COGNITIVE AND BEHAVIOURAL ASPECTS

The Influence of Alcohol Intake and Alcohol Expectations on the Recognition of Emotions

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Abstract — Aims: To investigate the effects of actual and expected alcohol intake on the detection and interpretation of the basic emotions happiness and anger in facial expressions. Methods: n = 102 healthy participants performed a dynamic emotion recognition task before and after receiving a drink which contained either a moderate alcohol dose or no alcohol in a double-blind design. Results: The actual alcohol intake had no effect on detecting and interpreting facial expressions. However, subjects who expected to drink alcohol judged facial expressions significantly more often as happy. No effects were observable for the recognition of anger in facial expressions. Conclusion: Our results corroborate recent studies that found that the belief of consuming alcohol does not increase anger recognition or aggressive behavior but decreases aggression and social stress.

INTRODUCTION

Alcohol consumption is associated with undesirable social behavior such as aggression or sexual assault but also with desirable behavior such as being extraverted and sociable. The existence of a causal relationship between alcohol consumption and aggressive behavior is widely agreed (reviewed by Bushman and Cooper, 1990; Taylor and Chermack, 1993; Chermack and Ginacola, 1997). Using the Taylor paradigm (Taylor, 1967) in which participants can administer electrical shocks to an opponent, several studies found that after having received an alcoholic beverage participants chose shocks with a higher intensity level (e.g. Taylor and Gammon, 1975, 1976; Taylor et al., 1976; Taylor and Sears, 1988). Studies investigating mediating factors between alcohol intake and aggressive behavior (Giancola, 2000, 2004; Quigley and Leonard, 2006) conclude that both are linked in a such way that alcohol disrupts executive control which in turn enhances the probability of aggressive behavior. This might be due to dysfunctions in a specific brain network, including the orbitofrontal cortex, anterior cingulate cortex and amygdala, which constitute the neuronal substrate linking emotion regulation to aggression (Davidson et al., 2000). Despite alcohol-induced aggressive assaults, the most common reasons to drink alcohol among young adolescents are social motives such as facilitating social interactions or to boost social events (Feldmann et al., 1999; Kuntsche et al., 2005). In line with this, several studies have pointed out the relationship between social anxiety or social phobia and alcohol use (e.g. Schneier et al., 1989; Lepine and Pelissolo, 1998; Stevens et al., 2008). According to the appraisal-disruption model by Sayette (1993), alcohol decreases social anxiety due to its influence on cognitive processes. Within this model, it is suggested that the consumption of alcohol disrupts the appraisal of typically anxiety provoking stimuli which constrains the activation of previously established threat memory networks (Sayette, 1993; Stevens et al., 2008). For this reason, Stevens et al. (2008) investigated the influence of alcohol consumption on ratings of emotional facial expressions in patients with social phobia. The authors found that socially phobic patients as well as healthy controls rated angry faces as less rejecting after alcohol intake.

Corroborating the cognitive model by Sayette (1993), Tucker and Vuchinich (1983) claim that alcohol changes social behavior in general indirectly due to an altered perception and processing of social cues, such as verbal and non-verbal components of communications and not directly through the pharmacological (e.g. anxiolytic) properties of alcohol on motivational processes. The accurate perception of non-verbal communicational cues like the identification of emotions in facial expressions plays a crucial role for social interactions. Inferring emotions and the mental states from our peers’ faces are prerequisites for interpersonal communication (Carton et al., 1999). The influences of alcohol consumption on the detection and recognition of emotions in facial expressions have also been successfully investigated in healthy subjects (e.g. Tucker and Vuchinich, 1983; Kano et al., 2003; Attwood et al., 2009a,b) with some conflicting results. For instance, Attwood et al. (2009a,b) presented their participants static pictures of facial expressions which varied in their emotional intensity. The studies yielded that a moderate alcohol dose (0.4 g/kg) lead to an enhanced interpretation of negative expressions as anger in male faces, whereas the detection of sadness was hampered but only in male participants. By contrast, effects of alcohol on emotion recognition have also been found for positive facial expressions: small doses of alcohol can accelerate the detection of happiness in facial expression, whereas large doses of alcohol hamper it (Kano et al., 2003). This ostensible conflict can be solved by considering two kinds of drinking strategies: drinking to increase or intensify positive emotions or to decrease negative emotions (Cooper et al., 1995). The first strategy would account for the accelerated detection of happiness, whereas the second one would explain the hampered detection of sadness.

