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Short Communication

Effects of noise and distraction on alcohol perception

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ABSTRACT

Recent research demonstrated that noise unconnected to the target stimulus can alter taste perception of food, but it is not clear whether similar effects might be seen with respect to alcohol. This is particularly important, as it might help explain previous reports of higher/faster alcohol consumption in loud music environments. In the between subjects experiment here, participants ($n = 80$) completed standardised taste and olfactory tests, followed by a taste test of alcoholic beverages varying in strength (0, 1.9, 3.9, 5.6, and 7.5 pct abv) in a randomly allocated distractive or control condition. Distractive conditions were either music, shadow (listening and repeating a news story) or shadow and music (S-Music). We found that exposure to music led to higher sweetness ratings compared to all remaining groups. Interestingly, discrimination of alcohol strength was impaired for individuals in the S-Music compared to remaining groups which was accompanied by increased negative mood. This is the first experimental work to demonstrate how music and other forms of distraction alter taste perception of alcohol and suggest a mechanism by which distraction leads to increases in alcohol consumption.

1. Introduction

The extent to which auditory cues can influence food and drink perception has become a lively area of research in recent years, with a number of theories attempting to explain these effects.

In terms of background music, it has been proposed that increases in certain dimensions (e.g. volume/speed) lead to raised levels of arousal, resulting in increasing behavioural responses toward the food/drink (Gueguen, Le Guellec, & Jacob, 2004). The evidence for this theory rests on observational work, where for

(72 dB) level of popular music. Though the precise mechanism linking arousal to consumption is not clear, and as acknowledged by these authors, no research has measured whether arousal actually changes in these conditions. A second theory speculates that music acts to alter mood states (e.g. increasing positive mood) and thereby concurrent activities; as has been demonstrated with pleasant music leading to longer periods spent in drinking environments (Jacob, 2006). A third theory more generally posits that music causes a distraction away from the main activity of drinking/eating and thereby may explain why perception is altered (Bellisle & Dalix, 2001; Crocker, 1950). Finally, and most relevant here is the theory that music alters the perception of the taste of the food/drink via multi-sensory integration of sensory cues and specifically the aspect of sensory dominance (Spence & Shankar, 2010). The latter is where information used to make a decision about stimuli derive from one sensory modality only, which may be straightforward in some instances – e.g. visual spatial judgments rely most heavily on the visual sense – but less so in others. In terms of sound arising from the food itself, it was demonstrated that manipulating the volume made when an individual bit into the same potato crisp resulted in altered perception of freshness and crispness (Zampini & Spence, 2004); therefore suggesting that in judging the fresh- ... ates over gusta- ... dressed whether environmental sound that is unconnected to the food itself can influence perception, where it was found that the same food items were rated as less salty and sweet in a loud versus quiet (white) noise environment (Woods et al., 2011).

The aim of the present study was to extend this research to examine whether background noise can also influence the perception of alcohol. On the basis of sensory integration, we theorise that the perception and specifically the taste of alcohol may actually change as a result of background music/distraction. Relevant to the present study, work has shown that individuals who rated whisky as sweeter (and less bitter) had higher habitual alcohol consumption (Lanier, Hayes, & Duffy, 2005). This could be due to humans having an innate preference for sweet foods (Steiner, 1979), which would suggest that those who find alcohol sweeter will consume more. This also connects to work where individuals unable to discriminate alcohol from placebo consumed twice as much alcohol in the previous 6 months (Jackson, Stephens, & Duka,

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2001). Moreover, the main difference between alcohol discriminators and non-discriminators was in terms of initial dislike of the test beverage (alcohol, tonic, and tabasco). These two studies highlight the important connection between sensory factors of taste and alcohol consumption.

This may help explain why individuals drink more alcohol in a noisy environment (Gueguen et al., 2004; Gueguen, Jacob, Le Guellec, Morineau, & Lourel, 2008), in terms of alcohol being perceived as higher in sweetness (lower bitterness). We also examine the effects of background noise on perceived alcohol strength, since there is evidence linking this factor to the longer duration to consume stronger alcoholic beverages (study 1, Higgs, Stafford, Attwood, Walker, & Terry, 2008).

