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Impaired face symmetry detection under alcohol, but no 'beer goggles' effect

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Abstract

Background: The 'beer goggles' phenomenon describes sexual attraction to individuals when alcohol intoxicated whom we would not desire when sober. One possible explanation of the effect is that alcohol impairs the detection of facial asymmetry, thus lowering the drinker's threshold for physical attraction.

Aims: We therefore tested the hypotheses that higher breath alcohol drinkers would award more generous ratings of attractiveness to asymmetrical faces, and be poorer at discriminating bilateral facial asymmetry than less intoxicated counterparts.

Methods: Ninety-nine male and female bar patrons rated 18 individual faces for attractiveness and symmetry. Each type of rating was given twice, once per face with an enhanced asymmetry and once again for each face in its natural form. Participants then judged which of two same-face versions (one normal, the other perfectly symmetrised) was more attractive and, in the final task, more symmetrical.

Results: Alcohol had no influence on attractiveness judgements but higher blood alcohol concentrations were associated with higher symmetry ratings. Furthermore, as predicted, heavily intoxicated individuals were less able to distinguish natural from perfectly symmetrised face versions than more sober drinkers.

Conclusions: Findings therefore suggest alcohol impairs face asymmetry detection, but it seems that this perceptual distortion does not contribute to the 'beer goggles' phenomenon.

Keywords

alcohol, attraction, 'beer goggles', face judgements, symmetry perception

Introduction

Alcohol is a strong predictor of sexual behaviour often consumed prior to and during dates (Fielder and Carey, 2010; Grello et al., 2006; LaBrie et al., 2014; Lewis et al., 2012; Lindgren et al., 2009; Owen et al., 2010). Fielder and Carey (2010), for example, found 64% of female college students consume at least one alcoholic beverage right before a date (three on average), while LaBrie et al. (2014) found those who drink to excess typically engage in more advanced (often regrettable) sexual behaviours, including an increased likelihood of unprotected sex (Hingson et al., 2005). There are a range of possible reasons why alcohol drinkers are more inclined to engage in casual and potentially risky sex than sober counterparts. These include disinhibition, increased sexual motivation (Neave et al., 2008), heightened expectations of pleasure (George and Norris, 1991), personality factors (e.g. impulsivity, reward seeking) (Franken et al., 2006; Justus et al., 2000), *alcohol myopia* – a narrowing of attention to immediate goals (e.g. sexual satisfaction), rendering drinkers less capable of weighing the longer-term consequences of their actions (e.g. unwanted pregnancy, sexually transmitted infections, marital breakdown, etc.) (Steele and Josephs, 1990) and – the focus of the present study – a perceptual distortion referred to as the 'beer goggles' phenomenon.

The 'beer goggles' effect describes drunken attraction towards individuals we are unlikely to desire in a sober state (e.g. Jones et al., 2003; Monk et al, 2020; Pennebaker et al., 1979;). The basis of the effect is assumed to be alcohol-enhanced perceptions of physical beauty for inanimate and animate objects but particularly human faces, including our own (Bègue et al., 2013; Chen et al., 2014). In the earliest reported 'beer goggles' study, Pennebaker and Colleagues (1979) found patrons of a local bar were significantly more attracted to fellow drinkers at closing time compared to earlier that evening. A result later replicated using a within-subjects design (Gladue and Delany, 1990), though neither study reports the amount of alcohol consumed. This limitation was eventually addressed by Jones et al. (2003), who found a positive association between the number of reported alcohol beverages consumed and participant ratings of attractiveness towards opposite-sex individuals. The beer goggles phenomenon has since been associated with increases in breath alcohol concentration in real-world drinking scenarios (Johnco et al., 2010; Lyvers et al., 2011) and under more rigorous laboratory conditions (Chen et al., 2014; Monk et al., 2020; Parker et al., 2008). A meta-analytic review by Bowdring and Sayette (2018), however, revealed only a small positive effect of alcohol on ratings of physical attractiveness across 16 studies ($n = 1811$), and some attempts at observing the relationship are unsuccessful (Attwood et al., 2012; Bowdring and Sayette, 2023; Maynard et al., 2016; Neave et al, 2008). It is worth noting, though, that

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Attwood et al. (2012) did find significantly higher attractiveness ratings for an alcohol + nicotine (via cigarette) group, for a mix of face and landscape images. Also, while Bowdring and Sayette (2023) found no effect of alcohol on facial attractiveness ratings, when selecting images of people they would most like to interact with in a future study, alcohol intoxicated participants chose more attractive targets than sober controls.

So how might alcohol influence the visual perception of physical attractiveness? One influential view is that it disrupts the ability to detect subtle bilateral asymmetries of the face, leading to more forgiving judgements of physical beauty (Souto et al., 2008). Symmetry is so pervasive in nature that it is referred to in some scientific disciplines as a universal law of beauty (Leder et al., 2019; Voloshinov, 1996; Weyl, 1952). Many species favour symmetrical over asymmetrical forms (Enquist and Arak, 1994; Johnston et al., 2022; Stewart, 2001) and this extends to the shape of fellow organisms in particular (Watson and Thornhill, 1994). A sensory bias towards facial symmetry has been found in both human (Grammer and Thornhill, 1994; Penton-Voak et al, 2001) and non-human primates (Waitt and Little, 2006) and it is subtle enough, in humans at least, to discriminate attractiveness ratings between identical twins (Mealey et al., 1999).

Studies of developmental stability and ecological fitness suggest phenotypic symmetry is an important visual marker for genetic quality and therefore mate selection. Poorer rates of growth, fertility and longevity are observed in asymmetrical organisms (Møller, 1997; Møller and Thornhill, 1998) and this 'good genes' or 'honest signalling' theory of sexual selection is supported by human face judgement studies. For example, the extent of bilateral facial asymmetry is negatively associated with judgements of attractiveness, apparent health (Fink et al., 2006; Jones et al., 2001) and even measures of actual illness and infection (Thornhill and Gangestad, 2006 – although for exceptions see, Foo et al., 2017; Jones and Jaeger, 2019; Jones et al, 2021; Pound et al., 2014).

Oinonen (2003) first observed a negative association between the ability of female undergraduates to perceive facial asymmetries and the amount of alcohol they reported consuming over previous months. This effect was subsequently replicated but the deficit did not extend to non-face shapes, suggesting a toxic effect of alcohol on neural mechanisms dedicated specifically to face symmetry detection (Oinonen and Sterniczuk, 2007). In a field study of acute alcohol effects, however, Souto and Colleagues (2008) found intoxicated participants were significantly less able than sober counterparts to detect asymmetry in simple non-facial shapes, such as triangles. Furthermore, Halsey and Colleagues (2010) found acute alcohol intoxication in a sample of local bar drinkers significantly weakened both the preference for and ability to detect facial symmetry. However, in a subsequent attempt to replicate these effects under placebo-controlled laboratory conditions, only an alcohol deficit for symmetry detection was observed (Halsey et al., 2012).

