



Impact of alcohol-promoting and alcohol-warning advertisements on alcohol consumption, affect, and implicit cognition in heavy-drinking young adults: A laboratory-based randomized controlled trial

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Objectives. There is sparse evidence regarding the effect of alcohol-advertising exposure on alcohol consumption among heavy drinkers. This study aimed to assess the immediate effects of alcohol-promoting and alcohol-warning video advertising on objective alcohol consumption in heavy-drinking young adults, and to examine underlying processes.

Design. Between-participants randomized controlled trial with three conditions.

Methods. Two hundred and four young adults (aged 18–25) who self-reported as heavy drinkers were randomized to view one of three sets of 10 video advertisements that included either (1) alcohol-promoting, (2) alcohol-warning, or (3) non-alcohol advertisements. The primary outcome was the proportion of alcoholic beverages consumed in a sham taste test. Affective responses to advertisements, implicit alcohol approach bias, and alcohol attentional bias were assessed as secondary outcomes and possible mediators. Typical alcohol consumption, Internet use, and television use were measured as covariates.

Results. There was no main effect of condition on alcohol consumption. Participants exposed to alcohol-promoting advertisements showed increased positive affect and an increased approach/reduced avoidance bias towards alcohol relative to those exposed to non-alcohol advertisements. There was an indirect effect of exposure to alcohol-warning advertisements on reduced alcohol consumption via negative affect experienced in response to these advertisements.

Conclusions. Restricting alcohol-promoting advertising could remove a potential influence on positive alcohol-related emotions and cognitions among heavy-drinking young adults. Producing alcohol-warning advertising that generates negative emotion may be an effective strategy to reduce alcohol consumption.

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Statement of contribution**What is already known on this subject?**

- Exposure to alcohol advertising has immediate and distal effects on alcohol consumption.
- There is some evidence that effects may be larger in heavy drinkers.
- Alcohol-warning advertising has been found to have mixed effects on alcohol-related cognitions.

What does this study add?

Among heavy-drinking young adults:

- Alcohol advertising does not appear to have an immediate impact on alcohol consumption.
- Alcohol advertising generates positive affect and increases alcohol approach bias.
- Alcohol-warning advertising that generates displeasure reduces alcohol consumption.

Alcohol consumption is a risk factor for over 200 injuries, diseases, and health conditions (World Health Organization, 2014). In the United Kingdom, young adult drinkers are more likely to engage in very heavy single occasion drinking than drinkers of other age groups (Office for National Statistics, 2016). They are therefore at risk of acute alcohol-related harms such as injury, as well as chronic health consequences resulting from harmful consumption patterns. Among females, those aged 16–24 show the highest prevalence of alcohol dependence relative to other age groups (Health & Social Care Information Centre, 2015).

One possible influence on young adults' drinking behaviour is an environment saturated with alcohol marketing and advertising. Alcohol marketing campaigns are frequently aimed at young adults, with the short-term objective of increasing sales among this demographic and longer term objectives including developing consumer identification with brands and products and associating products with contexts for use (Hastings, 2009; Wind & Sharp, 2009). Alcohol marketing therefore has immediate (i.e., increased sales leading to excessive consumption) and insidious (i.e., development of drinking cultures that are resistant to change) public health risks. Restricting or banning alcohol marketing is suggested to be a cost-effective strategy to reduce population-level alcohol consumption (Anderson, Chisholm, & Fuhr, 2009), and one with high public acceptability (Pechey, Burge, Mentzakis, Suhrcke, & Marteau, 2014), but there is currently limited, low-quality evidence regarding the effectiveness of such restrictions (Siegfried *et al.*, 2014). There is, however, consistent evidence from observational studies that exposure to alcohol advertising is associated with earlier initiation of alcohol use and increased alcohol consumption in young people (Anderson, De Bruijn, Angus, Gordon, & Hastings, 2009; Booth *et al.*, 2008; Smith & Foxcroft, 2009). Experimental evidence provides tentative support for a causal link, indicating that a single exposure to alcohol advertising may lead to small increases in alcohol consumed immediately following exposure (Stautz, Brown, King, Shemilt, & Marteau, 2016).

A consistent limitation of previous experimental studies is their focus on moderate drinkers recruited solely from student populations. Effects of alcohol advertising on consumption may differ by previous experience with alcohol. Heavy drinkers have an increased sensitivity to alcohol-related cues (Field, Munafò, & Franken, 2009; Sharma, Albery, & Cook, 2001), and may be more likely to crave and consume alcohol after exposure to such cues (Jones & Field, 2013). Indeed, alcohol-dependent patients report elevated alcohol cravings following exposure to alcohol advertisements (Witteman *et al.*, 2015). Behavioural economic analysis indicates that the effect of alcohol advertising on consumption is larger among those who typically drink more (Saffer, Dave, & Grossman, 2016). There is also experimental evidence

suggesting that heavier weekly drinkers consume more alcohol than lighter drinkers following exposure to alcohol-promoting advertising (Koordeman, Anschutz, & Engels, 2011). As heavy drinkers are at increased risk of alcohol-related harm, it is important to identify modifiable factors, such as alcohol advertising, that contribute to their increased consumption. Furthermore, as hazardous and harmful drinkers consume the majority of alcohol sold (estimated to be 69% in the UK; Boseley, 2016), reducing alcohol consumption in this group may have a pronounced impact on reducing consumption at the population level.

