e., binge drinking at university). As a result, there may have been little need for participants to self-affirm to overcome defensive processing. The fact that the messages were found to have significant effects on cognitions about binge drinking and subsequent alcohol consumption at university is consistent with such an explanation. Future research could therefore test the effects of repeated administration of self-affirmation manipulations at different points across the transition into university when messages about the risks of binge drinking may be more threatening.

The present research also found some evidence that the self-affirmation manipulation may have been counterproductive, such that the messages only reduced the frequency of binge drinking at university if participants did *not* self-affirm. Knight and Norman (2016) argued that self-affirmation manipulations may inadvertently prime social goals that are closely associated with drinking in university students, thereby counteracting the effects of such manipulations on the processing of health-risk information about alcohol. Consistent with this argument, Norman and Wrona-Clarke (2016) found that university students who affirmed a social value had stronger intentions to engage in binge drinking than those who affirmed a non-social value. Similarly, Voisin, Girandola, David and Aim (2016) found that a self-affirmation manipulation only reduced students' derogation of a health message about the risks of binge drinking when the message did not contain incongruent normative information about the prevalence of binge drinking in young people. Alternative self-affirmation manipulations that avoid priming social goals may need to be developed.

The non-significant effects of forming implementation intentions contrast with the significant effects on alcohol consumption reported in other studies (Hagger et al., 2012; Murgraff et al., 1996, 2007; Norman & Wrona-Clarke, 2016). One key difference between the

present study and previous work is that implementation intentions were formed before students started university. Research on the hot-cold empathy gap (Loewenstein, 1996) suggests that people often fail to appreciate in advance how "hot" affective states (e.g., feelings of excitement) will influence their behavior at the moment of acting. Furthermore, Sugarman and Carey (2009) have argued that experienced drinkers at university are likely to have developed appropriate protective strategies. In contrast, incoming students may lack knowledge of the high-risk situations they are likely to encounter at university and how to deal with them. As a result, they may make poor quality plans to avoid binge drinking at university. The task of forming implementation intentions could therefore be delayed or repeated at university when students have more experience of drinking contexts and pressures as occurs in the AlcoholEdu for College programme (EverFi, 2016) which is used in many US universities.

The present study had a number of limitations that should be noted. First, participants randomly allocated to the implementation intentions condition were more likely to drop out of the study between randomisation and completion of the immediate post-intervention measures. This may simply reflect the additional burden of this task or that participants did not consider making plans to avoid binge drinking before starting university to be relevant. Second, participants lost to follow-up were more likely to be male and non-White and consumed more alcohol at baseline than those who completed all follow-up questionnaires, thereby limiting the generalizability of the findings. Third, attrition across the follow-up period was relatively high. Intention-to-treat analyses were therefore conducted to examine the effect of the interventions on the primary outcomes (i.e., units of alcohol consumed and frequency of binge drinking) at six-month follow-up using both last observation carried forward (from one-month follow-up) and multiple imputation methods. These additional analyses produced broadly consistent results. Fourth, alcohol consumption was assessed by

self-report which may introduce self-presentation biases. However, self-report measures of

the type used in the present study have been found to provide accurate estimates of alcohol

consumption (Del Boca & Noll, 2000). Finally, the present study tested a single TPB

intervention. Testing separate manipulations of attitudes, norms and perceptions of control in

a full factorial design would provide a stronger experimental test of the TPB (Sniehotta,

Presseau, & Araújo-Soares, 2014).

A number of important implications can be drawn from the current findings. First, the

findings support the idea that brief interventions delivered to students before they enter

university can reduce alcohol consumption at university (e.g., Hustad, Barnett, Borsari, &

Jackson, 2010). Second, the findings suggest that the TPB provides a strong theoretical

framework for developing interventions to reduce alcohol consumption in university students.

Third, the findings suggest that the timing of interventions may influence their effectiveness.

The significant effects of the messages may, in part, be due to the fact that they were

delivered just before a significant life transition (i.e., at a "teachable moment) when students'

beliefs about binge drinking may have been more amenable to change (Lawson & Flocke,

2009). In contrast, administering a self-affirmation manipulation at this point in time may be

unnecessary given that the message targeted a future, rather than a current, behaviour (i.e.,

binge drinking at university). As a result, the messages may not have represented a threat to

participants' self-integrity. Similarly, forming implementation intentions to avoid binge

drinking before starting university may not be effective, as incoming students may not have

sufficient knowledge of the high-risk situations they are likely to encounter at university.

Thus, it may be premature to suggest that prompting students to self-affirm or form

implementation intentions (or do both) is not an effective way to reduce alcohol consumption.

Instead, future interventions to reduce binge drinking in new university students might test the

effects of repeated (or delayed) administration of different intervention components across the

transition into university (e.g., before and after students have entered university).

Footnotes

1.   Additional analyses were conducted to examine whether any of the main effects or interactions on alcohol consumption were moderated by baseline drinker status (drinker versus non-drinker). All of the interaction terms with drinker status were non-significant (see Supplementary Materials 1).

2.   Given the relatively high level of attrition, intention-to-treat analyses were also conducted for the primary outcome measures using last observation carried forward (from one-month follow-up) and multiple imputation where data were missing. The results were broadly consistent with the original analyses (see Supplementary Materials 2).

3.   Given that the primary outcome measures were based on count data, the data were also analysed using negative binomial generalized linear mixed models, both with and without data imputation. Again, the results were broadly consistent with the original analyses (see Supplementary Materials 3).

References

Ajzen, I. (1988). Attitudes, personality and behavior. Milton Keynes: Open University Press.

Armitage, C.J., Harris, P.R., & Arden, M.A. (2011). Evidence that self-affirmation reduces
        alcohol consumption: Randomized exploratory trial with a new, brief means of self-
        affirming. Health Psychology, 30, 633-641. doi:10.1037/a0023738

Babor, T.F., Higgins-Biddle, J.C., Saunders, J.B., & Nonteiro, M.G. (2001). The alcohol use
        disorders identification test. Geneva: World Health Organization.