Additionally, findings from several studies demonstrate that social behavior is not only affected by the actual alcohol intake but also by the participant’s expectation of receiving alcohol. For instance, Giancola (2004) found that the mere belief that alcohol was consumed but not the alcohol intake itself suppressed aggressive behavior in the Taylor paradigm in female participants. Balodis et al. (2011) reported that both, alcohol intake and the belief of receiving alcohol resulted in less physiological and subjective stress responses.
after the Trier Social Stress Test. In the light of emotion perception and recognition, Tucker and Vuchinich (1983) demonstrated a significant statistical alcohol intake by the expectation interaction effect on general emotional perception indicating that alcohol-induced deficits were more pronounced in subjects who expected to receive alcohol than in subjects who did not. No expectation effects were found for the recognition and detection of the negative emotions of anger and sadness (Attwood et al., 2009a,b; Craig et al., 2009).

In the present study, we seek to investigate the effects of acute alcohol consumption and of the expectation of receiving alcohol on the correct detection and on the subjective interpretation of the basic emotions from facial expressions in healthy participants. Within the scope of the information processing approach, it can be argued that alcohol influences social behavior in such a way that the ability to correctly detect emotions in facial expressions is either disrupted or improved. Moreover, facial expressions might be misinterpreted dependent on the emotion expressed. With respect to the question whether alcohol intake and/or the expectation of receiving alcohol leads to socially desirable or undesirable behavior we will focus on the detection and interpretation of anger and happiness for the following reasons: on the one hand, aggression is often caused by anger and anger recognition (e.g. Calder et al., 2004; Hall, 2006; Nelson and Trainor, 2007; Ohlsson and Ireland, 2011). Furthermore, the existing literature suggests that the influence of alcohol intake on emotion recognition is most notable for the emotion anger in patients with social phobia as well as in healthy subjects (Stevens et al., 2008; Attwood et al., 2009b). With respect to the existing literature, we hypothesized that alcohol intake influences the detection and interpretation of anger in facial expressions. Due to the partially conflicting results whether alcohol intake increases or decreases the recognition of anger this hypothesis remains non-directional. Additionally, alcohol consumption has been reported to function as a coping strategy in socially anxious people (Sayette, 1993; Cooper et al., 1995; Stevens et al., 2008). Furthermore, after considering that the main reason for consuming alcohol in young adolescents is to become more sociable and extraverted and to facilitate social interactions, we assume that the belief of receiving alcohol increases the detection and interpretation of happiness in facial expressions.

MATERIALS AND METHODS

Participants

\(n = 102\) healthy, undergraduate psychology students (\(n = 22\) males, age \(M = 21.7, SD = 3.5\)) volunteered for the present study. Participants were asked to report their general alcohol consumption per week (amount and kind of alcohol). All subjects were social drinkers with a mean alcohol consumption of 40 g alcohol (ca. 11 beer) per week. Participants were informed about the study protocol including the fact that half of the participants would be served an alcoholic beverage. Exclusion criteria were present or former neurological disorders, mental disorders such as anxiety or mood disorders as well as history or family history of substance or alcohol abuse and addiction. Participants who reported taking any kind of drugs or medication currently or continuously were excluded from the study. Additionally, participants were asked to abstain from alcohol within the last 24 h before the experiment started. To exclude medical risks in case of pregnancy, only women who reported taking contraceptives were allowed to participate. Informed written consent was obtained at least 24 h before the experiment. The study protocol was approved by the local ethics committee of the University of Bonn, Germany (authorization number: 10-11-04).

Behavioral task

For a detailed description of the utilized emotion recognition task (ERT) see Fischer-Shofty et al. (2010).

