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# The effects of a priming dose of alcohol and drinking environment on snack food intake

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ABSTRACT

Alcohol consumption is a potential risk factor for being overweight. We aimed to investigate the effects of an alcohol priming dose and an alcohol-related environment on snacking behaviour. One hundred and fourteen social drinkers completed one of four experimental sessions either receiving a priming dose of alcohol (.6 g/kg) or soft drink in a bar-lab or a sterile lab. Participants provided ratings of appetite, snack urge, and alcohol urge before and after consuming their drinks. Participants completed an *ad libitum* snack taste test of savoury and sweet, healthy and unhealthy foods before completing the self-reports a final time. Appetite and snack urge increased more following alcohol consumption, and decreased to a lesser extent following the taste test relative to the soft drink. Total calories (including drink calories) consumed were significantly higher in the alcohol groups. There was a marginal effect of environment; those in the bar-lab consumed a higher proportion of unhealthy foods. These effects were more pronounced in those who were disinhibited. While alcohol may not increase food consumption *per se*, alcohol may acutely disrupt appetite signals, perhaps via processes of reward and inhibitory control, resulting in overall greater calorie intake. Individuals who are generally disinhibited may be more vulnerable to the effects of alcohol and drinking environments on eating behaviour.



## 1. Introduction

Rates of being overweight are high in England (41% and 33% of men and women, respectively), as are rates of obesity which rose between 1999 and 2013 from 13.2 to 26% in men, and 16.4–23.8% in women (HSCIC, 2013). This means that over half of men and women fall within the increased – very high risk categories of weight-related harm (HSCIC, 2013), which costs the NHS £4.2b p/year and the wider economy up to £27b (Morgan & Dent, 2010). Identifying the risk factors for over-eating is clearly important and a recent meta-analysis found that of several lifestyle factors, alcohol consumption had the greatest acute effect on calorie intake (Chapman, Benedict, Brooks, & Schioth, 2012). Such findings may suggest that alcohol can promote less-restricted eating behaviour (Morgan & Dent, 2010). It has been well-documented that moderate doses of alcohol (~.6 g/kg) increase urge for alcohol and stimulate further drinking, and evidence suggests that this may occur through several processes which, we suggest, may also help us understand alcohol's association with weight gain. Firstly, alcohol stimulates the activity of neurotransmitters which are involved in reward, for instance; alcohol stimulates the μ-opioid system and opioid agonists increase the consumption of palatable food (Stice, Figlewicz, Gosnell, Levine, & Pratt, 2013). Therefore, a priming dose of alcohol may not only increase urge to drink (suggesting an increase in alcohol's positive reinforcement) (Rose & Duka, 2006) but also to consume food. Alternatively, moderate doses of alcohol can impair inhibitory control (Rose & Duka, 2007) which may support risky drinking practices and, potentially, also increase food consumption via disinhibition (which would not necessarily involve changes in urge).

It is important to note that alcohol's acute effects differ from its chronic effects. Chronic alcohol dependence is often associated with decreased appetite and changes in the digestive system and liver function which impairs absorption of nutrients and fat, resulting in weight loss and malnutrition (World, Ryle, & Thomson, 1985). Therefore, the current study's focus is the effect of acute alcohol consumption on snacking behaviour in healthy drinkers.

Chapman and colleague's (2012) meta-analysis, which identified alcohol as having the greatest effect on calorie intake, compared total calories consumed between alcohol and non-

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alcohol groups. Although total calories consumed were greater in the alcohol conditions in 12 of the 14 studies included, it is possible that alcohol did not actually increase food consumption. Gram for gram, alcohol is the most calorie-dense source of energy after fat (7 cal/g), therefore, the greater number of calories consumed in the alcohol groups may indicate that people tend not to compensate for drink-related calories by eating less food (Yeomans, 2010a).

However, some studies have found that actual food consumption increases following alcohol. Yeomans (2010b) showed that a small preload of alcohol (approx. 1.5 units [UK unit = 8 g of alcohol]) stimulated food intake, but that this effect did not differ between restrained/non-restrained eaters. Polivy and Herman (1976a) also found, against expectation, that alcohol (~2.4 units) did not stimulate eating behaviour in restrained eaters. Both studies concluded that alcohol's effect on eating is not mediated by disinhibition. However, these doses of alcohol are low and may not have been sufficient to affect inhibitory processes. Previous work has shown that moderate doses of alcohol (~.6 g/kg) are required to consistently produce an alcohol priming effect (i.e., increased motivation to drink) and that these doses also impair inhibitory control (Rose & Duka, 2006, 2007; Rose & Grunsell, 2008). The primary aim of the current study was to identify the impact of a priming dose of alcohol (.6 g/kg) on snacking behaviour; does a priming dose of alcohol increase acute food intake *per se* or do participants fail to reduce their food intake to compensate for the drink-related calories.

