Effects of alcohol on the processing of social threat-related stimuli in socially phobic women

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Background. Social phobics are at a higher risk of developing alcohol problems. The mechanism promoting this association is not clear. According to Sayette (1993b), alcohol attenuates anxiety responses by disrupting initial appraisal of threatening stimuli. We used the emotional Stroop test and an implicit memory test to investigate whether alcohol hinders appraisal of social threat words in patients diagnosed with social phobia.

Procedure. Thirty-two women with social phobia (DSM-IV) and 32 female controls performed an emotional Stroop test either after drinking alcohol resulting in a blood alcohol levels (BAL) of 0.6‰ or after drinking a non-alcoholic beverage. The emotional Stroop test contained social anxiety-related and neutral stimuli. Implicit memory for the words presented was tested with a word-stem completion test.

Results. Without alcohol, both controls and socially-phobic participants took longer to name the colour of socially-threatening stimuli than of neutral stimuli. Alcohol levelled response latencies to the two stimulus categories only in controls. Socially-phobic participants responded more slowly to social anxiety-related stimuli than to neutral stimuli, irrespective of their BAL. In contrast to controls, social phobics showed an implicit memory bias for social threat words. This bias was attenuated by alcohol.

Discussion. Alcohol disrupts appraisal of social anxiety-related stimuli in controls but not in social phobics; in these it hinders the consolidation of memory. This also suggests that social phobics experience similar anxiety with and without alcohol, but remember this experienced anxiety less precisely. This effect might act as a reinforcer for the use of alcohol for the purpose of self-medication in future situations.

Epidemiological studies show that socially anxious people are at a higher risk of abusing alcohol or developing alcohol dependence (Schneier, Martin, Liebowitz, Gorman, & Fyer, 1989; Allan, 1995; Holle, Heimberg, Sweet, & Holt, 1995; Himle & Hill, 1991;
Page & Andrews, 1996; Nardi & Versiani, 1997; Clark & Sayette, 1993; Stockwell & Bolderston, 1987). A prospective study found a 2.3-fold increased risk for alcohol abuse and dependence in subclinical social phobia (Crum & Pratt, 2001). However, there are also reports that people with a diagnosis of social phobia consume less alcohol than controls (Holle et al., 1995). This result cannot simply be explained as a social desirability effect, since social desirability and reported alcohol consumption were not correlated in a different sample of patients with social phobia (Cox, Swinson, Direnfeld, & Bourdeau, 1994). Thus, different processes may be at work as different intensities of social anxiety lead to the overlap of social phobia, alcohol abuse and dependence.

A number of models attempt to explain the connection between anxiety or stress and alcohol use. Conger (1956) suggested that alcohol reduces tension (or anxiety) and that people consume alcohol to this effect. In line with this suggestion, social phobia patients consume more alcohol in a socially stressful situation (public speaking), and they report more attenuation of anxiety by drinking alcohol than controls, especially if they expected that alcohol would have such an effect (Abrams, Kushner, Medina, & Voight, 2001; Abrams, Kushner, Medina, & Voight, 2002). These findings support a self-medication theory of alcohol abuse. In this model, alcohol serves as a readily-available means to cope with anxiety, inadvertently leading to abuse and dependence. In contrast to this model, however, direct anxiety-reducing effects of alcohol in socially anxious people have not been found consistently. For example, a direct effect of alcohol on anxiety was lacking when social phobics were to give a speech under the influence of alcohol (Himle et al., 1999; Naftolowitz, Vaughn, Ranc, & Tancer, 1994).

The tension-reduction theory as stated by Conger (1956) has not remained undisputed. According to Sayette’s (1993b) appraisal-disruption model, ‘SRD [stress-response dampening] occurs to the degree that alcohol acts pharmacologically to interfere with a person’s appraisal of stressful information’ (p. 463). Sayette suggests that alcohol has this effect because it reduces the propensity of relevant stimuli to activate stressor-associated memories. In the context of social phobia, these considerations imply that biased processing of social phobia-related stimuli is reduced after the consumption of alcohol, since phobia-related memories are not activated. However, Sayette also proposed that in case of stressors which are most readily or automatically apprised, alcohol is much less likely to hinder appraisal. This proposition is based on the conviction that highly automatic cognitive processes cannot easily be disrupted. Accordingly, alcohol may not affect processing of threat-related stimuli in clinically-phobic subjects. Whereas this notion seems reasonable, it has not yet been tested directly in an information-processing paradigm.