Due to the limited research on this topic, we ran a field experiment designed to test the influence of acute alcohol intoxication on judgements of both facial attractiveness and bilateral symmetry. The design of our study is similar to that of Halsey et al. (2010, 2012) but with some important exceptions. Those authors used stimulus pairs for the face preference task (each trial showing a symmetrical and non-symmetrical version of the same face) and single faces for the symmetry detection task (each face being either symmetrical or non-symmetrical). Here, however, we employ two different types of face preference and face symmetry judgement test, one showing single faces (i.e. rate how attractive; rate how symmetrical), and the other showing face pairs (i.e. choose the more attractive; choose the more symmetrical). This extended method allows us to compare attractiveness and symmetry judgements between two widely used face processing tasks and provides a more sensitive (scale) measure of single face judgements than an exclusively binary choice approach. Finally, Halsey et al. presented only cropped stimulus faces (concealing the hair for ease of symmetrising), which may have cast an undue influence on attractiveness judgements. In the present study we used cropped facial images for the paired-face tasks only, with the normal face interior presented on one side of the screen and a perfectly *symmetrised* version of the face presented on the other. For the single face rating tasks we showed each model's full face including their true hairstyle, but with the facial interior presented as either normal (unedited) or in an enhanced *asymmetrical* form.

Our main predictions for the study were quite simple. Pub dwellers with lower breath alcohol concentrations were expected to, (a) favour symmetrical faces more strongly, and (b) detect facial asymmetry more accurately than counterparts with higher breath alcohol concentrations. Given that judgements of facial attractiveness have been shown to vary unexpectedly depending on the age and gender of the perceiver and the face perceived (e.g. Ebner et al., 2018; Foos and Clark, 2011; He et al., 2021) we also incorporated participant age, participant sex and stimulus face gender comparisons into the design.

Method

Participants

Patrons of a local pub volunteered for a study on the effects of alcohol on perceptions of facial attractiveness. This convenience sample initially comprised 101 individuals; however, EPrime malfunctions prevented data collection for two cases reducing the sample to 99 participants (54 males, 45 females) ranging in age from 18 to 62 years (M = 28.92, SD = 12.07) (see Figure 1).

All reported normal or corrected-to-normal vision. Sample size was based on an *a priori* power analysis using G*Power (Faul et al. 2009). This indicated a minimum of 84 participants were needed for an 80% chance of detecting a small effect of alcohol intoxication (f = 0.10), using a mixed-design factorial analysis of variance (ANOVA) with two independent groups, four repeated measures, (assuming a correlation of r = 0.7 among these) and an alpha of 0.05.

As the task required judgements of both same- and opposite-sex face stimuli we requested information about each participant's sexual identity and all were happy to provide this personal information. The majority (87%) identified as heterosexual and the remainder as bisexual (9%), homosexual (3%), or pansexual (1%).

In order to assess the possible influence of racial biases in facial judgements, volunteers were invited to provide details of their ethnic origin and countries of past and present residence.

All were currently residing in the UK with the majority describing themselves as being of white/UK origin. Exceptions were one participant of black/UK origin, one of Arab/English origin, one of Arab/Moroccan origin and one of white/Croatian origin. Only five participants had ever spent more than 6 months

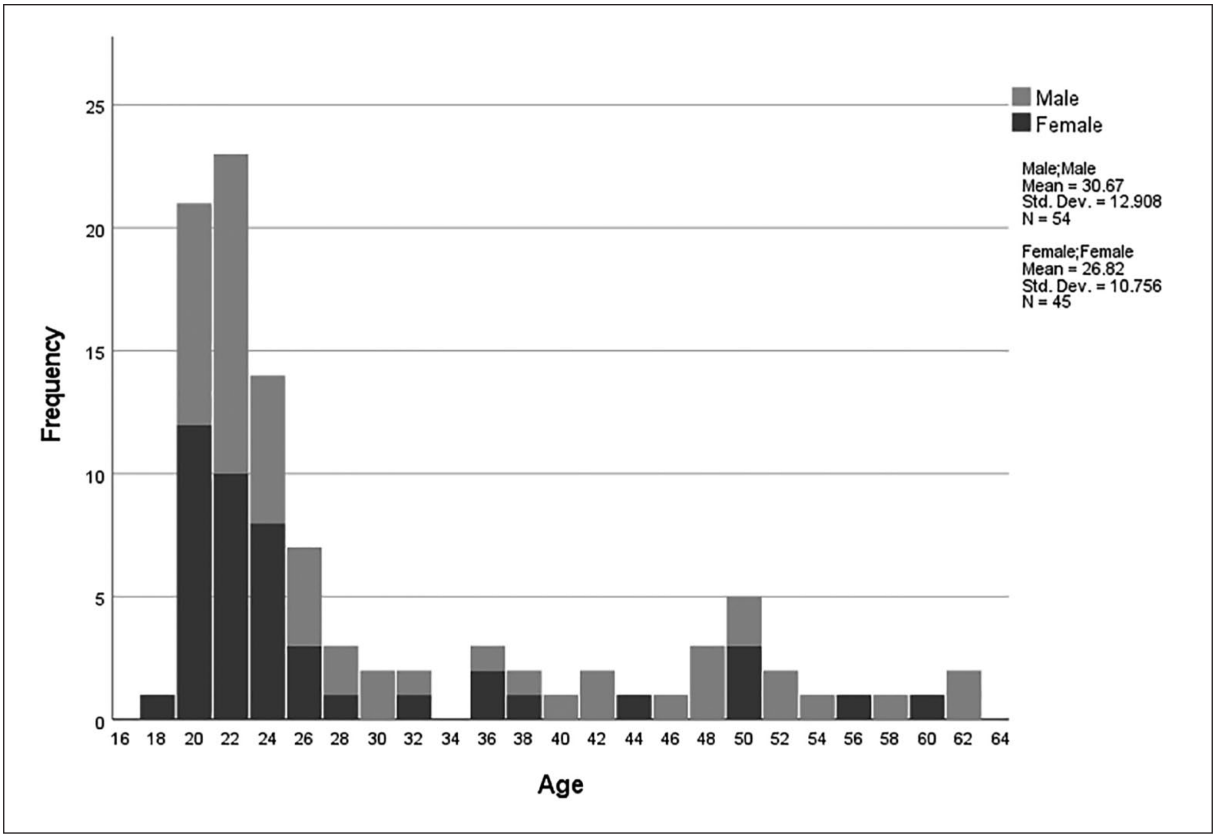

Figure 1. Distribution of participant age for males and females.

residing in a country other than the UK. Using a seven-point scale, participants were also asked to estimate the extent to which they had interacted with individuals from different ethnic origins (1 = 'I rarely see them in my community', 7 = 'They compose my entire circle of friends'). Although they reported having most contact with individuals of white (European) origin (M = 6.34, SD = 0.53), participants also reported moderate levels of contact with members of mixed (M = 4.76, SD = 1.36), black (African/Caribbean) (M = 4.48, SD = 1.36), Asian (M = 3.92, SD = 1.76) or other unspecified (M = 3.97, SD = 1.53) ethnic groups.

