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EFFECTS OF AROMAS FROM DRINKS ON MOOD AND PERFORMANCE

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ABSTRACT

Background: Research on aromas and mood and cognition shows that effects may depend on the method of presenting the aroma, duration of exposure, aroma type, and the outcome measures examined. The present study examined the effects of aromas from drinks on mood, a focused attention choice reaction time task and a categoric search choice reaction time task. **Method:** A between-subject design was used, with each group being exposed to a different aroma (lemon, beer, whisky, gin and water-control). One hundred and ten university students completed the study. Participants carried out **a** baseline session with no aroma, followed by a test session with the aroma being sniffed over the course of the session. Liking of aromas was recorded at a familiarisation session. **Results:** The lemon aroma was rated as the most pleasant, followed by the gin, beer, and whisky. Prior to completing the performance tasks, those exposed to the whisky felt more sociable and happier than the control group. After completing the tasks, the group exposed to the lemon aroma felt more alert than those in the control group and those exposed to the beer. Those exposed to the lemon also felt more sociable and happier than the control group. Ratings of alertness were also significantly correlated with the liking of the aroma. However, the effects of the lemon aroma were still significant when the effect of liking was controlled. The only performance measures to show significant effects of the aromas were those relating to lapses of attention (occasional very long response times). Gin and whisky aromas reduced the number of lapses relative to the control condition in the focused attention task. Gin also reduced the lapses of attention relative to the lemon aroma and control condition in the categoric search task. Again, these effects of the aromas did not reflect the liking of them. **Conclusion:** The present study has shown that sniffing aromas from drinks can lead to

changes in mood and sustained attention. Further research is now required to identify the mechanisms underlying these effects and evaluate the practical significance of these changes.

KEYWORDS: Aroma; Mood; Attention; Choice Reaction Time; Lemon; Beer; Gin; Whisky; Aroma acceptability.

INTRODUCTION

Psychological research has reported changes in mood when a person is exposed to aromas[1], and it has also been shown that aromas can affect aspects of cognitive function.[2,3] Research has examined the effects of odour on memory,[4] complex and simple tasks,[5] risk-taking[6] and goal setting.[2] Research has either used unpleasant odours with the aim being to mimic environmental pollution or pleasant fragrances such as those used in perfumery. Aromas can come from many sources, and there are now commercial products that can circulate aromas in the home and at work. Aromatics are also a key component in the treatment of mild upper respiratory tract illnesses.[7]

People can detect very small differences in odour intensity and distinguish between some 10,000 different odours. Human perception guides our olfactory system, creating perceptions from the molecules which enter the nostrils. The present research question is how odour molecules interact with the human brain and lead to changes in mood and cognition. The olfactory bulb connects to the olfactory cortex area, which is linked to the limbic system. The limbic system governs emotion and memory storage, and it is, therefore, plausible that aromas may affect mood and cognition. The olfactory projections synapse more directly and specifically with the amygdala-hippocampal complex than do the afferents from any other sensory modality.[8]

Nearly a hundred years ago, it was suggested that pleasant odours have a retroactive facilitative effect on learning and unpleasant odours have a retroactive inhibitory effect.[9] Since then, it has been widely recognised that aromas can have some effect on emotion and mood, although recent findings have produced mixed results.[10] Methodological differences and odour delivery may largely explain this lack of consistent results. Aromas are generally assumed to be either 'pleasant' or 'unpleasant', and it has proven very difficult to find an odour which is consistently rated as neutral.[11] One study[10] used three conditions (pleasant, unpleasant and no aroma) and examined their effect on mood, perceived health and performance tasks (multiplication, addition, odd-word identification and proofreading).