One way in which governments and public health bodies have attempted to reduce excessive alcohol consumption is through media campaigns warning about the risks and harms of alcohol use. There is currently limited evidence on the effectiveness of such alcohol-warning advertising. One previous experimental study found that viewing alcohol-warning advertisements led to reductions in self-reported urges to consume alcohol in young adults, an effect mediated by displeasure experienced when viewing the advertisements (Stautz & Marteau, 2016). Another indicated that viewing alcohol warnings via a mass media campaign led to reduced self-reported alcohol consumption, though only among participants who had been alerted to the campaign (Barber, Bradshaw, & Walsh, 1989). Conversely, another study showed that heavier drinkers showed a decrease in negative implicit attitudes after viewing alcohol-warning advertisements (Brown, Stautz, Hollands, Winpenny, & Marteau, 2016), suggestive of a reactance effect whereby viewing a warning message makes the behaviour being warned against more likely, perhaps due to a threat to self-esteem (Jessop, Albery, & Garrod, 2008; Ringold, 2002). Self-affirmation theory indicates that such effects may be stronger among those who frequently engage in the behaviour, as they are more likely to perceive such highlighting of their behaviour's negative consequences as a threat to their self-worth and integrity, which may in turn induce defensive responses (Harris & Napper, 2005; Steele, 1988). It is also possible that the information about alcohol harms presented in warnings is more difficult to remember and, in turn, to access than the associative content and behavioural cues present in the messages, such as images of people drinking (e.g., Krank, Ames, Grenard, Schoenfeld, & Stacy, 2010). To our knowledge, no previous studies have assessed the impact of alcohol-warning advertising on objective alcohol consumption.

There is limited understanding of the mechanisms by which exposure to alcohol advertising influences consumption. One posited mechanism is via increased positive attitudes towards alcohol and expectancies of use (e.g., Bot, Engels, & Knibbe, 2005), although a meta-analysis of data from seven experimental studies did not find support for an immediate effect of advertising exposure on these 'explicit' alcohol-related cognitions (Stautz *et al.*, 2016). Understanding of the impact of alcohol advertising on non-conscious, 'implicit' cognitions is even less developed. One study found that exposure to alcohol advertising led to increases in positive implicit alcohol-related attitudes, yet only in heavier drinkers (Brown *et al.*, 2016). Implicit biases in the way drinkers associate alcohol with approach versus avoidance and attend to alcohol cues are associated with consumption (Cox, Fardadi, & Pothos, 2006; Palfai & Ostafin, 2003). Whether alcohol-advertising exposure influences these cognitive biases remains unexplored. There is also sparse evidence on the affective impact of alcohol advertising and how this might influence consumption. This is despite long-standing perspectives in the marketing literature that advertising impact can be enhanced by targeting affective processes (e.g., Moore & Hutchinson, 1983; Ray & Batra, 1982). The current study aims to address these gaps.

Aims and hypotheses

The primary aim of this study was to estimate the immediate impact of viewing alcohol-promoting and alcohol-warning advertisements on observed alcohol consumption in young adult heavy drinkers. The second aim was to identify mediators of any such effect. We predict that participants exposed to alcohol-promoting advertisements will consume more alcohol than those exposed to non-alcohol advertisements. Based on limited prior research, we predict that viewing alcohol-warning messages will also lead to increased alcohol consumption. We further predict that these effects will be mediated by (1) affective responses to advertisements (i.e., positive affect and high arousal in response to alcohol-promoting advertisements, and negative affect and high arousal in response to alcohol-warning advertisements), (2) increased alcohol approach bias, and (3) increased alcohol attentional bias.

Method

The study was approved by the University of Cambridge Psychology Department Ethics Committee (Ref: Pre.2015.032) and by the London South Bank University Research Ethics Committee (Ref: UREC 1534), and was registered as a randomized controlled trial (Ref: ISRCTN11570646). The study is reported in line with the CONSORT statement for reporting of trials (Moher, Schulz, & Altman, 2001).

Participants

Two hundred and four young adults were recruited via a research agency (*MRFGR*) using requests to their existing panel, posts on online forums, and social media advertisements. Interested participants were pre-screened online. Inclusion criteria were that participants were aged 18–25 and were heavy drinkers, defined as scoring 5 or above on the AUDIT-C, a 3-item measure of typical alcohol consumption (see Measures; eligible participants' scores ranged from 5 to 11). Pre-specified exclusion criteria were as follows: pregnant, currently taking medication (both assessed by self-report), and detectable levels of alcohol on breath, which was assessed on arrival at the laboratory with a Lion Alcometer 600 breathalyser. Participants who completed the study were reimbursed with £35 cash, delivered via the research agency.

Setting

The study was conducted in a bar laboratory, located within a university psychology department in the United Kingdom. The bar laboratory is a testing room that has been built specifically to resemble a typical pub environment, featuring a 4.5-m bar, optics, bar taps, bottles, a fruit machine, bar stools, and appropriate wall decoration. Testing took place on weekdays in 1-hr slots between 11.30 and 16.30. This time period was selected due to constraints on laboratory opening time and availability, and to the likelihood that participants would not want to consume alcohol in the morning.

Design

A between-participants experimental design was used with participants randomized to one of three conditions. Participants viewed a set of 10 advertisements that included

either (1) alcohol-promoting advertisements, (2) alcohol-warning advertisements, or (3) only non-alcohol advertisements, before completing the outcome measures. To assess possible dose–response effects of advertising exposure, participants in the alcohol-promoting and alcohol-warning advertisement conditions were further randomized to view between 5 and 10 condition-specific advertisements, with the remaining advertisements being non-alcohol filler advertisements. The order of advertisement presentation was randomized for each participant. All randomization was conducted by the Qualtrics software (Qualtrics, Provo, UT, USA). As assignment was conducted digitally, study personnel were blind to condition. Participants were not made aware of the study conditions until debrief. Success of blinding was assessed using a post-experiment questionnaire on perceived awareness of the study aims.

Sample size determination

The sample size was calculated based on data from a previous study, which found that heavier drinkers consumed more alcohol than lighter drinkers following exposure to alcohol-promoting advertising (Koordeman *et al.*, 2011). This effect was of moderate size ($d = .7$). The current study was powered to detect main effects of this magnitude with 80% power, using an alpha-level of .05. Using baseline consumption data from a review of studies using the taste test paradigm (Jones *et al.*, 2016), this effect equates to a difference of around 18.5% in proportion consumed. The study was also powered to detect indirect effects of the magnitude observed in previous research (see Appendix S1).