Black, N., Mullan, B., & Sharpe, L. (2016). Computer-delivered interventions for reducing
        alcohol consumption: Meta-analysis and meta-regression using behaviour change
        techniques and theory. Health Psychology Review, 10, 341-357. doi:
        10.1080/17437199.2016.1168268

Cameron, D., Epton, T., Norman, P., Sheeran, P., Harris, P.R., Webb, T.L., Julious, S.A.,
        Brennan, A., Thomas, C., Petroczi, A., Naughton, D., & Shah, I. (2015). A theory-
        based online health behaviour intervention for new university students
        (U@Uni:LifeGuide): Results from a repeat randomised controlled trial. BMC Trials,
        16, 555. doi: 10.1186/s13063-015-1092-4

Cooke, R., Dahdah, M., Norman, P., & French, D. (2016). How well does the theory of
        planned behaviour predict alcohol consumption? A systematic review and meta-
        analysis. Health Psychology Review, 10, 128-167. doi:
        10.1080/17437199.2014.947547

Cooke, R., Sniehotta, F., & Schüz, B. (2007). Predicting binge-drinking behaviour using an
        extended TPB: Examining the impact of anticipated regret and descriptive norms.
        Alcohol and Alcoholism, 42, 84-91. doi: 10.1093/alcalc/agl115

Del Boca, F.K., & Noll, J.A. (2000). Truth or consequences: The validity of self-report data in
        health services research on addictions. Addiction, 95(Suppl. 3), S347-S360.

Epton, T., Harris, P. R., Kane, R., van Koningsbruggen, G. M., & Sheeran, P. (2015). The

    impact of self-affirmation on health-behavior change: A meta-analysis. Health

    Psychology, 34, 187-196. doi:10.1037/hea0000116

Epton, T., Norman, P., Harris, P Webb, T., Snowsill, A., & Sheeran, P. (2015). Development

    of theory-based health messages: Three-phase programme of formative research.

    Health Promotion International, 30, 756-768. doi:10.1093/heapro/dau005

EverFi. (2016). EduAlcohol for College. https://everfi.com/higher-education/alcoholedu/

Fishbein, M., & Ajzen, I. (2010). Predicting and changing behavior: The reasoned action

    approach. New York: Psychology Press.

Fromme, K., Corbin, W.R., & Kruse, M.I. (2008). Behavioral risks during the transition from

    high school to college. Developmental Psychology, 44, 1497–1504.

    doi:10.1037/a0012614

Gill, J.S. (2002). Reported levels of alcohol consumption and binge drinking within the UK

    undergraduate student population over the last 25 years. Alcohol and Alcoholism, *37*,

    109-120. http://dx.doi.org/10.1093/alcalc/37.2.109

Glanz, K., & Bishop, D.B. (2010). The role of behavioral science theory in development and

    implementation of public health interventions. Annual Review of Public Health, 31,

    399-418. doi: 10.1146/annurev.publhealth.012809.103604

Gollwizer, PM. (1999). Implementation intentions: Strong effects of simple plans. American

    Psychologist, 29, 971-979. doi:10.1037/0003-066X.54.7.493

Gollwitzer, P.M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A

    meta-analysis of effects and processes. Advances in Experimental Socical Psychology,

    38. 69-119. doi:10.1013/S0065-2601(06)38002-1

Hagger, M., Anderson, M., Kyriakaki, M., & Darkings, S. (2007). Aspects of identity and
their influence on intentional behavior: Comparing effects for three health behaviors.
Personality and Individual Differences, 42, 355-367. doi: 10.1016/j.paid.2006.07.017

Hagger, M.S., Lonsdale, A., Koka, A., Hein, V., Pasi, H., Lintunen, T., & Chatzisarantis,
N.L.D. (2012). An intervention to reduce alcohol consumption in undergraduate
students using implementation intentions and mental simulations: A cross-national
study. International Journal of Behavioral Medicine, 19, 82-96. doi:10.1007/s12529-
011-9163-8

Harris, P.R., & Epton, T. (2009). The impact of self-affirmation on health cognition, health
behaviour and other health-related responses: A narrative review. Social and
Personality Psychology Compass, 3, 962-978. doi:10.1111/j.1751-9004.2009.00233.x

Harris, P.R., & Napper, L. (2005). Self-affirmation and the biased processing of threatening
health-risk information. Personality and Social Psychology Bulletin, 31, 1250–1263.
doi:10.1177/014167205274694

Heatherton, T.F, & Nichols, P.A. (1994). Personal accounts of successful versus failed
attempts at life change. Personality and Social Psychology Bulletin, 20, 664-675. doi:
10.1177/0146167294206005

House of Commons Health Committee. (2009). Alcohol. Retrieved 3 March, 2015, from
http://www.publications.parliament.uk/pa/cm200910/cmselect/cmhealth/151/15102.htm

Hustad, J.T.P., Barnett, N.P., Borsari, B., & Jackson, M.J. (2010). Web-based alcohol
prevention for incoming college students: A randomized controlled trial. *Addictive
Behaviors, 35*, 183-189. doi: 10.1016/j.adbeh.2009.10.012

Johnston, K.L., & White, K.M. (2003). Binge drinking: A test of the role of group norms in
the theory of planned behaviour. Psychology and Health, 18, 63-77. doi:
10.1080/0887044021000037835

Kamboj, S.K., Place, H., Barton, J.A., Linke, S., Curran, H.V., & Harris, P.R. (2016).

   Processing of alcohol-related health threat in at-risk drinkers: An online study of

   gender-related self-affirmation effects. Alcohol and Alcoholism. doi:

   10.1093/alcalc/agw013

Knight, R., & Norman, P. (2016). Impact of brief self-affirmation manipulations on university

   students' reactions to risk information about binge drinking. British Journal of Health

   Psychology. doi: 10.1111/bjhp.12186

Lawson, P.J., & Flocke, S.A. (2009). Teachable moments for health behavior change: A

   concept analysis. Patient Education and Counseling, 76, 25-30. doi:

   10.1016/j.pec.2008.11.002

Leffingwell, T.R., Neumann, C., Leedy, M.J., & Babitzke, A.C. (2007). Defensively biased

   responding to risk information among alcohol-using college students. Addictive

   Behaviors, 32, 158-165. doi:10.1016/j.addbeh.2006.03.009

Loewenstein, G. (1996). Out of control: Visceral influences on behavior. Organizational

   Behavior and Human Decision Processes, 65, 272-292. doi:10.1006/obhd.1996.0028

McEachan, R.R.C., Conner, M., Taylor, N.J., & Lawton, R.J. (2011). Prospective prediction

   of health-related behaviours with the Theory of Planned Behaviour: A meta-analysis.