In order to investigate this issue, we completed an experiment to see whether music and other distractions influence perception of alcohol. We chose music rather than white noise, since this is consistent with the previous research (Gueguen et al., 2004, 2008) on alcohol and offers more ecological validity in that alcohol is more commonly experienced with music than white noise. Participants were randomly allocated to one of four conditions and simultaneously provided sensory ratings of beverages varying in alcohol content. The four conditions varied in the level of distraction: (1) control-no distraction, (2) music, (3) shadowing task, requiring the listening and repeating of a general news story, and (4) shadowing task (other ear) and music (one ear). The rationale for using shadowing tasks in addition to just music was based on the fact that in the previous study (Gueguen et al., 2008) participants were observed in pairs in popular bars which meant that in addition to being exposed to the background music, individuals were also talking to each other whilst consuming their beverages. It therefore seemed important in the present study to understand whether music alone, listening/talking or a combination of the two produce the largest variations in sensory evaluation. In order to study this experimentally, we adopted the use of a shadowing task used in previous dichotic listening research (Stafford & Scheffler, 2008), which requires the participant to both listen and repeat information and is therefore a relatively good simulation of the more natural behaviour.

Since this is the first study to investigate this question, our predictions are mainly exploratory. We tentatively theorise that the estimation of sweetness, bitterness and alcohol strength will be significantly different in the distracting versus control condition. We also wished to verify whether arousal and mood were altered by the distracting conditions, as has been theorised (Gueguen et al., 2004; Jacob, 2006). Finally, since we are examining a dimension of taste sensitivity, it was also important that prior to testing, that we measured participants general taste and olfactory sensitivity (since olfaction plays an important role in taste perception, Stevenson, Boakes, & Wilson, 2000) to check for any differences between groups.

2. Methods

2.1. Participants

Eighty university students (69 females/11 males) participated in the study, aged between 18 and 28 years of age (M = 18.9, SD = 1.7). Participants were recruited using an online system where the study was advertised as examining what factors influence our sense of alcohol perception. Participants were invited to take part if they were aged between 18 and 30 and were regular consumers of alcohol, consuming at least eight units of alcohol per week, consistent with previous research (Higgs et al., 2008). The study protocol was given ethical approval from the department's ethics committee (BPS guidelines).

2.2. Design

The study used a mixed design where participants were randomly allocated to one of four groups (Table 1) and made sensory ratings of five different drinks. Group was therefore studied between-subjects and drink was within-subjects. The main dependent variable was their sensory ratings of the five drinks.

2.3. Materials

2.3.1. Alcohol usage questionnaire (AUQ)

Patterns of habitual alcohol consumption were measured using a questionnaire (based on (Mehrabian & Russell, 1978)). Participants were accepted into the study only if their total weekly alcohol consumption was over eight units of alcohol.

2.3.2. Olfactory and taste tests

The olfactory threshold and taste tests were from the 'Sniffin Sticks' battery (Burghart Instruments, West Germany). The olfactory test uses pen like instruments to test minimum (i.e. smallest concentrations of the test odour, *n*-butanol) olfactory thresholds, whilst the taste test uses four different sprays (sweet–sour–salty–bitter) to measure whether individuals can discern the presented taste. These tests have been used widely in research (Albrecht et al., 2009; Hummel, Kobal, Gudziol, & Mackay-Sim, 2007; Seo & Hummel, 2009).

2.3.3. Arousal, thirst, and hunger

Arousal and hunger were measured using 100 mm visual analogue scales (VASs) unmarked lines anchored with "not at all" and "extremely". The adjectives were centred above each line in the following order; "alert", "thirsty", "drowsy", and "hungry".

2.3.4. Positive and negative mood

The positive and negative affect schedule (PANAS) from (Watson, Clark, & Tellegen, 1988) was used to measure mood during the experiment. The PANAS consisted of a five point Likert scales ranging from 1 (very slightly or not at all) to 5 (extremely) on which participants rated their feelings and indicated the extent to which they currently experienced 10 positive and 10 negative emotions.