Ambient sporadic delivery was used, with the aromas being delivered from two hidden fan units, which turned on randomly six times, each for one-minute periods. The pleasant aroma condition consisted of both lemon and ylang, and this aroma had no significant effects. The unpleasant aroma condition had a negative effect on perceived mood, health and performance, which may reflect the person's attitude to the aroma.[12]

Another study[13] compared the effects of an 'alerting' aroma (peppermint), a 'relaxing' aroma (bergamot), and a no aroma control condition on a vigilance task. The results revealed a significant difference between the relaxing aroma and the control but no difference between the alerting aroma and the control. However, participants may not have been exposed to the alerting aroma long enough for it to have an effect. Other research has identified the specific contexts which lead to an aroma affecting performance.[14] For example, it has been suggested that aromas may only facilitate performance under more demanding experimental conditions. This view was supported by the finding that peppermint only had an alerting effect in a complex task, where it led to more correct responses and better performance. The effects of the aroma may vary over time, and one study[1] reported significant findings when participants filled in a mood questionnaire five minutes after entering a laboratory, but it was not produced after only two minutes of exposure to the aroma. Other research has shown that the initial effects of aromas disappear over time due to habituation.[15] Indeed, olfactory adaptation in humans can take place so rapidly that the person may become completely insensitive to an odour.[16]

Gatti and Cayola[17] reported that odours affect mood and emotion via the nerve endings of the olfactive mucosa, and lemon was named as one such stimulating essence. Furthermore, researchers have suggested the use of lemon oil to treat depression.[18] A recent study[19] examined the effects of lemon from a commercial diffuser on mood and performance. Those in the aroma condition reported a more positive mood (higher hedonic tone scores) both before and after the performance tests. Those in the aroma condition were more accurate but slower. They also showed faster encoding of new information.

There are differences in changes in brain function when sniffing and smelling an odour. The current study involved active sniffing rather than smelling. The aromas come from different drinks, and the aroma from the drinks is an important feature of the product. A good example of this is the bouquet associated with different wines. Similarly, other alcoholic drinks have aromas, and this may relate to their acceptability. Sobel et al.[20] found that sniffing and

smelling aromas activate two different areas of the brain, with olfactory exploration (sniffing) and olfactory content (smell) showing different brain organisation profiles.

The present study also investigated the effects of a lemon aroma, which has been previously used in behavioural research.[1,19] Gordon (1925) asked a sample of 200 people to rate ten aromas and found lemon to be the most pleasant.[10] Findley (1942) had his sample rate 19 aromas, and, again, lemon was the overall preferred aroma.[10] In the present study, the aroma came from drinks rather than diffusion of aromatic vapours. The objectives of the project were:

1. To investigate the effects of different aromas on mood and cognitive performance.
2. To develop a methodology that will allow extension of the research to consider issues such as dose response, effects of exposure duration, the range of cognitive functions affected by aromas, and electrophysiological correlates of the behavioural changes induced by aromas.

METHOD

The study was carried out with the approval of the School of Psychology Ethics Committee, Cardiff University, and the informed consent of the volunteers.

Pilot study

The main aim of the pilot study was to assess the method of delivery of the aromas (the methodology for mood and performance testing is well established). The samples were provided by a drinks company, and all proved suitable except for the beer aroma. After extensive testing, it was decided to use actual beer and brown ale was found to be the product which everyone agreed had a distinctive beer aroma. In terms of the method of delivery, passing a bottle under the nose for a few seconds at frequent intervals was found to be the most effective.

Main Study

In this first study, four aromas (lemon, beer, gin and whisky) were assessed. One hundred and twenty-five volunteers were recruited (25 per condition – 4 aromas plus no aroma condition). Each volunteer was familiarised with the procedures. In the next session, the volunteers carried out a baseline session on a standardised computerised battery, which measured mood, aspects of attention, and psychomotor speed. Following this, the volunteers repeated the procedure while being exposed to aromas. Each aroma was sniffed for approximately 3

seconds at the start of each task and during the rest pauses in the focussed attention and categoric search tasks (4 per task occurring approximately every minute). The control condition consisted of a similar procedure involving sniffing a bottle of water.

Details of the tasks

Mood rating: Mood was assessed both before and after each set of performance tests using 18 computerised visual analogue rating scales (e.g. Drowsy/Alert; Happy/Sad; Tense/Calm.).[21,22] These yield three mood dimensions: Alertness, Hedonic tone and Anxiety.