   Health Psychology Review, 5, 97-144. doi: 10.1080/17437199.2010.521684

McMillan, B., & Conner, M. (2003). Using the theory of planned behaviour to understand

   alcohol and tobacco use in students. Psychology, Health and Medicine, 8, 317-328.

   http://dx.doi.org/10.1080/1354850031000135759

Meier, E., Miller, M.B., Lechner, W.V., Lombardi, N., Claborn, K.R., & Leffingwell, T.R.

   (2015). The inability of self-affirmations to decrease defensive bias toward an alcohol-

   related risk message among high-risk college students. Journal of American College

   Health, 63, 324-329. doi:10.1080/07448481.2014.1003377

Miller, P., Plant, M., & Plant, M. (2005). Spreading out or concentrating weekly consumption: alcohol problems and other consequences within a UK population sample. Alcohol and Alcoholism, *40*, 461-468. https://doi.org/10.1093/alcalc/agh169

Murgraff, V., Abraham, C., & McDermot, M. (2007). Reducing Friday alcohol consumption among moderate, women drinkers: Evaluation of a brief evidence-based intervention. Alcohol and Alcoholism, 42, 37-41. doi:10.1093/alcalc/ag1083

Murgraff, V., White, D., & Phillips, K. (1996). Moderating binge drinking: It is possible to change behaviour if you plan it in advance. Alcohol and Alcoholism, 31, 577-582. https://doi.org/10.1093/oxfordjournals.alcalc.a008193

Naimi, T.S., Brewer, R.D., Mokdad, A., Denny, C., Sredula, M.K., & Marks, J.S. (2003). Binge drinking among U.S. adults. Journal of the American Medical Association, 289, 70-75. doi:10.1001/jama.289.1.70

Napper, L., Harris, P.R., & Epton, T. (2009). Developing and testing a self-affirmation manipulation. Self and Identity, 8, 45-62. doi: 10.1080/15298860802079786

National Health Service. (2014a). Binge drinking. Retrieved from http://www.nhs.uk/Livewell/alcohol/Pages/Bingedrinking.aspx

National Health Service. (2014b). Alcohol units. Retrieved from http://www.nhs.uk/Livewell/alcohol/Pages/alcohol-units.aspx.

Noar, S.M., Benac, C.N., & Harris, M.S. (2007). Does tailoring matter? Meta-analytic review of tailored print health Behavior change interventions. *Psychological Bulletin*, 133, 673-693. doi: 10.1037/0033-2909.133.4.673

Norman, P. (2011). The theory of planned behaviour and binge drinking among undergraduate students: Assessing the impact of habit strength. *Addictive Behaviors, 36*, 502-507. doi:10.1016/j.addbeh.2011.01.025

Norman, P., Armitage, C.J., & Quigley, C. (2007). The theory of planned behavior and binge

    drinking: Assessing the impact of binge drinker prototypes. Addictive Behaviors, 32,

    1753-1768. doi:10.1016/j.addbeh.2006.12.009

Norman, P., & Conner, M. (2006). The theory of planned behaviour and binge drinking:

    Assessing the moderating role of past behaviour within the theory of planned

    behaviour. British Journal of Health Psychology, 11, 55-70.

    doi:10.1348/135910705X43741

Norman, P., & Conner, M. (2015). Predicting and changing health behaviour: Future research

    directions. In M. Conner, and P. Norman, (Eds.), Predicting and changing health

    behaviour: Research and practice with social cognition models (3rd ed., pp. 390-430).

    Buckingham: Open University Press.

Norman, P., & Wrona-Clarke, A. (2016). Combining self-affirmation and implementation

    intentions to reduce heavy episodic drinking in university students. Psychology of

    Addictive Behaviors, 30, 434-441. doi: 10.1037/adb0000144

Peterson, C., & Seligman, M.E.P. (2004). *Character strengths and virtues: A classification

    and handbook*. New York: Oxford University Press.

Preacher, K.J., & Hayes, A.F. (2008). Asymptotic and resampling strategies for assessing and

    comparing indirect effects in multiple mediator models. *Behavior Research Methods,

    40*, 879–891. doi: 10.3758/BRM.40.3.879

Scott, J.L., Brown, A.C., Phair, J.K., Westland, J.N., & Schüz, B. (2013). Self-affirmation,

    intentions and alcohol consumption in students: A randomized exploratory trial.

    Alcohol and Alcoholism, 48, 458-463. doi:10.1093/alcalc/agt027

Scott-Sheldon, L.A.J., Carey, K.B., Elliot, J.C., Garey, L., & Carey, M.P. (2014). Efficacy of

    alcohol interventions for first-year college students: A meta-analytic review of

randomized controlled trials. Journal of Consulting and Clinical Psychology, 82, 177-188. doi: 10.1037/a0035192

Sniehotta, F., Presseau, J., & Araújo-Soares, V. (2014). Time to retire the theory of planned behaviour. Health Psychology Review, 8, 1-7. doi: 10.1080/17437199.2013.869710

Steele, C.M. (1988). The psychology of self-affirmation: Sustaining the integrity of the self. Advances in Experimental Social Psychology, 21, 261-302. doi:10.1016/S0065-2601(08)60229-4

Sugarman, D.E., & Carey, K.B. (2009). Drink less or drink slower: The effects of instruction on alcohol consumption and drinking control strategy use. Psychology of Addictive Behaviors, 23, 577–585. doi:10.1037/a0016580