Alternatively, Josephs and Steele (1990) Steele and Josephs (1988) suggested that alcohol will narrow the attention of an individual to immediate and salient cues, hindering the processing of more remote or less salient cues (alcohol myopia theory): only if a cue is present that is more salient or more easily processed than the anxiety-related cues, will alcohol alleviate anxiety by hindering the processing of the anxiety-related cue.

The processing of social phobia-related stimuli can be assessed by various procedures. The paradigm that is probably most often used in social phobia and anxiety disorders is the emotional Stroop test. Colour-naming latency to social phobia-related words as compared with neutral words was longer in a number of studies in social phobia patients (Amir, Freshman, & Foa, 2002; Amir et al., 1996; Becker, Rinck, Margraf, & Roth, 2001; Holle, Neely, & Heimberg, 1997; Lundh & Öst, 1996; Mattia, Heimberg, & Hope, 1993; McNeil et al., 1995; Orsillo, Lilienfeld, & Heimberg, 1994). How can this slowed
processing be accounted for? The emotional Stroop effect can at least partially be attributed to increased activation of negative emotion-related identity nodes, which spreads automatically to related nodes ‘in some sort of semantic recognition’ (White, 1996; p. 206). Sayette (1993b) argues that ‘alcohol disrupts initial appraisal of stressful information by constraining the spread of activation of associated information previously established in long-term memory’ (p. 247). Thus, alcohol can be expected to alter performance in the emotional Stroop test.

The alcohol myopia theory states that alcohol influences behaviour when conflicting cues simultaneously influence behaviour (Josephs & Steele, 1990; Steele & Josephs, 1988). Stroop interference is the result of a response conflict (e.g. MacLeod, 1991). Thus, according to alcohol myopia theory, ingestion of alcohol will increase the emotional Stroop effect. Colour naming is the process that is less automatic and less salient compared with word reading. Since alcohol reduces cognitive control, word reading that interferes with colour naming should be processed with priority and consequently an increased interference should occur. Indeed, Curtin and Fairchild (2003) found an increase in error rate and a tendency for longer reaction times after ingestion of alcohol (0.08 per mille) in incongruent trials in the colour word version of the Stroop test.

Alcohol, in addition to potentially preventing appraisal of information, also possesses powerful amnesic effects (Weissenborn & Duka, 2000). Generally, it is assumed that alcohol impairs the encoding and storage of new information (Sayette, 1993b). However, with respect to acute alcohol effects on implicit memory there is very little and contradictory information. Hashtroudi et al. (1984) found increased performance on an implicit memory test after consumption of alcohol. Duka et al. (2001) and Lister et al. (1991) found that alcohol had a profound negative impact on explicit memory but left implicit memory intact.

During the emotional Stroop test, perceptual priming takes place, resulting in enhanced implicit memory for emotional stimuli of negative valence (Rajaram, Srinivas, and Travers, 2001). Although information-processing models of emotional disorders suggest that anxious people (e.g. social phobics) have a memory bias for threat-related stimuli (e.g. Williams & Scott, 1988), empirical support for such a memory bias is weak. Specifically for social phobia, there is only limited evidence for either an explicit or an implicit memory bias for social threat stimuli (Coles & Heimberg, 2002). Amir et al. (2003) argued that methodological issues may have prevented the detection of memory biases for social threat material in social phobics in previous studies. For example, Rapee et al. (1994) failed to find an implicit memory bias for social threat words in social phobics. However, participants were tested not before 15–35 minutes after first exposure to the stimulus material. In the Lundh and Öst study (1997) that found an implicit memory bias in non-generalized social phobics, memory performance was tested only 5 minutes after the first exposure. Graf and Mandler (1984) argued convincingly that the duration between acquisition and testing is critical if implicit memory is measured by word-stem completion. In two newer studies using tests for implicit memory other than word-stem completion, Amir and colleagues demonstrated implicit memory biases for social threat stimuli in social phobics (Amir et al., 2003; Amir, Foa, & Coles, 2000). Consequently, we additionally planned to explore whether implicit memory measured by word-stem completion for social phobia-related words used in our emotional Stroop test would be enhanced in social phobics and whether this bias would be affected by alcohol.
Based on these considerations we investigated whether consumption of alcohol attenuated the effect of social phobia-related words on colour-naming latencies and also reduced a possible implicit memory bias for such words in social phobics. Since alcohol has different effects on men and women (Eckardt et al., 1998), only female participants were tested. In a number of information-processing studies, anxiety induction was employed in order to activate social threat-relevant schemata. In his 1993 paper, Sayette argued that SRD is unlikely to occur when a stressor is sufficiently threatening to override appraisal deficits. Consequently, we decided not to use an anxiety-inducing procedure in order to test the appraisal disruption hypothesis explicitly under conditions of low threat. It is still likely that social phobics will experience more evaluation anxiety during the stress test than non-anxious controls.