Briefly, the ERT consisted of video clips in which facial expressions changed gradually and continuously from a neutral to an emotional expression. The face stimuli were grey-scaled and standardized photographs of six different individuals that reflected the six different basic emotions (happy, sad, disgust, fearful, angry and surprised). The six individuals (three male and three female faces) were selected from the Ekman series (Ekman and Friesen, 1975, 1976). Each of the six individual faces displayed each basic emotion resulting in a total of 36 stimuli (video clips). Using the morphing technique each video clip included 100 frames. Each frame was presented for 100 ms, so that each clip lasted 10 s. Stimuli were presented on a 19-inch computer screen against a black background. The ERT was designed and implemented with E-prime 2.0 software. Participants were told to press the spacebar key once they detected an emotion emerging from the neutral expression. Immediately after pressing the spacebar key subjects were asked to decide which of the six basic emotions they recognized using a forced-choice paradigm. Altogether, subjects require approximately 10 min to perform the task. A dynamic ERT was used because brain regions processing emotional affect show a greater response to dynamic than to static emotional expressions (LaBar et al., 2003). Dynamic facial expressions simulate the actor to get happy, angry, sad etc., so that they are closer to real-life face-to-face communications and thus have a higher ecological validity than static pictures of emotional expressions. Although the ERT is designed to test the detection and interpretation of all six basic emotions (happiness, fear, sadness, anger, surprise and disgust), we focused our analyses particularly on the two target emotions of anger and happiness.

Dependent variables

Three different types of dependent variables were measured separately for the two target emotions under investigation (happiness and anger). At first accuracy scores were recorded as the number of faces correctly detected as happy and angry, respectively. Irrespective of accuracy, the entire number of faces judged as happy and angry were also recorded and henceforth referred to as interpretation as happy and angry, respectively. As described above, subjects had to press the spacebar while watching the video clips once they had detected an emotion emerging from the neutral expression. Reaction times were also assessed as dependent variable (with a maximum of 10,000 ms; video clips stopped automatically after 10 s).
Questionnaire data
The Toronto Alexithymia Scales (TAS-20) with 20 items (Franz et al., 2008) is the most widely used self-report questionnaire for measuring Alexithymia. It consists of the subscales ‘Difficulties Identifying Feelings’, ‘Difficulties Describing Feelings’ and ‘Externally Oriented Thinking’. In the light of the present study, the overall TAS-20 score was included into the analyses. The Temperament and Character Inventory (Cloninger et al., 1993) is a self-report questionnaire consisting of 240 dichotomous items measuring four temperaments and three characters. The four temperaments are Novelty Seeking, Harm Avoidance (HA), Reward Dependence and Persistence. The three characters are cooperativeness, self-directedness and self-transcendence. With respect to the findings by Stevens et al. (2008) we will control for the anxiety-related personality of HA (Cloninger et al., 1993) as well as for Alexithymia. Alexithymia refers to difficulties in emotional self-regulation which result from disturbances in emotional processing. A recent study has shown that HA and Alexithymia are highly correlated (Walter et al., 2011). For \( n = 6 \) participants questionnaire data were not available.