As well as alcohol's direct effects, there is a large body of research suggesting that environment affects drinking behaviour, which has led to the development of bar-labs (laboratories made to look like a bar/pub) and field studies in bars (Anton, Voronin, Drobes, Moak, & Myrick, 2004; Drobes, Anton, Thomas, & Voronin, 2003; Mckay & Schare, 1999; Schoenmakers & Wiers, 2010). There is also evidence that environment influences various food measures. Meiselman, Johnson, Reeve, and Crouch (2000) found that consumers reported liking the same food more when it was consumed in a restaurant rather than a student cafeteria. Consumers also rated food attributes (e.g., texture, flavour) differently depending on environment (Meiselman et al., 2000). However, this research recruited participants from the environment's natural customer base (e.g., middle aged workers in restaurants and younger students in the cafeteria) which may have affected results. Environment may also have different effects depending on the type of food available. King, Weber, Meiselman, and Lv (2004) compared liking of salad (healthy) and pizza (unhealthy) consumed within a sterile environment (plastic cutlery, fluorescent lights) or a restaurant (china and silverware, incandescent lighting). Consumers gave the salad lower ratings and the pizza (non-significantly) higher ratings in the restaurant environment. Although a follow-up study failed to find an effect of environment on food ratings (King, Meiselman, Hottenstein, Work, & Cronk, 2007), another found that a combination of restaurant environment and other diners resulted in higher food consumption (Weber, King, & Meiselman, 2004).

Clearly, the effect of environment on food measures is complex. In addition, Polivy and Herman (1976a) suggested that their finding that alcohol failed to stimulate food intake in restrained eaters may have been due to the environment, specifically because it did not include any disinhibiting cues. It is arguable that a bar-lab is more associated with drinking behaviour and relaxation relative to a sterile lab. Although not tested before, a more disinhibiting environment may enhance the effect of alcohol on snack consumption, and this effect may be more pronounced in restrained eaters. Additional aims of the study were therefore to determine 1) the effect of context (bar-lab vs sterile lab) on eating behaviour, 2) whether any alcohol effects interacted with environmental context, 3) whether restraint status influenced the effects of alcohol and/or environment.

In summary, although there is an argument that alcohol consumption is a factor in higher calorie intake and may pose a risk for being overweight, there is a lack of research looking at the acute effects of moderate (priming) doses of alcohol on eating behaviour. In addition the effects of alcohol-related contexts on food consumption have not been tested. The current study aimed to provide some clarification on these issues by comparing the effects of a moderate priming dose of alcohol (.6 g/kg) with a soft drink on snacking behaviour, either in a sterile lab or bar-lab. We hypothesised that 1) alcohol would increase snacking behaviour (compared with soft drink), 2) snacking would be greatest in the bar-lab (compared with the sterile lab), 3) the effects of alcohol and environment may interact so that snacking was greatest while intoxicated in the bar-lab, and 4) any relationships between key personality characteristics (BIS total, TFEQ Disinhibition and Restraint) and snacking may be exacerbated while intoxicated or when in the bar lab.

## 2. Materials and methods

*Participants:* 114 student social drinkers (66 female) were recruited from the University of Liverpool via intranet and poster advertisements.

*Inclusion criteria:* fluency in English, no history of food allergies or intolerances, regular alcohol consumption (defined as consuming alcohol at least once a week and consuming $\geq$10 units p/week), providing an alcohol breathalyser reading of .0 mg/l before participation.

*Exclusion criteria:* current or past alcohol use disorder, current or recent illness that may increase sensitivity to alcohol (e.g., cold and flu), taking medication which may be affected by alcohol (e.g., antidepressants). Female participants were not breastfeeding or pregnant.

All participants provided written informed consent before taking part in the study, which was approved by the University of Liverpool Ethics Committee.

*Beverage Preparation and Administration:* Alcoholic drinks contained vodka (37.5% ABV) at a dose of .6 g/kg (approx. 5 UK units for an individual weighing 70 kg), although maximum dose was capped at 200 ml of vodka. Alcohol was mixed with chilled diet lemonade to create a total volume of 400 ml. The soft drink was 400 ml of chilled diet lemonade (supermarket own brand). As in previous alcohol priming research, beverages were divided equally across three glasses and consumed in a semi-structured fashion over 20 min (i.e., participants could consume the drink as they wished but could not start a subsequent drink until the 6.6 m time period had finished, timed by the researcher) (Rose & Duka, 2006). The calorie content of the vodka was 2.08 kcal/ml (e.g., 104 kcal/50 ml), while the lemonade calorie content was trace only. So, for example, participants weighing 70 kg in the alcohol group would be given 143 ml of vodka mixed with diet lemonade which would provide 297 calories, while a participant weighing 70 kg in the soft drink group would consume a trace amount of calories.

*Snack Preparation:* Snacks were supermarket own brand chocolate chip cookies [150 g serving (492 kcal/100 g)], plain tortilla chips [90 g serving (487 kcal/100 g)], plain breadsticks [60 g serving (415 kcal/100 g)], and white grapes [280 g serving (64 kcal/100 g)]. Breadsticks, tortillas and cookies were broken into smaller pieces so that participants could not easily monitor the amount consumed (Higgs & Woodward, 2009). Foods were presented in four identical white bowls on a plain tray.