Method

Recruitment

Women who responded to newspaper advertisements seeking women either with or without fear of social situations and who successfully completed a brief telephone screening were invited to attend a diagnostic session for approximately 2-hours. This session included completion of several questionnaires and the German Version of the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders (SCID; Wittchen). Interviews were conducted by clinicians with several years of experience in treating social phobia patients and who were trained in using the SCID. Control participants received 60 or 40 German marks (DM), depending on whether they received alcohol or not. Socially-phobic participants were offered the choice of the same amount of money or participation in a 6-hour workshop dealing with social phobia. Exclusion criteria for participation in the study were current or past drug or alcohol abuse or dependence, complete abstinence from alcohol, colour-blindness, use of psychoactive medication, liver damage, and current or past psychotic episodes.

Participants

Forty-two socially phobic patients and 36 control participants took part in the experiment. Due to equipment failure (malfunction of the throat microphone), data for only 32 socially phobic and 32 control participants were available. We did not control the phase of the menstrual cycle of our participants at the time of testing. Table 1 shows significant differences in the expected direction of social phobia-related measures. These were the German versions of the Fear of negative evaluation scale (Vormbrock & Neuser, 1983), the Social phobia scale (Stangier, Heidenreich, Berardi, Golbs, & Hoyer, 1999), the Social interaction and anxiety scale (Stangier et al., 1999), Drinking due to social anxiety scale (‘Trinken wegen sozialer Angst’, Heidenreich, Wagner, & Stangier, 2003), and the Blushing propensity scale (Leary & Meadows, 1991), the Beck Depression Inventory (Hautzinger, Bailer, Wörrall, & Keller, 1994), and an Alcohol Expectancy Questionnaire (Demmel & Hagen, 2002a). On the Alcohol Expectancy Questionnaire socially-phobic participants reported that they expected more tension-reduction and regulation of negative mood and more enhanced socio-emotional functioning due to alcohol than the control group. Finally, all participants filled out the German version of the Short Michigan Alcoholism Screening Test for father and mother (Demmel & Hagen, 2002b). Based on the cut-off score of 6 as suggested by Demmel and Hagen (2002b), the percentage of participants with at least one parent with alcohol problems was calculated.
All participants gave written informed consent after learning about the experiment, but prior to randomization. They were then randomized to either the alcohol or the orange juice condition. Thus, all participants agreed to participate irrespective of whether they would receive alcohol or not. The randomization procedure resulted in 18 controls and 17 social phobics receiving alcohol, and 14 controls and 15 social phobics receiving orange juice. Neither the two resulting social phobic groups nor the two control groups differed on any of the baseline variables. Thus, the randomization procedure was successful in creating equivalent groups.

**Procedure**

Once randomized, all participants were asked to eat a ‘light meal’, specified in a hand-out, approximately 3.5 hours before the start of the experiment. They were also asked to refrain from drinking anything containing caffeine (coffee, tea, soft drinks) during the 4 hours prior to the experiment, and not to drink alcohol for 24 hours prior to the experiment.

All participants were informed whether they would receive alcohol or not before coming to the laboratory. No attempt was made to deceive participants about the nature
of the beverage they were about to get. Sayette (1993a) argues convincingly that appraisal disruption will only take place if a person is pharmacologically sufficiently intoxicated. Unfortunately, a full balanced placebo design cannot be achieved successfully if behaviourally-relevant alcohol doses are used. In a thorough study by Lyvers and Maltzman (1991), 90% of the participants that were lead to believe that they drank a non-alcoholic beverage but received alcohol (>0.5‰) were able to sense the intoxication resulting from drinking the alcohol. In a study by Sayette et al. (1994) using alcohol levels of 0.6‰, 94% of their subjects receiving alcohol in the placebo condition were not deceived.