Stimuli

Alcohol-promoting and non-alcohol advertisements were selected using data on popular brands among 18- to 24-year-olds in the UK (Voxburner, 2014). Advertisements were uploaded within the previous year on brands' official *YouTube* accounts as of May 2015. Non-alcohol advertisements were for electronic products, clothing stores, and online services. None contained drink- or food-related cues.

Alcohol-warning advertisements were identified by searching *YouTube* with the terms 'alcohol warning', 'anti-alcohol', and 'alcohol AND health'. As few alcohol-warning advertisements have been produced in the UK in recent years, we included advertisements from the past decade and from other English-speaking countries. Selection criteria were that advertisements were professionally produced, appeared to be relevant to young adults, and highlighted acute or chronic negative consequences of alcohol consumption. Selected advertisements were produced between 2006 and 2015 in the United Kingdom (seven advertisements), Australia (four), New Zealand (one), and the Republic of Ireland (one).

Table 1 presents further details about the advertisements used.

Procedure

The experiment was presented as two separate studies. Participants were informed that the 'first' study was investigating emotional responses to advertising. Participants were seated within the bar laboratory, facing away from the bar area at a desk with a laptop computer. They completed questionnaires and then a rating task that required them to report their affective responses to 10 advertisements. Participants then completed computer tasks measuring alcohol approach bias and alcohol attentional bias. Study

Table 1. Advertisements used in the study

Producer	Duration (seconds)	Description of content	Presentation style
Non-alcohol advertisements			
Microsoft	30	Promotes 'Surface Pro 3' tablet	Images demonstrating product capabilities with voiceover
Facebook	60	Shows many different friends interacting and bonding	No product images; images of friends with upbeat music backing
Apple	65	Promotes 'Macbook' laptop	Slow-motion shots of product
H&M	83	Promotes 'Conscious' recycled clothing line	Animated images with voiceover
New look	60	Group of young adults model range of clothing in sunny outdoor setting	Slow-motion shots of models with upbeat music backing
Disney	94	Promotes 'DisneyNature: Bears' television programme	Shots of bears and other animals with voiceover
PayPal	30	A female explains the simplicity of using the service	Friendly tone; actor surrounded by constantly changing animated surroundings
Primark	31	Young adult male and female cycle, skate, and walk around a city on a sunny day, wearing different outfits	Fast-paced shots of models with upbeat music backing
Samsung	94	Promotes 'Galaxy S6' phone	Comedian plays two roles, each promoting different aspects of the product
Ebay	31	A woman browses products to buy in a virtual store	Images of products with voiceover
Skype	37	Musicians collaborate whilst using the service	Positive and upbeat; emphasizes friendship and communication
Waterstones	98	Promotes spoof product – a watch with a book attached	Humorous; images of spoof product with voiceover
Netflix	46	Promotes free trial to service	Animation with computerized voiceover

Continued

Table 1. (Continued)

Producer	Duration (seconds)	Description of content	Presentation style
Alcohol-promoting advertisements			
Absolut	20	People drinking and dancing to a music performance at a venue in a desert as fireworks go off outside	Fast-moving shots of dancing, fireworks and bartenders serving product, with dance music backing
Smirnoff	100	Male 'mixologist' demonstrates how to make a Marmalade Collins cocktail	Fast paced; emphasizes ease of making the cocktail; close-ups of Smirnoff bottle
Carlsberg	90	Three males are shown around a football 'fan academy' before consuming a pint of lager received as an award for graduation	Humorous; features cameos from football celebrities
Desperados	73	Shows preparation for a brand-sponsored dance music event held in a butcher's shop, with interviews with the DJ and butcher interspersed with images of people dancing	Fast paced; emphasizes uniqueness of the event and the brand; dance music backing
Corona	32	People drinking and dancing at a daytime pool party then an evening beach party	Slow-motion shots of people enjoying the product; text overlays informing about the calorie content and 'lightness' of the product
Budweiser	19	A DJ plays an outdoor party at a hotel, then raises the football world cup trophy	Fast paced; shots of DJ and crowd; dance music backing
Strongbow	40	Shows cider apple farmers working through different seasons, before drinking the finished product	Long shots of apple farming; emphasizes effort and expertise. Relaxed music backing
Malibu	55	Female friends enjoying drinks at an outdoor evening party, interspersed with images of drinks being prepared by a female bartender	Soft-focus shots of people talking and dancing; relaxed music backing
Jack Daniels	32	Profile of Frank Sinatra, detailing his drinking preferences, interspersed with images of product	Images and voice clips of Frank Sinatra, with male voiceover

Continued

Table 1. (Continued)

Producer	Duration (seconds)	Description of content	Presentation style
Bacardi	60	A man walks through a carnival procession to get to a bar and drink the product, voiceover gives historical information about the brand	Dramatic; shots of main character walking with purpose; male voiceover
Kopparberg	20	A dog runs through a forest as large ice blocks crack to reveal fruit and bottles of the product	Mostly computer-generated imagery with shots of the product
Baileys	60	Aerial view of four female friends at a restaurant, eating food, and then drinking the product	Sped up images of multiple occasions shown in one continuous shot with text overlay
Alcohol-warning advertisements UK government/ National Health Service	43	Intoxicated male climbs on scaffolding believing he is a superhero, before falling and sustaining severe injury	Graphic imagery; highlights possibility of injury when drinking
UK government	39	Young adult male injures himself and dishevels clothes as he prepares for a night out (mimicking consequences of alcohol use)	Graphic imagery; highlights short-term negative consequences of drinking
UK government	40	Young adult female injures herself and dishevels clothes as she prepares for a night out (mimicking consequences of alcohol use)	Graphic imagery; highlights short-term negative consequences of drinking
Balance (UK health promotion agency)	40	Tumour develops in glass of alcoholic beverage as it is consumed by a male drinker	Graphic imagery; highlights long-term health consequences of drinking
UK National Health Service	69	A young adult friend group are shown drinking on a night out. One of the group vomits, gets into fights, is thrown out of a venue, and loses consciousness	Depicted scenes of intoxication; graphic imagery; highlights social consequences and short-term negative health consequences of drinking
UK National Health Service	40	Two young adults, one male and one female, are shown semi-conscious surrounded by their vomit	Graphic imagery; highlights short-term negative health consequences of drinking