Design

The experiment conformed to a 2(Face Sex) × 2(Participant Sex) × 2(Face Type) mixed design with face type and face sex serving as within-subject variables. Blood alcohol concentration (estimated from breath readings) and participant age served as covariates. There were four dependent variables, ratings of attractiveness and facial symmetry both based on a five-point scale, with one denoting the lowest and five the highest degree of facial attractiveness and symmetry, plus two binary forced-choice ratings of attractiveness and facial symmetry. All manipulations and measures included in the study are reported below.

Materials and apparatus

Breath alcohol concentrations were measured using a Dräger Alcotest 3000 fuel-cell breathalyser (Dräger, 2014). Participants provided two readings, one at the start of the session and one at the end. The breath alcohol unit reported on the device (mg/L) was converted to a blood alcohol concentration estimate using a 2300:1 blood/breath partition ratio (g/230 L). Thus, a breath reading of 0.35 mg alcohol per 1 L of breath, for example, converts to: 0.00035 g × 230 L = 0.08 BAC%.

Stimuli were derived from high definition facial portrait photographs of 18 young adults aged 20–25 years, representing a variety of ethnicities. Half were female, half were male and all posed with a neutral expression. The images were sampled from the Chicago Face Database (Ma et al., 2015), each shot against a white background under standardised lighting conditions (see Appendix 1). Face stimuli were displayed on an Acer Travel Mate laptop with a 14-inch screen using E-Prime 3.0 stimulus presentation software. Each image was approximately 22 cm (width) × 15 cm (height) as presented on-screen, with a viewing distance of around 50–60 cm. For single image tasks each face was rated twice, once in its natural form and once with the facial interior showing an artificially enhanced bilateral asymmetry (see Figure 2).

For two-alternative forced-choice judgements the external features of each same-face pair were masked such that only the facial interior was visible, the image on one side showing the natural (unmanipulated face) and the other a perfectly symmetrised version (see Figure 3).

Manipulations of facial symmetry and asymmetry were achieved using Psychomorph (Tiddeman et al., 2001), a facial morphing software package widely used in studies of face perception. In the original images, 160 facial landmarks were

Figure 2. Sample stimuli from the single face judgement tasks with the same face shown in its natural (left panel) and artficially asymmetrised form (right panel).

delineated and Psychomorph's symmetrise function was used to create a perfectly symmetrical version of each face. These versions were then cropped around the face to remove hair and background details as these tend to show blurring artefacts which make it obvious the face has been manipulated.

The asymmetrical faces were created using the unmanipulated and symmetrised versions as endpoints of a continuum, with a vector difference between the Cartesian coordinates of each facial landmark. This difference was then applied in the negative direction to each unmanipulated face, resulting in slightly asymmetrised versions. As these images still look realistic we were able to retain the hair and background features, thus enhancing the ecological validity of these stimuli.

Procedure

Testing took place in a local pub between the hours of 5 pm and 10 pm, over the course of a few weeks. Bar dwellers were cordially invited to participate in a study of alcohol's effect on the perception of human faces. Drinkers showing physical signs of extreme intoxication (e.g. bodily instability, unclear speech, confusion, stupor, etc.) were not approached. Each volunteer was invited to sit at a reserved table in a quiet corner of the pub where they were fully informed about the purpose of the study. In addition to this verbal explanation participants were given a study information sheet. After consenting to proceed, participants drank water to rinse residual alcohol from their mouth and were breathalysed (reading not disclosed). The experimenter recorded the breath reading then positioned the laptop in front of the participant.

In order to prevent attractiveness judgements being contaminated by notions of facial symmetry, the experiment was administered in two blocks, the first for measuring attractiveness judgements and the second for symmetry judgements, with all participants completing block one first. The task opened with on-screen instructions explaining that a series of single faces would be displayed in turn and that the participant was required to rate each one on a scale from 1 (very unattractive) to 5 (very attractive). To minimise errors, the response scale remained visible beneath each face, and progress to the next trial was only possible once a rating for the present face was provided. As described above, participants were shown 18 unique faces and each was presented twice: once in its natural form and once in an enhanced asymmetrical form. Each participant viewed the 36 images in a different randomised order.

This was followed by a new set of on-screen instructions. Participants were told they would be shown a sequence of same-face pairs and that they must choose the face version in each pair they found more attractive. Choices were indicated with a Z-key press for the left-side face or an M-key press for the right-side face and the next pair was not shown until a response was made. As a reminder, response letters were always displayed under the corresponding left/right face. Eighteen same-face pairs were presented in all, with one face natural and the other symmetrised. The side on which the symmetrical/natural face was displayed was counterbalanced and each participant viewed the sequence in a different randomised order.

The stimuli presented in Block 2 were exactly the same as those shown in Block 1, and the procedure was almost identical, too. Block 2 differed only in that participants now had to provide a symmetry rating on each of the 36 single face trials (1 = very asymmetrical; 5 = very symmetrical); then choose which face in each of the 18 same-face pairs they judged to be more symmetrical, again indicating this with a press of the Z (left) or M (right) key. Upon completion of Block 2, participants were breathalysed for a second and final time, thanked, then given a debrief form explaining the full aims and rationale of the study.

The study was approved by the host institution's ethics board and administered with full adherence to the British Psychological Society Code of Ethics and Conduct.

Results

Alcohol intoxication (BAC%)

Figure 4 shows the distribution of mean breath alcohol measures (averaged across two breath tests). BACs ranged from 0.00% to 0.35% with a median of 0.07% (M = 0.10%, SD = 0.09).