2.3.5. Drinks and administration

A mini-study was conducted in order to select the most appropriate levels of alcohol and mixer. Ten participants (eight females/two males) were presented with beverages varying in alcohol content (0, 1.9, 3.9, 5.6, and 7.5 pct abv, Tesco Value vodka, 37.5% abv), in three different mixers (Tesco smooth cranberry, Schweppes Indian tonic water, Tesco pure orange juice), presented in a counterbalanced order; participants rated the taste (and other sensory characteristics including alcohol strength) using VAS. Cranberry was selected for the main study since it was not exceedingly easy to detect differences in taste (sweet/bitter) and alcohol strength, as was the case for orange or very difficult, as was tonic water. Cranberry and vodka were refrigerated separately at a temperature of 7 °C. For the main study, participants received five freshly prepared drinks (counterbalanced order), each in 25 ml shot glasses (Arcoroc, Amazon, UK): 0 pct abv (20 ml cranberry); 1.9 pct abv (19 ml cranberry/1 ml vodka); 3.9 pct abv (18 ml/2 ml); 5.6 pct (17 ml/3 ml); 7.5 pct abv (16 ml/4 ml), hence all drinks were the same volume. For each beverage, participants used VAS anchored with "low" or "not at all" followed by the relevant adjective, and "high" or "very", again followed by the relevant adjective. The following descriptors within the context of a sentence verifying the question were centred above each line in the following order; "cold", "familiar", "alcohol strength", "like", "sweet", and "bitter". These descrip-

Table 1
Mean (SEM) participant characteristics.

	Group								Group differences
	Control		Music		Shadow		S-Music		
	M	SE	M	SE	M	SE	M	SE	
Age	19.2	0.5	19.2	0.5	18.8	0.2	18.8	0.3	$F = 0.32$, NS
UK alcohol units (p/week)	46.0	6.5	45.5	6.7	39.8	4.9	43.7	6.11	$F = 0.21$, NS
Odour threshold	7.9	0.6	7.6	0.5	8.5	0.4	9.2	1.6	$F = 0.60$, NS
Taste score	3.4	0.2	3.2	0.2	2.9	0.3	3.1	0.2	$F = 0.84$, NS
Gender (M:F)	3:17		2:18		4:16		2:18		$\chi^2 = 1.1$, NS
Number of smokers	5		6		6		4		$\chi^2 = 0.71$, NS

tors were the same as those used in previous research (Higgs et al., 2008).

2.3.6. Music and shadowing stimuli

A preliminary study was undertaken to select the most appropriate music to use for the study. Ten participants (one male/nine female) were presented with five separate pieces of music via headphones, that varied in modern genres (Drum and bass, House, Hardcore, Dubstep and Trance). After each (1 min) piece of music, participants completed VAS in terms of: likeability, volume, novelty, familiarity, and distractibility. The piece (Hardcore, 303 Freestyle, Jamie Ritmen – Scott Brown – Hardcore Heaven 4) with the highest levels of distractibility and volume were selected for the main study.

For the shadowing task, we used various news articles similar to a previous study (Stafford & Scheffler, 2008) all selected from the BBC news website (http://news.bbc.co.uk/) and different items for the practice task and main task. These articles were recorded by the same male voice (native English speaker) at approximately 120 words per minute. The same news articles were used for both the shadow and S-Music conditions. The music [prominent frequency: 56db at 65 Hz (note: C3)] and shadowing tasks were compiled in audio format (using Sound Forge 7.0) presented via stereo headphones (Unitone HD-3030) connected to a PC (Windows XP professional operating system), with sound volume set to 80 db. For the S-Music group, the ear of presentation was counterbalanced. For all three distracting conditions, 24 min of material (i.e. music and news article) were recorded, being easily sufficient for the task of tasting and rating the drinks (see Section 2.4).

2.4. Procedure

All testing took place between 1200 and 1700 and participants were asked to consume lunch before coming to the laboratory. Upon arrival, participants provided informed consent and completed the AUQ. Next, they were blindfolded and completed the olfactory threshold test, followed by the taste test, with sips of water (provided) between each tastant. After this, arousal, thirst and hunger ratings were taken, followed by positive and negative mood. Participants were then taken to a different room, where they were presented with the five test drinks and instructed to sample each drink by taking one sip only, then to complete the VAS, take a sip of water and to repeat for the next drink, working from left to right. Prior to this task, participants in the shadow and S-Music groups were given practice in shadowing the news article which lasted one minute, with participants in the shadow-music group having the news article presented to one ear and music to the second ear (same pairing for main task). Only when participants could complete this task adequately was the main task initiated. For the main task these participants were instructed to sample and rate drinks whilst simultaneously shadowing the article and (if relevant) listening to music. In all shadowing groups it was strongly emphasised that participants must attempt to repeat the information as much as possible throughout the task. When all of the drinks had been sampled, the completed VAS ratings were removed and if relevant, the distracter task was terminated. Next, final measures of arousal, thirst and hunger ratings were taken, followed by positive and negative mood. The participant was then given a full debriefing. The study took approximately 45 min.