Procedure
Participants were randomly assigned to receive either 0.4 g/kg alcohol using sparkling wine or a placebo drink consisting of an equal total volume of non-alcoholic sparkling wine. For example, a participant with a weight of 65 kg drank 286 ml alcoholic or non-alcoholic sparkling wine, respectively. Based on the study by Tucker and Vuchinich (1983), a double-blind placebo-controlled study with a \( 2 \times 2 \) mixed factorial design was conducted. The between subject factor DRUG consisted of the two levels alcohol and placebo (each participant received either an alcoholic or a non-alcoholic drink) and the within-subject factor constituted a pre-post-control design i.e. each participant performed on the ERT twice, once before and once after drink intake. Because the mere belief of receiving alcohol has been shown to influence behavior in social situations (Giancola, 2004; Balodis et al., 2011), we decided against a cross-over design. Thus, all participants performed on the first ERT trial without receiving any kind of drink so that this trial is entirely unaffected by expectation effects. Our design includes a short test-retest interval so that our results might be compromised by a test-retest bias. However, the advantage is that the interval between both trials was exactly the same for all participants and across drug conditions and that both trials were conducted on the same day. Thus, comparisons within participants are unaffected by differences in mood states, food intake or time of assessment. If test-retest biases occur, they should become apparent in a main/interaction effect of/with the within-subject factor. On the day of the experimental session, subjects were first familiarized with the ERT. After participants drank 286 ml alcoholic or non-alcoholic sparkling wine. For example, a participant with a weight of 65 kg drank 286 ml alcoholic or non-alcoholic sparkling wine, respectively. Based on the study by Tucker and Vuchinich (1983), a double-blind placebo-controlled study with a \( 2 \times 2 \) mixed factorial design was conducted. The between subject factor DRUG consisted of the two levels alcohol and placebo (each participant received either an alcoholic or a non-alcoholic drink) and the within-subject factor constituted a pre-post-control design i.e. each participant performed on the ERT twice, once before and once after drink intake. Because the mere belief of receiving alcohol has been shown to influence behavior in social situations (Giancola, 2004; Balodis et al., 2011), we decided against a cross-over design. Thus, all participants performed on the first ERT trial without receiving any kind of drink so that this trial is entirely unaffected by expectation effects. Our design includes a short test-retest interval so that our results might be compromised by a test-retest bias. However, the advantage is that the interval between both trials was exactly the same for all participants and across drug conditions and that both trials were conducted on the same day. Thus, comparisons within participants are unaffected by differences in mood states, food intake or time of assessment. If test-retest biases occur, they should become apparent in a main/interaction effect of/with the within-subject factor. On the day of the experimental session, subjects were first briefly and orally informed about the procedure by the coordinator of the experiment (subjects were already explicitly informed in written form at least 24 h before the experimental session started). Then, the subject’s body weight was recorded. Hereafter, participants were accompanied to the laboratory where they met the experimenter. Subjects were seated in test-cubicles in front of a 19-inch computer screen. At first possible neurological and psychiatric disorders and alcohol/substance consumption in general and within the last 24 h were assessed by a screening questionnaire. Then, participants were familiarized with the ERT. After participants read the introduction, a practice trial was given in which subjects worked on 6 out of the 36 ERT video clips (see description of the behavioral task). Within the practice trial, each of the six basic emotions was expressed by a different individual (three males, three females). If necessary, participant’s questions regarding the task were answered by the experimenter and then the first ERT trial started. Both ERT sessions were spaced by a different distractor task which took 20 min to complete. The second task was conducted within the scope of another research project and consisted of 24 short stories in which a certain behavior of a main character was illustrated. After each short story subjects had to answer a single question about the character’s responsibility regarding the story’s outcome on a 5-point Likert-scale. This task had nothing to do with the ERT or the aim of the present study and was completed by all participants. After finishing this task, subjects were given a strong mint to disguise the alcoholic flavor before the drink was served. At first, they were asked to take a full sip and then state whether their drink contained alcohol or not. The subject’s statement regarding the alcoholic content was recorded in written form as expectancy to drink alcohol (alcohol expectation). Thus, participants were not told whether receiving alcohol or not.

Statistical analysis
At first we conducted separate three-way analysis of variances (ANOVA) in order to control for possible differences in personality (alexithymia and HA) between drink groups (DRUG; alcohol vs. placebo), expectation groups (alcohol expected vs. no alcohol expected) and gender. Furthermore, \( \chi^2 \) statistics were computed to test if the subject’s internal expectation regarding the alcohol intake was independent of the actual alcohol intake. Additionally, to ensure that the ability to correctly recognize emotions in facial expressions is independent from age, correlational analyses were conducted between age and the number of faces correctly detected as angry and happy in the first ERT trial. Age was not correlated to the number of faces correctly detected as angry/happy (all \( P \)-values > 0.08). According to these results, age was not considered in the following analyses regarding alcohol intake, alcohol expectations and performance in the ERT trials. 2 (ERT trials) \( \times 2 \) (alcohol expectancy) \( \times 2 \) (DRUG) ANOVAs were conducted separately for the two...
emotions under consideration and the three different dependent variables (correct detection, interpretation, reaction times). The two ERT trials (pre- vs. post drink intake) were set as within-subject factors. Alcohol expectancy (yes vs. no) and DRUG (alcohol vs. placebo) were treated as between-subject factors. In order to control for possible gender effects, gender was entered as an additional between-subject factor into the analyses. We refrained from considering four-way interactions between the within-subject factor (ERT trials) and all three between-subject factors (DRUG, alcohol expectation and gender) because this would have led to inadequately low cell frequencies in the factorial design.