Focussed Attention Task

This task was developed by Broadbent et al.[23,24] Target letters appear as upper case A's and B's. On each trial, three warning crosses are presented on the screen, with the outside crosses separated from the middle one by either 1.02 or 2.60 degrees. Volunteers were told to respond to the letter presented in the centre of the screen and ignore any distracters presented in the periphery. The crosses are on the screen for 500 ms and are then replaced by the target letter. The central letter is either accompanied by 1) nothing, 2) asterisks, 3) letters which were the same as the target or 4) letters which differ - the two distracters are identical, and the targets and accompanying letters are always A or B. The correct response to A is to press a key with the forefinger of the left hand, while the correct response to B is to press a different key with the forefinger of the right hand. Volunteers were given ten practice trials followed by five blocks of 64 trials. In each block, there are equal numbers of near/far conditions, A or B responses and equal numbers of the four distracter conditions. The nature of the previous trial is controlled. The task gives three types of outcome measures:

1. Global indicators of speed, accuracy and lapses of attention.
2. Speed of encoding of stimuli
3. Resistance to distraction and focusing of attention.

Categoric search task

This task was also developed by Broadbent et al.[23,24] Each trial starts with the appearance of two crosses in the positions occupied by the non-targets in the focused attention task (i.e. 2.04 or 5.20 degrees apart). Volunteers do not know which of the crosses will be followed by the target in this task. The letter A or B is presented alone on half the trials and is accompanied by a digit (1-7) on the other half. Again, the number of near/far stimuli, A versus B responses and digit/blank conditions are controlled. Half of the trials lead to compatible responses (i.e. the letter A on the left side of the screen or the letter B on the right), whereas the others are

incompatible. The nature of the preceding trial is also controlled. In other respects (practice, number of trials, etc.), the task is identical to the focused attention task.

The task gives four types of measures

1. Global indicators of speed, accuracy and lapses of attention.
2. Speed of encoding of stimuli
3. Speed of response organisation
4. Measures of spatial attention.

These tasks have been shown to be sensitive measuring instruments that are capable of detecting subtle changes in state.[25-44] In addition, there were pauses in the tasks every 64 trials, which provided opportunities for exposure to the aromas.

Ratings of Liking of Aromas

At familiarisation, volunteers also rated how much they liked each of the aromas using a visual analogue scale of 1-100. They also completed questionnaires measuring demographic and psychosocial characteristics, as well as health status.

RESULTS

One hundred ten volunteers completed the study (mean age 21 years, range 18-41 years). Preliminary analyses showed that the volunteers in the different aroma conditions were well-matched in terms of demographics, psychosocial characteristics and state of health.

Statistical Analyses

Analyses of covariance, with the appropriate baseline measures as covariates, were carried out on the mood and performance data. These compared the different aromas with the control condition and each other. Correlations were also computed for the ratings of acceptability of the aroma and the mood and performance changes.

Liking of aromas

The lemon aroma was rated as the most pleasant (mean =80.1, s.e. 1.8), then the gin (mean = 53.4, s.e.2.2), then the beer (mean =34.3, s.e. 2.2) and finally the whisky (mean =29.1, s.e.2.2). The different aroma groups did not show a significant difference in their liking of the aromas (e.g. those who sniffed the lemon gave a rating that was representative of the group as a whole).

Mood ratings prior to the performance tasks

The only ratings to show a significant difference at this stage were the ratings of hedonic tone, with those exposed to the whisky feeling more sociable and happy than the control group ($p < 0.05$). This effect is shown in Figure 1.

