COGNITIVE AND BEHAVIOURAL EFFECTS

Cues that Signal the Alcohol Content of a Beverage and their Effectiveness at Altering Drinking Rates in Young Social Drinkers

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Abstract — Aims: The aim of this study was to assess the impact of cues that signal the alcoholic strength of a beverage on drinking rate in young social drinkers. Methods: In Experiment 1, two groups of young social drinkers (n = 20 per group) consumed a lager-based drink containing either 3% or 7% alcohol-by-volume. The pattern of drinking behaviour was observed, and drinking time was recorded. Self-reported mood was measured across the session, and participants also provided ratings of the drinks’ sensory and hedonic properties. Experiment 2 replicated Experiment 1, but used a within-subjects design (n = 12). Results: In both experiments, participants took significantly longer to consume the 7% drink compared with the 3% drink, and the total inter-sip interval was longer for the 7% drink. These effects were most closely related to the participants’ changing estimates of alcohol strength across the test session, alongside concomitant changes in various aspects of self-reported mood. Sensory and hedonic evaluations of the drinks did not affect drinking behaviour in either experiment. Conclusions: The findings suggest that the consumption rate of an alcoholic beverage can be modulated by its alcohol content, and that the perceived pharmacological effect of the alcohol serves as an effective signal to alter drinking behaviour.

INTRODUCTION

The level of intoxication produced by an alcoholic beverage is dependent on a number of factors, including the alcohol content of the drink and the rate at which the drink is consumed. Thus if two drinks of different alcoholic strengths are consumed at the same rate, then the stronger drink will produce a greater pharmacological effect. A consequence of this simple fact is that if an individual is unable to slow their drinking rate when consuming a drink containing a greater concentration of alcohol than they usually drink, then they will experience stronger effects. Conversely, switching from a higher to a lower alcohol content beverage without adjusting drinking rate will result in less intoxication. It is perhaps surprising therefore that there has been no direct investigation of the impact of a drink’s alcohol content on drinking rate.

In contrast, the question of whether consumers of drugs adjust their behaviour to ‘compensate’ for changes in drug strength has been extensively studied in relation to another widely used drug: nicotine. The evidence suggests that cigarettes with high nicotine yield are smoked less intensively than lower yield cigarettes, and that changing between cigarettes with different nicotine yields leads to changes in puff intensity that partially compensate for the altered nicotine content (e.g. Jarvik et al., 1978; Gust and Pickens, 1982). These compensatory changes are more effective when switching from lower yield to higher yield cigarettes than vice versa (for review see Scherer, 1999). It remains to be determined whether any such compensatory changes in drinking behaviour are associated with changes in the alcohol contents of beverages.

Some indication that consumers of alcohol might adjust their drinking rate in response to changes in the alcohol content of a drink comes from studies that have measured the blood alcohol levels (BALs) of social drinkers who are allowed free access to drinks of different alcoholic strengths. For example, a study of young drinkers attending a fraternity party (Geller et al., 1991) found that beer drinkers and consumers of cocktails had similar BALs at the end of the party despite the beer drinkers having to drink more cups to achieve similar levels of alcohol intake, suggesting some compensation for dose between beverage types. However, in the same study, partiers who were given low-alcohol beer did not consume more than partiers given higher alcohol beer, suggesting only limited compensation for dose within a beverage type (Geller et al., 1991). Similar results were obtained by Van Houten et al. (1994) in a small study of four drinkers. Conversely, Shortt and Vogel-Sprott (1978) found that social drinkers given free access to drinks could regulate their drinking to achieve similar BALs on two separate occasions. This was the case for two types of drink that had different alcoholic strengths, but the maximum BAL achieved with the lower alcohol drink was lower than that achieved with the higher alcohol drink, implying imperfect compensation. Others have also suggested that drinkers can be sensitive to internal cues, indicating alcohol strength, and can adjust their intakes accordingly (e.g. Bois and Vogel-Sprott, 1974); indeed, Huber et al. (1976) demonstrated that participants can estimate their own BALs with some accuracy and can improve their judgments with training. Hence, there are clear indications that social drinkers can self-monitor BAL, but the evidence for a relationship between consumption pattern and a drink’s alcohol content is rather contradictory, suggesting that if compensation does occur, it is at best only partial.

