A taste of things to come: the effect of extrinsic and intrinsic cues on perceived properties of beer mediated by expectations

Article (Accepted Version)

Blackmore, Helena, Hidrio, Claire and Yeomans, Martin R (2021) A taste of things to come: the effect of extrinsic and intrinsic cues on perceived properties of beer mediated by expectations. Food Quality and Preference, 94. a104326 1-12. ISSN 0950-3293

This version is available from Sussex Research Online: http://sro.sussex.ac.uk/id/eprint/100242/

This document is made available in accordance with publisher policies and may differ from the published version or from the version of record. If you wish to cite this item you are advised to consult the publisher’s version. Please see the URL above for details on accessing the published version.

Copyright and reuse:
Sussex Research Online is a digital repository of the research output of the University.

Copyright and all moral rights to the version of the paper presented here belong to the individual author(s) and/or other copyright owners. To the extent reasonable and practicable, the material made available in SRO has been checked for eligibility before being made available.

Copies of full text items generally can be reproduced, displayed or performed and given to third parties in any format or medium for personal research or study, educational, or not-for-profit purposes without prior permission or charge, provided that the authors, title and full bibliographic details are credited, a hyperlink and/or URL is given for the original metadata page and the content is not changed in any way.
A taste of things to come: The effect of extrinsic and intrinsic cues on perceived properties of beer mediated by expectations

Helena Blackmore\textsuperscript{a}, Claire Hidrio\textsuperscript{b}, Martin R. Yeomans\textsuperscript{a}

\textsuperscript{a} School of Psychology, University of Sussex, Brighton, BN1 9QH UK

\textsuperscript{b} AB InBev, Leuven, Belgium

\textbf{Running head:} Perceived properties of beer mediated by expectations

\textbf{Address correspondence to:}

Helena Blackmore

School of Psychology

University of Sussex

Brighton

BN1 9QH, UK

Email: Helena.Blackmore@sussex.ac.uk

Tel: +44 7715273807

Declaration of interest:

This experiment was carried out as a part of a PhD project funded by Fund Baillet Latour. Claire Hidrio is an employee of AB InBev, and while she has provided feedback on the design of the study and
assisted with sourcing the samples, she did not contribute to the data analysis or interpretation of the results. Helena Blackmore and Prof. Martin Yeomans have no conflicts of interest to declare.
Abstract

Before consuming a food or beverage, consumers are exposed to many sources of information related to the product. Such product-related cues can generate expectations, some of which can improve consumers' sensory perception and liking of the product. The question posed in the current study is whether labelling and colour of beer can be used to modify consumers' expectations and improve perception of its taste, flavour and mouthfeel, as these properties can be problematic in reduced alcohol beers. The aim of the current study was to explore how the most salient extrinsic and intrinsic cues affect expectations and perception in the context of beer.

Using a repeated measures design, 72 participants viewed label-based sensory information and tasted 16 beer samples differing in colour and bitterness. Participants rated expected and perceived liking, bitterness, refreshment, and body. As predicted, both sensory descriptor and beer colour generated sensory and hedonic expectations. We have also demonstrated that expectations mediate the effect of product related cues on perception and liking. Beer colour affected perceived liking, bitterness, refreshment, and body both directly and indirectly, yet the sensory descriptor ‘bitter’ only affected sensory perception and liking indirectly. Overall, we conclude that extrinsic and intrinsic cues can together change expectations and more importantly perception and thus potentially compensate for the perceived deficits in taste, flavour and mouthfeel commonly found in reduced alcohol beers.
1 INTRODUCTION

Past research has showed that different aspects of product appearance, labelling and marketing can and do influence consumers’ expectations and orosensory perception of a product (Olson & Dover, 1978b; Piqueras-Fiszman & Spence, 2015; Spence, 2019). Beer is one of the most popular beverages in the world (Salanță et al., 2020; Van Doorn, Timora, Watson, Moore, & Spence, 2019), yet it has until recently been somewhat understudied. Current trends suggest, that beer consumption patterns are changing, partially due to an increase in demand of reduced alcohol beverages, including non-alcoholic beer (Betancur, Motoki, Spence, & Velasco, 2020). In order to effectively respond to the changing consumer demand and improve consumer experience, it is crucial to understand the complex relationships between product-related cues that shape consumer experience, consumer expectations and perception. The aim of the present study was to investigate the relationship between product-related cues, expectations, and perceived sensory and hedonic properties of beer, specifically focusing on the role of expectations. More broadly, we wanted to test whether consumer perception can be modified without changing chemo-sensory properties of the product itself.

1.1 EXPECTATIONS

Our interaction with food and beverages starts before we put them in the mouth. Before taking the first sip or bite, we might look at the label, read the nutritional information, inspect the colour and perhaps even smell the product (Piqueras-Fiszman, Velasco, & Spence, 2012; Spence, 2016). We use these cues, together with our previous experience, to generate expectations about what we are going to taste. Expectations can then modify not only how much we like the product, but also how we perceive its taste, flavour and even mouthfeel (Cardello, 2007; Deliza & MacFie, 1996; Fernqvist & Ekelund, 2014; Piqueras-Fiszman & Spence, 2015). Simply put, product-related cues and information can generate expectations which in turn can change sensory and hedonic experience. The cues responsible for generating expectations can be related to the intrinsic properties of the product, such as aroma or appearance, or linked to external indicators of quality, such as label, packaging or other sources of information (Deliza & MacFie, 1996; Fernqvist & Ekelund, 2014; Piqueras-Fiszman & Spence, 2015; Spence et al., 2015; Velasco, Salgado-Montejo, Marmolejo-Ramos, & Spence, 2014).
After initial inspection of a product, we taste it. It is then that our expectations are confronted with the actual sensory properties of the food and beverage. These expectations can be either confirmed, when the sensory properties match the expectations, or disconfirmed, when the sensory properties of the product differ from expectations. What happens to consumer experience/perception in the case of disconfirmed expectations depends, among other things, on the size of the mismatch between expected and actual properties of the product. If the difference is small, the mismatch will be further minimized and the flavour or liking will be perceived as being closer to the expected flavour or liking, i.e. assimilation will occur (see Piqueras-Fiszman and Spence, 2012 and Deliza & MacFie, 1996). However, if the difference between expected and actual properties is large, the perceived mismatch will be magnified, i.e. contrast will occur (Yeomans et al. 2008, Zellner et al., 2004).