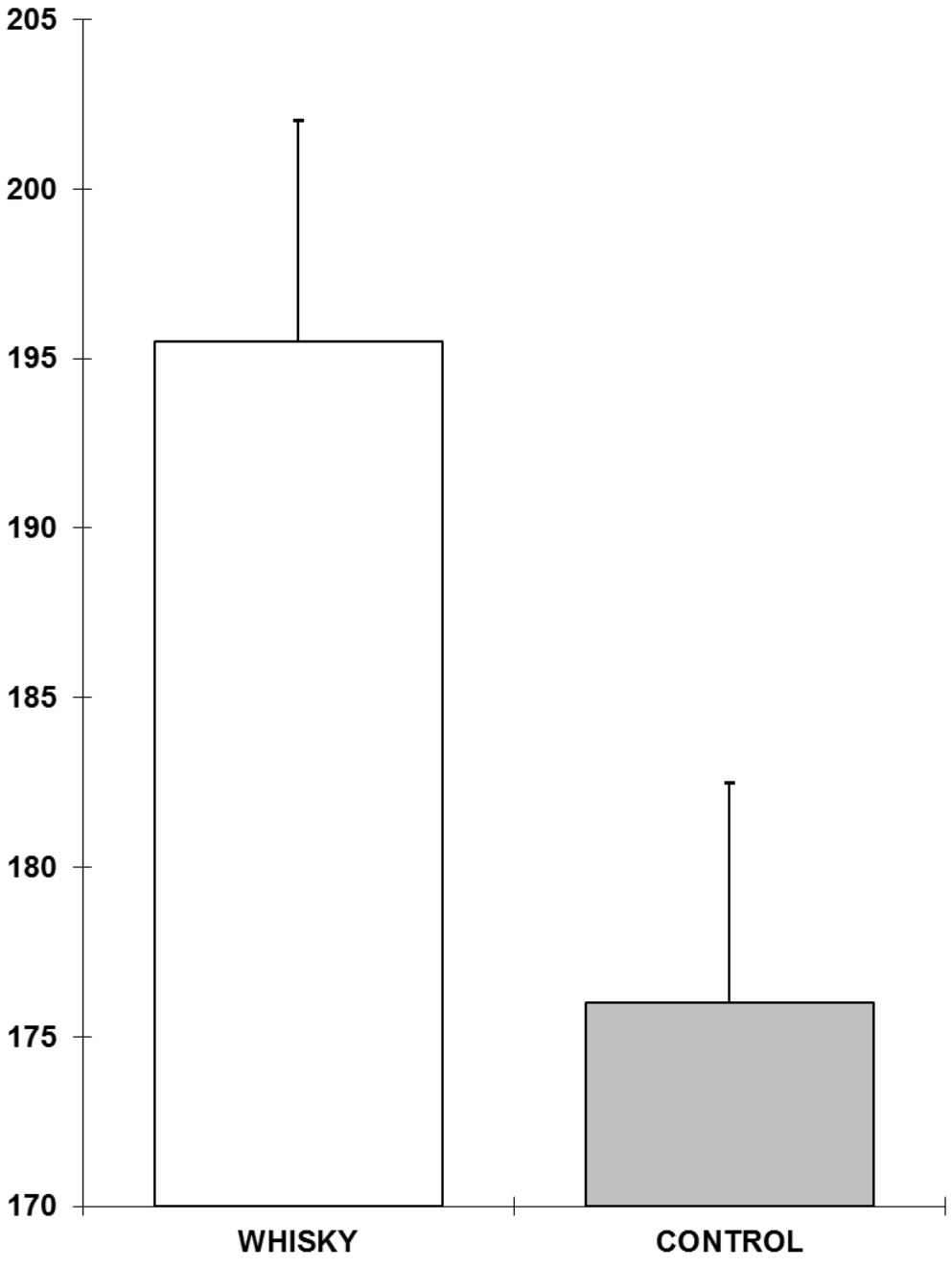

Figure 1: Effects of the whisky aroma on pre-testing hedonic tone (scores are the adjusted means from the analysis of covariance; s.e.s. shown as bars; high scores = more happy, sociable, etc).

Ratings after completing the tasks

The group exposed to the lemon aroma felt more alert than those in the control group and those exposed to the beer (lemon v control, $p < 0.01$; lemon v beer, $p < 0.05$). These effects are shown in Figure 2.

Those exposed to the lemon also felt more sociable and happy than the control group ($p < 0.05$). This effect is shown in Figure 3.

Ratings of alertness were also significantly correlated with the liking of the aroma ($r = 0.25$, $p < 0.05$). However, the effects of the lemon aroma were still significant when the effect of liking was controlled.