The aim of the two experiments reported here was to assess directly the effect of manipulating the strength of an alcoholic
beverage on drinking behaviour. Beverage strength was altered by adding vodka to an alcohol-free lager drink, and drinking behaviour was video recorded in a laboratory setting. The time taken by young social drinkers to consume the drink was measured, along with other parameters of drinking behaviour (such as sip time and inter-sip interval). On the basis of previous work, it was predicted that participants consuming the stronger drink would take longer to finish the beverage than participants consuming the weaker drink, but that this compensation would be partial. Microstructural analysis of drinking behaviour allowed us to identify the specific changes in behaviour that might underlie any compensatory changes in drinking rate. Additionally, measures of self-reported mood over time and the participants’ evaluations of the drinks’ sensory and hedonic properties were taken to assess the contribution of these subjective factors to drinking behaviour.

EXPERIMENT 1

Method

Participants. Forty male volunteers (18–27 years old; mean = 20.1 years, SD = 2.1 years) were recruited from the student population at the University of Birmingham. The study was advertised as ‘an investigation of alcohol and behaviour’, and those who responded to the advertisement completed a questionnaire that characterized their patterns of habitual alcohol consumption (based on Mehrabian and Russell, 1978), included the Michigan Alcohol Screening Test (MAST) and recorded their expectancies of behavioural impairment associated with alcohol (from Southwick et al., 1981). Participants were accepted into the study only if their total weekly alcohol consumption was between 8 and 50 units of alcohol (actual mean intake was 31.4 units/week, SD = 10.4 units/week, minimum weekly consumption 11 units, maximum weekly consumption 49 units), and their MAST score was < 6. This was to ensure that the sample included social but not hazardous drinkers (defined as weekly consumption > 51 units for men; Webb et al., 2006). Also, since the study presented lager-based drinks, there was a requirement that participants consumed lager beers as part of their habitual alcohol consumption. Participants gave written informed consent after reading a description of what the study involved; the protocol was approved by the University of Birmingham School of Psychology Ethics Committee, and the study was conducted according to the ethical standards laid down in the Declaration of Helsinki 1964. The sample comprised the first 40 volunteers who met the study’s requirements. Each participant was randomly allocated to one of two groups: ‘low alcohol’ (to be given a 3% alcohol-by-volume drink) or ‘high alcohol’ (to be given a 7% alcohol-by-volume drink).

Materials and apparatus. Drinks were administered double blind. They were freshly prepared for each participant by one of two experimenters by mixing alcohol-free lager (Becks) with vodka (Safeways own brand, 37.5% alcohol-by-volume). Pilot experiments had established that the drinks were closely matched for taste characteristics. All participants received a preload and a target drink that were identical in terms of alcohol-by-volume. The low alcohol (3%) preload drink contained 19 ml vodka and 216 ml alcohol-free lager, and the target drink contained 38 ml vodka and 432 ml alcohol-free lager. The high alcohol (7% alcohol-by-volume) drinks contained 44 ml vodka and 191 ml lager (preload), and 88 ml vodka plus 382 ml lager (target drink). Thus, the high alcohol target drink contained ∼3.5 UK units of alcohol, and the low alcohol drink contained ∼1.5 units; the higher alcohol content also yielded ∼150 more calories than the low alcohol drink. The sensory qualities of the drinks were assessed using visual analogue scales (VAS) comprising 100 mm unmarked lines anchored with ‘Low’ or ‘Not at all’ (depending on the adjective) and ‘High’ or ‘Very’, with the following descriptors written (centred) above the line: ‘Alcohol Strength’, ‘Like’, ‘Bitter’, ‘Cold’, ‘Dislike’, ‘Sweet’, ‘Similarity to lager beers normally consumed’, ‘Fizzy’ and ‘Likelihood of drinking this on a normal social night out’. Alcohol intoxication and mood were also measured using 100 mm VAS unmarked lines, anchored with ‘Not At All’ and ‘Very’, with the following descriptors centred above the line: ‘Relaxed’, ‘Irritable’, ‘Alert’, ‘Contented’, ‘Lightheaded/Drink’, ‘Stimulated’, ‘Drowsy’ and ‘Anxious’.