Liem et al.( 2012) demonstrated the assimilation effect when they asked participants to taste and rate soups differing in labelled and actual salt content. Soup with reduced salt content which was also labelled as ‘reduced salt’ was not only expected to taste less salty but was also rated as significantly less salty than the same soup without the sensory label. To compare, Yeomans et al. (2008) demonstrated contrast in their ‘smoked salmon mousse’ study. In that experiment, participants rated smoked salmon mousse which looked like a fruit ice cream. When participants expected to taste a dessert, the mousse was rated as significantly saltier and more bitter than when the participants expected to taste a frozen savoury mousse. However, the contrast effect is rare and in the context of food and beverages has been demonstrated experimentally only a handful of times as the mismatch or the strength of expectations must be very large (Yeomans et al., 2008; Zellner et al., 2004). The difficulty in demonstrating the contrast effect experimentally would suggest that assimilation is more likely, perhaps because most product properties only deviate from our expectations by a relatively small amount. That is, we are more likely to encounter situations in which we taste a very bitter product that we expected to taste only somewhat bitter, than situations in which we taste a bitter product that we expected to taste sweet.
1.2 **Extrinsic and Intrinsic Cues**

Product related cues can either be extrinsic or intrinsic to the product. Intrinsic cues are directly related to the chemosensory properties of the product, such as aroma or colour (Cardello, 2007). Given that most products in shops are packaged, consumers usually don’t encounter sensory properties of the products, such as the smell, feeling in the mouth, temperature etc., before tasting it, intrinsic cues tend to modify the sensory perception directly rather than through expectations. Apart from the product colour and other aspects of appearance, consumers can rarely rely on intrinsic product cues when forming their expectations. In direct contrast, extrinsic cues are linked to information presented on or with the product (Piqueras-Fiszman & Spence, 2015). We only need to look around when shopping to observe that labelling is arguably the most common and convenient way of presenting product-relevant information to customers. Yet, even though we are frequently exposed to extrinsic and intrinsic cues simultaneously, their effect on expectations and perception is usually studied separately (Spence & Piqueras-Fiszman, 2016; Wang et al., 2019). Here we argue that to understand how extrinsic and intrinsic cues interact and shape consumer experience, it is not only desirable but necessary to study them together.

While there are a number of intrinsic product cues that could potentially elicit flavour-related expectations in beer, such as sound resulting from pouring the drink, the head and other aspects of appearance, arguably the most salient intrinsic factor is the colour of the beverage. Several studies have demonstrated the effect of colour on expectations and perception of flavour and mouthfeel of alcoholic beverages. Indeed, in the context of alcoholic beverages, colour can result in altered expectations and even perception of body, bitterness and sweetness (Carvalho, Moors, Wagemans, & Spence, 2017; Reinoso-Carvalho, Dakduk, Wagemans, & Spence, 2019; Sugrue & Dando, 2018). More specifically, dark colour has been shown to be associated with expected or perceived fuller body in beer (Carvalho et al., 2017; Ivanova et al., 2018; Reinoso-Carvalho et al., 2019), wine (Niimi, Danner, Li, Bossan, & Bastian, 2017) and even cider (Sugrue & Dando, 2018). Ivanova et al. (2018) reported that consumers normally associated dark colour in alcoholic beverages, both wine and beer with fuller body and more intense flavour. Dark beers are also expected to taste more bitter than light coloured beers (Carvalho et al., 2017; Reinoso-Carvalho et al., 2019) and the colour of cider can change expectations and perception of sweetness (Sugrue & Dando, 2018). This is in line with results of our previous study (Blackmore, Hidrio, Godineau, & Yeomans, 2020) in which expected body strongly correlated with expected beer colour, that
is beer, which was expected to be dark, was also expected to have a fuller body. However, it should be noted that not all studies demonstrated the effect of beer colour on perceived taste and mouthfeel (Carvalho et al., 2017; Reinoso-Carvalho et al., 2019, see VanDoorn et al., 2019 for a review).

As mentioned earlier, a common way of modifying consumer expectations and perception of flavour is the use of labelling. There have been a number of studies that looked at the effect of information on expected or perceived taste and flavour. Information about taste and sensory properties of the product (Okamoto et al., 2009; Yeomans et al., 2008), nutritional information (Liem et al., 2012), brand logo (Allison & Uhl, 1964; Varela, Ares, Giménez, & Gámbaro, 2010), packaging colour (Piquerás-Fiszman & Spence, 2012; Sousa, Carvalho, & Pereira, 2020; Velasco, Wan, et al., 2014), imagery (Gil-Pérez et al., 2019) and even information about production (Caporale & Monteleone, 2004; Cardello, 2003; Napolitano, Caporale, Carlucci, & Monteleone, 2007) have all been shown to have an effect on expectations. However, similarly to studies on product colour, few studies explicitly demonstrated the relationship between labelling, expectations and taste or flavour perception. It appears that short sensory descriptors, such as ‘reduced salt’, ‘sweet’ ‘creamy’ or ‘savoury’ were the most successful in not only eliciting flavour-related expectations, but also shifting participants perception of flavour and mouthfeel (e.g. Liem et al., 2012; Olson & Dover, 1978; Yeomans et al., 2008; Yeomans, Lartamo, Procter, Lee, & Gray, 2001). Arguably, in the case of beer, the most salient taste is bitter\(^1\), which has previously been associated with colour of the drink (Van Doorn et al., 2019). For this reason, the present study used the descriptor “bitter” as an extrinsic cue together with beer colour (pale and dark amber) to investigate the combined effect of extrinsic and intrinsic product cues on perception of taste and mouthfeel of beer. In the UK, uniquely, “bitter” is also used as a collective name for a particular type of beer (ale), and so UK beer consumers may show especially strong expectations around this descriptor.

---

\(^1\) Note that while beer has a particularly complex flavour profile, here we specifically refer to taste. Taste is one of the sensory modalities comprising of five broadly agreed on qualities: bitter, sweet, sour, salty, umami (savoury), which are represented in the gustatory system. Flavour, on the other hand is a complex multisensory percept resulting from a combination of gustatory (taste), olfactory (aroma) and somatosensory input (e.g. mouthfeel) (Buck & Bargmann, 2013)
1.3 EXPECTATIONS MEDIATE THE EFFECT OF PRODUCT CUES

Notably, the effect of extrinsic and intrinsic cues on sensory and hedonic perception is thought to be mediated by expectations. Yet, the relationship between product cues, expectations and perception is rarely explicitly modelled as a causal mediation. For example, Okamoto et al. (2013) described expectations as a mediator of extrinsic cues, referring to two literature reviews (Cardello, 2007, Deliza and MacFie, 1996)\(^2\), which themselves do not explicitly discuss mediation, let alone causal mediation analysis. Similarly, Shankar et al. (2010) in their review aimed to explain “how the expectations induced by colour–flavour associations … mediate flavour perception.” They referred to nine research articles (Cardello and Sawyer, 1992, Deliza and MacFie, 1996, Kahkonen and Tuorila, 1998, Lee et al., 2006, Levin and Gaeth, 1988, Schifferstein et al., 1999, Shankar et al., 2009, Wansink et al., 2000, Yeomans et al., 2008) to support their claim that “A wide range of research has explored the role that labelling can play in mediating people’s expectations and their subsequent flavour experiences.” Yet only three of the articles explicitly mentioned mediation and none reported or referred to causal mediation analysis. The literature is filled with examples such as these. Indeed, the majority of studies infer mediation without appropriate statistical modelling. While we do not dispute the role of expectations as a mediator, we argue that this needs to be reflected in the way data are analysed.