Voisin, D., Girandola, F., David, M., & Aim, M.A. (2016). Self-affirmation and an incongruent drinking norm: alcohol abuse prevention messages targeting young people. Self and Identity, 15, 262-282. doi: 10.1080/15298868.2015.1121916

Webb, T.L., Joseph, J., Yardley, L., & Michie, S. (2010). Using the internet to promote health behavior change: A systematic review and meta-analysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy. *Journal of Medical Internet Research, 12,* e4. doi:10.2196/jmir.1376

Wechsler, H., Lee, J.E., Kuo, M., Seibring, M., Nelson, T.F., & Lee, H.P. (2002). Trends in college binge drinking during a period of increased prevention efforts: Findings from four Harvard School of Public Health study surveys, 1993-2001. Journal of American College Health, 50, 203-217. http://dx.doi.org/10.1080/07448480209595713

Wood, W., Tam, L., & Witt, M.G. (2005). Changing circumstances, disrupting habits. Journal of Personality and Social Psychology, 88, 918-933. doi: 10.1037/0022-3514.88.6.918

Table 1

Alcohol Consumption Assessed after One Week, One Month and Six Months at University by Condition

	Non-Affirmed				Self-Affirmed			
	No Message		Message		No Message		Message	
	No II	II	No II	II	No II	II	No II	II
Units per Week								
One Week	23.75 (2.15)	27.25 (2.18)	19.15 (2.07)	22.12 (2.14)	24.39 (2.09)	23.46 (2.18)	23.44 (1.95)	24.72 (2.12)
One Month	14.23 (1.30)	14.07 (1.32)	10.37 (1.26)	12.98 (1.30)	13.02 (1.27)	14.03 (1.32)	12.30 (1.18)	13.31 (1.29)
Six Months	14.81 (1.40)	16.79 (1.42)	10.24 (1.35)	11.72 (1.39)	12.84 (1.36)	14.11 (1.42)	10.89 (1.27)	12.77 (1.38)
Binge Drinking Frequency								
One Week	1.49 (0.18)	1.74 (0.18)	1.14 (0.17)	1.32 (0.18)	1.61 (0.17)	1.35 (0.18)	1.61 (0.16)	1.66 (0.18)
One Month	1.02 (0.11)	0.83 (0.11)	0.67 (0.11)	0.74 (0.11)	0.89 (0.11)	1.02 (0.11)	0.83 (0.10)	0.89 (0.11)
Six Months	1.03 (0.12)	1.06 (0.12)	0.67 (0.11)	0.71 (0.11)	0.90 (0.11)	0.91 (0.12)	0.77 (0.10)	0.90 (0.11)

Note. Values are adjusted means controlling for baseline scores. Standard errors are in parentheses. II = Implementation intention.

Table 2

Alcohol Consumption Assessed after One Week, One Month and Six Months at University by Message Condition

	No Message	Message	Total
Units per Week			
One Week	24.71 (1.07)	22.36 (1.03)	23.54 (0.75)
One Month	13.84 (0.65)	12.24 (0.63)	13.04 (0.45)
Six Months	14.64 (0.70)	11.41 (0.67)	13.02 (0.49)
Total	17.73 (0.69)	15.33 (0.66)	16.53 (0.48)
Binge Drinking Frequency			
One Week	1.55 (0.09)	1.43 (0.09)	1.49 (0.06)
One Month	0.94 (0.06)	0.78 (0.05)	0.86 (0.04)
Six Months	0.97 (0.06)	0.76 (0.06)	0.87 (0.04)
Total	1.15 (0.06)	0.99 (0.05)	1.07 (0.04)

Note. Values are adjusted means controlling for baseline scores. Standard errors are in parentheses.

Table 3

Theory of Planned Behaviour Measures Assessed Immediately Post-Intervention and after One Month and Six Months at University by

Condition

	Non-Affirmed				Self-Affirmed			
	No Message		Message		No Message		Message	
	No II	II	No II	II	No II	II	No II	II
Intention								
Immediate	3.77 (0.20)	3.44 (0.22)	2.60 (0.20)	2.96 (0.22)	3.52 (0.21)	3.21 (0.22)	3.00 (0.20)	2.99 (0.21)
One Month	3.84 (0.22)	3.53 (0.23)	2.82 (0.21)	3.22 (0.23)	3.53 (0.22)	3.20 (0.24)	2.96 (0.22)	3.12 (0.22)
Six Months	3.65 (0.23)	3.60 (0.24)	2.80 (0.22)	3.47 (0.24)	3.74 (0.23)	3.57 (0.25)	3.12 (0.23)	3.31 (0.24)
Affective Attitude								
Immediate	3.63 (0.19)	3.27 (0.20)	2.67 (0.18)	2.71 (0.20)	3.37 (0.19)	3.27 (0.20)	2.85 (0.19)	2.98 (0.19)
One Month	3.74 (0.20)	3.33 (0.21)	2.93 (0.19)	3.01 (0.21)	3.35 (0.20)	3.13 (0.21)	2.87 (0.20)	3.23 (0.20)
Six Months	3.65 (0.21)	3.49 (0.22)	3.06 (0.20)	3.35 (0.22)	3.48 (0.21)	3.40 (0.22)	3.03 (0.21)	3.40 (0.21)
Cognitive Attitude								
Immediate	2.63 (0.12)	2.44 (0.13)	2.09 (0.12)	1.94 (0.13)	2.43 (0.13)	2.51 (0.13)	1.98 (0.12)	2.17 (0.13)
One Month	2.73 (0.13)	2.46 (0.14)	2.20 (0.12)	2.20 (0.14)	2.50 (0.13)	2.39 (0.14)	2.17 (0.13)	2.41 (0.13)
Six Months	2.72 (0.14)	2.65 (0.15)	2.34 (0.14)	2.37 (0.15)	2.50 (0.14)	2.48 (0.15)	2.25 (0.14)	2.69 (0.14)
Subjective Norm								
Immediate	3.27 (0.16)	2.90 (0.17)	2.57 (0.16)	2.56 (0.13)	2.75 (0.17)	3.11 (0.18)	2.49 (0.16)	2.81 (0.17)
One Month	3.25 (0.15)	3.06 (0.16)	2.76 (0.15)	2.55 (0.14)	2.93 (0.15)	3.03 (0.16)	2.76 (0.16)	2.98 (0.16)
Six Months	3.11 (0.16)	3.04 (0.17)	2.67 (0.16)	2.74 (0.15)	2.87 (0.16)	3.17 (0.17)	2.98 (0.16)	3.18 (0.16)