Attractiveness ratings for single faces: Natural versus asymmetrised

To evaluate the influence of alcohol consumption on ratings of facial attractiveness we ran a 2(Face Sex) × 2(Face Type) × 2(Participant Sex) mixed-design analysis of covariance (ANCOVA) on those data, using BAC (%) and participant age as covariates. This revealed a significant main effect of face type confirming, as expected, that the natural face images were rated as more attractive (M_{adj} = 2.87, SD = 0.76) than their artificially asymmetrised counterparts (M_{adj} = 2.59, SD = 0.74), $F(1, 95) = 39.36$, $p < 0.001$, $\eta_p^2 = 0.29$. The interaction between face type and participant sex was significant, $F(1, 96) = 4.66$, $p = 0.033$, $\eta_p^2 = 0.05$. Both male and female participants rated natural faces as being more attractive than asymmetrised faces but this bias was stronger among female (M_{diff} = 0.35) than male participants (M_{diff} = 0.21). The interaction between face type and participant age was also significant, $F(1, 96) = 6.67$, $p = 0.011$, $\eta_p^2 = 0.07$, reflecting the fact that older participants tended to give lower attractiveness ratings to natural faces than asymmetrised faces.

No other effects in this analysis were statistically significant, including the interaction between BAC, face sex and face type, $F(1, 95) = 1.50$, $p = 0.224$, $\eta_p^2 = 0.02$. Furthermore, the above pattern of findings remain when non-heterosexual participants are excluded from the ANCOVA.

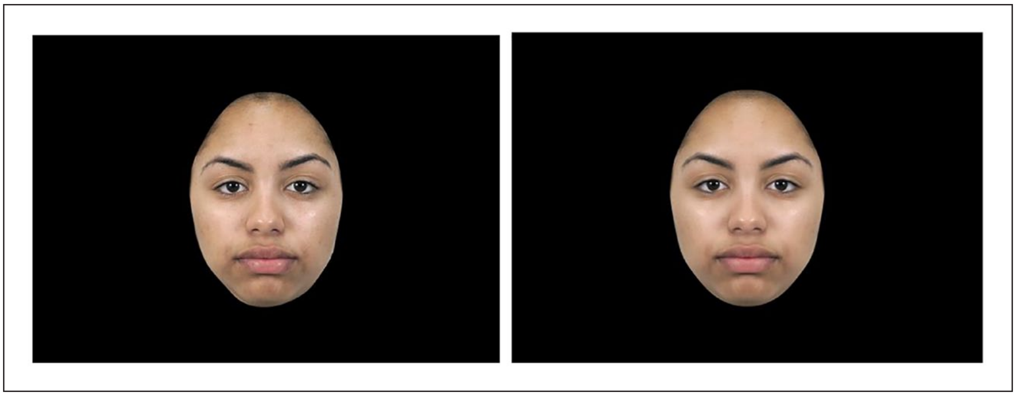

Figure 3. Sample stimuli from the two-alternative forced-choice tasks with the same face shown in its natural (left panel) and perfectly symmetrised form (right panel).

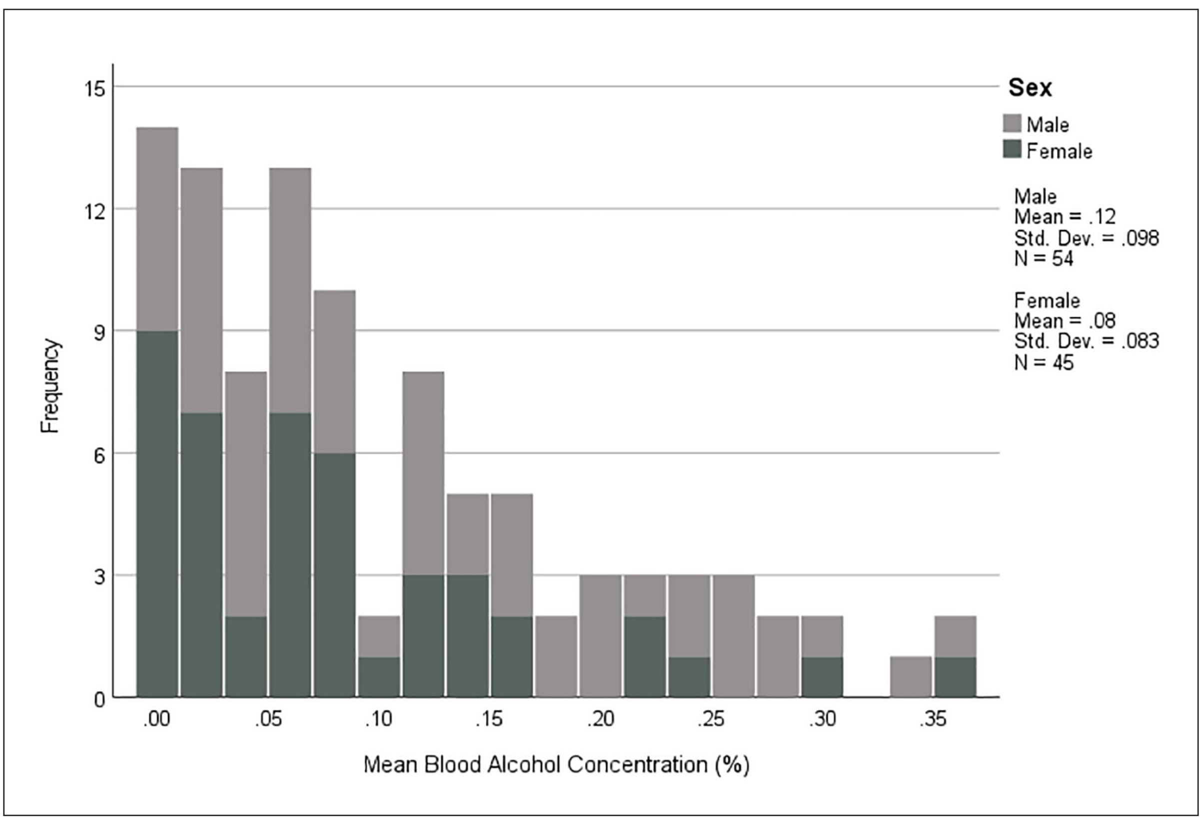

Figure 4. Distribution of male and female breath alcohol concentrations (BAC%).