Mediation analysis is a tool used to investigate a relationship between multiple variables independent variable(s) (IV), mediator(s)(M), and dependent variable(s) (DV). Mediating variables transmit the effect of IV on the DV and thus act as both IV and DV. Figure 1 A shows a simple single mediator model, while Figure 1 B shows a mediation model specific to this paper: a model with two predictors (IV), single mediator and single outcome variable (DV). In the current study we used mediation analysis to test whether the effect of extrinsic and intrinsic cues on perception is mediated by expectations. More detailed explanation of mediation and mediation models in experimental contexts can be found in MacKinnon, Fairchild, & Fritz (2007).

\(^2\) Deliza and McFie (1996) discussed the dual mediation model in relation to attitude formation and brand evaluation, however they did not discuss the mediating effect of expectations on sensory perception.
To summarise, both extrinsic and intrinsic cues play an important role in eliciting expectations and thus have the potential to improve consumer experience. The aim of the present study was to test whether sensory descriptor and beer colour can elicit consumer expectations strong enough to change their perception of taste, flavour and mouthfeel. We also set to explicitly test and quantify the extent to which the effects of beer colour and sensory descriptor are mediated by expectations. Based on previous research, we formulated the following hypotheses. **H1**: Darker coloured beers will be expected to taste more bitter and have fuller body than lighter coloured beers. **H2**: The sensory descriptor “bitter” will affect expectations of bitterness, liking, body and refreshment. **H3**: Darker coloured beers will be rated as tasting more bitter and having fuller body than lighter coloured beers. **H4**: Beers with sensory descriptor “bitter” will be rated as significantly more bitter than unlabelled beers or beers labelled as “standard”. **H5**: The effects of beer colour and sensory descriptor on perception will be mediated by expectations they generate.

## 2 Methods

### 2.1 Design

The experiment had a 2 x 2 x 3 repeated measures design: the factors were taste (bitter/mild), beer colour (light/dark), label (no label/descriptor “standard”/ descriptor “bitter”), all factors were repeated measures. The taste was manipulated to test whether it interacted with product-related cues to modify consumers’ perception. Varying the bitterness of samples contributed to the impression that participants were evaluating an array of different beer samples and thus helped to conceal the experimental manipulation, and reduce bias, such as demand characteristics. Thus, there were four different beer samples (dark bitter, dark mild, light bitter and light mild), each tasted once during a blind session to obtain baseline taste ratings and then each sample was presented once without label, once with beer label described as “standard” and once with a label with a sensory descriptor “bitter (see Figure 2). Dependent variables of interest were expected and perceived bitterness, refreshment, liking and body. While expectations were first looked at as one of the outcome variables, they were later modelled as a mediator.
2.2 Participants

One of the main aims of the experiment was to explore the effect of sensory descriptor on expectations and perception of taste. Based on previous research (Blackmore et al., 2020) we expected a medium to large effect. G*power software was used to calculate the required sample size. To detect a medium effect, we needed to test approximately 72 participants ($f=0.25$, $\alpha=0.05$, $1-\beta=0.8$, $n=72$). The real aim of the study was disguised, and potential participants were recruited for an experiment investigating the effects of current mood state on perception of bitterness. All participants were informed about the real purpose of the study during debriefing at the end of the experiment.

While 76 participants were recruited, only data from 74 (25 males) participants were analysed due to several missing responses in two cases. All participants identified as regular beer drinkers, on average consuming at least one beer a month, criteria previously used by other researchers (Fukuda, 2019; Nijman et al., 2019). We relied on participants’ intuitive understanding of bitterness, refreshment, liking and body, as these are commonly used when talking about beverages. Participants were young adults ($M=21.3$ years, $SD=3.51$) mostly, but not exclusively from the student population at the University of Sussex. The average BMI of participants was $23.5$ kg/m$^2$ ($SD=3.2$).

Exclusion criteria included: diabetes, an alcohol use or eating disorder, colour blindness, smoking more than five cigarettes a day, pregnancy or breastfeeding, any medication (excluding contraceptive pill). Before the study, all participants read an information sheet outlining the exclusion criteria and study protocol. If they agreed to take part, they gave informed consent in accordance with the Declaration of Helsinki. The Science & Technology Cross-Schools Ethics Committee at the University of Sussex has approved the experimental protocol (application ER/HB315/5), and the study was conducted according to the ethical standards defined by the British Psychological Society.
2.3 MATERIALS

2.3.1 Beer labels

We used four different beer labels, which are illustrated in Figure 2. To avoid familiarity, realistic, but fictitious beer labels were designed using an online resource (www.beerlabelizer.com) and Adobe Photoshop CC 2017. Two of the labels featured the sensory descriptor “bitter”, and two the descriptor “standard” (a control label). The labels also differed in terms of their design, however this was only to reduce monotony of the experiment and to disguise the experimental manipulation. Presentation of the labels was counterbalanced.

2.3.2 Beer samples

The bitterness and colour of the samples were manipulated specifically for this project, with the test beers produced at a pilot-plant facility at the University of Nottingham. To achieve two levels of bitterness (mild/bitter) and two different colours (light/dark, see Figure 3) a commercial light-coloured (EBC = 5) beer with low bitterness (IBU = 10) was used as a starting point. Food grade caramel was added to darken the colour of the beer (EBC = 25): iso-alpha acids were added to increase bitterness (IBU = 20). Both caramel and iso-alpha acids are standard ingredients used in beverages. After blending, the four resulting beers (light mild, light bitter, dark mild, dark bitter) were packed into glass bottles under CO₂ atmosphere to preserve from oxidation. The pH (4.4), carbonation (5.2 g/l) and alcohol content (3.5% ABV) of the samples were identical, only the colour and bitterness differed. The beer was stored in a fridge chilled to 4°C, served immediately and consumed within 25 minutes. The beer was served as 75 g (± 5) samples in a standard 160 ml capacity drinking glass: each sample was labelled with a random three-digit code.

2.3.3 Rating scales

Participants were asked to rate expectations of bitterness, refreshment, liking and body, strength of their expectations and perception of bitterness, refreshment, liking and body. All scales were visual analogue scales ranging from 0 – 100. Scales were displayed on a computer screen and participants moved a slider to

3 Some beer samples were also presented without any label, see Design and Procedure sections for more detail.
indicate their response. Anchors used were as follows: expected bitterness (not at all – extremely), perceived bitterness (not at all- extremely), expected refreshment (not at all- extremely), perceived refreshment (not at all-extremely), expected liking (dislike extremely – like extremely), perceived liking (dislike extremely – like extremely), expected body (light – full), perceived body (light - full), strength of expectations (I am just guessing – I am certain). For expected and perceived liking, the slider starting position was at 50 (middle), for all other scales the slider was positioned at 0 (far left).

2.4 Procedure

The experiment consisted of two sessions: a blind tasting session, followed by an experimental session. The experiment was designed and administered using Qualtrics software (Qualtrics, Provo, UT, 2018) and used a black background to minimise the light in the experimental cubicle helping to conceal the colour of the samples during an initial blind tasting session. The experimental procedure is illustrated in Figure 4.

