ATTENTIONAL BIAS FOR ALCOHOL-RELATED INFORMATION IN ADOLESCENTS WITH ALCOHOL-DEPENDENT PARENTS

JESSICA I. ZETTELER1, BRIAN T. STOLLERY2*, AVIV M. WEINSTEIN3 and ANNE R. LINGFORD-HUGHES4,5

1Academic Unit of Psychiatry, Cottingham House, Bristol BS6 6JL and 2Department of Experimental Psychology, University of Bristol, Bristol BS8 1TN, UK,
3Neuropsychiatric (PET/SPECT) Brain Imaging Laboratory, Department of Nuclear Medicine, Sourasky Medical Centre, Weizman 6, Tel Aviv 64239,
Israel, 4Bristol Area Specialist Alcohol Service, Avon & Wiltshire Mental Health Partnership NHS Trust, 12 Mortimer Road, Bristol BS8 4EX and
5The Psychopharmacology Unit, University of Bristol, Dorothy Hodgkin Building, Whitson Street, Bristol BS1 3NY, UK

(Received 2 June 2005; first review notified 7 July 2005; accepted in revised form 16 March 2006; advance access publication 19 April 2006)

Abstract — Aims: to assess the attentional bias for alcohol-related information in adolescents with (n = 15), and without (n = 15), a parental history of alcohol dependence. Methods: participants completed questionnaires assessing depression, weekly alcohol consumption, anxiety, and concerns about alcohol consumption and undertook subliminal and supraliminal computerized Stroop tasks using color-words, alcohol-related words, and control words. Results: adolescents with alcohol-dependent parents showed supraliminal interference for alcohol-related words. The magnitude of this interference was correlated with higher trait and state anxiety, and lower levels of weekly alcohol consumption. No interference was found on the subliminal alcohol Stroop task. Conclusions: while it is likely that this attentional bias for alcohol-related cues reflects the concerns regarding parental drinking, it is also possible that this might underlie the increased risk of future alcohol dependence in the children of alcohol-dependent parents.

INTRODUCTION

Alcohol dependence involves a strong and compulsive desire to consume alcohol, arising from the wish to either experience its positive effects or avoid the aversive experiences produced by its absence (Ludwig and Wikler, 1974). Cognitive models explain alcohol use in terms of automatic and non-automatic processes (Tiffany, 1990; Tiffany and Conklin, 2000) where, over the course of repeated experiences with alcohol, the cognitive systems mediating drinking behaviour in alcohol-dependent individuals become automatic. In eliciting stimulus conditions, the action schema for alcohol use are activated and craving represents the ‘operation of nonautomatic cognitive processes activated to facilitate or impede the execution of automatized drug-use action schema’ (Tiffany, 1990, p. 159). This model, therefore, proposes that the mere presentation of stimuli that have become associated with drug-use behaviour can trigger the execution of the automatized sequence of behaviours.

One method of assessing attentional bias is the Stroop task. The automatic tendency to read the word, as opposed to naming the colour, produces interference in the incongruent condition as a consequence of the allocation of attention to the word. Salient, aspects of stimuli (MacLeod, 1991), The Stroop test has been modified to reveal such interference not only in populations with alcohol dependence (Johnsen et al., 1994; Bauer and Cox, 1998; Sharma et al., 2001; Ryan, 2002) but also in those with anxiety disorders (Mogg et al., 1993; Williams et al., 1997), nicotine dependence (Gross et al., 1993), heroin dependence (Franken et al., 2000), and compulsive gambling (McCusker and Gettings, 1997).

Most studies using alcohol Stroop tasks have investigated the interference occurring after conscious, elaborative processing of the stimuli has taken place. These are referred to as supraliminal (with awareness) versions of the Stroop task. An alternative approach, termed subliminal (without awareness) has been employed in some studies (e.g. Mogg et al., 1993; Franken et al., 2000) and stimuli are presented very briefly followed by a visual mask so stimuli are not consciously processed. This allows potential pre-attentive bias to be examined and permits inferences about the processing stage of attentional bias. The theoretical implication of a pre-attentive bias is that behavioural regulation is then governed by appraisal systems that operate rapidly outside conscious control and this may be associated with an increased risk of developing a dependency.

There are many demonstrations of attentional bias for alcohol-dependent adults on supraliminal alcohol Stroop tasks (e.g. Sharma et al., 2001; Ryan, 2002; Lusher et al., 2004). Non-dependent social drinkers also have been observed to show interference for alcohol cues, although not to the same degree as alcohol-dependent drinkers (Bauer and Cox, 1998; Sharma et al., 2001). Cox et al. (1999) found interference only among heavy drinkers with the degree of interference for non-dependent drinkers varying directly with the amount of alcohol habitually consumed. Together these studies suggest that attention is directed to cues that have some degree of motivational significance, whether it is positive or negative.

Children develop alcohol expectancies by observing drinking behaviour at home or among their peers. Children with alcohol-dependent parents appear to develop alcohol schema at an early age (e.g. Zucker et al., 1995) and even pre-school children are better able to identify specific alcoholic beverages, and identify more alcoholic beverages, than children of non-alcohol-dependent parents. This precocious knowledge has been viewed as an early component in a risk matrix that can lead to earlier and heavier alcohol use when it becomes available. Indeed, a family history of alcohol dependency is one of the most noted risk factors for the development of pathological alcohol involvement (Sher and Gotham, 1999).