Symmetry ratings for single faces: Natural versus asymmetrised

A 2(Face Sex) × 2(Face Type) × 2(Participant Sex) mixed-design ANCOVA was conducted on the symmetry ratings, with participant age and BAC serving again as covariates. This produced a significant effect of face type, $F(1, 95) = 84.05$, $p < 0.001$, $\eta_p^2 = 0.47$, reflecting higher symmetry ratings for natural faces ($M_{adj} = 3.33$, SD = 0.61) than for the asymmetrised versions ($M_{adj} = 2.37$, SD = 0.58). The main effect of face sex was highly significant, $F(1, 95) = 5.20$, $p = 0.025$, $\eta_p^2 = 0.05$, with female faces rated more symmetrical ($M_{adj} = 3.04$, SD = 0.59) than male faces ($M_{adj} = 2.67$, SD = 0.57). Crucially, the ANCOVA produced a highly significant BAC × face type interaction, $F(1, 95) = 15.8$, $p < 0.001$, $\eta_p^2 = 0.14$, the form of which is shown in Figure 5. Symmetry ratings for natural faces were negatively though not significantly correlated with mean BAC, r (99) = −0.185, $p = 0.066$, whereas symmetry ratings for asymmetrised face versions were positively and significantly correlated with mean BAC, r (99) = 0.215, $p = 0.032$.

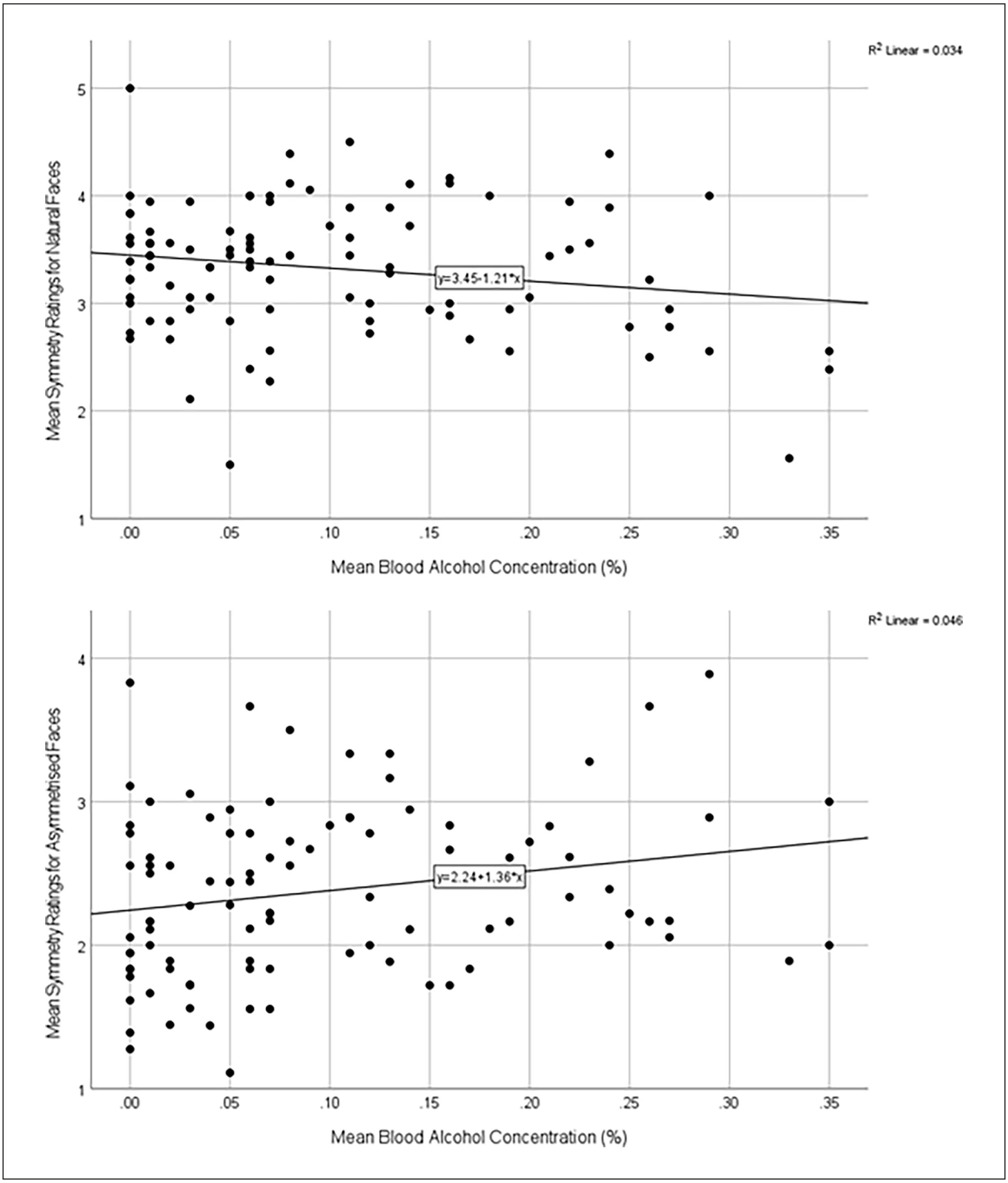

Figure 5. Scatterplot showing the correlation between BAC (%) and mean symmetry ratings for natural (upper panel) and asymmetrised faces (lower panel).

No other effects in this analysis were statistically significant. Furthermore, the above pattern of effects holds when ANCOVA is conducted on only the heterosexual participants.

Attractiveness judgements for same-face pairs: Natural versus symmetrised

Attractiveness judgements for trials containing same-face pairs were initially evaluated using one-sample *t*-tests, comparing the mean proportion of symmetrical (as opposed to natural) face selections against a test score of 0.5, representing no bias. The proportion of symmetrical face selections differed significantly from 0.5 for both male, $t(98)=6.77$, $p<0.001$, Cohen's $d=0.68$; and female faces, $t(98)=5.91$, $p<0.001$, Cohen's $d=0.59$, confirming a strong preference for perfectly symmetrical over natural face forms. To explore the effects of alcohol on this we conducted a 2(Face Sex) × 2(Participant Sex) mixed-design ANCOVA on the mean proportion of symmetrical face choices, with participant age and BAC as covariates. However, the analysis produced no significant effects ($p > 0.9$, for all BAC related effects).

We also note that the pattern of results for this analysis remain the same when only heterosexual participants are included for analysis.

Symmetry judgements for same-face pairs: Natural versus symmetrised

Unsurprisingly, as with the attractiveness choice data, one-sample *t*-tests on the mean proportion of symmetrical face choices revealed a highly significant bias towards choosing perfectly symmetrical over natural faces (relative to the test value of 0.5) for both male, $t(98) = 21.11$, $p < 0.001$, Cohen's $d = 2.12$; and female faces, $t(98) = 17.00$, $p < 0.001$, Cohen's $d = 1.71$, confirming that participants were generally excellent at detecting facial symmetry. Furthermore, a 2(Face Sex) × 2(Participant Sex) mixed-design ANCOVA, with participant age and BAC as covariates, revealed a significant main effect of BAC on the mean proportion of symmetrical face decisions, $F(1, 95) = 10.81$, $p = 0.001$, $\eta_p^2 = 0.10$. Higher BACs were associated with a weakened ability to discriminate perfectly symmetrical from natural face forms. This association was observed for both male, $B = -0.66$, $p < 0.001$, $\eta_p^2 = 0.13$, and female faces, $B = -0.42$, $p = 0.05$, $\eta_p^2 = 0.04$ (see Figure 6).