Descriptive Norm								
Immediate	5.35 (0.13)	4.91 (0.13)	4.31 (0.12)	4.37 (0.13)	5.26 (0.13)	5.20 (0.14)	4.48 (0.12)	4.52 (0.13)
One Month	5.15 (0.12)	5.10 (0.12)	4.65 (0.11)	4.66 (0.15)	5.02 (0.12)	5.16 (0.13)	4.80 (0.11)	4.68 (0.12)
Six Months	5.18 (0.12)	5.15 (0.13)	4.69 (0.11)	4.70 (0.13)	5.23 (0.12)	5.26 (0.13)	4.71 (0.12)	4.95 (0.12)
Self-Efficacy								
Immediate	5.52 (0.20)	5.36 (0.21)	4.87 (0.20)	5.18 (0.21)	5.42 (0.20)	5.14 (0.22)	4.76 (0.20)	5.24 (0.21)
One Month	6.13 (0.17)	5.67 (0.18)	5.61 (0.16)	5.49 (0.18)	5.96 (0.17)	5.68 (0.18)	5.48 (0.17)	5.91 (0.17)
Six Months	6.10 (0.16)	5.94 (0.17)	5.88 (0.16)	5.10 (0.17)	6.12 (0.17)	5.95 (0.18)	5.56 (0.16)	6.10 (0.17)
Perceived Control								
Immediate	6.15 (0.12)	6.15 (0.12)	6.32 (0.11)	6.06 (0.12)	6.08 (0.12)	6.19 (0.13)	6.31 (0.11)	6.20 (0.12)
One Month	6.19 (0.12)	6.17 (0.12)	6.36 (0.11)	6.17 (0.12)	6.37 (0.12)	6.25 (0.13)	6.30 (0.12)	6.39 (0.12)
Six Months	6.18 (0.12)	6.37 (0.12)	6.37 (0.11)	6.33 (0.12)	6.09 (0.12)	6.18 (0.13)	6.50 (0.11)	6.46 (0.12)
Belief 1 – Fun								
Immediate	4.03 (0.21)	3.65 (0.22)	3.18 (0.20)	3.03 (0.22)	3.67 (0.21)	3.82 (0.23)	3.14 (0.21)	3.50 (0.22)
One Month	4.21 (0.22)	3.72 (0.23)	3.45 (0.21)	3.40 (0.23)	3.91 (0.22)	3.74 (0.24)	3.43 (0.21)	3.85 (0.23)
Six Months	4.06 (0.22)	3.92 (0.24)	3.47 (0.22)	3.56 (0.24)	3.85 (0.23)	4.04 (0.24)	3.58 (0.22)	4.04 (0.23)
Belief 2 – Impact on Studies								
Immediate	5.26 (0.16)	5.40 (0.17)	6.11 (0.15)	6.36 (0.16)	5.67 (0.16)	5.37 (0.17)	6.27 (0.15)	5.93 (0.16)
One Month	5.19 (0.16)	5.39 (0.16)	6.04 (0.15)	5.96 (0.16)	5.65 (0.16)	5.34 (0.17)	5.96 (0.15)	5.86 (0.16)
Six Months	5.23 (0.17)	5.39 (0.18)	5.67 (0.16)	5.82 (0.18)	5.79 (0.17)	5.43 (0.18)	5.69 (0.17)	5.43 (0.17)
Belief 3 – Friends Bingeing								
Immediate	4.25 (0.22)	3.77 (0.23)	3.57 (0.21)	3.91 (0.23)	3.91 (0.22)	3.67 (0.24)	3.76 (0.21)	3.62 (0.22)
One Month	4.42 (0.22)	3.78 (0.23)	3.60 (0.21)	3.91 (0.23)	3.93 (0.22)	3.69 (0.24)	3.81 (0.22)	3.90 (0.23)
Six Months	4.24 (0.23)	3.99 (0.24)	3.66 (0.22)	4.18 (0.24)	4.06 (0.23)	4.03 (0.25)	3.81 (0.23)	3.74 (0.24)

Note. Values are means. Standard errors are in parentheses. II = Implementation intention.

Table 4

Theory of Planned Behaviour Measures Assessed Immediately Post-Intervention and after One Month and Six Months at University by Message
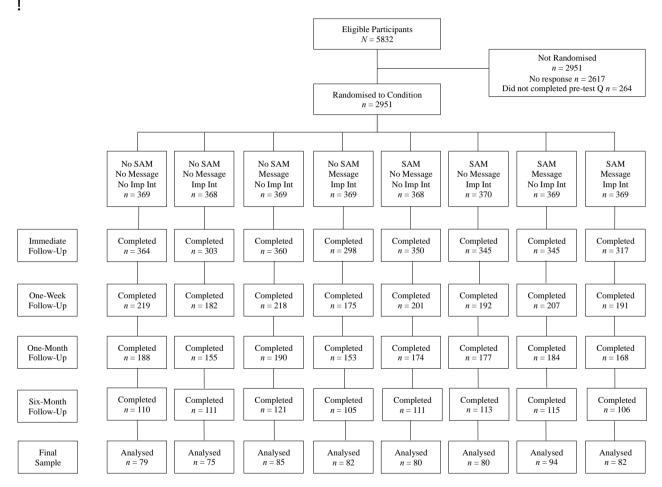
Condition