RESULTS

Participant characteristics
Participants had a mean TAS-20 score of 43.86 (SD = 10.77) and a mean HA score of 15.54 (SD = 6.74). To control for potential group differences, two separate three-way ANOVAs were conducted with alcohol expectation, DRUG and gender as between-subject factors. No significant main or interaction effects on the TAS-20 scores could be observed. The second ANOVA on HA showed that females had significantly higher HA scores than men ($F_{(1, 88)} = 5.11, P = 0.026$). Due to the fact that TAS-20 and HA were not at all related to the principal independent variables under investigation (alcohol expectation and DRUG) these personality variables are not controlled for in the following. No gender effects could be observed on the accuracy scores for male and female faces (all $P$-values > 0.05).

$n = 35$ participants believed that their drinks contained alcohol. The expectancy of drinking alcohol was independent of the actual provided drink (alcoholic, $n = 51$ vs. $n = 51$ non-alcoholic; $\chi^2 = 0.087$, df = 1, $P = 0.78$).

Alcohol intake, alcohol expectations and anger
At first the ANOVA was conducted for the correct detection of anger in facial expressions. No significant main effect for the ERT trials as within-subject-factor occurred. No significant interaction between ERT trials and DRUG, between ERT trials and alcohol expectation or between ERT trials and gender occurred (all $P$-values > 0.05). None of the three possible three-way interactions between the within-subject factor and any between-subject factor configuration (DRUG × alcohol expectation, DRUG × gender, alcohol expectation × gender) was significant (all $P$-values > 0.05).

The ANOVA conducted with facial expressions judged as angry as dependent variable yielded no main effect for the within-subject factor and no two- or three-way interaction between within- and between-subject factors was significant (all $P$-values > 0.05).

The ANOVA with reaction times for the detection of angry faces as dependent variable came to the same results. Again, no significant main- or interaction effects could be observed (all $P$-values > 0.05).

Alcohol intake, alcohol expectations and happiness
The ANOVA with the correct detection of happy faces as dependent variable was conducted analog to the anger emotion. ERT trials were set as within-subject factor, whereas DRUG, alcohol expectation and gender were set as between subject factors. No main effect for the within-subject factor occurred. A significant interaction effect between ERT trials and alcohol expectations turned up ($F_{(1, 94)} = 5.77, P = 0.018, \eta^2 = 0.058$). Subjects who believed to drink alcohol detected more faces correctly as happy in the second compared with the first ERT trial, whereas subjects who expected to drink a non-alcohol beverage did not show any difference between the two ERT trials. Considering the number of tests conducted, this effect does not hold the correction for multiple testing. No further significant interaction effects (two- or three-way) between the ERT trials and any between-subject factors occurred (all $P$-values >0.05).

In a second step, the same ANOVA was conducted with the number of faces judged as happy as dependent variable. Again, the ANOVA did not reveal a significant main-effect of the within-subject factor. The analysis yielded no significant interaction between the ERT trials and gender or between ERT trials and DRUG (all $P$-values > 0.05). A significant interaction effect between ERT trials and alcohol expectations turned up ($F_{(1, 94)} = 9.03, P = 0.003, \eta^2 = 0.09$). Subjects who expected to drink alcohol judged significantly more faces as happy in the second ($M = 6.92$) than in the first ERT trial ($M = 5.82$) ($T = -2.86, df = 33, P = 0.007$). No significant difference occurred between the two ERT trials regarding the interpretation of facial expressions as happy for subjects who believed to drink a non-alcoholic beverage (first trial $M = 6.25$; second trial $M = 6.17$; $T = 0.67, df = 67, P = 0.50$) (see Fig. 1). This interaction effect between ERT trials and alcohol expectations holds the Bonferroni correction for multiple testing.