Continued

Table 1. (Continued)

Producer	Duration (seconds)	Description of content	Presentation style
Australian government	90	A young adult male recounts an evening drinking, his face shows increasing signs of injury as his recollection unfolds	Graphic imagery; highlights possibility of injury when drinking
New Zealand Health Promotion Agency	45	A man gets a progressively more intoxicated at a barbecue, before accidentally injuring a young child	Depicted scenes of intoxication; shocking imagery; highlights possibility of harm to others
Western Australia Drug and Alcohol Office	38	A man becomes intoxicated at a party before falling into a pregnant woman, causing her to lose the child	Depicted scenes of intoxication; highlights possibility of harm to others
Alcoholthinkagain (Australian alcohol education organization)	45	Various people (taxi driver, paramedic, school counsellor) talk about seeing the negative consequences of alcohol use in young people	Depicted scenes of alcohol harms; highlights social consequences, short-term and long-term negative health consequences of drinking, specifically in young people
Alcoholthinkagain	30	As a man drinks alcohol at home, a voiceover warns of long-term health consequences of drinking over the recommended guidelines, which are presented in text	Depicted scenes of drinking mixed with animations showing effects of excessive alcohol use on internal organs; highlights long-term health consequences of drinking
Drinkaware UK (industry-funded alcohol awareness organization)	40	Warns about the link between excessive alcohol use and making unwanted physical contact with others	Animated text with voiceover
Drinkaware Ireland	42	Members of the public and health services state that they have had enough of the consequences of excessive drinking, as images of some of these consequences appear	Depiction using actors; highlights the harms to others caused by drinking

personnel provided scripted instructions for each. Tasks were presented on Millisecond Inquisit 4 Lab software (Millisecond, Seattle, WA, USA) and completed using a Cedrus RB-740 USB (Cedrus, San Pedro, CA, USA) response box.

We note that previous experimental studies into the effects of alcohol advertising have manipulated exposure in a variety of contexts. Bar laboratories have been used on occasion, as have student dorm rooms, real-world movie theatres, and semi-naturalistic lounges (see Stautz *et al.*, 2016 for a review of studies). There is thus no standard for an optimal exposure setting, and each has its own strengths and limitations regarding generalizability. We chose to carry out the advertising exposure in the bar laboratory as we consider advertising, when presented in pubs and bars, to be a highly salient feature of the drinking microenvironment that could influence immediate alcohol consumption in that setting (see Hollands *et al.*, 2013).

For the 'second' study, framed as investigating how mood influences the way certain drinks taste, participants were seated at a stool at the bar. Participants completed a mood adjective checklist (Mathews, Jones, & Chamberlain, 1990 – used only for the cover story), and then a sham taste test. Participants were presented with four glasses, each containing 150 ml of beverage: one normal strength lager (4% alcohol by volume [ABV]) or cider (4.5% ABV), one non-alcoholic lager or cider, one mixed drink with 20 ml of either rum or vodka (both 37.5% ABV) mixed with cola or lemonade, respectively, and one non-alcoholic fruit squash. Participants were informed only that the drinks were: two types of lager/cider, a mixed drink, and a soft drink. The placebo non-alcoholic option was presented to limit participant intoxication whilst circumventing possible ceiling effects. The soft drink option was provided both to reduce demand characteristics and to assess whether any observed differences in consumption were alcohol specific. A glass containing 150 ml of water was also presented as a palate cleanser. Participants were asked to rate the drinks for pleasantness, strength of taste, sweetness, and fizziness (adapted from Field & Eastwood, 2005). Participants were told that they could drink as much as they liked to make their ratings and were informed that they had ten minutes to complete the taste test. The experimenter remained in the laboratory for the duration of the taste test.

Following the taste test, participants reported which of the drinks they believed contained alcohol. They then completed a measure of their awareness of the research hypothesis and were debriefed.

Measures

Primary outcome

Alcohol consumption. Amount of alcoholic beverages consumed as a proportion of the total available was used as our measure of alcohol consumption. For participants ($n = 109$, 56.2%) who reported believing that the placebo beverage was alcoholic, this beverage was included in the calculation of the consumption score. The taste test paradigm has been found to be a valid objective measure of alcohol consumption (Jones *et al.*, 2016).

Secondary outcomes/potential mediators

Implicit alcohol approach bias. Participants completed an adapted version of the Implicit Association Test (IAT) designed to assess implicit approach versus avoidance

towards alcohol versus soft drinks (Ostafin & Palfai, 2006). Scores were converted to *D* scores, which range from -2.0 to 2.0 , according to recommended procedures (Nosek, Greenwald, & Banaji, 2007). Higher scores reflect a larger alcohol approach bias. Appendix S2 presents details about task administration.

Implicit alcohol attentional bias. Participants completed an alcohol version of the Stroop colour naming task (Bauer & Cox, 1998; Cox *et al.*, 2006). Scores represent the interference to mean reaction time latency (in milliseconds) caused by alcohol-related compared to control words. Details about task administration are presented in Appendix S2.

Affective responses to advertisements. Pleasure (vs. displeasure) and arousal (vs. tiredness) were assessed immediately after each advertisement. Pleasure was assessed with the item 'How pleasant did this advertisement make you feel?' Arousal was assessed with 'How alert did this advertisement make you feel?' Responses were given on 11-point visual analogue scales, anchored with '0-Very unpleasant and negative' to '10-Very pleasant and positive' for pleasure; and '0-Inactive and tired' to '10-Alert and energetic' for arousal. Items were adapted from the Affect Grid (Russell & Feldman Barrett, 1999; Russell, Weiss, & Mendelsohn, 1989). Affective responses to condition-specific advertisements were summed and averaged to provide two continuous summary scores of momentary pleasure and arousal.