Breath alcohol level (BrAL) was measured using a Lion Alcoholmeter S-D2 breathalyzer. Equipment also included a video camera (Sony Digital Handycam TRV59E), video player and TV (JVC Video HR-J600EK, Sanyo 28-inch TV) and a pre-recorded video to watch (Trials of Life, Part 1, Episode 1, BBCV 4680). The film sequence selected was considered to contain no emotive material. It was rated by participants using 100 mm VAS lines anchored as above for items ‘Exciting’, ‘Enjoyable’ and ‘Novel’.

Procedure. Participants were asked not to drink alcohol from 2300 h in the evening before the experiment and to consume a moderate lunch at least 2 h before testing (scheduled at 1400, 1500 or 1600 h). On arrival, they were weighed, completed a short food diary describing what they had consumed most recently and a BrAL reading was taken. Any participant whose BrAL exceeded 0.00 mg/l, or who had not complied with the eating and drinking requirements, was rescheduled. Participants then completed a mood VAS form, after which they were asked to drink a small shot glass of chilled water (40 ml) described as a ‘thirst quencher’. They were then instructed to take two sips of the preload drink before completing the sensory qualities VAS form. Two minutes after sipping, the participant was asked to consume the rest of the drink at an even pace over ∼10 min. Three minutes after finishing the preload, the participant filled out a second sensory qualities VAS form and a second mood VAS form. The target drink was then introduced, a second BrAL measure was taken and video recording of the participant commenced (the video camera was positioned ∼2 m to the side of the participant). The participant was instructed to drink all of the target drink ‘at a rate that is comfortable for you’ and told that ‘there was no advantage in drinking the drink as rapidly as possible, as the session will last the same amount of time’. They were asked to press a button to sound a bell when they had completed the drink ‘so that the next part of the study could take place’. To further distract participants from the real purpose of the study, they were asked to watch a short documentary film on a TV screen while they consumed the drink and were told that they would be asked for their opinion about it afterwards. When the drink was finished, participants continued watching the film for a further 5 min before a final BrAL measure was taken. They then completed final sensory and mood VAS forms, a brief VAS evaluation of the film, and they were given a structured debriefing in which
they were asked to report what they felt the purpose of the study was and whether the second drink contained 0, 3% or 7% alcohol-by-volume. They were paid a small amount for their participation and told that a full debriefing would be sent to them by e-mail when the study was completed.

**Data analyses.** An independent observer who had no knowledge of group allocation or the purpose of the study scored the video recordings of participant drinking behaviour. Total drink duration was the period from first sip of the target drink to the point at which the glass was emptied. Also quantified were time to first sip, total sipping duration, total interval between sips, number of sips, mean sip duration and mean sip interval. Video data for five participants were independently rated by a second observer, and the between-observer correlation was near perfect and highly significant, suggesting excellent inter-rater reliability, \( r = 0.99 \) (30), \( P < 0.01 \). Statistical analyses were by SPSS 14.0 for Windows. Drink pattern scores were analysed by independent \( t \)-tests with drink (3% versus 7%) as a between-groups factor. BrAL scores and the sensory and mood VAS ratings were analysed by 2-way ANOVA with Time (baseline, time 2, time 3) as a within-subjects factor and Drink as a between-subjects factor.

**RESULTS**

**Participant characteristics and BrAL scores**
The two groups did not differ significantly in terms of age, body weight, weekly alcohol consumption or MAST scores (for all: \( t < 1.50, df = 38, P > 0.1 \)). As expected, there was a significant main effect of Time on BrAL \( [F(2, 76) = 233.76, P < 0.001] \) and a significant Time \( \times \) Drink interaction \( [F(2, 76) = 34.34, P < 0.001] \), reflecting greater increases from baseline after 7% (mean = 0.40 mg/l, SD = 0.12 mg/l at final test) compared to 3% alcohol (mean = 0.17 mg/l, SD = 0.18 mg/l at the final test).