When the participants receiving alcohol arrived on the test day, a urine sample was collected for pregnancy testing (Hilary, Dolorgiet). None of the participants tested positive. Subsequently, their height and weight was measured. Breath alcohol concentrations were measured using a standard breathalyzer with an accuracy of ±0.03 mg/L (Dräger, Alkotester 7410). Test results for all participants upon arrival were 0.00‰. For participants receiving alcohol, the necessary amount of alcohol based on their weight and height was estimated following a version of the Widmark formula (Widmark, 1932), modified by Fisher et al. (1987), Kapur, (1991) and Breslin et al. (1997). We aimed for a blood alcohol concentration of 0.06% based on findings that people are able to perform the Stroop test without significant performance deficits with similar blood alcohol levels (BAL; Gustafson & Källmén, 1990a, 1990b).

The alcoholic beverage was one part vodka and two parts orange juice, the non-alcoholic beverage was juice only in comparable amounts. Participants received their respective beverages in three equal doses, each to be finished within 5 minutes. All participants were able to complete this procedure. No participant reported nausea or other feelings of being uncomfortable. At the end of the experiment, participants who had received alcohol either were given newspapers to read until their BAL reached less than 0.04‰ or they were fetched by their partners.

Presentation of the stimuli
ERTS software (Beringer, 1994) was used to present the stimuli and to measure reaction times. Words were presented in a blocked format on a computer screen: half of the participants were first asked to name the colours of the social phobia-related words and then of the neutral words, whereas the other half of the participants first had to name the colours of the neutral words and then the colours of the social phobia-related words. Each word was presented individually. Within blocks, word order was randomized. Word presentation ended as soon as the colour naming was registered by a throat microphone. The colours were red, blue, green, and yellow, randomly chosen for each word presentation. After naming the colour of a word there was a 1-second interval before the next word was presented. Participants were allowed a maximum of 3 seconds to name the colour of a word, but no participant needed that much time.

Stimuli and measures
The emotional Stroop test was composed of 16 social phobia-related words and 16 neutral words. Social phobia-related words and neutral words were matched based on word length and frequency of use in the German language. Reaction times for colour naming were measured with a throat microphone attached with double-coated adhesive
electrode rings (Marquette Hellige). Estimates of mean reaction times for each stimulus class were calculated after elimination of values above or below two standard deviations (Ratcliff, 1993). Although the Stroop test is emotionally demanding, participants rarely make errors in naming the word colour. To check the prevalence of errors, 11 socially phobic and 10 control participants (13 under the influence of alcohol) were selected randomly and their errors were counted using a videotape of the Stroop session. Only 31 errors were made out of the total of 2,016 trials that we checked. There was no difference in the number of errors between social phobics and controls (Mann–Whitney U tests: social phobia-related words $Z = -0.49$, $p = .62$; neutral words: $Z = 0$, $p = 1.0$) or between participants in the alcoholic or non-alcoholic beverage group (Mann–Whitney U tests: social phobia-related words $Z = -0.07$, $p = .94$; neutral words: $Z = 1.01$, $p = .20$).

Implicit memory was assessed with a word-stem completion test. Participants were asked to complete 32 three-letter word stems to the first word that came to their mind, without a time restriction. Of these 32 word stems, 16 word stems could only be completed to previously-presented social phobia-related words and 16 word stems could only be completed to previously-presented neutral words. With the exception of one neutral word (‘dringend’, English: urgent) and one social phobia-related word (‘peinlich’, English: embarrassing), all word stems could be completed to more frequent words other than the primed words. This was ensured using the Corpus Search, Management, and Analysis System (COSMAS; Belica, Herberger, & al-Wadi, 1992). For the results presented here, only words that were identical to the ones presented during the Stroop test were counted. However, more liberal scoring including words that shared the same root as the words from the emotional Stroop test did not affect the pattern of findings. Participants could achieve a maximum implicit memory score of 16 for anxiety-related and 16 for neutral stimuli.

In addition, we also assessed explicit memory for the words employed in the Stroop task. While the instructions for the Stroop task make it unlikely that the participants will remember many words explicitly, assessing explicit recollection of the words by free-recall will allow for the control of effects of explicit recollection on the implicit memory test. Presentation of the implicit and the explicit memory test was counterbalanced.

We also measured anxiety state using 10-centimetre visual analogue scales. Participants were asked to rate how anxious they felt ‘right now’ at baseline and after completing the emotional Stroop test.