	No Message	Message	Total
Intention			
Immediate	3.48 (0.11)	2.89 (0.10)	3.19 (0.07)
One Month	3.52 (0.11)	3.03 (0.11)	3.28 (0.07)
Six Months	3.64 (0.12)	3.17 (0.12)	3.41 (0.08)
Total	3.55 (0.11)	3.03 (0.10)	3.29 (0.07)
Affective Attitude			
Immediate	3.38 (0.10)	2.80 (0.09)	3.09 (0.07)
One Month	3.39 (0.10)	3.01 (0.11)	3.20 (0.07)
Six Months	3.50 (0.11)	3.21 (0.11)	3.36 (0.08)
Total	3.43 (0.10)	3.01 (0.09)	3.21 (0.07)
Cognitive Attitude			
Immediate	2.50 (0.06)	2.04 (0.06)	2.27 (0.05)
One Month	2.52 (0.07)	2.24 (0.06)	2.38 (0.05)
Six Months	2.59 (0.07)	2.41 (0.07)	2.50 (0.05)
Total	2.53 (0.06	2.23 (0.06)	2.38 (0.04)
Subjective Norm			
Immediate	3.01 (0.08)	2.61 (0.08)	2.81 (0.06)
One Month	3.07 (0.08)	2.76 (0.08)	2.92 (0.06)
Six Months	3.05 (0.08)	2.89 (0.08)	2.97 (0.06)
Total	3.04 (0.07)	2.75 (0.07)	2.90 (0.05)

Descriptive Norm

Immediate	5.18 (0.07)	4.92 (0.06)	4.80 (0.05)
One Month	5.11 (0.06)	4.70 (0.06)	4.90 (0.04)
Six Months	5.21 (0.06)	4.77 (0.06)	5.00 (0.04)
Total	5.16 (0.05)	4.63 (0.05)	4.90 (0.04)

Self-Efficacy

Immediate	5.36 (0.10)	5.01 (0.10)	5.19 (0.07)
One Month	5.86 (0.09)	5.63 (0.09)	5.74 (0.06)
Six Months	6.03 (0.09)	5.81 (0.08)	5.92 (0.06)
Total	5.75 (0.08)	5.48 (0.08)	5.61 (0.06)

Perceived Control

Immediate	6.14 (0.06)	6.22 (0.06)	6.18 (0.04)
One Month	6.25 (0.06)	6.31 (0.06)	6.28 (0.04)
Six Months	6.20 (0.06)	6.42 (0.06)	6.31 (0.04)
Total	6.20 (0.05)	6.32 (0.05)	6.26 (0.03)

Belief 1 – Fun

Immediate	3.80 (0.11)	3.21 (0.11)	3.30 (0.08)
One Month	3.89 (0.12)	3.53 (0.11)	3.71 (0.08)
Six Months	3.97 (0.12)	3.66 (0.11)	3.82 (0.08)
Total	3.89 (0.10)	3.47 (0.10)	3.68 (0.07)

Belief 2 – Impact on Studies

Immediate	5.43 (0.08)	6.17 (0.08)	5.76 (0.06)
One Month	5.39 (0.08)	5.96 (0.08)	5.67 (0.06)
Six Months	5.46 (0.09)	5.65 (0.09)	5.56 (0.06)
Total	5.43 (0.07)	5.92 (0.07)	5.68 (0.07)

Belief 3 – Friends Bingeing

Immediate	3.90 (0.11)	3.72 (0.11)	3.81 (0.08)
One Month	3.95 (0.11)	3.81 (0.11)	3.88 (0.08)
Six Months	4.08 (0.12)	3.85 (0.12)	3.96 (0.08)
Total	3.89 (0.10)	3.79 (0.10)	3.88 (0.07)

Note. Values are means. Standard errors are in parentheses.

Figure 1 *Flow of Participants Through the Experiment*
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Supplementary Materials 1: Moderation analyses

Additional analyses were conducted to examine whether any of the main effects or interactions on alcohol consumption were moderated by baseline drinker status (drinker versus non-drinker). Specifically, the ANCOVAs were repeated with baseline drinker status as an additional between-participants factor.

All of the interaction terms with drinker status on units of alcohol consumed were non-significant: Self-affirmation × drinker status, $F(1, 608) = 2.22$, $p = .14$, messages × drinker status, $F(1, 608) = 0.86$, $p = .35$, implementation intentions × drinker status, $F(1, 608) = 0.09$, $p = .77$, self-affirmation × messages × drinker status, $F(1, 608) = 0.46$, $p = .50$, self-affirmation × implementation intentions × drinker status, $F(1, 608) = 1.01$, $p = .32$, messages × implementation intentions × drinker status, $F(1, 608) = 0.61$, $p = .44$, and self-affirmation × messages × implementation intentions × drinker status, $F(1, 608) = 0.08$, $p = .78$.

All of the interaction terms with drinker status on the frequency of binge drinking were also non-significant: Self-affirmation × drinker status, $F(1, 608) = 0.91$, $p = .34$, messages × drinker status, $F(1, 608) = 0.36$, $p = .55$, implementation intentions × drinker status, $F(1, 608) = 0.02$, $p = .90$, self-affirmation × messages × drinker status, $F(1, 608) = 1.46$, $p = .23$, self-affirmation × implementation intentions × drinker status, $F(1, 608) = 0.17$, $p = .68$, messages × implementation intentions × drinker status, $F(1, 608) = 0.24$, $p = .62$, and self-affirmation × messages × implementation intentions × drinker status, $F(1, 608) = 0.003$, $p = .95$.

Taken together, these findings indicate that the effects of the intervention conditions on alcohol consumption at university were not moderated by baseline drinker status.

Supplementary Materials 2: Intention-to-treat analyses

Given that there was a large amount of missing data at six-month follow-up, intention-to-treat analyses were conducted to examine the effect of the conditions on the primary outcomes (i.e., units of alcohol consumed and frequency of binge drinking) at six-month follow-up, using both last observation carried forward (from one-month follow-up) and multiple imputation methods where data were missing. Such an approach is consistent with the recommendations of Altman (2009). Missing value analysis indicated that data for the primary measures were missing at random, Little's MCAR test $\chi^2 = 5.21$, $p = .27$.