2.4.1 Blind tasting session

During the blind tasting session participants tasted the four beer samples, to disguise the difference in colour the experimental cubicle was lit with red light. Participants rated their perception of bitterness (not at all- extremely), refreshment (not at all-extremely), liking (dislike extremely-like extremely) and body (light – full) on a 0-100 visual analogue scale (VAS). Importantly, as all ratings were done on a computer screen with black background to minimise the amount of white light in the room. The order of the beer samples and the ratings were randomized during both the blind and experimental sessions. Participants were instructed to take one sip from each sample, swish it around their mouth for 5 s and then swallow, using mineral water between samples to rinse their mouth.

2.4.2 Experimental session

The blind tasting session was immediately followed by the experimental session during which participants performed ratings in a well-lit experimental cubicle. The beer samples were presented again, sometimes without a label (no label condition) and sometimes accompanied by an on-screen label with either
the sensory descriptor “bitter” or descriptor “standard” (sensory descriptor condition and control descriptor condition, as shown in Figure 2). Altogether participants had to taste and rate 12 samples (4 beer samples x 3 label conditions), presented in a random order.

After locating the sample participants rated their expectations of bitterness, refreshment, liking and body, based on the appearance of the sample and label (if present). Participants also rated the strength of these expectations. After rating their expectations, participants proceeded to taste and rate the perceived bitterness, refreshment, body and liking of the samples, which was identical to the blind session: sip, swish for 5 s, swallow, rate perceived bitterness, refreshment, liking and body, and rinse. At the end of the experiment participants were weighed and measured and fully debriefed.

2.5 DATA ANALYSIS

Data were analysed using R studio, R 3.6.2. To examine the effect of colour and sensory descriptor on expectations and perception of bitterness, refreshment, liking and body a multilevel model (MLM) with participants as random, and colour, taste (in the case of perceived ratings) and sensory descriptor as fixed effects, was used. Given the repeated measures design of the study, we could assume that measures from the same participants concerning sensory and hedonic ratings, especially in a short space of time would be highly correlated (Littell, Pendergast, Natarajan, 2000). As MLM takes into account this correlation and models this dependency, it avoids inflating Type I and type II errors compared to repeated measures ANOVA (Field, Miles and Field, 2012; Hoffman & Rovine, 2007). Using the “lmerTest” package (Kuznetsova, Brockhoff, Christensen, 2017), the MLM was fitted as a linear mixed model fitted by the restricted maximum likelihood (REML), with t-tests using Satterthwaite’s method to estimate the degrees of freedom. The model tested all main effects and interactions. In order determine the difference between sensory descriptor and no sensory descriptor (i.e. “bitter” vs. “standard” and no label) and the difference between the two control labels (“standard” vs. no label) the main analysis was followed by pair-wise t-tests with planned non-orthogonal contrasts using Bonferroni correction.
The purpose of the blind tasting session was to obtain baseline ratings unaffected by expectations, and to carry out a manipulation check. A MLM, as described above was run to establish whether the beer colour and taste had a significant effect on perceived bitterness, refreshment, liking and body.

Finally, to establish whether the effect of product-related cues on sensory and hedonic perception was mediated by expectations, a causal mediation analysis was carried out. While there are other approaches to build and evaluate structural equation models, such as partial least square path modelling (PLS) and sequential orthogonalised partial least square path modelling (SO-PLS), these are better suited for data exploration and theory building rather than theory testing, as is the case for the current study (Menichelli, Almøy, Tomic, Olsen, & Næs, 2014). For this reason, we employed a causal mediation analysis. We used the “brms” (Bürkner, 2018) and “bmlm” (Vuorre, 2017) R packages which allowed us to perform Bayesian analysis of multilevel models and Bayesian within-subjects mediation analysis.

First, the “standard” and “no label” conditions were grouped together, as there was no statistically significant difference between the two conditions, making the descriptor a two-level variable (‘bitter’, control). Then the relationship between predictor and outcome variable and predictor, mediator, and outcome variable were modelled as a MLM with participants as random effect, colour and sensory descriptor as predictors, expectations as mediator and perception as outcome variable. Due to the lack of previous research we used the software default, minimally informative prior. The mediation models were then evaluated using the estimates and 95% credible intervals, which were derived from posterior distributions. There is evidence of mediation when the credible interval can rule out zero as a likely population value (Vuorre & Bolger, 2018). Because all scales ranged from 0-100, we report unstandardized coefficients. Unstandardised coefficients allow for direct estimate of the effect on the dependent variable, as the unstandardized coefficient quantifies the amount of change in a dependent variable due to a change of one unit of independent variable, which makes them more intuitive to interpret, and in the case of the present study preferable (Kim and Mueller, 1976; Glen, 2019, Baguley, 2009).

We should also comment on the use of two different beer labels (see Figure 2). While the effect of design or typeface was not a primary interest of the present study, a number of previous studies reported the effect of typeface on consumer expectations and experience (Velasco, Hyndman, & Spence, 2018; Velasco,
Woods, Hyndman, & Spence, 2015). Using an independent samples t-test we compared the effect of label (angular and round typeface) on expected and perceived bitterness, refreshment, liking and body. The difference between the two label designs was not statistically significant ($p>0.05$) and the results are visualised in Figure 5. The analysis scripts can be found here [https://github.com/HelenaBlackmore/study2.git](https://github.com/HelenaBlackmore/study2.git).

3 RESULTS

3.1 BLIND TASTING SESSION

As expected, participants’ ratings of liking and refreshment were not significantly affected by either colour or taste ($p > 0.05$), and the ratings of bitterness were significantly affected by taste ($\chi^2(5) = 4.82, p = 0.028$), with bitter beers rated as tasting more bitter ($b = -5.75, t(220) = -2.40, p = 0.017, r = 0.16$). However, unexpectedly the dark beers were also rated as tasting slightly, but significantly, more bitter ($b = 5.26, t(220) = 2.20, p = 0.029, r = 0.15$). Finally, the rated body was not significantly affected by the taste of the beer, but there was a significant effect of colour ($\chi^2(5) = 7.55, p = 0.006$), with the dark beers rated as having fuller body ($b = 6.33, t(220) = 2.76, p = 0.006, r = 0.18$). More details are in Table 1.

3.2 THE EFFECT OF BEER COLOUR AND SENSORY DESCRIPTOR ON EXPECTATIONS

3.2.1 Bitterness

Both the sensory descriptor “bitter” and the beer colour had a significant effect on expectations of bitterness ($\chi^2(6) = 148.82, p < 0.001$; see Table 2). There were no significant interactions. More specifically, the darker coloured beers were expected to be more bitter than the lighter coloured beers ($b = 20.25, t(814) = 15.63, p < 0.001, r = 0.48$). In terms of labelling, the descriptor “bitter” generated expectations of increased bitterness compared to unlabelled beer or beer labelled "standard" ($b = 5.75, t(814) = 12.55, p < 0.001, r = 0.40$), and additionally, the beer labelled as “standard” was expected to be less bitter than the unlabelled beer ($b = 1.92, t(814) = 2.42, p = 0.016, r = 0.08$).
3.2.2 Refreshment

Both the beer colour and the sensory descriptor "bitter" significantly affected ratings of expected refreshment ($\chi^2(6) = 16.49, p < 0.001$: see Table 3). Overall, the descriptor “bitter” resulted in significantly lower ratings of expected refreshment than descriptor "standard" or no label ($b = 1.76, t(811) = 4.06, p < 0.001, r = 0.14$) and there was no difference between the beer labelled as “standard and the unlabelled beer ($b= 0.24, t(911)=0.32, p = 0.745$). Darker coloured beers were also expected to be significantly less refreshing than lighter coloured beers ($b = -19.84, t(811) = -16.17, p < 0.001, r = 0.49$).