**Timeline**
After arrival, all participants were weighed. Participants in the alcohol condition were also tested for pregnancy. Then everybody was seated in the experimenter room and the first breath alcohol measurement (BAC 1) was taken. Then participants were asked to drink their respective beverages within 15 minutes (three cups presented at 0, 5, and 10 minutes). After 5 additional minutes allowed for absorption, the breath alcohol was measured again (BAC 2). Then all participants performed the Stroop test (5–6 minutes) and the third breath alcohol measurement was taken (BAC 3) and participants were asked to report their amount of anxiety (SUDS 1). The two memory tests were presented in balanced order. Half of the participants were first asked to perform the explicit (5 minutes) and then the implicit memory test (5 minutes), half of the participants were asked to first perform the implicit and then the explicit memory test. Finally, breath
alcohol was measured again (BAC 4) and the participants were asked to report their respective intensity of anxiety (SUDS 2).

Data analysis
Colour-naming reaction times were analyzed with repeated measures ANOVAs/MANOVAs with group (social phobics and controls) and condition (alcohol vs. orange juice) as between-subjects factors and category (anxiety stimuli vs. neutral stimuli) as the repeated measurement factor. Planned comparisons were calculated between social phobics and controls. An alpha level of 0.05 was used for all statistical tests. F-statistics are misleading when the means are correlated with variances across cells of the design (Winer, Brown, & Michels, 1991). Therefore, for the comparison of self-report measures of social phobics and controls, Mann–Whitney U tests were employed.

Results
Blood alcohol concentration and anxiety state
Figure 1 shows that the social phobic and the control participants who had received alcohol reached comparable levels of BAL. There was no difference in blood alcohol concentration between the two groups ($F = 1.0, p = .4$). Socially-phobic participants reported significantly more anxiety than controls, $F(1, 60) = 17.64$, $p < .001$ (social phobics with alcohol after Stroop test: $M = 2.5$ ($SE$: 0.4); after the two memory tests: $M = 3.1$ ($SE$: 0.4), social phobics without alcohol after Stroop test: $M = 3.4$ ($SE$: 0.4); after the two memory tests: $M = 3.0$ ($SE$: 0.4), controls with alcohol after the Stroop test $M = 1.3$ ($SE$: 0.4), after the two memory tests: $M = 1.1$ ($SE$: 0.4); controls without alcohol after the Stroop test $M = 1.6$ ($SE$: 0.4), after the two memory tests:

![Figure 1. Blood alcohol concentration in participants that received alcohol.](image)

Note. BAC 1 = blood alcohol concentration at baseline, BAC 2 = blood alcohol concentration 5 minutes after last drink, BAC 3 = blood alcohol concentration after Stroop test, BAC 4 = blood alcohol concentration after memory test at the end of the session.
$M = 1.3$ (SE: 0.5). However, neither consuming alcohol nor performing the emotional Stroop test influenced self-report anxiety level. There was neither an effect of time (post-Stroop test vs. post-memory tests), condition (alcohol vs. no alcohol), nor an interaction effect of Group $\times$ Time $\times$ Condition, $F(1, 60) \leq 0.8$.

**Emotional Stroop test**

The analysis of reaction times with group (social phobics vs. controls) and condition (alcohol vs. no alcohol) as a between-subjects factor and category (anxiety stimuli vs. neutral stimuli) as a within-subjects factor resulted in a significant interaction Group $\times$ Condition $\times$ Category, $F(1, 60) = 4.02$, $p = .049$. Also, a significant main effect of category $F(1, 60) = 8.57$, $p = .005$ was found, but no main effect of group or condition or any two-way interaction effects were (see Fig. 2 for an illustration of the significant effects). The three-way interaction was due to an interaction of Condition $\times$ Category in the control group, $F(1, 60) = 4.92$, $p = .030$, but not in the social phobia group $F(1, 60) = 0.37$, $p = .54$). Accordingly, differential effects of alcohol on colour-naming latencies were confined to the control group without alcohol. Controls responded more slowly to anxiety stimuli than to neutral stimuli, $F(1, 60) = 5.08$, $p = .028$, as did the social phobics. With alcohol, colour-naming latencies to anxiety-related words in controls were reduced to the level of colour-naming latencies for neutral words, $F(1, 60) = 0.63$, $p = .42$. In contrast, the social phobia patients took longer to name the colour of the anxiety stimuli compared with neutral stimuli, irrespective of the beverage consumed, $F(1, 60) = 8.89$, $p = .004$). Thus, social phobics show an attentional bias, but not more so than controls. Alcohol reduces this bias in controls, but not in patients.