Last Observation Carried Forward

Given that alcohol consumption (i.e., units consumed and frequency of binge drinking) peaked at one-week follow-up, but remained stable between one- and six-month follow-ups, the intention-to-treat analyses were first conducted with the last observation carried forward from the one-month to the six-month follow-up where data were missing. The means and standard errors for units of alcohol consumed and the frequency of binge drinking by condition for these analyses are displayed in Supplementary Table 1.

The results were broadly in line with the original analyses. The message condition had a significant effect on units of alcohol consumed ($M_{MESS} = 12.95$, $SE = 0.47$; $M_{NoMESS} = 14.30$, $SE = 0.46$), $F(1, 1396) = 4.18$, $p = .04$. The main effect was qualified by a significant interaction with the self-affirmation condition, $F(1, 1396) = 4.57$, $p = .03$, such that the effect of the message condition was significant among non-affirmed participants ($M_{MESS} = 12.12$, $SE = 0.67$; $M_{NoMESS} = 14.89$, $SE = 0.66$), $F(1, 694) = 9.10$, $p = .003$, but non-significant among self-affirmed participants ($M_{MESS} = 13.77$, $SE = 0.67$; $M_{NoMESS} = 13.71$, $SE = 0.65$), $F(1, 705) = 0.004$, $p = .95$. No other main effects or interactions were significant.

A significant message $\times$ self-affirmation interaction was also found on the frequency of binge drinking, $F(1, 1396) = 5.13$, $p = .02$. Again, the effect of the message condition was

significant among non-affirmed participants ($M_{MESS} = 0.77$, SE = 0.05; $M_{NoMESS} = 0.98$, SE = 0.05), $F(1, 694) = 7.64$, p = .006, but non-significant among self-affirmed participants (M_{MESS} = 0.90, SE = 0.05; $M_{NoMESS} = 0.86$, SE = 0.05), $F(1, 705) = 0.21$, p = .65. Similarly, a significant implementation intention × self-affirmation interaction was found on the frequency of binge drinking, $F(1, 1396) = 4.06$, p = .04, such that the effect of forming implementation intentions approached significance among non-affirmed participants (M_{IMPS} = 0.81, SE = 0.06; $M_{NoIMPS} = 0.94$, SE = 0.05), $F(1, 694) = 3.15$, p = .08, but was non-significant among self-affirmed participants ($M_{IMPS} = 0.92$, SE = 0.05; $M_{NoIMPS} = 0.84$, SE = 0.05), $F(1, 705) = 1.13$, p = .29. No other main effects or interactions were significant.

Multiple Imputation

Using last observation carried forward as a method for dealing with missing data has attracted criticism as it may introduce bias in the results (in either direction) and lead to overly narrow confidence intervals (Altman, 2009). While alcohol assumption was stable (among completers) between one- and six-month follow-up, the last observation carried forward method assumes that "in each randomised group, the mean of the unobserved values of the final outcome equals (in expectation) the mean of the last observed outcomes in the individuals that drop out" (White, Carpenter & Horton, 2012, p. 398) which is untestable.

The intention-to-treat analyses were therefore repeated using the multiple imputation method using all participants who received the interventions at baseline (N = 2682). Five imputed datasets were created. The pooled means and standard errors for units of alcohol consumed and the frequency of binge drinking by condition are displayed in Supplementary Table 2. The results were again broadly in line with the original analyses. Message condition was found to have a significant effect on units of alcohol consumed in three of the five of the imputed datasets; $F(1, 2645) = 9.59$, p = .002, $F(1, 2645) = 5.04$, p = .03, $F(1, 2645) = 4.39$, p = .04. The main effect of message condition approached significance in the other two

datasets; $F(1, 2645) = 3.34$, $p = .07$, $F(1, 2645) = 3.18$, $p = .07$. Inspection of the pooled means indicated that participants who received the messages consumed fewer units of alcohol at university than those who did not receive the messages ($M_{MESS} = 17.16$, $SE = 0.36$; $M_{NoMESS} = 16.17$, $SE = 0.37$).

Message condition was also found to have a significant effect on the frequency of binge drinking in two of the imputed datasets, $F(1, 2645) = 6.58$, $p = .01$, $F(1, 2645) = 5.46$, $p = .02$, and the effect approached significance in a third dataset, $F(1, 2645) = 3.25$, $p = .07$. Inspection of the pooled means indicated that participants who received the messages engaged in binge drinking less frequently at university than those who did not receive the messages ($M_{MESS} = 1.09$, $SE = 0.05$; $M_{NoMESS} = 1.21$, $SE = 0.04$). A significant interaction was found between the self-affirmation and message conditions in two of the imputed datasets, $F(1, 2645) = 7.00$, $p = .008$, $F(1, 2645) = 6.04$, $p = .01$. Inspection of the pooled means indicated a difference between those who received versus did not receive the messages in the non-affirmed condition ($M_{MESS} = 1.09$, $SE = 0.05$; $M_{NoMESS} = 1.21$, $SE = 0.04$) but not in the self-affirmed condition ($M_{MESS} = 1.12$, $SE = 0.06$; $M_{NoMESS} = 1.13$, $SE = 0.04$).

Supplementary Materials 3: Negative binomial generalized linear mixed models

The primary outcome measures (units consumed and frequency of binge drinking) were based on count data. Given the number of non-drinkers (with zero scores) these data were positively skewed. Atkins, Baldwin, Zheng, Gallop and Neighbors (2013) recommend that such data should be analysed using negative binomial generalized linear mixed models (GLMMs). Analyses of the effects of the interventions on alcohol consumption at six-month follow-up were therefore first conducted using negative binomial GLMMs with the self-affirmation, messages and implementation intention conditions (and their interactions) as predictors of alcohol consumption (i.e., units consumed, frequency of binge drinking) at six-month follow-up, along with the corresponding baseline scores entered as a covariate. Next, these analyses were repeated as intention-to-treat analyses using last observation carried forward and multiple imputation methods, as described above. The findings of these analyses were broadly in line with the original analyses.