**Consumption time and drinking pattern**
There was no significant main effect of Drink on time to consume the beverage \( [t = 2.21, df = 38, P < 0.05] \); mean duration was longer for the 7% drink compared with the 3% drink (see Table 1). There was also a main effect of Drink on the total interval between sips \( [t = 2.20, df = 38, P < 0.05] \), being longer again for the 7% drink (Table 1). None of the other parameters of drinking behaviour differed between groups.

**Sensory quality VAS measures**
Analysis of the alcohol strength ratings revealed a significant main effect of Time \( [F(2, 76) = 5.12, P < 0.01] \), with rated strength increasing from the first time period onwards, and a significant Time \( \times \) Drink interaction \( [F(2, 76) = 5.37, P < 0.01] \), reflecting a much larger increase following the 7% drink compared with the 3% drink (Fig. 1). Indeed, post hoc comparisons showed that only the increase over time for the 7% drink was significant (from first sip to completion of target drink: \( t = 4.45, df = 19, P < 0.001 \)).

Ratings of several items changed over time, but showed no main effects of Drink or Drink \( \times \) Time interactions: ‘Like’ [decreased: \( F(2, 76) = 7.63, P < 0.001 \); ‘Dislike’ [increased: \( F(2, 76) = 4.08, P < 0.05 \); ‘Cold’ [decreased: \( F(2, 76) = 13.13, P < 0.001 \); ‘Fizzy’ [decreased: \( F(2, 76) = 5.87, P < 0.005 \) and ‘Likelihood of drinking this drink on a normal social night out’ [decreased: \( F(2, 76) = 3.74, P < 0.05 \). There were no main effects or interactions for items ‘Bitter’ or ‘Similarity to drinks normally consumed’. The only item that discriminated between groups (apart from ‘Strength’) was ‘Sweet’, for which there was a significant Time \( \times \) Drink interaction \( [F(2, 76) = 3.61, P < 0.05] \), reflecting higher scores for the 7% drink compared with the 3% drink after first sip only \( [t = 2.20, df = 38, P < 0.05] \). No other items differentiated the two groups at first sip.

**Mood VAS measures**
The ratings of several items showed main effects of Time, reflecting increases over the test session for ‘Relaxed’ \( [F(2, 76) = 16.2, P < 0.05] \), ‘Lightheaded’ \( [F(1, 37) = 77.3, P < 0.001] \) and ‘Drowsy’ \( [F(1, 37) = 6.59, P < 0.05] \), and decreases for ‘Alert’ \( [F(2, 76) = 23.1, P < 0.001] \) and ‘Anxious’ \( [F(2, 76) = 14.3, P < 0.001] \). There was also a marginally significant interaction of Time \( \times \) Drink for ‘Drowsy’ \( [F(2, 76) = 2.8, P = 0.068] \). Post hoc analysis revealed that rated drowsiness increased for both drinks from baseline to the end of the preload but that there was an increase between the end of preload (time 2) and the end of the test drink (time 3) after the 7% drink only \( (t = 3.02, df = 19, P < 0.01); mean for time 2 = 30.1, \) SD = 24.6; mean for time 3 = 45.1, SD = 26.1). There were no effects for items ‘Irritable’, or ‘Stimulated’ or ‘Contented’.

**Table 1. Mean drinking pattern scores for participants given either the 3% or 7% alcohol-by-volume drink in Experiment 1**

<table>
<thead>
<tr>
<th>Measure</th>
<th>3% alcohol (min)</th>
<th>7% alcohol (min)</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total drinking time</td>
<td>14.7 (4.2)</td>
<td>18.7 (6.8)</td>
<td>( P &lt; 0.05 )</td>
</tr>
<tr>
<td>Total sipping duration</td>
<td>0.62 (0.64)</td>
<td>0.63 (0.20)</td>
<td>NS</td>
</tr>
<tr>
<td>Total interval between sips</td>
<td>14.1 (4.3)</td>
<td>18.1 (6.7)</td>
<td>( P &lt; 0.05 )</td>
</tr>
<tr>
<td>Number of sips</td>
<td>17.7 (8.1)</td>
<td>21.6 (7.8)</td>
<td>NS</td>
</tr>
<tr>
<td>Mean sip duration</td>
<td>0.035 (0.02)</td>
<td>0.031 (0.01)</td>
<td>NS</td>
</tr>
<tr>
<td>Mean inter-sip interval</td>
<td>0.95 (0.51)</td>
<td>0.94 (0.51)</td>
<td>NS</td>
</tr>
</tbody>
</table>

SD in parentheses; NS for no significant difference between groups; \( N = 20 \) per group.