3.2.3 Liking

Both the colour of the beer and the sensory descriptor “bitter” significantly affected ratings of expected liking ($\chi^2(6) = 14.41, p < 0.001$: Table 4). Darker coloured beers and beers described as “bitter” were expected to be liked significantly less than lighter coloured or beers without a sensory descriptor ($b = -13.71, t(811) = -10.57, p < 0.001, r = 0.35$, and $b = 1.70, t(811) = 3.70, p < 0.001, r = 0.13$ , respectively). The effect of label “standard” on expected liking did not significantly differ from the effect of no label ($b = 0.71, t(811) = 0.89, p = 0.373$).

3.2.4 Body

Expected body was significantly affected by both the colour and the sensory descriptor ($\chi^2(6) = 53.92, p < 0.001$: Table 5 and Figure 6D). More specifically, the darker coloured beers were expected to have significantly fuller body ($b = 28.72, t(811) = 23.89, p < 0.001, r = 0.64$) than the lighter coloured beers. In terms of the labelling, beers described as “bitter” were expected to have fuller body than beers without a sensory descriptor ($b = -3.00, t(811) = -7.07, p < 0.001, r = 0.24$). Moreover, the unlabelled beer was expected to have lighter body than beer labelled as “standard ($b = 1.74, t(811) = 2.36, p = 0.018, r = 0.08$).
3.3 THE EFFECT OF BEER COLOUR, TASTE AND SENSORY DESCRIPTOR ON PERCEPTION

3.3.1 Bitterness

There was a significant effect of taste, colour and sensory descriptor on perceived bitterness ($\chi^2(7) = 23.02, p < 0.001$: see Table 2). The bitter, as well as the darker coloured beers were rated as more bitter ($b = -7.00, t(814) = -4.66, p < 0.001, r = 0.16$, and $b = 8.20, t(814) = 5.46, p < 0.001, r = 0.19$, respectively). The beer labelled as “bitter” was perceived as more bitter ($b = -2.55, t(814) = -4.81, p < 0.001, r = 0.17$), compared to beers without the sensory descriptor “bitter”. There was no difference in perceived bitterness between the unlabelled beer and beer labelled as “standard” ($b = 0.47, t(814) = 0.51, p = 0.611$). There were no significant interactions between the variables.

3.3.2 Refreshment

Perceived refreshment was affected by taste and colour ($\chi^2(5) = 73.10, p < 0.001$), but not the sensory descriptor ($\chi^2(7) = 2.40, p = 0.301$). More specifically, the bitter beer was rated as significantly less refreshing compared to the mild beer ($b = 5.75, t(814) = 4.41, p < 0.001, r = 0.15$). The darker coloured beer was rated as significantly less refreshing than the lighter coloured beer ($b = -11.41, t(814) = -8.75, p < 0.001, r = 0.29$). See Table 3. None of the interactions reached statistical significance.

3.3.3 Liking

Again, only the taste and the beer colour had a significant effect on perceived liking ($\chi^2(5) = 49.24, p < 0.001$: Table 4), while the sensory descriptor had no effect on perceived liking ($\chi^2(7) = 2.30, p = 0.317$). The bitter and the dark beers were liked significantly less than the mild and light beer ($b = 4.96, t(812) = -3.48, p < 0.001, r = 0.12$, and $b = -10.12, t(812) = -7.12, p < 0.001, r = 0.24$, respectively). Again, no significant interaction between the taste and product cues was observed.
3.3.4 Body

Perceived body was significantly affected by taste and colour of the beer ($\chi^2(5) = 226.92$, $p < 0.001$), while the sensory descriptor had no effect ($\chi^2(7) = 1.72$, $p = 0.423$). Bitter beer was rated as having fuller body than the mild beer ($b = -3.07$, $t(812) = -2.30$, $p = 0.022$, $r = 0.08$). Similarly, the dark beer was perceived as having fuller body than the light beer ($b = 21.50$, $t(812) = 16.16$, $p < 0.001$, $r = 0.49$). None of the interactions reached statistical significance ($p > 0.05$). See Table 5.

3.4 EXPECTATIONS MEDIATE THE EFFECT OF PRODUCT-RELATED CUES

The outcomes of the mediation analyses are visualised in Figures 5A-5D and described below.

3.4.1 Bitterness

Both the effect of colour and sensory descriptor on perceived bitterness were mediated via the expectations of bitterness as Figure 7A illustrates. Both darker beer colour and the sensory descriptor ‘bitter’ were associated with higher expectations of bitterness (20.25, 95% CI [16.20, 24.51] and 17.24, 95% CI [14.23, 20.29], respectively). Beer colour then directly and indirectly increased participants’ perception of bitterness (4.01, 95% CI [0.23, 7.84] and 4.18, 95% CI [1.76, 6.93], respectively). The sensory descriptor bitter indirectly increased perception of bitterness (4.76, 95% CI [2.91, 6.86]). There was no direct effect of sensory descriptor on perceived bitterness (2.68, 95% CI [-0.74, 6.13]).

3.4.2 Refreshment

Again, both the effect of colour and sensory descriptor on perceived refreshment were mediated by expected refreshment. As Figure 6B shows, beer colour had an effect on expected refreshment (-19.90, 95% CI [-24.13, -15.94]) as well as direct (-7.60, 95% CI [-11.42, -3.95]) and indirect effect (-3.92, 95% CI [-6.79, -1.31]) on perceived refreshment. The effect of sensory descriptor ‘bitter’ lowered expectations of refreshment (-5.30, 95% CI [-8.11, -2.53] which indirectly affected perception of refreshment (-1.54, 95% CI [-2.79, -0.29]). However, there was no direct effect of sensory descriptor on perceived refreshment (0.35, 95% CI [-2.36, 3.17]).
3.4.3 Liking

As Figure 7C demonstrates, the effect of beer colour and sensory descriptor on participants’ liking was mediated by expectations of liking. Participants expected to like less beer samples that were dark (-13.70, 95% CI [-18.36, -8.98]) and that were described as ‘bitter’ (-5.13, 95% CI [-8.07, -2.20]). Beer colour had a direct (-8.32, 95% CI [-13.00, -3.83] and indirect effect [-1.78, 95% CI [-3.60, -0.26]) on perceived liking. Sensory descriptor affected liking only indirectly (-1.49, 95% CI [-2.74, -0.46]) with direct effect around 0 (-0.87, 95% CI [-3.60, -0.26]).