2.5. Analysis

The alcohol strength and other sensory data were analysed using separate repeated measures ANOVAs, using the within-subjects factor of Drink (0, 1.9, 3.9, 5.6, and 7.5 pct abv) and between-subjects factors of group (control/music/shadow/S-Music). The positive and negative mood and arousal/thirst/hunger data were analysed by using the change scores from baseline which were entered into separate Univariate ANOVAs using the between-subjects factor of group (control/music/shadow/S-Music).

3. Results

3.1. Sensory ratings

For sweetness, we found an effect of Drink, $F(4,300) = 8.66$, $p < .001$, $\eta^2 = .10$, with as expected ratings decreasing in line with increasing alcohol content of drink (Table 2). More importantly, a main effect of group was also observed, $F(3,75) = 6.23$, $p = .001$, $\eta^2 = .20$, where ratings were higher in the music compared to all remaining groups (all *ps* < .05), who did not vary from each other (Fig. 1). In terms of bitterness, there was a main effect of drink, $F(4,304) = 12.33$, $p < .001$, $\eta^2 = .14$, where increases in bitterness were generally found with increases in alcohol content (Table 2). There was a marginal effect of group, $F(3,76) = 2.49$, $p = .06$, $\eta^2 = .09$, where comparisons revealed lower bitterness ratings for music compared to both control and shadow (*ps* < .05) but not S-Music ($p > .20$), with the three latter groups not varying from each other. For liking, we found a main effect of drink, $F(4,304) = 6.71$, $p < .001$, $\eta^2 = .08$, with decreases in liking with increasing alcohol content (Table 2). There were no effects for familiarity or cold. In summary, these data suggest that music alone had the largest effect on altering sweet/bitter perception.

Table 2
Mean (SEM) sensory drink ratings dependent on drink.

	0	1.9	3.9	5.6	7.5
Sweet	55.9 (2.8)	54.3 (2.6)	51.7 (2.4)	44.0 (2.5)	42.0 (2.5)
Bitter	30.8 (2.6)	37.3 (2.9)	36.0 (2.7)	45.8 (2.8)	49.0 (2.8)
Liking	53.6 (3.1)	51.9 (2.9)	48.6 (2.9)	45.1 (2.6)	39.2 (2.8)
Familiar	53.1 (2.9)	52.5 (2.8)	48.6 (2.7)	49.8 (3.1)	48.8 (3.0)

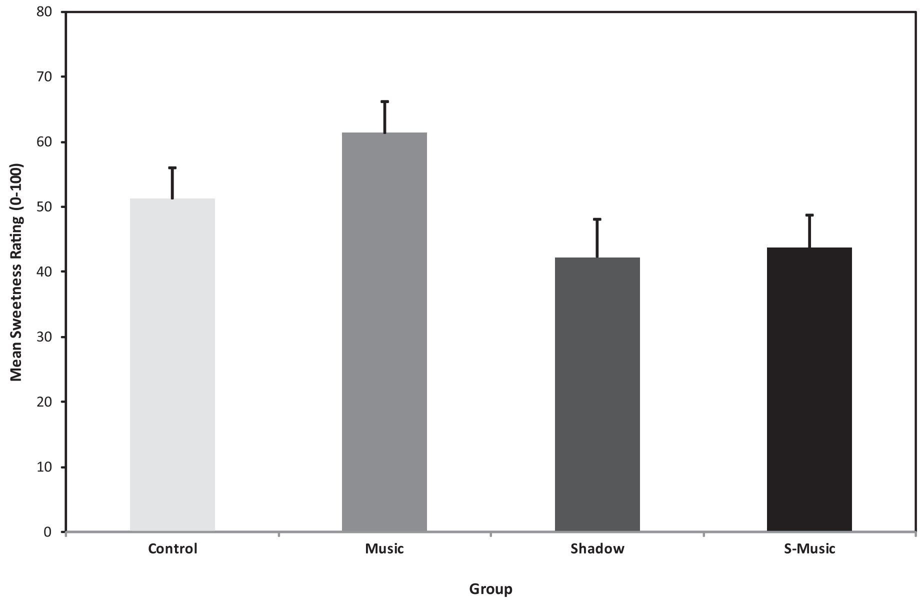

Fig. 1. Mean sweetness ratings by group error bars represent standard errors of the mean.