Covariates

Typical alcohol use. The Alcohol Use Disorders Identification Test (AUDIT; Babor, Higgins-Biddle, Saunders, & Monteiro, 2001) was used to assess typical alcohol consumption and hazardous use. The first three items of the AUDIT (AUDIT-C; Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998) ask about typical quantity and frequency of consumption, whilst the remaining items assess negative consequences. The AUDIT-C provides a measure of typical alcohol consumption with scores ranging from 0 to 12. The AUDIT total score provides a measure of hazardous/harmful alcohol use with scores ranging from 0 to 40.

Typical use of digital media. Two items were used to gauge participants' general level of exposure to video advertising. Typical television usage was assessed with the item: 'On average, how many hours per day do you watch television'. Typical recreational Internet use was assessed with the item 'On average, how many hours per day do you use the internet for non-work purposes?' Responses could range from 0 to 24. Scores were treated as continuous.

Additional measures

Demographic characteristics. Participants reported their age, gender, ethnicity, highest educational qualification, and occupation status. They also reported the subjective social class of their childhood family.

Executive function. A six-item self-report measure, the WebExec (Buchanan *et al.*, 2010), was used to test for pre-existing group differences on executive function that might influence cognitive task performance.

Awareness of the research aims. The Perceived Awareness of the Research Hypothesis Scale (Rubin, Paolini, & Crisp, 2010) assesses the possible influence of demand characteristics. The scale contains four items, each with a 7-point Likert-type response format, that ask whether participants knew what the researchers were investigating. Item scores were summed and averaged for a total score between 1 and 7. A one-sample *t*-test was used to assess whether mean scores were significantly higher than a neutral score of 4.

Data analysis

Data met assumptions of independence and homoscedasticity. One missing data point on typical television use was imputed using the group mean. Typical television and Internet use scores showed positive skew and were log-transformed. One-way ANOVAs were used to test for pre-existing group differences. ANCOVAs were used to test for main effects of condition on alcohol consumption, alcohol approach bias, alcohol attentional bias, pleasure responses, and arousal responses, with typical alcohol consumption, television use, and Internet use as covariates. Gender (coded 0 = male, 1 = female) was included as an additional factor in all analyses. Pre-specified multiple mediation analysis was used to test indirect effects of condition on alcohol consumption via alcohol approach bias, alcohol attentional bias, pleasure responses, and arousal responses. Two analyses were conducted. The first tested differences between participants in the alcohol-promoting and non-alcohol advertisement conditions; the second tested differences between participants in the alcohol-warning and non-alcohol advertisement conditions. The SPSS PROCESS macro, model 4, was used (Hayes, 2013), adjusting for covariates (as above) in both the mediator and outcome models. Bias-corrected bootstrapping with 5,000 samples was used to ascertain 95% confidence intervals. To assess the influence of demand characteristics, Pearson correlations between perceived awareness of study hypothesis scores and outcome variables were calculated.

Results

Recruitment

Recruitment took place from July 2015 to January 2016. Figure 1 displays the flow of participants through the study. Ten of the 204 randomized participants were excluded leaving a study sample of 194.

Sample characteristics and randomization checks

Table 2 presents baseline characteristics of the sample. There were no differences between experimental conditions in age, typical or hazardous/harmful alcohol consumption, television use, Internet use, or executive function, indicating successful randomization. Males consumed significantly more alcohol than females in the taste test, $t(191) = 5.60$, $p < .001$. No other gender differences in outcome measures were observed.

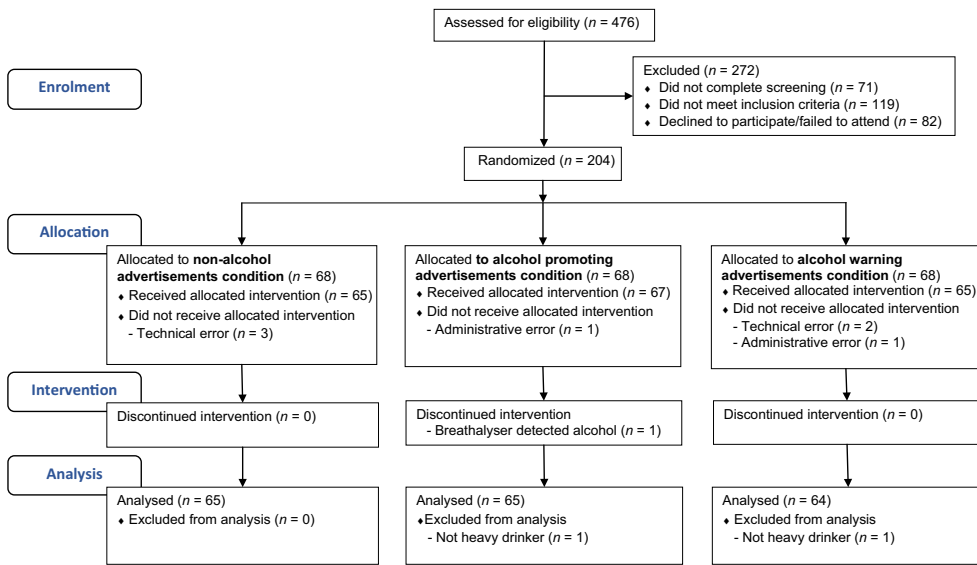


Figure 1. CONSORT diagram of participant flow through the study. [Colour figure can be viewed at wileyonlinelibrary.com]

Experimental effects

Table 3 presents mean scores on all outcome measures, ANCOVA main effects, and effect size estimates. There was no main effect of condition on proportion of alcoholic beverages consumed. There was no evidence of a condition by gender interaction, $F(2, 184) = 0.57$, $p = .57$. Among the specific alcoholic beverages, the only notable difference between conditions was for mean lager/cider consumption between participants in the alcohol-promoting and non-alcohol advertisement conditions, although this difference was not significant ($p = .23$).