3.4.4 Body

In the case of perception of body, only the effect of sensory descriptor was mediated by expectations. Beer colour and sensory descriptor ‘bitter’ both increased expectations of body (28.81, 95% CI [25.05, 32.60] and 9.00, 95% CI [5.84, 12.22], respectively). Dark colour also seemed to directly increase perception of body (18.50, 95% CI [14.03, 23.18]), however we did not observe an indirect effect of beer colour (3.05, 95% CI [-0.12, 6.30]) on ratings of perceived body. Similarly to other percepts reported above, the sensory descriptor ‘bitter’ did not affect perception of body directly (-1.86, 95% CI [-4.75, 0.94]), but the effect was mediated through expectations and so as to indirectly increase ratings of body (3.58, 95% CI [2.00, 5.32]). See Figure 7D.
4 DISCUSSION

The present study set to investigate how beer colour (intrinsic cue) and sensory descriptor (extrinsic cue) affected consumers’ expectations and perception of beer, as well as testing and quantifying the mediating effect of these expectations. Manipulating colour of the beer and the way the beer is described led to assimilation: the extrinsic and intrinsic cues affected the way participants rated the beer samples, and this effect was partially mediated by expectations. The rest of this section discusses the results of the study in more detail, highlighting the contribution of the novel findings and analytic approach, and commenting on limitations of the study.

Firstly, we observed that extrinsic and intrinsic cues clearly affected participants’ expectations. Dark coloured beers were overall expected to taste more bitter, have fuller body, be less refreshing and liked less. When participants saw the descriptor “bitter” or the darker colour, they expected the beer to be more bitter, less refreshing, liked less and have fuller body. This was in line with data from our previous study (Blackmore et al., 2020).

Secondly, we demonstrated that presentation of a sensory descriptor can change consumer perception by assimilating expectations. However, as the results of the present study and the literature suggest, the effects of sensory descriptors are only limited to a specific aspect of the taste or flavour. For example, as described earlier, the descriptor “bitter” only changed perception of bitterness. A number of studies found similar pattern of results (for example: Bowen, Tomoyasu, Anderson, Carney, & Kristal, 1992; Shankar, Levitan, Prescott, & Spence, 2009; Skaczkowski, Durkin, Kashima, & Wakefield, 2016; Yeomans et al., 2001). It seems that labels related to sensory properties tend to have a specific effect on perception of taste, flavour, or mouthfeel. It is common that in instances in which there is a close link between taste intensity and liking, hedonic descriptors (e.g. “pleasant”) affect ratings of taste and flavour intensity as well as activity in the primary taste cortex (Nitschke et al., 2006). Similarly, sensory information can affect ratings of pleasantness and liking (Woods et al., 2011; Yeomans et al., 2001). However, rarely does a sensory label (e.g. salty) affect perception of other unrelated sensory percepts (e.g. bitter). Considering previous research and the results of the present study, we
conclude that in order to improve consumers’ sensory perception of taste, flavour or mouthfeel we need to use a product-relevant description of the sensory aspect we are trying to modulate.

Finally, while the effect of product labels seems to be quite specific and narrow, colour of the beer, appears to be more versatile. In the present study beer colour modified perception of not only bitterness, but also liking, refreshment and body. The effects of colour on perceived intensity of flavour have been demonstrated before (for reviews see Spence & Piqueras-Fiszman, 2016; Spence, 2015). Adding more colouring to a beverage usually results in ratings of more intense taste or flavour, which explains why darker beers in our experiment were rated as more bitter and having fuller body, given that body and especially bitterness are important attributes relating to intensity of overall flavour and mouthfeel.

Yet, we should point out that there are studies in the literature, which reported null results, that is no effect of beverage colour on perceived intensity of taste or flavour (Spence & Piqueras-Fiszman, 2016). Most notably, two recent studies suggested that while beer colour can generate expectations of body and bitterness, this did not affect participants’ perception (Carvalho et al., 2017; Reinoso-Carvalho et al., 2019). In both studies, the researchers used amber and dark beer and investigated, among other things, the effect of beer colour on sensory and hedonic expectations and perception, looking at sweetness, sourness, strength, body, bitterness and liking. Contrary to the findings of the present study they did not observe an effect of beer colour on any of the sensory properties measured. How could this be? A notable difference between the present study and the studies discussed above is the colour of the beer samples used. While our samples were pale and dark amber (see Figure 3), the samples used by Carvalho et al. (2017) and Reinoso-Carvalho et al. (2019) were noticeably darker: pale amber and dark. The notion of ‘degree of discrepancy’ offers a possible explanation. Spence & Piqueras-Fiszman (2016) describe ‘degree of discrepancy’ as a mismatch between the expected flavour set by colour and the actual flavour. In simple terms, the colour of the beverage must be realistic and the mismatch between expected and actual properties relatively small. This would explain why the present study successfully demonstrated the effect of colour, while Carvalho et al. (2017) and Reinoso-Carvalho et al. (2019) did not: the samples they used were probably too dark. It would be interesting to explore the effect of beer colour on perception further using a wider range of beer colours. This would allow us to precisely
pinpoint the optimal ‘degree of discrepancy’ and answer the question ‘how dark is too dark’ for assimilation of expectations to occur.

Overall, it appears that the colour of beer can be used to fine tune consumer experience. Colouring, or lack of, could thus be used to increase perceived bitterness and body or highlight perception of refreshment and liking, alternatively. To give an example, as reduced alcohol beers are often described as lacking body (Sohrabvandi, Mousavi, Razavi, Mortazavian, & Rezaei, 2010), making non-alcoholic beer darker could potentially improve this aspect of the flavour profile. However, it should be noted that darker colour and thus increase in bitterness and body was also associated with decreased refreshment and liking. While not desirable, these effects of colour on perceived refreshment and liking could be balanced out by a sensory descriptor.

4.1 Mediaion

Apart from the novel findings discussed above, the present study contributes to the literature with an explicit demonstration of the mediating effect of expectations. As described in the introduction, there are several studies that claim that the effect of product-related cues on sensory perception and hedonic evaluation is mediated by expectations. As defined by MacKinnon (MacKinnon, Fairchild, & Fritz, 2007), a mediating variable transmits the effect of an independent variable on a dependent variable and testing mediation can explain the process by which one variable affects another. This and other expectations studies claim that expectations mediate or transmit the effect of extrinsic and intrinsic cues on perception of beer. Mediation analysis allows us to demonstrate that the relationship between product-related cues and change in perception is caused, at least in part, by expectations. While the relationship between cues/information, expectations and perception is intuitive, intuition and personal experience are not sufficient to support such a claim. In the present study, we were able to demonstrate that the effects of colour and sensory descriptor were indeed mediated by expectations.