An index for the observed interference effect was formed by subtracting the colour-naming latency for neutral words from the colour-naming latency for anxiety-related words. This index was significantly correlated (Spearman rank correlation, $p < .05$) with the SPS ($r = .26$), the SIAS ($r = .27$), and the TWSA ($r = .27$). The correlation with the German FNE was not significant ($r = .17$). Neither during baseline nor following the Stroop test did interference correlate with anxiety state ($r = -.06$ and $r = .01$). Finally, alcohol expectancy as measured with the AEQ-KO and AEQ-SP was also not

![Figure 2. Emotional Stroop interference depending on stimuli and diagnostic group.](image_url)
correlated with Stroop interference, neither in the social phobic group \((r = .08 \text{ AEQ-KO}, r = -.1 \text{ AEQ-SP})\), nor in the control group \((\text{AEQ-KO: } r < -.01, \text{ AEQSP: } r = -.1)\).

**Explicit memory test**

As expected, all participants did poorly on the free-recall test. The average number of correctly-remembered social threat words was 1.8 \((SE = 1.19)\) and 0.19 \((SE = 0.06)\) for neutral words. That is, 27 participants per group (social phobics and controls) did not remember one single neutral word, four participants in each group remembered one word and one participant in each group remembered two neutral words. Seven social phobics and six controls remembered no social threat-related word, 11 social phobics and 10 controls remembered one social threat-related word, five social phobics and six controls remembered two social threat-related words, and nine social phobics and 10 controls remembered three or more social threat words. Based on these low rates no statistical analyses were computed.

**Implicit memory test**

The ANOVA of the implicit memory scores with category (anxiety stimuli vs. neutral stimuli) as a within-subjects factor, group (social phobics vs. controls) and condition (alcohol vs. no alcohol) as between-subjects factors, resulted in a significant effect of category, \(F(1, 60) = 5.93, p < .05\), and a trend for group, \(F(1, 60) = 3.72, p = .06\), which was moderated by a Group \(\times\) Category effect, \(F(1, 60) = 5.43, p < .05\). (see Fig. 3 for an illustration of the significant effects). The socially-phobic participants remembered more socially negative words than neutral words, \(F(1, 60) = 11.42, p < .05\). Furthermore, social phobics remembered more social threat words than controls, \(F(1, 60) = 7.01, p < .05\). There were no differences between social phobics and control participants on implicit memory for neutral words, \(F(1, 60) = 0.54, \text{ ns}\).

In addition, we found a tendency for an interaction of Group \(\times\) Condition \(\times\) Category, \(F(1, 60) = 3.04, p = .09\). In order to evaluate the tendency for a three-fold interaction, we analyzed the Condition \(\times\) Category interaction in the social phobia group only and found a significant effect, \(F(1, 60) = 4.54, p < .05\). Hence, social
Phobics showed a significantly lesser implicit memory bias for social threat words if they were drinking alcohol. The implicit memory bias for social threat (memory scores for anxiety-related words minus memory score for neutral words) was significantly correlated (Spearman–Brown) with the SIAS, $r = .31, t(62) = 2.5, p < .01$, and the SPS, $r = .29, t(62) = 2.1$. There was also a trend for the TWSA, $r = .27, t(62) = 1.8, p < .08$, and the German FNE, $r = .21$, to be correlated with implicit memory bias for social threat words. Thus, a higher self-rating on measures of social anxiety tended to be related to better retention of social anxiety-related words.

**Discussion**

We used an emotional Stroop procedure with neutral and social anxiety-related word stimuli and an implicit memory test for these words to assess the effect of alcohol on cognitive processing in social phobics as compared with non-anxious controls. We hypothesized an information-processing bias in social phobics, evident in longer colour-naming latencies and a better implicit memory for social threat words. Based on functional analysis, considerations of the link between social phobia and alcohol consumption and on the core proposition of Sayette’s appraisal disruption theory, we further expected that alcohol would have a stronger effect on social phobics in the sense of reducing both the interference produced by anxiety stimuli and their enhanced memory effect. Alternative expectations were derived from the alcohol myopia theory, namely that alcohol should increase Stroop interference. In line with these considerations, social phobia patients did take longer to name the colour of anxiety words than of neutral words, and they remembered more anxiety words than the controls. But contrary to our expectation, alcohol attenuated the effect of anxiety-related word stimuli on colour-naming latencies only in non-anxious controls, but not in social phobics, and it did not affect memory performance. Hence, we disconfirmed the alcohol myopia theory and at least partially failed to confirm the appraisal disruption theory as applied to social phobia patients.