All remaining effects for the above analysis were non-significant. We should note, however, that when the ANCOVA was conducted on only heterosexual participants, a marginally significant interaction between BAC and face sex emerged, $F(1, 82) = 3.95$, $p = 0.05$, $\eta_p^2 = 0.05$. This is driven by the fact that, for heterosexual participants, the negative association between BAC and symmetry detection performance is stronger for male, $B = -8.28$, $t = -4.74$, $p < 0.001$, $\eta_p^2 = 0.22$, than for female faces, $B = -4.82$, $t = -2.36$, $p = 0.02$, $\eta_p^2 = 0.06$.

Decision times

While no predictions were made concerning task response times, we nevertheless analysed these data to explore the potentially confounding possibility of variations in the time participants spent viewing each stimulus face prior to registering their decision. A 2(Face Sex) × 2(Face Symmetry) × 2(Participant Sex) mixed-design ANCOVA on response times for attractiveness ratings, with participant age and BAC as covariates, revealed four significant effects, though none were related to alcohol. First, there was a significant main effect of participant age $F(1, 95) = 14.10$, $p < 0.001$, $\eta_p^2 = 0.13$, reflecting a strong positive correlation between age and response times. But this is qualified by a significant face sex × participant age interaction, $F(1, 95) = 5.03$, $p = 0.027$, $\eta_p^2 = 0.05$, driven by a stronger correlation between age and attractiveness rating response times for female faces, $r(99) = 0.358$, $p < 0.001$, than for male faces, $r(99) = 0.279$, $p = 0.003$. Thirdly, there was a significant main effect of face sex indicating that male faces ($M_{adj} = 2323$ ms, SD = 920) were rated faster than female faces ($M_{adj} = 2570$, SD = 1771), $F(1, 95) = 4.44$, $p = 0.038$, $\eta_p^2 = 0.05$. Finally, there was a main effect of participant sex, $F(1, 95) = 5.34$, $p = 0.023$, $\eta_p^2 = 0.05$, as males made slower responses ($M_{adj} = 2727$ ms, SD = 1602) than females ($M_{adj} = 2165$ ms, SD = 1761).[1]

A 2(Face Sex) × 2(Face Symmetry) × 2(Participant Sex) mixed-design ANCOVA on response times for the symmetry rating data, with participant age and BAC as covariates, also revealed no significant alcohol effects. However, it did yield three other significant effects. There was a main effect of age, $F(1, 95) = 15.48$, $p < 0.001$, $\eta_p^2 = 0.14$, reflecting slower response times for older participants, $r(99) = 0.401$, $p < 0.001$. A face type × age interaction, $F(1, 95) = 7.15$, $p = 0.009$, $\eta_p^2 = 0.07$, reflecting a stronger correlation between age and reaction time for natural, $r(99) = 0.469$, $p < 0.001$, than asymmetrised faces, $r(99) = 0.320$, $p < .001$. And, thirdly, a face sex × age interaction, $F(1, 95) = 3.97$, $p = 0.049$, $\eta_p^2 = 0.04$, due to a stronger positive correlation between age and reaction time for female, $r(99) = 0.424$, $p < 0.001$, than male faces, $r(99) = 0.357$, $p < 0.001$.

A 2(Participant Sex) × 2(Face Sex) mixed-design ANCOVA on the two-alternative forced-choice (2AFC) attractiveness decision task data, with participant age and BAC as covariates, revealed a significant main effect of BAC, $F(1, 95) = 6.21$, $p = 0.014$, $\eta_p^2 = 0.06$. Higher BACs were associated with faster attractiveness rating times for both male, $B = -2958$, $t = -2.27$, $p < 0.001$, $\eta_p^2 = 0.05$, and female faces, $B = -2678$, $t = 2.07$, $p = 0.03$, $\eta_p^2 = 0.04$. A main effect of age was observed, $F(1, 95) = 32.00$, $p < 0.001$, $\eta_p^2 = 0.25$, with older participants associated with slower ratings times than younger participants for male, $B = 49.41$, $t = 4.97$, $p < 0.001$, $\eta_p^2 = 0.21$, and female faces, $B = 48.15$, $t = 4.89$, $p < 0.001$, $\varpi_p^2 = 0.20$. Also, a main effect of participant sex emerged, $F(1, 95) = 5.51$, $p = 0.021$, $\eta_p^2 = 0.06$, revealing that males were slower to make an attractiveness decision (*M*adj = 2863 ms, SD = 1393) than females (*M*adj = 2368 ms, SD = 1532).

Finally, a 2(Participant Sex) × 2(Face Sex) mixed-design ANCOVA on response times for the 2AFC symmetry decision task, with participant age and BAC as covariates, revealed only a significant effect of age, $F(1, 95) = 20.50$, $p < 0.001$, $\eta_p^2 = 0.18$, again reflecting a positive association between age and response time for discriminating both male, $B = 49.77$, $t = 4.01$, $p < 0.001$, $\eta_p^2 = 0.15$, and female faces, $B = 56.30$, $t = 4.41$, $p < 0.001$, $\eta_p^2 = 0.17$.

Discussion

Following the suggestion that impaired bilateral symmetry perception contributes to the so-called 'beer goggles' phenomenon (e.g. Souto et al., 2008), we examined the impact of real-world alcohol intoxication on judgements of facial attractiveness and symmetry across a single set of face stimuli. We expected increased levels of alcohol intoxication to be associated with higher ratings of facial attractiveness and facial symmetry for artificially asymmetrised faces, and with impairments in discriminating perfectly symmetrical from natural face forms (Halsey et al. 2010; Oinonen, 2003; Oinonen and Sterniczuk, 2007). As predicted, asymmetrised faces were judged less attractive and less symmetrical than their natural (unmanipulated) forms. More importantly, higher levels of intoxication were associated with both higher symmetry ratings for asymmetrical faces, and a poorer ability to distinguish perfectly symmetrical from natural face forms. Contrary to previous observations of the 'beer goggles' effect, however (Chen et al., 2014; Gladue and Delaney, 1990; Jones et al., 2003; Johnco et al., 2010, Lyvers et al., 2011; Parker et al., 2008; Pennebaker et al, 1979), alcohol had no influence on attractiveness ratings for single faces, nor on the extent to which participants favoured perfectly symmetrical over natural face forms viewed side-by-side.