3.2. Alcohol strength

We found a main effect of drink, $F(4,304) = 39.81$, $p < .001$, $\eta^2 = .34$ with ratings increasing with alcohol content. The main effect of group was not significant ($F < 1$), though importantly, we found a significant group × drink interaction, $F(12,304) = 1.85$, $p = .04$, $\eta^2 = .07$, with clearly poorer discrimination between drinks for those in the S-Music group (Fig. 2). In order to analyse this interaction, we first examined the group differences for each drink separately using pairwise comparisons. This revealed a difference in the 0 pct drink only, with higher ratings in the S-Music versus shadow ($p < .01$) condition (Fig. 2). Secondly, since we also wished to understand how the perception of drinks varied within each distraction condition, we calculated a discrimination index score by measuring the mean difference between the five drinks, with larger resulting figures indicative of higher discrimination between beverages. This index was then entered into a univariate ANOVA with group as the between-subjects factor. A group effect was found, $F(3,76) = 2.73$, $p = .04$, $\eta^2 = .10$, with poorer discrimination between the S-Music and control and shadow groups (both *ps* < .05), with these three groups not differing from the music group (all *ps* > .10) (Fig. 3). This demonstrates that discrimination of alcohol strength was most impaired in the S-Music group.

3.3. Arousal/thirst/hunger

There were no significant effects in either alertness or drowsy ratings (all *Fs* < 1.1), suggesting that arousal did not vary between distracting conditions. No other effects were significant.

3.4. Positive and negative mood

Negative mood ratings demonstrated a group effect $F(3,76) = 3.49$, $p = .02$, $\eta^2 = .12$, where ratings increased signifi-

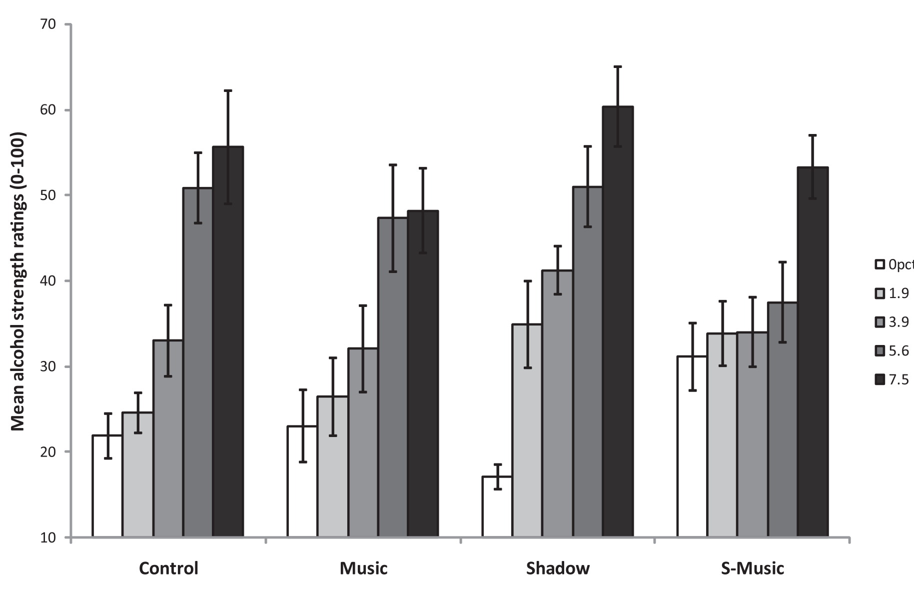

Fig. 2. Mean alcohol strength ratings dependent on drink and group error bars represent standard errors of the mean.