In the case of perceived bitterness, refreshment, liking and body the sensory descriptor ‘bitter’ only affected ratings indirectly: that is the effect of sensory descriptor was clearly mediated through expectations. While we observed only direct effects of beer colour on ratings of body, with bitterness, refreshment and
liking beer colour had both a direct and indirect effect. The fact that colour affected perception both directly and indirectly suggests that its effect is only partially mediated through expectations. A partial mediation would suggest that the model may be incomplete and there may be another latent variable in the model. In our study, participants thought about and then rated their expectations, thus these expectations ratings only accounted for the conscious associations between the cues and sensory/hedonic perception. It is possible that there are associations between cues and sensory perception that are processed unconsciously, yet can still generate changes in perception of taste, flavour and liking. This needs to be directly tested and modelled in future studies.

Returning to the theory of expectations, researchers often want to determine whether product-related cues generate expectations that lead to change in perception. This change in perceived properties of a food or beverage can be either in line with (assimilation) or in contrast (contrast) to these expectations. Mediation analysis is a convenient tool to test whether assimilation or contrast effect occurred. In order to establish assimilation or contrast, we first need to test whether a given cue has an effect on perception and expectations, then we need to establish that expectations affect perception, and finally we need to test the mediating effect of expectations. Looking at a simple mediation model, like one visualized in Figure 1 A, if mediation is established, both paths \( a \) and \( b \), as well as the indirect effect \( c' \) should be significant. If both the direct and indirect effect (\( c' \) and \( ab \)) are in the same direction (i.e. both positive or both negative), we can conclude that assimilation occurred. In the case of a contrast effect, the mediator would act as a suppressor (a case of inconsistent mediation) and we would observe direct and indirect effects to be in opposite directions (\(-c'\), \( ab \) or \( c'\), \(-ab\)). The present data strongly support a simple assimilation effect. The circumstances and boundary conditions of these scenarios need to be investigated in future studies. In conclusion, compared to other approaches, mediation analysis is an elegant way to develop and subsequently test models and theories.

4.2 LIMITATIONS

A slight concern in interpretation of the current data was the unexpected effect of beer colour on ratings of body and bitterness during the blind tasting. While we tried to minimise the lighting in
the room by using black computer background and red lightbulb, it is possible that this did not mask
the colour differences and participants could distinguish between the light and dark beer samples. It
is also likely that participants paid close attention to the beer samples in such an unusual environment
(dark, red-lit testing cubicle), noticing even minor differences between the samples. Concealing
aspects of appearance is generally problematic both in a laboratory and a more realistic setting. If,
like in the present study, researchers do not manage or cannot completely obscure the appearance of
the samples, it can affect results and their interpretation.

The boxplots in Figures 6 A-D show the means as well as the spread of the data from the
blind tasting session, and while in the case of bitterness and body the effect of colour was statistically
significant, the mean differences appear to be relatively small and inconsistent. More importantly,
these small baseline differences did not prevent generation and ultimately assimilation of
expectations in the experimental session. In the case of the present study, the failure to completely
obscure the colour difference between the samples would result in reduced power and ultimately
underestimation of the effects of beer colour on sensory and hedonic perception. However, overly
conservative estimates of effect sizes are considered to be a smaller issue than their overestimation,
as most psychological studies indeed tend to overestimate effect sizes (Brand, Bradley, Best, &
George, 2011).

4.3 Summary

What are the implications of the findings discussed above? The findings of the present study suggest
that in the context of beer both sensory descriptor and beer colour can change not only consumers’
expectations but also their sensory and hedonic perception. This knowledge is invaluable for improving
consumers’ experience of beers with reduced alcohol content. The conclusions made in this study could be
used to increase consumers’ acceptance and enjoyment of non-alcoholic beers. We suggest using sensory
descriptors on labels to strengthen consumers’ expectations of the sensory properties that need to be improved.
The effect of extrinsic cue, such as sensory descriptor can be furthered modulated by colour (or vice versa). Beer colour appears to be a versatile tool to modify expectations and ultimately perception of body, as well as other aspects of taste, flavour, mouthfeel and even liking, aspects that consumers may find problematic in the context of non-alcoholic beer. Of course, because the current study only used samples containing alcohol and only tested one sensory descriptor, the findings reported here need to be replicated in beers ranging in alcohol content and using other sensory descriptors.

While beer is one of the most popular alcoholic beverages in the world (Ritchie & Rossier, 2019), consumers are encouraged to moderate its intake (UK Department of Health, 2016; Rehm, Lachenmeier, Llopis, Intia, & Anderson, 2016). As a result, the demand for alternatives with reduced alcohol content is rising (Abboud, 2019). Despite the rise of sales of beer with reduced alcohol content, consumers are often not satisfied with its flavour profile (Catarino & Mendes, 2011), especially criticizing the lack of perceived body (Sohrabvandi et al., 2010). The findings presented above suggest that cues not directly related to the chemosensory properties of the beer can be used to further improve consumers experience of beer, particularly useful for the development of reduced alcohol beer.
5 References


6 Figures

Figure 1. A: Single mediator model and commonly used notification. B: Proposed mediation model describing the relationship between extrinsic and intrinsic cues, expectations and perception of taste and flavour. Total effect: \( c = c' + ab \). Direct effect: \( c' \). Mediated effect: \( me = ab \). Path a: Effect of IV on M. Path b: Effect of M on DV.
Figure 2. Beer labels presented to participants on a computer screen during the experimental session. The labels contained the same information and only differed in the design: angular typeface (A), round typeface (B).
Figure 3. The colour difference between the light and dark beer samples
Figure 4. Experimental procedure: Participants rated four different beer samples in the blind tasting session and twelve sample-label combinations in the experimental session.
Figure 5. The effect of label typeface (round vs. angular) on expected and perceived bitterness, refreshment, liking and body. All differences between theangular and round typeface label were statistically non-significant ($p>0.05$).
Figure 6. Ratings of perceived bitterness (A), refreshment (B), liking (C) and body (D) during the blind tasting session. * $p<0.05$, ** $p<0.01$, *** $p<0.001$
Figure 7. Expectations mediating the effect of extrinsic cues. A: The effect of actual bitterness (taste), descriptor “bitter” and darker beer colour on expected and perceived bitterness (A), refreshment (B), liking (C) and body (D). Numeric values represent estimates of the direct effect ($a$, $b$, $c'$) with the indirect effect ($m$) in brackets below. Presence of a line in the mediation model denotes a presence and a nature of a relationship between the variables:
### Table 1
Mean (SE) perceived characteristics of the four samples of beer when tasted blind.