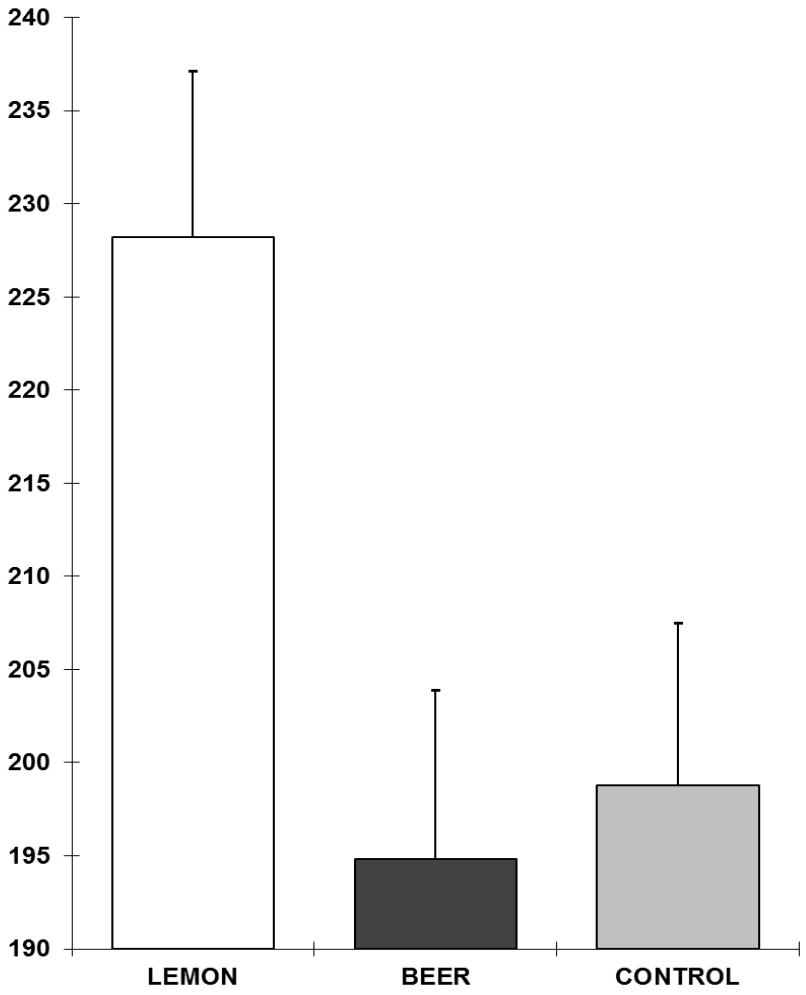

Figure 2: Effects of the lemon aroma on post-testing alertness (scores are the adjusted means from the analysis of covariance; s.e.s. shown as bars; high scores = greater alertness).