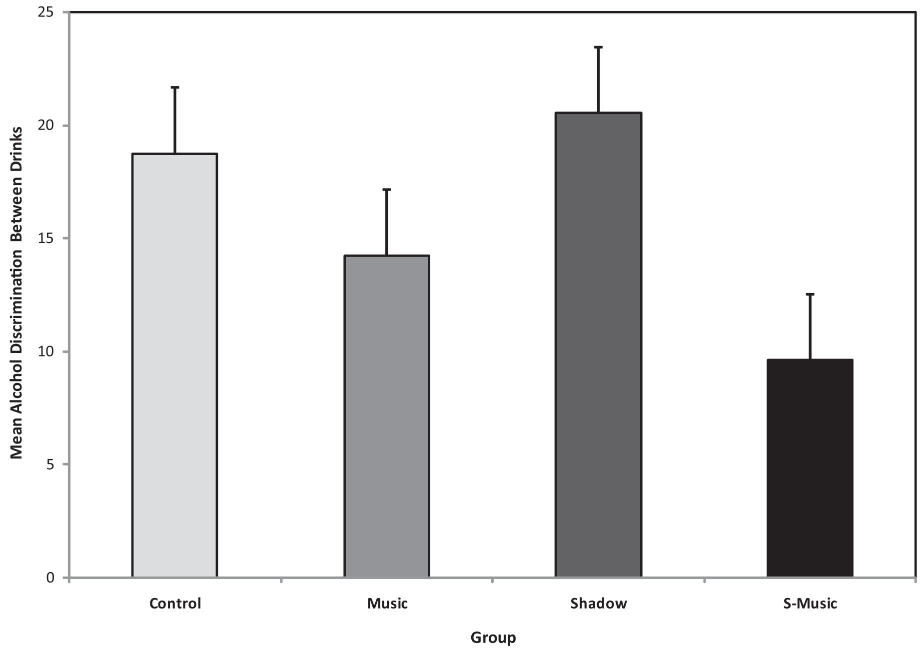

Fig. 3. Mean alcohol strength index dependent on group error bars represent standard errors of the mean.

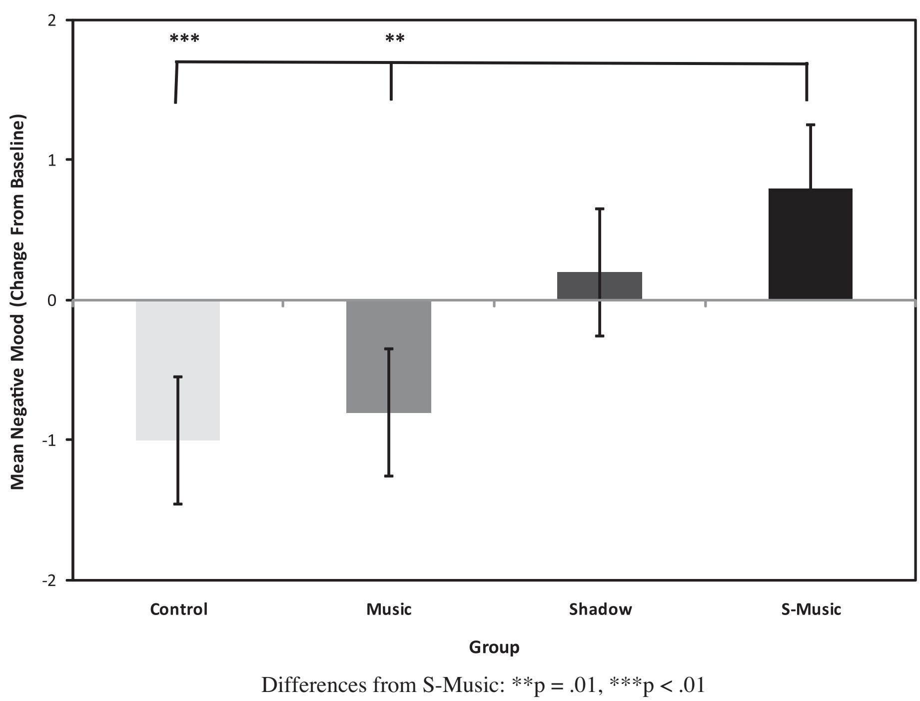

Fig. 4. Mean negative mood (changes from baseline) dependent on group error bars represent standard errors of the mean.

cantly for the S-Music group compared to both control and music groups (both *ps* $< .05$) (Fig. 4). No effects were found for positive mood. This suggests that for those in the S-Music condition, negative ratings increased during the course of the experiment.

3.5. Correlations

In an effort to examine the relationship of the three most relevant sensory factors in this study under distraction conditions, we computed index scores (same method as for alcohol strength) for both the sweet and bitter data; we then correlated these index scores with alcohol strength index for the three distraction groups. This revealed significant associations for alcohol strength to both sweet, $r(59) = .39$, $p < .01$ and bitter, $r(60) = .33$, $p < .01$, who correlated more strongly between themselves, $r(60) = .66$, $p < .001$. This suggests a moderate association between the discrimination of alcohol strength and sweet/bitter, but unsurprisingly a far stronger association between sweet and bitter discrimination.