There was a main effect of condition on IAT performance. Participants exposed to alcohol-promoting advertisements had more positive scores than those exposed to non-alcohol advertisements, indicating a small effect on increased approach/reduced avoidance bias towards alcoholic drinks. There was no main effect of condition on Stroop interference scores. There was a main effect of condition on both pleasure and arousal responses to advertisements. Participants in the alcohol-promoting condition had higher mean pleasure scores than participants in the non-alcohol condition, whilst participants in the alcohol-warning condition had lower scores than those in the non-alcohol condition.

There was no evidence of dose–response effects on any of the outcome variables.

There was no evidence of an indirect effect of alcohol-promoting advertisements on alcohol consumption via alcohol approach bias, alcohol attentional bias, or affective responses to advertisements. There was an indirect effect of alcohol-warning advertising on reduced alcohol consumption via low pleasure (displeasure) in response to the advertisements ($\beta = .22$, $SE = 0.11$, 95% CI = 0.01, 0.44; Sobel test: $z = 2.24$, $p = .03$).

Sensitivity analysis

Participants' consumption of genuine alcoholic beverages only (i.e., excluding the placebo beverage) was used as an outcome variable in an additional ANCOVA (Table 3). There was no main effect of condition and no significant differences between groups.

Table 2. Sample characteristics

	Total	Condition		
		Non-alcohol advertisements	Alcohol-promoting advertisements	Alcohol-warning advertisements
N	194	65	65	64
Age	21.86 (2.02)	21.65 (2.04)	21.91 (2.10)	22.03 (1.93)
Gender (%)				
Male	89 (45.9)	30 (46.2)	30 (46.2)	29 (45.3)
Female	105 (54.1)	35 (53.8)	35 (53.8)	35 (54.7)
Highest educational qualification (%)				
GCSEs	10 (5.2)	4 (6.2)	0	6 (9.4)
A-levels	84 (43.3)	28 (43.1)	27 (41.5)	29 (45.3)
Degree	72 (37.1)	23 (35.4)	28 (43.1)	21 (32.8)
Vocational or work-related qualification	13 (6.7)	6 (9.2)	2 (3.1)	5 (7.8)
Higher degree	11 (5.7)	2 (3.1)	7 (10.8)	2 (3.1)
Other	4 (2.1)	2 (3.1)	1 (1.5)	1 (1.6)
Occupation (%)				
Student	104 (53.6)	36 (55.4)	37 (56.9)	31 (48.4)
Casual worker	1 (0.5)	0	1 (1.5)	0
Semi-skilled or unskilled manual worker	15 (7.7)	5 (7.7)	7 (10.8)	3 (4.6)
Skilled manual worker	13 (6.7)	4 (6.2)	4 (6.2)	5 (7.8)
Supervisory or clerical, junior managerial, administrative or professional	33 (17.0)	12 (18.5)	7 (10.8)	14 (21.9)
Intermediate managerial, administrative or professional	18 (9.3)	3 (4.6)	6 (9.2)	9 (14.1)
Higher managerial, administrative or professional	6 (3.1)	3 (4.6)	3 (4.6)	0
Missing	4 (2.1)	2 (3.1)	0	2 (3.1)
Subjective childhood socioeconomic position (%)				
Working class	60 (30.9)	16 (24.6)	14 (21.5)	30 (46.9)
Lower middle class	42 (21.6)	13 (20.0)	13 (20)	16 (25.0)
Middle class	74 (38.1)	29 (44.6)	30 (46.2)	15 (23.4)

Continued

Table 2. (Continued)

	Total	Condition		
		Non-alcohol advertisements	Alcohol-promoting advertisements	Alcohol-warning advertisements
Upper middle class	16 (8.2)	6 (9.2)	7 (10.8)	3 (4.7)
Upper class	1 (0.5)	0	1 (1.5)	0
Missing	1 (0.5)	1 (1.5)	0	0
Ethnicity (%)				
African	25 (12.9)	7 (10.8)	9 (13.8)	9 (14.1)
Bangladeshi	1 (0.5)	0	1 (1.5)	0
Caribbean	10 (5.2)	3 (4.6)	4 (6.2)	3 (4.7)
Chinese	3 (1.5)	2 (3.1)	0	1 (1.6)
Indian	6 (3.1)	0	3 (4.6)	3 (4.7)
Mixed White and Black African	3 (1.5)	1 (1.5)	0	2 (3.1)
Mixed White and Black Caribbean	12 (6.2)	6 (9.2)	0	6 (9.4)
Mixed White and Asian	7 (3.6)	1 (1.5)	4 (6.2)	2 (3.1)
White British	90 (46.4)	33 (50.8)	29 (44.6)	28 (43.8)
White Irish	3 (1.5)	1 (1.5)	1 (1.5)	1 (1.6)
Any other Black background	4 (2.1)	0	2 (3.1)	2 (3.1)
Any other White background	14 (7.2)	4 (6.2)	6 (9.2)	4 (6.3)
Any other mixed background	11 (5.7)	3 (4.6)	6 (9.2)	2 (3.1)
Other ethnic group	4 (2.1)	3 (4.6)	0	1 (1.6)
Missing	1 (0.5)	1 (1.5)	0	0
Alcohol consumption (AUDIT-C)	6.43 (1.38)	6.60 (1.58)	6.40 (1.30)	6.30 (1.24)
Hazardous/harmful alcohol use (AUDIT total)	11.94 (4.82)	12.18 (5.34)	11.91 (4.32)	11.73 (4.81)
Executive function (WebExec)	8.98 (3.18)	9.43 (3.02)	8.32 (3.35)	9.20 (3.10)
Typical television use (hours per day)	2.88 (3.43)	2.83 (3.89)	2.60 (2.83)	3.22 (3.53)
Typical recreational Internet use (hours per day)	6.00 (5.10)	5.89 (5.02)	6.15 (5.53)	5.95 (4.78)

Table 3. Group means (SD) for outcome measures, main effects of ANCOVAs, and effect size estimates