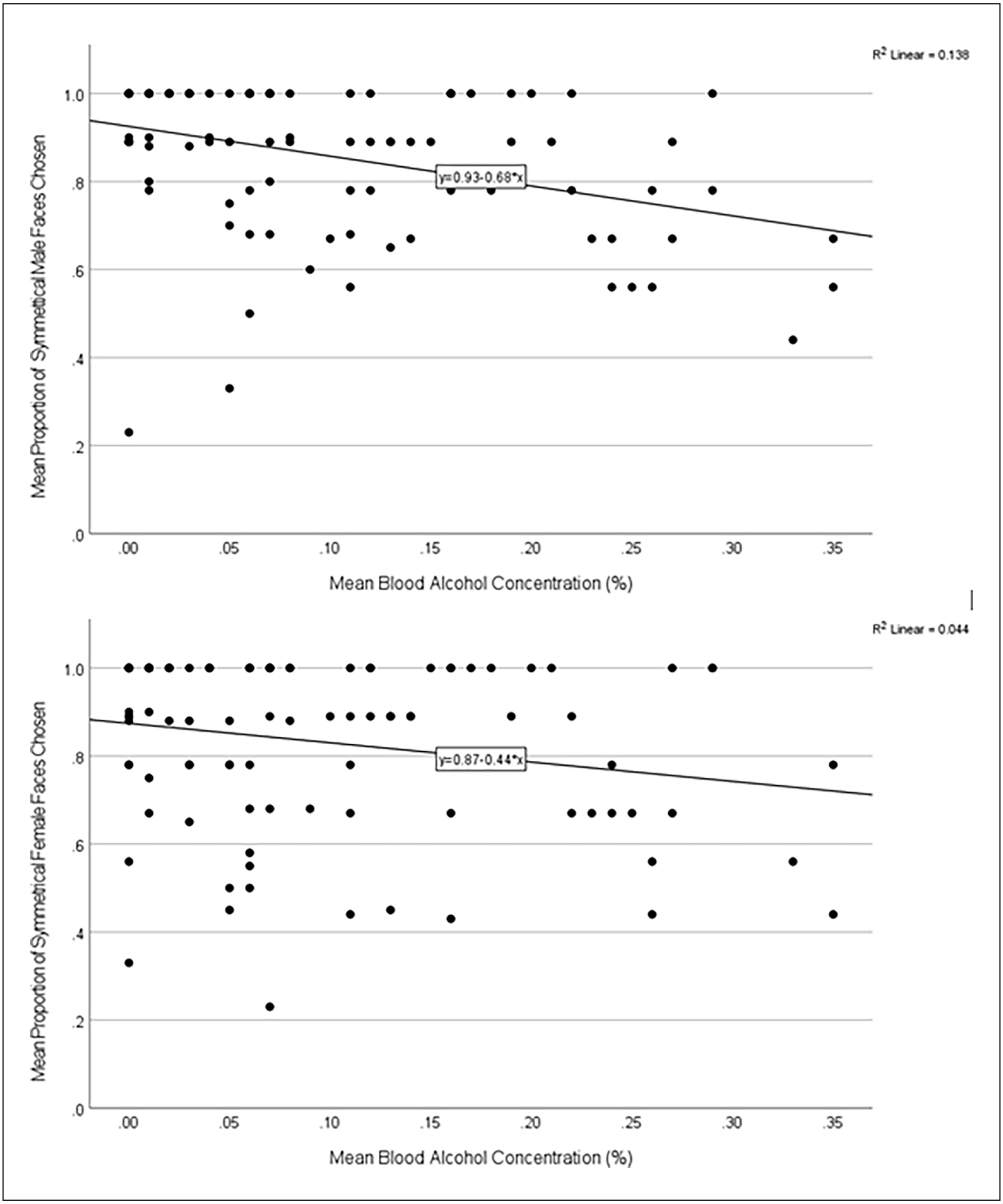

Figure 6. Scatterplot showing the correlation between BAC (%) and mean proportion of symmetrical male (upper panel) and female (lower panel) faces chosen.

Our findings are therefore consistent with past failures to observe a 'beer goggles' effect (Attwood et al., 2012; Halsey, et al., 2012; Maynard et al., 2016; Neave et al., 2008), but lend weight to the suggestion that acute alcohol intoxication impairs perceptions of bilateral symmetry (Halsey et al., 2010; Halsey et al., 2012; Oinonen, 2003; Oinonen and Sterniczuk, 2007; Souto et al., 2008), particularly the work of Halsey and Colleagues. In their initial bar study, Halsey et al. (2010) presented sober and intoxicated participants with same-face pairs in which one face had been made symmetrical and the other asymmetrical (the hair was always cropped out). Participants first had to choose the more attractive face then, in a follow-up task in which the same faces were presented singly, determine if each was either symmetrical or asymmetrical. In line with the 'beer goggles' hypothesis, the sober group showed a stronger preference for symmetrical faces and were better than the alcohol group at detecting whether a face was symmetrical or not. However, in a placebo-controlled lab-based replication of their study, Halsey et al. (2012) observed an alcohol-based symmetry detection deficit but with no accompanying 'beer goggles' effect. We now present the same alcohol effects but using a more extensive experimental design, measuring judgements of both perfectly symmetrised faces with hair fully cropped, and artificially asymmetrised (though still natural looking) faces with hair fully visible.

These findings therefore raise the question as to why, following alcohol consumption, impaired face symmetry detection does not always produce inflated attractiveness ratings for less symmetrical faces (Halsey et al, 2012; Maynard et al., 2016; Neave et al., 2008). One possibility is that attractiveness depends on many factors that may simply swamp small effects of face symmetry, as it has been suggested that symmetry is one of the weakest attractiveness cues (e.g. Jones and Jaeger, 2019). Given the scientific evidence reviewed above, we do not deny the existence of a 'beer goggles' effect, but we suspect it is larger and therefore more easily detectable when measuring interpersonal attractiveness between 'live' individuals (Gladue and Delaney, 1990; Jones et al., 2003; Johnco et al., 2010, Lyvers et al., 2011; Pennebaker et al, 1979) than from attractiveness ratings of face photographs (Chen et al., 2014; Monk et al., 2020; Parker et al., 2008). Static images conceal a range of important visual criteria for attractiveness (e.g. build, body shape, height, emotional expression, clothing, etc.) and the thresholds of each may be independently sensitive to increasing levels of alcohol intoxication. Attractiveness judgements based on the restricted range of cues gleaned from face photographs may therefore be highly sensitive to stimulus effects. For example, as is typical for studies of this nature, we did not obtain prior attractiveness ratings for the faces selected for the present experiment. But if the models in a stimulus set happen to be rated high in attractiveness, the variance of attractiveness ratings would be low, making it harder to detect alcohol effects. This was demonstrated by Chen et al. (2014) who manipulated the attractiveness of visual stimuli presented in their 'beer goggles' study. Interestingly, they found alcohol inflated attractiveness ratings only for stimuli rated low rather than high in attractiveness, and this was for images of both faces and landscapes.