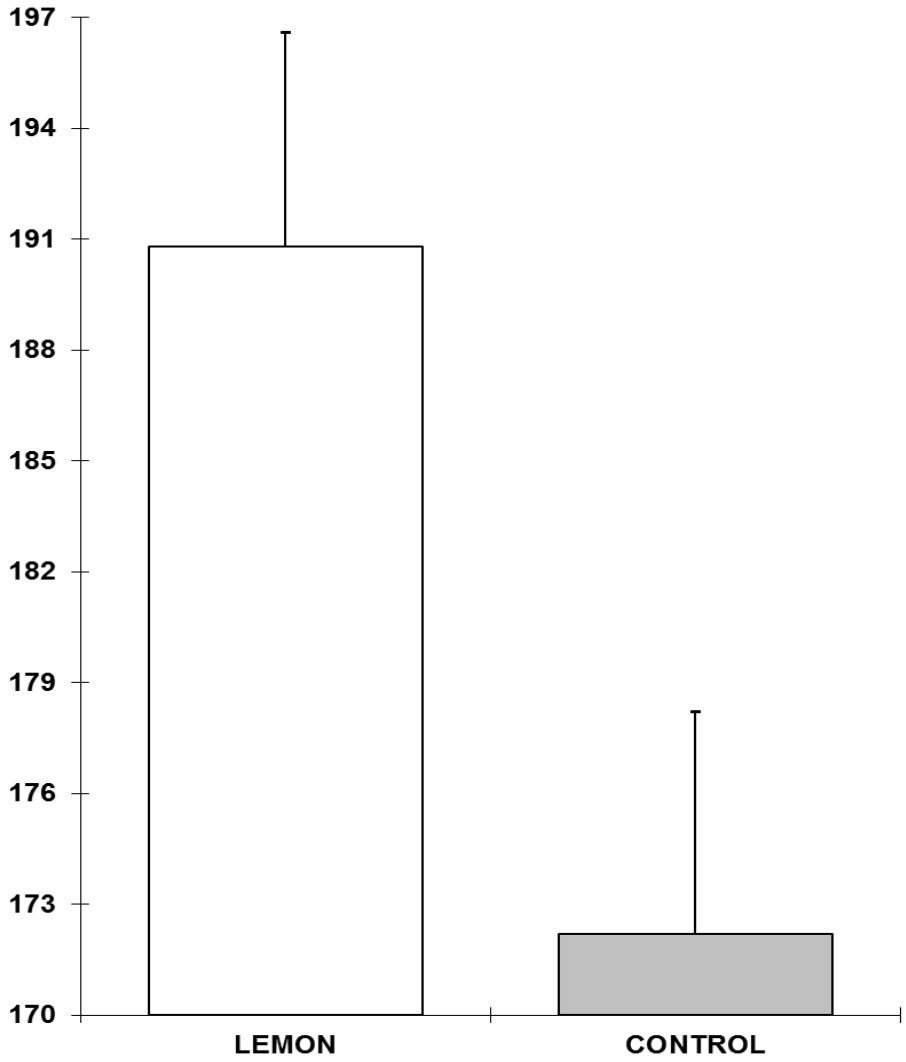

Figure 3: Effects of the lemon aroma on post-testing hedonic tone (scores are the adjusted means from the analysis of covariance; s.e.s. shown as bars; high scores = more happy, sociable, etc.).

Performance tasks

The only measures to show significant effects of the aromas were those relating to lapses of attention (occasional very long response times). Gin and whisky aromas reduced the number of lapses relative to the control condition in the focussed attention task (both p's < 0.05). This is shown in Figure 4.

Gin also reduced the lapses of attention relative to the lemon aroma and control condition in the categoric search task (gin v control, $p < 0.01$; gin v lemon, $p < 0.05$). This is shown in Figure 5. Again, these effects of the aromas did not reflect the liking of them.