**Fig. 1.** Mean alcohol strength ratings (100 mm visual analogue scale) given by each of two drink conditions (3% versus 7% alcohol-by-volume) at three timepoints across a test session in Experiment 1. \( N = 20 \) per drink condition. Error bars represent \( \pm 1 \) SEM.
Film evaluations and post-test measures and reports
There were no significant differences between the two drink conditions for ratings of the documentary film as ‘Exciting’, ‘Enjoyable’ or ‘Novel’. When asked about the purpose of the study, only one participant made explicit reference to drink duration as a possible focus of the study. When asked to guess which drink they had consumed, participants were significantly more correct than might be expected by chance (binomial test, \(P < 0.01\)). Participants in the 3% group were more often correct than those in the 7% group \(\chi^2 (2 \text{ df}) = 6.14, P < 0.05\).

**DISCUSSION**

In Experiment 1, we found that a group of young social drinkers who consumed a 7% lager-based drink took longer to finish their drink than did a similar group who consumed a 3% lager-based drink, suggesting some compensation for alcohol strength via slowing of drinking rate. The groups were matched in their drinking habits, ages and weights, and their sensory evaluations of the drinks were also very similar, suggesting that these factors cannot account for the difference in drinking rate. In addition, it is unlikely that the difference in energy provided by the two drink (150 calories) had any effect on drinking rate as there is little evidence that calories in liquid form (especially alcohol) elicit dietary responses (Matts, 2006). However, compared with the 3% group, the 7% group rated the drink as sweeter after the first sip (even though they did not rate the drink as more alcoholic at that point). This initial difference in rated drink sweetness is unlikely to account for the effect of drink strength on total drinking time, but to check the reliability of the results and to control for possible differences in baseline drink preferences or other group characteristics, a follow-up experiment assessed the effect of drink strength on drinking rate using a similar method but with drink type as a within- rather than a between-subjects variable. In Experiment 2, each participant consumed the 3% and 7% drinks in a counterbalanced order. This design also allowed us to control for baseline variations in drinking rate.

**EXPERIMENT 2**

**Method**

Participants. Participants were 12 male students (who had not participated in Experiment 1) from the University of Birmingham recruited to the same criteria as Experiment 1. Their mean age was 21.7 years (SD = 1.9 years), and their average weekly alcohol intake was 21.1 units (SD = 9.1 units, minimum weekly consumption 11 units, maximum weekly consumption 35 units).

Materials and apparatus. These were the same as for Experiment 1 except that there was also a ‘placebo’ drink (see below), comprising Becks alcohol-free lager only (volume the same as for the alcoholic drinks: 470 ml). Two further episodes of the same documentary film series were also added so that participants did not view the same sequence more than once.

Procedure and data analyses. All participants first attended a practice session in which a placebo test drink containing no alcohol was given. This was to familiarize the participants with the test procedure and to provide a baseline measure of drinking speed. The average time to consume the placebo drink was 22 min. After the practice day, the 3% and 7% alcohol-by-volume test drinks were presented in counterbalanced order, double-blind, on the next two sessions. At least 48 h separated test sessions for a given participant. The participants were informed that they would not be told the amount of alcohol on any given test session but would be given this information at the very end of the experiment. Other details were as in Experiment 1. The preliminary session with the placebo drink provided covariates for repeated-measures ANOVAs on the measures of drinking behaviour. There were no significant interactions between the covariate and drink condition for the ANCOVA analyses.