	Condition			Effect size estimates		
	Non-alcohol advertisements	Alcohol-promoting advertisements	Alcohol-warming advertisements	ANCOVA main effect	Alcohol-promoting versus non-alcohol advertisements	Alcohol-warming versus non-alcohol advertisements
Beverage consumption (ml)						
Lager/cider	65.62 (46.62)	76.02 (51.22)	66.64 (47.09)			
Placebo	63.31 (43.43)	55.39 (41.99)	58.36 (47.11)			
non-alcoholic lager/cider						
Spirit and mixer	66.92 (44.24)	65.39 (46.58)	69.06 (46.58)			
Soft drink	45.85 (35.60)	41.64 (35.31)	41.25 (37.32)			
Proportion of available alcohol beverages consumed (including placebo beverage)	0.442 (0.256)	0.453 (0.273)	0.438 (0.277)	$F(2, 184) = 0.07, p = .94$	$d = .06; 95\% \text{ CI} = -0.28, 0.41$	$d = -.03; \text{ CI} = -0.32, 0.37$
Proportion of genuine alcoholic beverages consumed	0.442 (0.266)	0.471 (0.290)	0.452 (0.296)	$F(2, 184) = 0.23, p = .80$	$d = .12; 95\% \text{ CI} = -0.22, 0.47$	$d = .07; 95\% \text{ CI} = -0.28, 0.41$
Implicit cognition						
Alcohol approach bias (D score)	-0.21 (0.47)	-0.07 (0.45)	-0.26 (0.47)	$F(2, 183) = 3.72, p = .03$	$d = .40; 95\% \text{ CI} = 0.05, 0.75$	$d = -.04, 95\% \text{ CI} = -0.39, 0.31$
Alcohol attention bias (Stroop interference in milliseconds)	5.53 (37.23)	1.77 (37.12)	1.58 (39.04)	$F(2, 182) = 0.26, p = .77$	$d = -.10; 95\% \text{ CI} = -0.44, 0.25$	$d = -.12; 95\% \text{ CI} = -0.47, 0.22$
Affective responses to advertisements						
Pleasure	5.84 (1.33)	6.46 (1.04)	3.44 (1.31)	$F(2, 185) = 102.94, p < .001$	$d = .49; 95\% \text{ CI} = 0.14, 0.83$	$d = -1.93; 95\% \text{ CI} = -2.35, -1.51$
Arousal	5.31 (1.36)	6.12 (1.17)	5.65 (1.37)	$F(2, 185) = 5.78, p = .004$	$d = .59; 95\% \text{ CI} = 0.24, 0.95$	$d = .23; 95\% \text{ CI} = -0.12, 0.58$

Note. Effect size estimates based on adjusted marginal means from ANCOVAs. Significant effects, indicated by 95% confidence intervals that do not cross zero, presented in bold.

Participants' mean scores on the awareness questionnaire ($M = 3.92, SD = 1.31$) were not significantly different from a neutral score of 4, $t(192) = -0.80, p = .43$, indicating that participants were generally unclear about the hypotheses. Scores showed a small positive correlation with alcohol approach bias ($r = .14, p = .046$) and were not significantly correlated with any other outcome measure. There were no substantial differences in results when awareness scores were included as an additional covariate in ANCOVA models. We calculated nonparametric correlations to assess whether the number of condition-specific alcohol-related advertisements viewed was associated with awareness of the research hypothesis. Correlations were positive yet non-significant for participants in both the alcohol-promoting ($\rho = .18, p = .16$) and alcohol-warning ($\rho = .04, p = .75$) conditions.

In an additional *post-hoc* analysis, differences between student and non-student participants were tested. No differences between students and non-students were found for any of the outcome measures. The pattern of results was highly similar with student status added as an additional factor.

Synthesis with previous data

A previously reported meta-analysis of experimental studies examining effects of exposure to alcohol advertising, relative to non-alcohol advertising, on consumption identified a small effect (standardized mean difference [SMD] = 0.20; 95% CI = 0.05, 0.34) (Stautz *et al.*, 2016). Data from the current study regarding differences in alcohol consumption between participants in the alcohol-promoting and non-alcohol advertisement conditions were integrated into this meta-analysis. Inclusion of these data led to a small reduction in the pooled estimate of effect and a narrower 95% confidence interval (SMD = 0.17, CI = 0.04, 0.31; $I^2 = 0\%$). With these data included, there was still evidence of a small effect of exposure to alcohol advertising, relative to non-alcohol advertising, on increased alcohol consumption.

Discussion

This study investigated the immediate effects of viewing alcohol-promoting and alcohol-warning advertisements on alcohol consumption, and possible mediators of effect, in a sample of heavy-drinking young adults. We hypothesized that viewing either alcohol-promoting or alcohol-warning advertising would lead to increased alcohol consumption, relative to viewing non-alcohol advertising. Our hypothesis was not supported: alcohol consumption did not differ between participants exposed to alcohol-promoting, alcohol-warning, or non-alcohol advertisements. As no main effects were observed, our hypotheses regarding mediation were also not supported. Nonetheless, we did find effects of viewing alcohol-promoting advertising on increased alcohol approach bias and positive affect, and an indirect effect of viewing alcohol-warning advertising on reduced alcohol consumption via increased negative affect.

Our results suggest that any immediate impact of alcohol advertising on alcohol consumption is no greater in heavy drinkers than in moderate drinkers. However, findings from this and one previous study (Brown *et al.*, 2016) suggest that viewing alcohol advertising produces implicit cognitions favourable to alcohol in heavy drinkers. It may be that exposure to alcohol advertising contributes to an associative store of positive alcohol-related imagery in heavy drinkers that either has an effect on consumption too small to

observe with the current study's level of power, or that only impacts upon consumption when activated in certain contexts, such as when self-control resources are weak and alcohol is available and socially acceptable to consume (Ostafin, Marlatt, & Greenwald, 2008). For example, alcohol advertising viewed in a bar or at home on a weekend evening may be more likely to activate positive alcohol-related cognitions and in turn stimulate alcohol consumption than the same advertising viewed on the way to work.