4. Discussion

The study found that sweetness perception of alcohol was significantly higher in the music compared to control and other distracting conditions, which is a novel finding and to our knowledge, not seen previously. The direction of this effect is in contrast to earlier work where exposure to loud white noise resulted in lower ratings of sweetness for sweet and savoury food (Woods et al., 2011). In attempting to account for these divergent findings, it would seem likely that the type of background noise (white noise/music) and the stimuli being judged (food/drink) are instrumental in predicting the direction of any effect. So, even if we consider the more general behavioural effects of music alone, research has found that simply manipulating genre, volume of music, led to differences in time spent in bars and amount of drink consumption (Jacob, 2006; McCarron & Tierney, 1989). It therefore appears quite possible that sweetness perception might vary according to the more broader differences between music in the study here and white noise in the earlier work (Woods et al., 2011).

In terms of alcohol strength, there were no overall differences between groups, but instead poorer discrimination of strength between drinks for those in the S-Music condition. This finding is curious given that music alone led to higher sweetness ratings and since sweetness and alcohol strength were found to correlate, we might then have expected overall lower perceived alcohol strength in the music compared to other conditions. One possibility accounting for these differences, concern the dimension of 'alcohol strength'. It could be that whereas asking individuals to rate the sweetness of the drink demands analytic processing (as has been proposed elsewhere, e.g. Prescott, Johnstone, & Francis, 2004; Schifferstein & Verlegh, 1996), in contrast asking them to rate 'alcohol strength' requires more synthetic processing (as is theorised for liking/pleasantness). This distinction is made stronger when we consider that perceiving alcohol strength is not directly related to taste (as are sweet/bitter/sour/salty/umami) and is likely influenced by its indirect relation to the initial sweet/bitter taste of alcohol and the post-ingestive effects (e.g. drowsiness, lightheadedness) of the drug itself. It is therefore possible that the complex task of perceiving alcohol strength is more easily disrupted by concurrent tasks placing a higher cognitive load, e.g. S-Music. Relevant here is research that found olfactory 'discrimination' was impaired in the context of verbal versus non-verbal noise but in a subsequent experiment, there was no such impairment from background music (Seo, Gudziol, Hähner, & Hummel, 2011). Hence, even the act of listening to someone talking was sufficient to impair olfactory discrimination; whereas no commensurate effect was found for music. Therefore in the present study, it is perhaps unsurprising that those who were both listening and repeating information (S-Music) were impaired in their ability to discriminate alcohol strength, with no equivalent effect in the music condition. In summary, it may be the case that taste dimensions that demand higher level processing (such as alcohol strength) are more sensitive to the effects of concurrent mentally demanding tasks. This may also explain why S-Music did not influence estimates of sweetness; due to the higher cognitive load obscuring any sensory dominance effects. In contrast, we theorise that the act of listening to music is not sufficiently demanding to disrupt synthetic processing (alcohol strength), but does influence analytical processing (sweetness), possibly due to a stronger connection (than alcohol strength) between the liking of the music and the stimulus (alcohol) itself. Relevant here is the finding from previous work, where liking for one of the food items was positively associated with liking for the background white noise (Woods et al., 2011). Additionally, an olfactory study found that odours were rated as more pleasant in the presence of pleasant (e.g. baby laughing) versus unpleasant (e.g. baby crying) sounds (Seo & Hummel, 2011). Of course, both of these findings are based on the nature of background noise linking to synthetic measures (liking, pleasantness) rather than analytical measures (sweetness). Hence to validate this theory further, research needs to examine whether pleasant/unpleasant background 'music' influences sweet perception of alcohol in a similar way.

In terms of the theoretical implications of the findings here, the absence of an effect of distraction on arousal suggests that alterations in taste perception are unlikely to be due to this factor. However, this theory (Gueguen et al., 2004) cannot be discounted completely, as it may be the case for heightened arousal toward alcohol to occur as a more complex interaction of music/distraction and the pharmacological effects of alcohol. So, it could be that the intoxicating effects of alcohol itself (e.g. disinhibition, lightheadedness) interact with those of music/distraction to produce a nett effect of increases in arousal.