**RESULTS**

BrAL scores
There was a significant main effect of Drink on BrAL \([F(2, 76) = 19.8, P < 0.001]\) as the scores for the 7% drink were higher than the scores for the 3% drink (mean for 7% drink = 0.2 mg/l, SD = 0.14 mg/l at final test; mean for 3% drink = 0.1 mg/l, SD = 0.09 mg/l at final test).

Consumption time and drinking pattern
The mean time taken to consume the test drink was longer for the 7% drink (27.2 min, SD = 5.6 min) compared with the 3% drink (26.1 min, SD = 6.1 min): \(F(1, 10) = 6.30, P < 0.05\).

As in the previous experiment, the only feature of drinking microstructure that differentiated between drinks was the total inter-sip interval, which was again longer after the 7% drink (26.4 min, SD = 5.6 min) in comparison with the 3% drink (25.4 min, SD = 5.9 min): \(F(1, 10) = 5.70, P < 0.05\).

Sensory quality VAS measures
Ratings of alcohol ‘Strength’ increased over time \([F(2, 22) = 4.5, P < 0.05]\), but there was no Time \(	imes\) Drink interaction \([F(2, 22) = 0.37, P > 0.1]\) and no main effect of Drink \([F(1, 11) = 2.0, P > 0.1]\). There were no main effects of Drink, Time or interactions of Drink \(	imes\) Time for items ‘Like’; ‘Dislike’; ‘Fizzy’; ‘Bitter’; ‘Sweet’; ‘Likelihood of drinking this drink on a normal social night out’ and ‘Similarity to drinks normally consumed’. However, there was a significant Time \(	imes\) Drink interaction for item ‘Cold’ \([F(2, 22) = 5.1, P < 0.05]\), reflecting higher scores for the 3% drink compared with the 7% drink after first sip only \((t = 3.70, \text{ df} = 11, P < 0.005)\).

Mood VAS measures
There were main effects of Time, reflecting increases over the test session for: ‘Lightheaded’ \([F(2, 22) = 32.5, P < 0.001]\), ‘Relaxed’ \([F(2, 22) = 4.3, P < 0.05]\) and ‘Drowsy’ \([F(2, 22) = 5.6, P < 0.001]\) and decreases for ‘Irritable’ \([F(2, 22) = 4.0, P < 0.05]\) and ‘Alert’ \([F(2, 22) = 9.1, P < 0.05]\). There were also interactions of Time \(	imes\) Drink for ‘Contented’ \([F(2, 22) = 2.5, P < 0.05]\) and ‘Relaxed’ \([F(2, 22) = 4.8, P < 0.05]\). For ‘Contented’, scores increased significantly from time 1 to time 3 after the 7% drink only \((t = 2.4, \text{ df} = 11, P < 0.01)\; \text{mean time 1} = 56.1, \text{ SD} = 25.8; \text{mean time 3} = 68.6,
For ‘Relaxed’ scores increased from time 1 to time 3 for the 7% drink only ($t = 2.5$, $df = 11$, $P < 0.05$; mean time 1 = 60.9, SD = 23.4; mean time 3 = 75.3, SD = 15.1). There were no significant effects for items ‘Anxious’ or ‘Stimulated’.

Film evaluations and post-test measures and reports

There were no main effects of Drink on rated enjoyment, excitement or novelty of the documentary film. When asked about the purpose of the study, no participant made explicit reference to drinking duration as a possible focus of the study. Participants answered at around chance levels when asked which drinks they had consumed in the two test sessions (binomial test, $P > 0.3$).

DISCUSSION

Two experiments investigated the effect of manipulating the alcohol content of a beverage on drinking rate in young social drinkers using either a between-subjects design (Experiment 1) or a within-subjects design (Experiment 2). In both experiments we found that participants took longer to consume a 7% lager-based drink compared with a 3% lager-based drink. This is the first report of a direct effect of the strength of an alcoholic beverage on drinking rate, and the results are consistent with the suggestion that social drinkers tend to compensate for changes in the alcohol content of drinks by altering drinking speed (Geller et al., 1991; Van Houten et al., 1994).