Considering analyses with the complete datasets, message condition had a significant main effect on units of alcohol consumed at six-month follow-up, χ^2 (1, N = 882) = 12.06, p = .001, such that participants who received the messages consumed fewer units of alcohol than those who did not receive the messages (M_{MESS} = 12.24, SE = 0.61; M_{NoMESS} = 15.59, SE = 0.77). The main effect of forming implementation intentions was also significant, χ^2 (1, N = 882) = 4.41, p = .04, such that those who formed implementation intentions consumed more units of alcohol than participants who did not form implementation intentions ($M_{IMPINTS}$ = 14.86, SE = 0.74; $M_{NoIMPINTS}$ = 12.84, SE = 0.63). Message condition was also found to have a significant main effect on the frequency of binge drinking at six-month follow-up, χ^2 (1, N = 882) = 5.78, p = .02, such that participants who received the messages engaged in binge drinking less frequently than those who did not receive the messages (M_{MESS} = 0.81, SE = 0.06; M_{NoMESS} = 1.02, SE = 0.07).

Considering the intention-to-treat analyses using last observation carried forward, the main effect of message condition on units of alcohol consumed approached significance, χ^2 (1, N = 1405) = 3.47, p = .06; participants who received the messages consumed fewer units of alcohol at university than those who did not receive the messages (M_{MESS} = 12.91, SE = 0.51; M_{NoMESS} = 12.91, SE = 0.51). The main effect of message condition was qualified by a significant interaction with self-affirmation, χ^2 (1, N = 1405) = 7.83, p = .005, such that the messages produced a larger difference in alcohol consumption among participants in the non-affirmed condition (M_{MESS} = 11.99, SE = 0.68; M_{NoMESS} = 15.52, SE = 0.85) than among participants in the self-affirmed condition (M_{MESS} = 13.90, SE = 0.78; M_{NoMESS} = 13.20, SE = 0.72). A significant message × self-affirmation interaction was also found on the frequency of binge drinking at university, χ^2 (1, N = 1405) = 4.35, p = .04. The messages produced a larger difference in the frequency of binge drinking among participants in the non-affirmed condition (M_{MESS} = 0.76, SE = 0.06; M_{NoMESS} = 1.00, SE = 0.08) than among participants in the self-affirmed condition (M_{MESS} = 0.90, SE = 0.07; M_{NoMESS} = 0.85, SE = 0.07).

Considering the intention-to-treat analyses using multiple imputation, message condition had a significant main effect on units of alcohol consumed in one of the five imputed datasets, χ^2 (1, N = 2654) = 4.51, p = .03. The pooled means indicated that participants who received the messages consumed fewer units of alcohol at university than those who did not receive the messages (M_{MESS} = 16.17, SE = 0.49; M_{NoMESS} = 17.21, SE = 0.52). Message condition also had a significant main effect on frequency of binge drinking in one of the five imputed datasets, χ^2 (1, N = 2654) = 4.03, p = .04. The pooled means indicated that participants who received the messages engaged in binge drinking at university less frequently than those who did not receive the messages (M_{MESS} = 1.09, SE = 0.06; M_{NoMESS} = 1.16, SE = 0.05). In addition, a significant message × self-affirmation interaction was found on the frequency of binge drinking at university in one of the imputed datasets, χ^2

(1, N = 2654) = 4.27, p = .04. The pooled means indicated that among non-affirmed participants those who received the messages engaged in binge drinking at university less frequently than those who did not receive the messages (M_{MESS} = 1.07, SE = 0.07; M_{NoMESS} = 1.22, SE = 0.07), whereas among self-affirmed participants there was no difference in the frequency of binge drinking (M_{MESS} = 1.11, SE = 0.09; M_{NoMESS} = 1.10, SE = 0.06.

References

Altman, D.G. (2009). Missing outcomes in randomized trials: Addressing the dilemma. Open Medicine, 3, 51-3.

Atkins, D.C., Baldwin, S.A., Zheng, C., Gallop, R.J., & Neighbors, C. (2013). A tutorial on count regression and zero-altered count models for longitudinal substance abuse data. Psychology of Addictive Behaviors, 27, 166-177. doi: 10.1037/a0029508

White, I.R., Carpenter, J., & Horton, N.J. (2012). Including all individuals is not enough: lessons for intention-to-treat analysis. Clinical Trials, 9, 396-407. doi: 10.1177/1740774512450098

Supplementary Table 1

Alcohol Consumption at University by Condition for the Intention-to-Treat Analyses using Last Observation Carried Forward

	Non-Affirmed				Self-Affirmed			
	No Message		Message		No Message		Message	
	No II (n = 190)	II (n = 165)	No II (n = 183)	II (n = 159)	No II (n = 182)	II (n = 182)	No II (n = 180)	II (n = 164)
Units per Week	15.34 (0.90)	14.40 (0.96)	12.41 (0.92)	11.84 (0.98)	13.11 (0.92)	14.32 (0.92)	12.67 (0.92)	14.88 (0.97)
Binge Drinking Frequency	1.06 (0.07)	0.90 (0.08)	0.83 (0.07)	0.72 (0.08)	0.82 (0.07)	0.90 (0.07)	0.86 (0.07)	0.93 (0.08)

Note. Values are adjusted means (and standard errors) controlling for baseline scores. II = Implementation intention.

Table 2

Alcohol Consumption at University by Condition for the Intention-to-Treat Analyses using Multiple Imputation

	Non-Affirmed				Self-Affirmed			
	No Message		Message		No Message		Message	
	No II (n = 359)	II (n = 299)	No II (n = 358)	II (n = 295)	No II (n = 348)	II (n = 341)	No II (n = 340)	II (n = 314)
Units per Week	17.79 (0.73)	17.14 (0.69)	16.33 (0.65)	15.76 (0.76)	16.56 (0.76)	17.15 (0.77)	16.14 (0.75)	16.45 (0.85)
Binge Drinking Frequency	1.24 (0.06)	1.18 (0.06)	1.10 (0.06)	1.07 (0.08)	1.09 (0.05)	1.16 (0.06)	1.12 (0.08)	1.13 (0.07)

Note. Values are pooled adjusted means (and standard errors) controlling for baseline scores. II = Implementation intention.