Anxiety stimuli provoked an interference effect in colour-naming responses, in line with the literature on emotional Stroop effects. But why did this interference effect occur in controls also, and why was the effect not greater in social phobics than in controls? Interference effects for social threat words in non-anxious controls have been repeatedly reported (Amir et al., 1996; Mattia et al., 1993). Emotionally-salient words generally cause more interference than neutral words (MacLeod, 1991), and it seems reasonable to assume that social threat words also qualify as emotionally-salient words for non-anxious controls. Also, only the anxiety-related words were semantically related, whereas the neutral words were not. In a blocked presentation, this could result in increased interference (Waters, Sayette, & Wertz, 2003).

These considerations may explain the interference in controls in general, but Mattia et al. (1993), in contrast to our findings and the findings of Amir et al. (1996), found that the interference effect was nevertheless stronger in social phobics than in controls. We have no ready explanation for the lack of a similar group difference in our colour-naming latencies, but we will consider several possibilities drawn from the literature on emotional Stroop effects.

One possible explanation might be taken from Amir et al. (2002), who suggested that social phobics can inhibit emotional Stroop interference if they have the opportunity to strategically influence their reactions. When ‘opportunity’ was operationalized as a low or a high ratio of threat words, social phobics showed more emotional interference with
rare than with frequent social threat words (Amir et al., 2002). On the other hand, blocked presentation of threat words increases interference (Holle et al., 1997), although one could argue with Amir et al., that in a blocked format, patients have the perfect opportunity to strategically influence their reactions. We attempted to examine these intriguing possibilities by calculating interference effects separately for the first, second, third, and fourth quarters of the block of threat words. However, no interaction of time (first, second, third, and fourth quarters) with category (social threat vs. neutral words) and/or with condition (alcohol vs. no alcohol) was observed in the social phobic groups. In other words, interference was stable throughout the duration of the blocked presentation, which supports neither the hypothesis of Amir et al., nor the notion that interference will increase with increasing confrontation (blocked format).

We should also consider the possibility that particular aspects of our social anxiety challenge condition might have hindered the expected group difference to appear. Performance anxiety may attenuate the emotional Stroop interference in social phobics (Amir et al., 1996) and our socially-phobic participants did report more anxiety than controls. But the levels of anxiety were generally low (3 on a scale of 0–10). Also, level of acute anxiety was not correlated with emotional Stroop interference. Thus, emotional override cannot explain the lack of a higher interference effect in social phobics.

We found that alcohol did attenuate the emotional Stroop interference in controls but not in social phobics. According to the core assumption of the appraisal disruption theory, alcohol should constrain the spread of activation of associated information and thus attenuate the emotional Stroop interference produced by presenting words related to social anxiety. Sayette, Martin, Perrott, Wertz, and Hufford (2001) have shown this effect of alcohol in a non-anxious control group. Specifically, they demonstrated that alcohol, if ingested before conducting the emotional Stroop test, reduces the interference for social stress words. This finding has been replicated in our study. But why was this not true for social phobics as well, and what does this imply for the functional analysis of the relation between social phobia and a tendency to alcohol abuse and dependence?

It can be argued that the spread of social threat-related activation is much better organized in social phobics than in non-anxious controls. Sayette (1993b) argued that alcohol is less likely to hinder spread of activation if a stressor is ‘relatively easy to process’ or ‘sufficiently threatening to override appraisal deficits’ (p. 469). It seems conceivable that, for social phobia patients, not only indicators of acute stressors, but also social threat words, may either be easier to process or are associated strongly enough with impending danger so that alcohol may no longer effectively reduce spread of activation. However, in this context our second, exploratory finding is of interest. We found a significantly better implicit memory for social threat words in social phobics compared with controls. Furthermore, this memory bias was reduced by alcohol in the expected direction.