As the participants’ initial evaluations of drink strength did not differ, the effect of drink strength on drinking rate cannot be accounted for by expectations of drink strength acquired from the appearance or taste of the drinks. Furthermore, we found no consistent effect of drink condition on the participant’s ability to guess the strength of the drink that they had consumed. Participants in both studies were slower to consume the 7% drink compared with the 3% drink, but only the participants in Experiment 1 were better than chance at guessing drink strength. It is also unlikely that that the results can be explained by any demand characteristics related to participants being aware of the study’s predictions, because participants did not report being aware that their drinking speed was the measure of interest.

In addition, because the participants’ hedonic evaluations of the 7% and 3% drinks did not differ, a direct effect of drink strength on drink liking cannot explain the results. Participants in Experiment 1 rated the 7% drink as sweeter than the 3% drink, and participants in Experiment 2 rated the 3% drink as colder than the 7% drink, but as these sensory evaluations were not consistently associated with drink strength across experiments, they are also unlikely to account for differences in drinking rate.

Alternatively, the participants may have used the differential pharmacological effects of the drinks to inform drinking rate. In support, participants in both experiments reported changes in mood that strengthened over time for the 7% drink, but not for the 3% drink. In Experiment 1, only the 7% drink led to significant increases in self-reported ‘drowsiness’ between completing the preload and completing the main drink. In Experiment 2, participants felt significantly more relaxed and more contented over the test session after being given the 7% drink, but not after the 3% drink. Effects of alcohol on similar mood ratings have been found previously (e.g. Jackson et al., 2001), and although the specific mood items that were affected were not the same in Experiments 1 and 2, the results are consistent in suggesting that the participants detected stronger psychoactive effects after consuming the 7% drink compared with the 3% drink. Additionally, in Experiment 1, the rated strength of the 7% drink (but not the 3% drink) increased over the course of the experiment, suggesting that the participants became increasingly aware that this particular drink was producing psychoactive effects.

In both experiments, the microstructural analysis of drinking behaviour showed that the effect of the 7% drink on total drinking time was most likely related to increased inter-sip interval. This is perhaps not surprising, since although increased sipping due either to longer sips or more sips could account for increased drinking time, the amount of time actually spent sipping by participants during the session was only a small proportion of total drinking time. However, the relationship between drinking time and inter-sip interval is likely to be complex, because although total interval duration between sips was greater for the 7% drink compared with the 3% drink, the average inter-sip interval was not affected by the drink type. It is possible that large inter-sip intervals for a small number of sips were sufficient to increase total inter-sip interval significantly but have no significant impact on the average inter-sip interval.

While the participants in these studies took longer to consume a stronger versus a weaker alcoholic drink, there were nevertheless significant differences in BrALs as a function of drink type at the end of the session, indicating that participants did not effectively titrate to achieve similar BALs across drinks. Therefore, compensation for alcohol drink strength by adjusting drinking rate may only be partial. Alternatively, if the cues related to the psychoactive effects of an alcoholic drink are responsible for compensatory drinking, it is possible that offering participants more drinks over a longer period of time would lead to more accurate compensation via changes in drinking speed.

Some differences between the studies presented here should be noted. First, the average drinking time for participants in Experiment 2 was longer than for those in Experiment 1. This may relate to the fact that in Experiment 2, participants had been familiarized with the test procedure by attending a practice session. The fact that the participants in Experiment 1 had a higher weekly mean alcohol intake than those in Experiment 2 might also have been a factor that affected their general drinking speed. Of further note is that the BrALs achieved after consuming the drinks were lower in Experiment 2 compared with Experiment 1, but this is likely a function of the longer time-spent drinking, since by the end of the session in Experiment 2, BrALs were descending.

In summary, we found that drinking rate was slower when young social drinkers consumed a 7% alcohol-by-volume drink in comparison with a 3% alcohol-by-volume drink. The 7% drink induced more pronounced effects on mood during its consumption, but there were no systematic differences between the drinks in terms of their sensory or hedonic properties, or in how participants initially rated their strengths. These findings suggest that the consumption rate of an alcoholic beverage can be modulated by its alcoholic strength, and that the perceived...
pharmacological effect of the alcohol serves as an effective
signal to alter drinking behaviour.

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