In line with this idea, contemporary advertising strategies have shifted away from making overt demands to purchase and use products (termed the 'hot' sell), and towards subtler messages whereby a product is associated with contexts, experiences, and emotions relevant to the consumer (the 'cool' sell; Serazio, 2013). Marketers now tend to focus on linking products and brands with consumers' lifestyles, which may influence sales and consumption in ways not easily assessable in experimental studies examining immediate effects. Our findings that exposure to alcohol advertising increased positive affect and implicit alcohol approach bias is perhaps evidence of the effectiveness of this strategy.

An alternative explanation of our findings is that alcohol-promoting advertising has limited impact upon heavy drinkers' alcohol consumption as their drinking is influenced more by internal and external cues specific to their drinking experiences. Whilst sensitized to personally relevant cues, heavy drinkers may be habituated to alcohol advertising's more general cues. There is evidence that increased alcohol use leads to a crystallization of alcohol expectancies (Christiansen, Goldman, & Inn, 1982), suggesting that experience with drinking strengthens existing alcohol-related associations. Cues that are not concordant with these associations may therefore have little impact on cognition and behaviour.

We observed an indirect effect of viewing alcohol-warning advertising on reduced alcohol consumption via negative affect (displeasure) felt in response to these advertisements. This replicates and extends findings from a previous study, which found that a similar indirect effect reduced urges to drink alcohol (Stautz & Marteau, 2016). Alcohol-warning advertisements that can induce negative affect may be effective in reducing alcohol consumption. We found no indirect effect of high arousal in response to alcohol-warning advertising on consumption, indicating that the use of shocking graphic imagery in alcohol warnings may not be effective in changing drinking behaviour. Warnings that can induce negative emotion without shock, for example, by highlighting alcohol harms using upsetting testimonials or focusing on consequences such as social exclusion, may therefore warrant further investigation. Importantly, the alcohol-warning advertisements used in this study all focused on the negative consequences of drinking. It is not known whether messages that induce positive affect by highlighting the positive consequences of *not* drinking might be effective in reducing consumption.

We found no evidence of a reactance effect of exposure to alcohol-warning advertising on increased alcohol consumption. This is perhaps encouraging, in that messages designed to reduce consumption do not appear to have iatrogenic effects. This is in contrast to responsible drinking messages, widely used as part of the alcohol industry's self-regulation of its advertising practices, which have been shown to increase alcohol consumption (Moss *et al.*, 2015).

Strengths and limitations

To our knowledge, this is the first study to investigate the immediate effect of alcohol-promoting advertising on objectively measured alcohol consumption specifically in

heavier drinkers. It is also the first experimental study to assess the effect of alcohol-warning advertising on objective consumption, and the first study of its kind to be conducted in the United Kingdom. Limitations pertain to the validity of the setting and the outcome measure. Whilst the bar laboratory provided an environment more similar to typical drinking settings than a conventional laboratory, it was located within a university and testing took place during weekday afternoons – not times in which alcohol is most typically desired or consumed (Hofmann, Vohs, & Baumeister, 2012). The exposure part of the study also took place in the bar laboratory, which may limit the generalizability of the findings to other contexts where advertisements might influence drinking, such as at home, in cinemas, or at music venues. Another potential issue with our exposure paradigm was the threat to external validity raised by showing some participants a higher proportion of alcohol-related advertisements, which is unrealistic to a real-world viewing situation. Regarding the outcome measure, it could be argued that the taste test does not effectively mimic a real-world drinking situation. A further limitation is the focus on general alcohol consumption rather than brand-specific consumption. The alcohol industry argues that advertising encourages brand selection, not increased general consumption. There is evidence of brand-specific effects of advertising on consumption (Ross *et al.*, 2014). If multiple competing brands are able to increase brand-specific consumption, this may lead to overall increases in consumption that are only observable at the brand level. The current study was not designed to test such brand-specific effects, as participants in alcohol-promoting condition were exposed to advertisements from at least five different brands.

Implications for policy and research

Many governments are considering or implementing stricter restrictions on alcohol marketing to reduce alcohol-related harms (e.g., BBC, 2012; Ireland Department of Health, 2015; Ozbilgin, 2013). The current findings do not undermine conclusions from a synthesis of previous data, which indicated that alcohol-advertising exposure may have a small effect on increasing alcohol consumption, though do help to better estimate the size of that effect. Future studies examining the immediate impact of alcohol advertising, compared to non-alcohol advertising, on consumption should be powered to detect an effect size of .17. The observation that viewing alcohol advertising increases alcohol-related approach bias and positive affect in heavy drinkers may indicate that alcohol advertising produces cognitive and affective states that make it difficult for heavy drinkers to reduce their consumption, therefore supporting the need for regulation. Further investigation is needed to test these effects in real-world drinking environments with a broader age range of drinkers, and examining alcohol marketing other than advertising. Testing the cumulative nature of such effects over time would also be a useful next step. Finally, our findings support further research into alcohol-warning campaigns that associate alcohol use with negative affect as a strategy to reduce alcohol consumption.

Conclusions

The present research did not support the hypothesis that viewing alcohol-promoting or alcohol-warning advertising increases immediate alcohol consumption in heavy-drinking young adults. However, viewing alcohol-promoting advertisements increased alcohol approach bias and positive affect in this sample, implying that alcohol advertising creates cognitive and emotional states that may make it difficult for heavy drinkers to reduce

consumption. Restricting alcohol-promoting advertising could therefore remove a potential influence on positive alcohol-related cognitions and emotions among heavy-drinking young adults. Findings also support the development of alcohol-warning advertising that induces negative emotion as a strategy for reducing alcohol consumption.

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Conflict of interest

All authors declare no conflict of interest.

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Supporting Information

The following supporting information may be found in the online edition of the article:

Appendix S1. Sample size determination for indirect effects.

Appendix S2. Description of behavioural tasks.