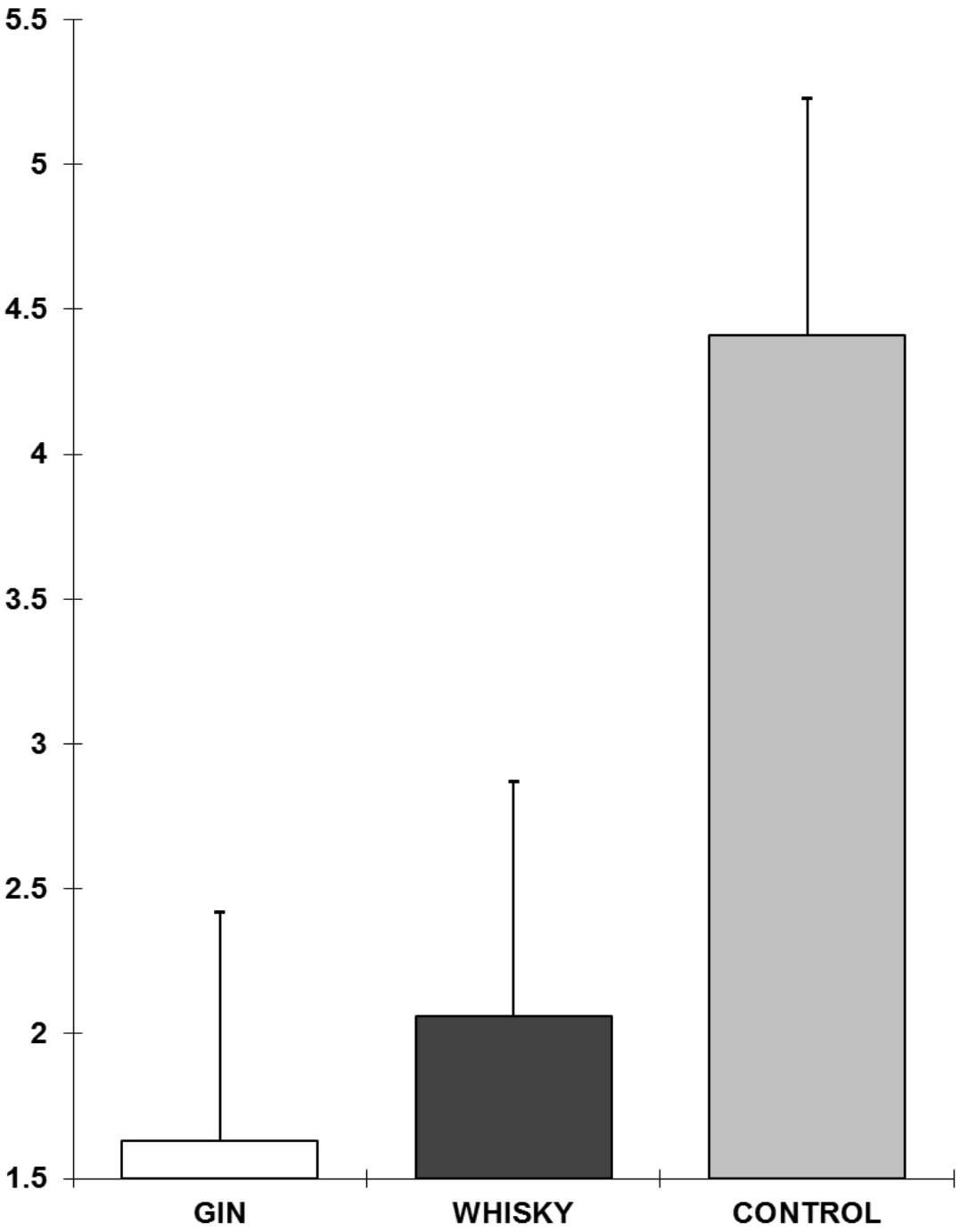

Figure 4: Effects of the gin and whisky aromas on lapses of attention in the focused attention task (scores are the adjusted means from the analysis of covariance; s.e.s. shown as bars; high scores = more lapses of attention).