Generally, it is assumed that two different processes are responsible for implicit memory biases. For the word-stem completion task it is assumed that more data-driven (or perceptually driven) processes are responsible. In this study, however, it is clear that conceptually-driven processes must be involved in order to produce a valence-associated (or threat-associated) bias. Indeed, at least four prior studies have demonstrated that conceptual/associative processing on perceptual implicit memory tests can be independent of explicit memory processes (e.g. Hirshman, Passannante, & Arndt, 2001). Note that participants had almost no traces of explicit memory for either neutral or social threat words. Thus, it is highly unlikely that explicit recollection of
social threat words may have contaminated performance on the stem completion task. Furthermore, due to our balanced design only half of the participants were first asked to consciously recollect the Stroop words. It is generally acknowledged that implicit memory processes play an important role in 'human affairs' (Tulving & Schacter, 1990). These authors proposed that 'conceptually driven priming reflects a process of semantic learning: the modification of, or adding of new information to, semantic memory' (p. 304). Consequently, our results suggest that, in clinically-anxious social phobics, not only is appraisal hindered by alcohol, but elaboration after initial processing also is also affected. If that notion is correct, a threatening situation entered by a social phobic after drinking alcohol may be experienced with similar anxiety with and without alcohol, but this anxiety is remembered less intensively, thus still encouraging the use of alcohol as self-medication in future situations. This may partly explain why studies focusing on direct effects of alcohol on anxiety in clinically socially anxious people have repeatedly failed to find significant anxiety-reducing effects of alcohol (Abrams et al., 2001; Himle et al., 1999; Naftelowitz et al., 1994).

It has been found that alcohol has a different effect on anxiety in women compared with men. Especially alcohol expectancy – the belief that one has received alcohol and that it will have specific effects – has been studied in this respect. For example, de Boer et al. (1993) showed that alcohol expectancy reduced social anxiety in women but not in men. However, paradoxical effects of alcohol expectancy have been demonstrated in women as well: for example, Abrams and Wilson (1979) found that women were more anxious during a social interaction test if they believed that they had received alcohol. Hence, findings regarding the effects of alcohol expectancy on women are inconclusive (Schippers, de Boer, van der Staak, & Cox, 1997). However, in the only experimental study testing the direct effects of alcohol on anxiety involving socially-phobic participants, alcohol expectancy reduced reported social anxiety while giving a public speech (Abrams et al., 2001). We did not directly test whether the pharmacological effects of alcohol were solely responsible for our findings or if alcohol expectancy or other psychological factors may have additionally led to the reduction of the emotional Stroop interference in controls. Our participants did know whether they received alcohol or orange juice. The socially-phobic women in our sample reported that they expected more tension-reduction and regulation of negative mood and also more enhanced socio-emotional functioning after drinking alcohol (as measured with the AEQ) than the control participants. Possibly this may have modulated the effects of alcohol in some way or another. We did not find any association between our measure of alcohol expectancy and Stroop interference. However, it may be that alcohol expectancies are a transient- or an affect-dependent form of cognition and consequently have to be measured in vivo rather than at baseline.

There are a number of other limitations of our study. Based on ethical considerations we recruited social drinkers without a history of abuse or dependence. It is possible that this may have led to recruitment of a group of participants who are especially unlikely to experience anxiety reduction by ingestion of alcohol. Also, we have only indirect information on the alcohol status of the relatives of our participants. Paternal alcoholism has been associated with an increased risk to develop alcohol problems and is also known to affect the propensity to use alcohol to dampen stress responses (Finn & Pihl, 1987). We cannot exclude the possibility that our recruitment procedure implicitly excluded a subgroup that could potentially react differently to alcohol. Also, we exclusively recruited women. Thus, our results are limited to female social phobics. Finally, whereas a full balanced placebo design may not be suitable if BAL above 0.6‰.
(Sayette et al., 1994; Lyvers & Maltzman, 1991), our design would clearly benefit from at least a third cell with participants receiving placebo but believing that they receive alcohol. Future studies consequently should include such a group in order to further explore the contribution of alcohol expectancies.

In summary, we were able to confirm the notion that alcohol disrupts appraisal of threatening information in non-anxious women. This effect was not observable in socially-phobic women, which supports the notion that highly effective processing of threatening information lessens such an effect of alcohol. In addition, we found an implicit memory bias for socially-threatening words in social phobics as compared with controls. This implicit memory bias was attenuated by alcohol. The overlap of excessive alcohol use and social phobia may not be the result of appraisal disruption exclusively, but also the result of a curtailed memory for the anxiety experienced during social situations.

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References


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