Having said this, we note the recent findings of Bowdring and Sayette (2023), who observed a 'beer goggles' effect for face images only when participants were asked to select photographs of the individuals they would most like to meet in a future study (Bowdring and Sayette, 2023). This selection-to-interact manipulation is a novel and interesting research development with the potential to shed further light on the beer goggles effect and alcohol's subsequent influence on prospective sexual intentions and behaviour.

When evaluating ratings of inter-personal attractiveness another important factor to consider is the amount of exposure participants are given to each stimulus face. Although rapid attractiveness judgements (e.g. 200 ms) are highly consistent with those made at longer exposures (e.g. Todorov et al., 2013), there may still be time thresholds at which alcohol-linked changes in face judgements occur. In previous alcohol research exposure times have varied enormously, ranging from all evening for bar patrons rating fellow drinkers (e.g. Pennebaker et al., 1979), to less than a second per face in more controlled (and contrived) experimental scenarios (e.g. Attwood et al., 2012). As ratings in the present study were self-paced we examined differences in the time participants took to evaluate each face in case these latencies were associated with variations in attractiveness and symmetry judgements. The only significant effect of alcohol we found was that higher BACs in the face pairs task were associated with faster attractiveness decisions. In the absence of a corresponding effect of alcohol on the attractiveness ratings themselves, we have no sensible explanation as to why this occurred.

We also found female participants made faster attractiveness and symmetry judgements than males. This too was unanticipated and difficult to interpret because participant sex was confounded by the amount of alcohol consumed. It is clear from the BAC histogram (see Figure 3) that the majority of more heavily intoxicated participants were male, so perhaps increased alcohol intake contributed to the slower male response times. The adverse effects of alcohol are usually more pronounced in females than males and this may, for example, be influenced by the menstrual cycle (Sutker et al., 1987), relative bodily water and fat content (Mumenthaler et al., 1999) or lower alcohol dehydrogenase levels, an enzyme responsible for metabolising alcohol (Baraona et al., 2001). Further research is therefore needed to understand the faster responding of females following alcohol administration. We note more generally that the blood–breath alcohol correlation is influenced by physiological and metabolic factors, such as body temperature, breathing pattern and pulmonary function (Jones and Cowan, 2020), which also vary between sexes, so these may have influenced our findings, particularly the breath alcohol measures. It is possible, however, that the present sex effects are not alcohol related at all. There may instead be evolutionary or socio-cultural factors causing females to evaluate faces more efficiently than males. This idea is supported by numerous observations of females recognising facial emotion expressions faster and more accurately than males (e.g. Hampson et al., 2006; Lee et al., 2013; Rahman et al., 2004; Vassallo et al., 2009; Wells et al., 2016; Wingenbach et al., 2018) and females also showing superior memory recognition for same sex faces (Hansen et al., 2021).

A more consistent pattern to emerge from our decision time analysis is that older participants were generally slower to make judgements of facial attractiveness and symmetry than their younger counterparts. This is a less surprising outcome given widespread evidence of age-related declines in response times across a range of visual choice reaction time tasks (e.g. Bugg et al., 2006; Deary and Der, 2005; Ballesteros et al., 2013; Woods et al., 2015). Curiously, this ageing effect was more pronounced for responses to natural than asymmetrised faces, and more so for female than male faces, though it is unclear why. It is possible that stimulus effects had some influence as male faces generally were rated more quickly than female faces.

Another question raised by our study concerns the cognitive mechanisms through which alcohol impairs symmetry judgements. Alcohol administration causes a decrease in visual acuity

(Watten and Lie, 1996) and contrast perception (Andre, 1996), which might impair symmetry detection. It has also been found to restrict visual scanning in various ways, such as by reducing the number of saccades, extending gaze fixations, and by narrowing the scope of visual attention (Buser et al. 1996; Harvey, 2014; Harvey 2016; Holdstock and de Wit, 1999; Moser et al.,1998; Nawrot et al., 2004). These deficits may disrupt normal processes of holistic face processing critical for the detection of bilateral asymmetry and other configural imperfections. Alcohol also constrains visual searching by slowing the detection of peripheral but not central visual targets (Hoyer et al., 2007), leading to longer fixations and more visual exploration of high as opposed to low interest areas (Moser et al., 1998). It is therefore possible that alcohol-intoxicated viewers are more inclined than sober counterparts to focus on one particularly salient face feature (e.g. hairstyle) at the expense of encoding the face in its entirety (Harvey and Tomlinson, 2020). These would be useful hypotheses to explore in future work along with attempts to identify the biological basis of the alcohol-based symmetry detection deficit.

The brain mechanisms by which alcohol might affect judgements of facial symmetry are unknown and we found no neuroscientific studies on alcohol and symmetry detection generally. However, alcohol is an agonist for gamma-aminobutyric acid (GABA), the primary inhibitory neurotransmitter, thus its administration causes inhibitory effects in the visual cortex (Wang et al., 2021) and across much of the visual perception network (Calhoun et al., 2004). Interestingly, naturally occurring variations in GABA levels in parietal and occipital areas are associated with increased susceptibility to visual illusions of size and orientation (Song et al., 2017). It is therefore plausible that occipital regions known to be implicated in face symmetry processing, such as the lateral occipital complex, the inferior and middle occipital gyrus, and areas around the intra-occipital sulcus (Bertamini and Makin, 2014; Chen et al., 2007) are similarly disrupted by alcohol.

In conclusion, we present new data supporting the view that acute alcohol consumption inhibits the detection of bilateral asymmetry in human faces. Further exploration of this effect may yield important insights into the actions of alcohol on human face processing. However, as this perceptual distortion was not associated with increased ratings of facial attractiveness for asymmetrised faces, alternative accounts of the well-known ‘beer goggles’ phenomenon should be explored.

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Note

1. This effect is non-significant when the ANCOVA is conducted on only heterosexual participants, $F(1, 82)=2.77$, $p=0.1$, $\eta_p^2=0.06$.

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Appendix 1

All face stimuli used for the experiment, in natural (unmanipulated) form