In terms of mood theory; however, the observed negative mood increases in the S-Music group do suggest this might have some relation to alterations in the taste of alcohol. Relevant here is work where negative mood induction reduced olfactory sensitivity (Pollatos et al., 2007). Since olfactory and gustatory processes are closely aligned (Stevenson et al., 2000), it could be in the present study, individuals in the S-Music condition experienced an increase in negative mood which thereby led to poorer discrimination of alcohol strength. Nevertheless, the absence of a mood effect in the music group who did however show a clear effect on sweetness, suggests that alterations in the sweetness of alcohol are not contingent on changes in mood. The general distraction theory that loud noise disrupts taste and smell (Crocker, 1950) receives some support from the study, although the theory would seem to predict that greater distraction would lead to larger effects which is not consistent with the sweetness data here; as it was individuals in the music rather than S-Music group that produced the largest discrepancies in sweetness ratings. To explain this 'sweetness effect' of music, the evidence points more toward sensory dominance theory. Analogous to how audition can dominate over certain gustatory/olfactory processes in the perception of food (Woods et al., 2011; Zampini & Spence, 2004), the study here demonstrates a similar effect in alcohol. Interestingly, this also connects to work where implicit associations were faster and more accurate when sweet related words were paired with high pitched sounds compared to low pitched sounds (Crisinel & Spence, 2010). It could be that background music that is higher in pitch induces a stronger association toward the dimension of sweet, resulting in increased sweet perception. The broader theory of multisensory perception is also supported by the present study, in that it is evidently not the case that taste perception exists solely in the gustatory/olfactory domain but has significant input from other modalities (Spence & Zampini, 2006). Relevant here, rodent work has shown that low level olfactory coding in the olfactory tubercle also receives inputs from the auditory cortex, suggesting cross modal olfactory-auditory convergence (Wesson & Wilson, 2010). Separately human research has shown how perception of sweet tastes are affected by olfactory manipulations (e.g. Stevenson, Prescott, & Boakes, 1999). Taken together, these two lines of research suggest a putative process by which auditory stimulation can affect taste, possibly via the olfactory (retronasal) system.

The findings here provide a plausible mechanism by which music influences alcohol consumption (Gueguen et al., 2008). By consistently judging alcoholic beverages to be sweeter in a noisy environment, suggests an underestimation of the underlying alcohol strength. Since humans are born with an innate preference for sweet foods (Steiner, 1979), together with evidence that more alcohol is routinely consumed when considered sweeter (Lanier et al., 2005), help explain why more alcohol is consumed in noisy environments (Gueguen et al., 2008); hence taste and possibly 'sweetness' is a key factor in alcohol consumption.

Considering the limitations of the study, we recognise that the work here examines one aspect of alcohol taste perception and distraction: the initial sensory differences and it is therefore unclear how these characteristics might interact with the intoxicating effect of alcohol and distraction to influence perception, which would certainly benefit from further research. It would also be useful to understand whether alcohol taste perception is differentiated by different levels of volume as might be inferred from observational work (Gueguen et al., 2008); hence higher levels of volume could induce even greater estimates of alcohol sweetness. Connected to this, the differences between different sources of background noise (music vs. white noise) could also be examined. It is also worth highlighting that even though there were no differences between groups in pre-test taste identification, we cannot be certain whether the participants in the different groups were matched for sweetness threshold. Hence, it could be that participants in the music group might have had a lower threshold for sweetness and this could explain their higher sweetness ratings. Future work should control for this factor, by either conducting a threshold test for sweetness, else ask participants to rate the pre-study tastant for bitter and sweetness.

Finally, we accept that using an experimental design decreases ecological validity, especially in contrast to the earlier study (Gueguen et al., 2008). However, we contend that the knowledge learned from the work here in controlled conditions outweigh these disadvantages and further provide a paradigm for future experimental research in this area. Interestingly, given the possible connection between music liking and sweetness (discussed above), it could be that in more naturalistic environments (e.g. bars, clubs), where presumably patrons have a general liking for the accompanying music, for music to have an even greater effect on sweetness.

In summary, we found that social drinkers exposed to music, perceived a range of alcoholic beverages as sweeter and less bitter compared to those in the no music and other distracting conditions. Additionally, listening to the same music whilst performing a shadowing task resulted in impaired discrimination of alcohol strength. These findings help explain previous observational work on the effects of music on alcohol consumption (Gueguen et al., 2008) suggesting that music can alter the taste of alcohol which can therefore have serious consequences to individuals in noisy drinking environments.

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