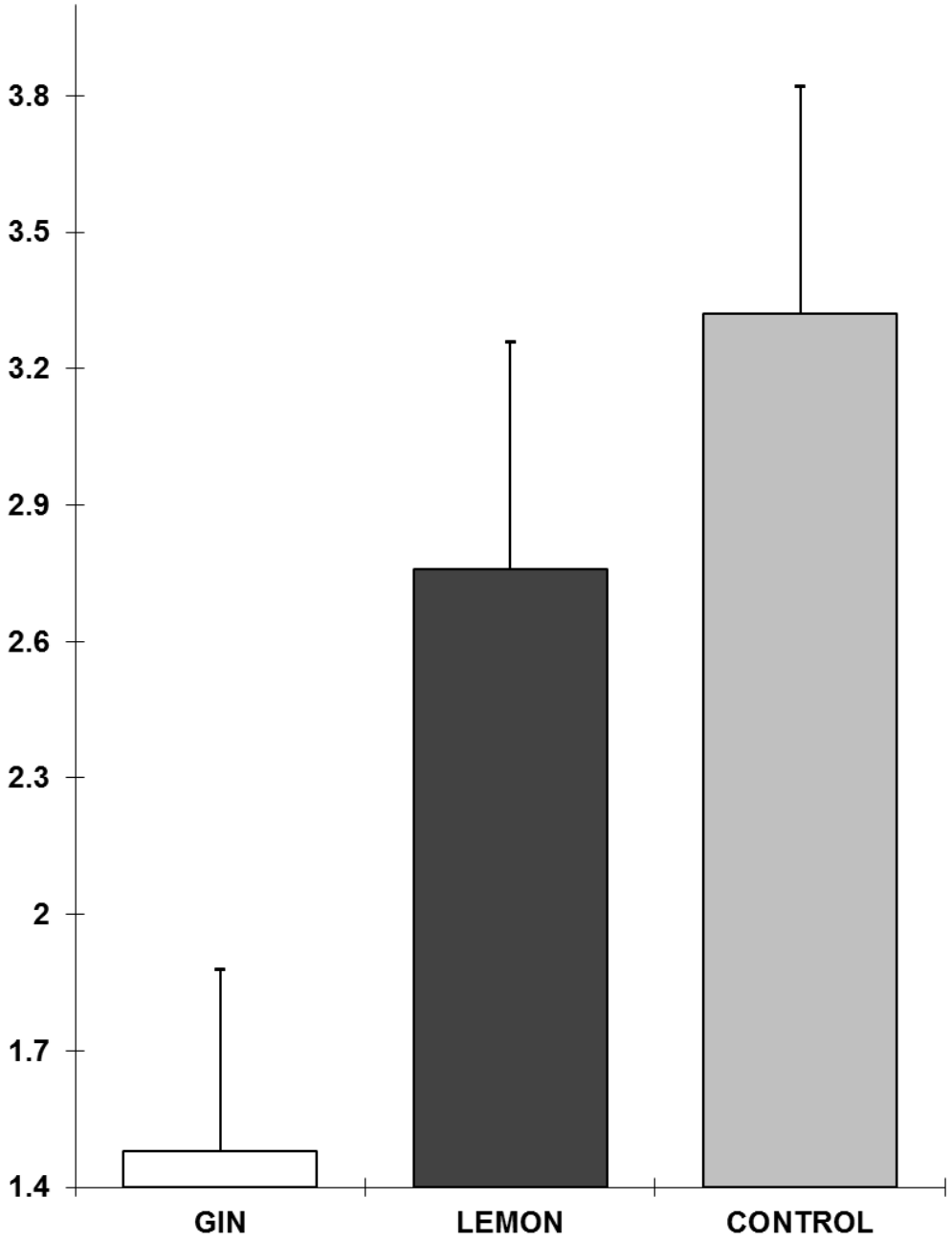

Figure 5: Effects of the gin aroma on lapses of attention in the categoric search task (scores are the adjusted means from the analysis of covariance; s.e.s. shown as bars; high scores = more lapses of attention).

DISCUSSION

The study showed that the methods used were appropriate for investigating the present topic. Few differences were observed between the aromas, and given the large number of analyses conducted, the significant effects must be treated with caution. More differences were

apparent when comparing the aromas with the control condition, and these appeared reliable. The lemon aroma was associated with a more positive mood but had no effect on performance. In contrast, the whisky and gin led to improved sustained attention. The liking of the aromas was found to have a significant effect but did not underlie the effects of the specific aromas on mood and performance. The significant effects are plausible and in line with previous findings. First, the correlation between acceptability and positive mood replicates the results of the association between mood and drink acceptability. The effect of the gin aroma on sustained attention is rather similar to results obtained using menthol vapour. This suggests that the gin aroma, and to a lesser extent the whisky aromas, may have strong trigeminal effects. The absence of effects of the beer aroma is consistent with the difficulties in finding an aroma that reflects beer. It is possible that the aroma one associates with beer reflects the general atmosphere of the drinking context rather than the beer itself.

The methodology can now be used to assess issues such as dose and duration of the aroma. However, alternative methods of exposure to the aromas may need to be used to do this. Sustained attention was the most appropriate outcome to detect the effects of aromas, and there are several suitable tasks that may prove even more sensitive than the ones used here. Electrophysiological indicators can also be included in future studies to assess the sensitivity of these measures of CNS and ANS function to exposure to aromas.

CONCLUSION

Research on the effects of aromas on mood and cognition shows that these effects may depend on how the aroma is presented, aroma type, duration of exposure, and the outcome measures examined. The present study examined the effects of sniffing aromas from drinks on mood and attention. Separate groups sniffed different aromas (lemon, beer, whisky, gin and water- the control). One hundred and ten university students completed the study. They carried out a baseline session with no aroma, followed by a test session where the aroma was sniffed over the course of the session. Liking of the aromas was recorded at a familiarisation session. The results showed that the lemon aroma was rated as the most pleasant, followed by the gin, beer, and whisky. Prior to completing the performance tasks, those exposed to the whisky felt more sociable and happier than the control group. After completing the tasks, the lemon aroma group felt more alert than those in the control group and those exposed to the beer. The lemon group also felt more sociable and happier than the control group. Ratings of alertness were significantly correlated with the liking of the aroma. However, the effects of

the lemon aroma were still significant when the liking ratings were covaried. The only performance measures to show significant effects of the aromas were lapses of attention (occasional very long response times). In the focused attention task, gin and whisky aromas reduced the number of lapses relative to the control condition. In the categoric search task, the gin aroma reduced the lapses of attention relative to the lemon aroma and control conditions. These effects of the aromas on lapses of attention did not reflect their liking of them. In summary, the present study has shown that sniffing aromas from drinks can lead to changes in mood and sustained attention. Further research is now required to identify the underlying mechanisms and evaluate the practical relevance of these changes.

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