<table>
<thead>
<tr>
<th></th>
<th>Bitter light</th>
<th>Bitter dark</th>
<th>Mild light</th>
<th>Mild dark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitter</td>
<td>34.6 (2.5)</td>
<td>41.5 (3.0)</td>
<td>30.5 (2.9)</td>
<td>34.1 (3.1)</td>
</tr>
<tr>
<td>Refreshment</td>
<td>52.8 (2.9)</td>
<td>47.7 (2.7)</td>
<td>52.6 (3.0)</td>
<td>51.6 (3.0)</td>
</tr>
<tr>
<td>Body</td>
<td>37.0 (2.5)</td>
<td>45.2 (2.3)</td>
<td>36.2 (2.7)</td>
<td>40.6 (2.4)</td>
</tr>
<tr>
<td>Liking</td>
<td>59.0 (2.2)</td>
<td>55.9 (2.5)</td>
<td>60.1 (2.6)</td>
<td>58.7 (2.6)</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>label</th>
<th>taste</th>
<th>colour</th>
<th>session</th>
<th>blind</th>
<th>dark</th>
<th>expected</th>
<th>light</th>
<th>dark</th>
<th>perceived</th>
<th>light</th>
<th>dark</th>
</tr>
</thead>
<tbody>
<tr>
<td>bitter</td>
<td>NA</td>
<td>NA</td>
<td>52.31</td>
<td>(3.0)</td>
<td>66.78</td>
<td>54.53</td>
<td>(2.7)</td>
<td>54.27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mild</td>
<td>NA</td>
<td>NA</td>
<td>53.68</td>
<td>(3.0)</td>
<td>67.76</td>
<td>44.57</td>
<td>(2.7)</td>
<td>48.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>standard</td>
<td>NA</td>
<td>NA</td>
<td>32.27</td>
<td>(2.6)</td>
<td>48.76</td>
<td>38.84</td>
<td>(3.1)</td>
<td>51.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mild</td>
<td>NA</td>
<td>NA</td>
<td>32.93</td>
<td>(2.2)</td>
<td>49.93</td>
<td>35.88</td>
<td>(2.9)</td>
<td>42.23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bitter</td>
<td>34.56</td>
<td>41.49</td>
<td>30.38</td>
<td>(2.7)</td>
<td>58.99</td>
<td>39.95</td>
<td>52.96</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mild</td>
<td>30.47</td>
<td>34.1</td>
<td>29.54</td>
<td>(2.9)</td>
<td>60.36</td>
<td>33.1</td>
<td>46.62</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3
Mean refreshment ratings (SE)

<table>
<thead>
<tr>
<th>label</th>
<th>taste</th>
<th>session</th>
<th>blind</th>
<th>expected</th>
<th>perceived</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>colour</td>
<td>light</td>
<td>dark</td>
<td>light</td>
</tr>
<tr>
<td>bitter</td>
<td>NA</td>
<td>50.86</td>
<td>31.05</td>
<td>45.57</td>
<td>35.82</td>
</tr>
<tr>
<td></td>
<td>NA</td>
<td>(2.8)</td>
<td>(2.0)</td>
<td>(3.0)</td>
<td>(2.6)</td>
</tr>
<tr>
<td>mild</td>
<td>NA</td>
<td>49.89</td>
<td>36.61</td>
<td>51.93</td>
<td>39.96</td>
</tr>
<tr>
<td></td>
<td>NA</td>
<td>(2.6)</td>
<td>(2.4)</td>
<td>(2.8)</td>
<td>(2.8)</td>
</tr>
<tr>
<td>bitter</td>
<td>NA</td>
<td>55.38</td>
<td>36.61</td>
<td>48.28</td>
<td>36.30</td>
</tr>
<tr>
<td></td>
<td>NA</td>
<td>(2.5)</td>
<td>(2.4)</td>
<td>(2.9)</td>
<td>(2.8)</td>
</tr>
<tr>
<td>standard</td>
<td>bitter</td>
<td>NA</td>
<td>NA</td>
<td>54.14</td>
<td>51.52</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.7)</td>
<td>(2.3)</td>
<td>(2.7)</td>
<td>(2.7)</td>
</tr>
<tr>
<td>mild</td>
<td>NA</td>
<td>52.76</td>
<td>47.69</td>
<td>61.82</td>
<td>45.93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.9)</td>
<td>(2.7)</td>
<td>(2.5)</td>
<td>(2.9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(2.8)</td>
</tr>
<tr>
<td>No label</td>
<td>bitter</td>
<td>52.58</td>
<td>51.59</td>
<td>61.19</td>
<td>54.55</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.0)</td>
<td>(3.0)</td>
<td>(2.5)</td>
<td>(3.1)</td>
</tr>
<tr>
<td></td>
<td>mild</td>
<td>52.58</td>
<td>51.59</td>
<td>61.19</td>
<td>37.54</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.0)</td>
<td>(3.0)</td>
<td>(2.5)</td>
<td>(2.7)</td>
</tr>
</tbody>
</table>
Table 4

Mean liking ratings (SE)

<table>
<thead>
<tr>
<th>label</th>
<th>taste</th>
<th>session colour</th>
<th>blind light</th>
<th>dark</th>
<th>expected light</th>
<th>dark</th>
<th>perceived light</th>
<th>dark</th>
</tr>
</thead>
<tbody>
<tr>
<td>bitter</td>
<td>NA</td>
<td>55.64 (2.5)</td>
<td>40.26 (2.5)</td>
<td>54.08 (2.8)</td>
<td>45.03 (2.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mild</td>
<td>NA</td>
<td>50.59 (2.5)</td>
<td>45.67 (2.5)</td>
<td>59.18 (2.4)</td>
<td>49.28 (2.9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>standard</td>
<td>bitter</td>
<td>57.26 (2.7)</td>
<td>45.30 (2.5)</td>
<td>58.54 (2.9)</td>
<td>43.81 (2.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mild</td>
<td>NA</td>
<td>59.18 (2.5)</td>
<td>47.96 (2.4)</td>
<td>60.05 (2.8)</td>
<td>53.00 (2.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No label</td>
<td>bitter</td>
<td>59.03 (2.2)</td>
<td>55.91 (2.5)</td>
<td>62.68 (2.2)</td>
<td>42.69 (2.7)</td>
<td>53.34 (2.8)</td>
<td>44.54 (3.1)</td>
<td></td>
</tr>
<tr>
<td>mild</td>
<td>NA</td>
<td>60.14 (2.6)</td>
<td>58.68 (2.6)</td>
<td>64.41 (2.1)</td>
<td>45.58 (2.5)</td>
<td>59.34 (2.7)</td>
<td>48.16 (2.6)</td>
<td></td>
</tr>
</tbody>
</table>
### Table 5
Mean ratings of Body (SE)

<table>
<thead>
<tr>
<th>label</th>
<th>taste</th>
<th>session</th>
<th>blind</th>
<th>colour</th>
<th>light</th>
<th>dark</th>
<th>expected</th>
<th>light</th>
<th>dark</th>
<th>perceived</th>
<th>light</th>
<th>dark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bitter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mild</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>standard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mild</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bitter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No label</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mild</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|         |       |         |       |        |       |      |          |       |      |           |       |      |
|         |       |         |       |        |       |      |          |       |      |           |       |      |
|         |       |         |       |        |       |      |          |       |      |           |       |      |
|         |       |         |       |        |       |      |          |       |      |           |       |      |
|         |       |         |       |        |       |      |          |       |      |           |       |      |
|         |       |         |       |        |       |      |          |       |      |           |       |      |
|         |       |         |       |        |       |      |          |       |      |           |       |      |
|         |       |         |       |        |       |      |          |       |      |           |       |      |
|         |       |         |       |        |       |      |          |       |      |           |       |      |
|         |       |         |       |        |       |      |          |       |      |           |       |      |