In a last step, the ANOVA with reaction times to detect happy faces was conducted. No significant main- or interaction effects occurred (all $P$-values > 0.05).

To summarize our findings, the only significant result that could be observed is that subjects who expected to receive an alcoholic drink judged significantly more faces as happy in the second compared with the first ERT trial. Thus, on average subjects judged one more facial expression as happy

Fig. 1. Depicted is the significant interaction between the within-subject factor ERT trials and the between-subject factor alcohol expectation on the percentage of faces judged as happy. Subjects who expected to receive alcohol judged significantly more faces as happy in the second compared with the first ERT trial.
DISCUSSION

The present study was targeted at the investigation of the influence of alcohol intake and the expectation of receiving alcohol on the detection and interpretation of anger and happiness in facial expressions. Due to our main result that the expectation of receiving alcohol leads to an enhanced interpretation of facial expressions as happy, we suggest that the mere belief of consuming alcohol leads to an enhanced interpretation and perception of happiness in facial expressions. This finding was independent of the actual alcohol intake. We could not observe any alcohol or alcohol expectation effect for the anger emotion. Thus, our results confirm our second hypothesis but we were not able to support the first one. Regarding the latter, we hypothesized that acute alcohol intake would influence the recognition and interpretation of anger. Mounting evidence suggests a causal relationship between alcohol intake and aggressive behavior (Bushman and Cooper, 1990; Taylor and Chermack, 1993; Chermack and Giancola, 1997). According to the information-processing approach (Tucker and Vuchinich, 1983) it can be assumed that alcohol intake influences the correct perception of social (non-verbal) cues, such as facially expressed emotions, which in turn leads to maladaptive social behavior. On the other hand, alcohol is often consumed to cope with threat provoking social situations in social phobic patients (Schneier et al., 1989; Lepine and Pelissolo, 1998; Stevens et al., 2008). And indeed, Stevens et al. (2008) found that participants rated angry faces as less inhibiting when alcohol is consumed and that this might be the reason for the absence of main effects. For this case, significant interactions between the within-subject factors and actual alcohol intake should have been observable. We did not find any significant interaction effect between alcohol intake and within-subject factors. We conclude that our design and results are not compromised by relevant test-retest biases.

However, to the best of our knowledge this is the first study demonstrating an effect of expected alcohol intake on the recognition of happy faces. Participants who believed that they had received an alcoholic beverage judged on average one facial expression (~3% of the presented facial expressions) more as happy after drink intake compared with the first ERT trial. This result corroborates the studies by Giancola (2004) as well as by Balodis et al. (2011) reporting that the mere belief of receiving alcohol decreased aggression and physiological as well as subjective stress responses to a social stressor, respectively. Of course, being less aggressive and less stressed in social situations does not reflect the same processes as recognizing happiness. The common denominator however, is that they facilitate social interactions. Interestingly, our finding is independent of actual alcohol intake. Our finding contributes to the social-drinking perspective stating that alcohol is consumed to boost social events (Feldmann et al., 1999; Kuntsche et al., 2005) or to cope with possible threatening stimuli in social situations (Schneier et al., 1989; Lepine and Pelissolo, 1998; Stevens et al., 2008). With our present study, we provide evidence that alterations in social relevant perception and behavior can be influenced by the expectation of receiving alcohol. Further research is needed to disentangle the association between expected alcohol intake and behavior by investigating underlying alcohol drinking motives and outcome expectations.

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REFERENCES


when they expected to drink alcohol. This effect was independent of the actual alcohol intake (DRUG). No significant effects could be observed for detecting and interpreting angry faces.