Children whose fathers are alcohol-dependent have been found to have higher levels of depression and negative mood, as well as hyperactivity, problematic social relationships,
greater deficits in cognitive functioning, and higher levels of aggressive behaviour (Fitzgerald et al., 2000). As yet, selective cognitive processing of alcohol-related words using the alcohol Stroop task has not been investigated in adolescents with alcohol-dependent parents, although changes in brain regions associated with attentional control have also been observed in adolescents who have developed an alcohol-use disorder (Tapert et al., 2003, 2004). An interference effect for alcohol-related words in these adolescents would indicate that an alcohol schema exists that is activated by the mere presentation of an alcohol-related word—potentially increasing vulnerability for future alcohol dependency.

Therefore, the study reported here examines the selective cognitive processing of alcohol-related information in adolescents with alcohol-dependent parents. The importance of this line of enquiry is that the selective processing of alcohol-related information has been argued to be one of the factors that may lead to the maintenance of alcohol dependence (Johnsen et al., 1994). The aim was, therefore, to investigate processing of alcohol stimuli on both a supraliminal (with awareness) and subliminal (without awareness) alcohol Stroop task. It was expected that adolescents with alcohol-dependent parents would show greater interference for alcohol-related words than control participants on the supraliminal alcohol Stroop task. If the bias also exists at a pre-attentive level, then interference should also be observed on the subliminal task.

PARTICIPANTS AND METHODS

Participants

Two groups of adolescents (aged 15–20 years) were recruited using advertisements in local youth oriented magazines (e.g. Big Issue, Venue) and posters in youth centres, clubs, and alcohol services. Semi-structured interviews established parental alcohol dependence and exclusion criteria. Adolescents with alcohol-dependent parents (n = 15, six females) declared that one or both parents had an alcohol dependence—eight were recruited via the National Association for the Children of Alcoholics. The treatment status of the parents was mixed, some having undergone treatment and others never having undergone treatment. Adolescents with non-dependent parents (n = 15, seven females) conveyed no parental history of alcohol dependency. All participants had normal or corrected to normal vision and their primary language was English. General exclusion criteria were colour blindness, previous head injury, severe current psychopathology, and a history of alcohol dependence. The local research ethics committee approved the study and all participants provided written informed consent. Participants under 16 years had parental consent to participate.

Procedure and materials

Participants completed a short demographic questionnaire that included questions about their age, years in education (after age 6), weekly alcohol consumption, and their level of concern about own, and parental, alcohol use. They then completed the NART in order to provide an estimate of their WAIS full-scale IQ (Nelson, 1991), the State-Trait Anxiety Inventory (Spielberger et al., 1983), and the Beck Depression Inventory (Beck et al., 1961). Participants then performed three tasks in the following order: subliminal Stroop, lexical decision task (awareness check), and supraliminal Stroop. Participants were then de-briefed and given £5 for their participation.

Four categories of words were used in the Stroop tasks. The 12 alcohol-related words (liquor, drink, alcohol, booze, wine, cocktail, beer, whiskey, pub, bar, drunk, and hangover) were adapted from the 20 used by Johnsen et al. (1994). The neutral words (watch, phone, window, king, lamp, silence, coat, building, region, lamp, cabinet, and pole) were selected so they matched (see Coltheart, 1981) the alcohol words in terms of their number of letters (5.42 vs 5.33), syllabic length (1.58 vs 1.50), and written frequency (37.3 vs 61.8). The colour words (blue, green, red, and yellow) were presented congruently or incongruently depending on the colour patch presented. Each colour word was used three times to equate the total number of stimuli used in the alcohol Stroop conditions. Stimuli were presented via a laptop computer using Visual Basic software. Response times were measured using a manual response box that had four buttons in the experimental colours: blue, green, red, and yellow. The 48 words were presented in a random order to prevent the rumination effects that have been observed with blocked category presentation (Holle et al., 1997).

Subliminal and supraliminal Stroop tasks

The subliminal alcohol Stroop task, modelled on Mogg et al. (1993), started with a central fixation box (10 mm wide × 40 mm high) for 500 ms followed by a word presented on a background colour patch (same size as fixation box). The word was displayed in white, lowercase letters (font: MS Sans Serif, size: 24) for 25 ms and then immediately replaced by a mask of white uppercase Xs matched for word length. The mask remained on until the response was made. The colour patch remained on for 50 ms so conscious awareness of the colour was possible and participants were able to perform the task. Participants were asked to respond to the colour of the patch as quickly, and accurately, as possible. After five practice trials, the 48 words were presented in random order, with a new random order for each participant. Practice trials were the same as experimental trials except that the stimuli used were people’s names (e.g. Bill, Maggie). In the supraliminal condition, the sequence of events was the same as above, except that there was no mask and the word remained on the screen until the participant responded. The duration of the background colour patch was the same in the subliminal and supraliminal conditions.

Awareness check

In this lexical decision task, 48 letter strings (24 words not used in the Stroop tasks and 24 non-words) were presented for 25 ms followed by a mask of white uppercase Xs matched for length. Participants decided whether the letter string presented before the mask was a word or not (yes/no).

RESULTS

Participant matching

Unrelated t-tests showed the two groups were matched for age (P = 0.456), NART IQ (P = 0.846), education (P = 0.271),
Table 1. Mean values (±SD) on participant demographics and other characteristics

<table>
<thead>
<tr>
<th>Participant characteristic</th>
<th>Dependent parents</th>
<th>Non-dependent parents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>17.8 ± 1.8</td>
<td>18.2 ± 1.0</td>
</tr>
<tr>
<td>Estimated full-scale IQ</td>
<td>115.5 ± 4.4</td>
<td>115.2 ± 3.3</td>
</tr>
<tr>
<td>Education (years)</td>
<td>11.6 ± 1.8</td>
<td>12.2 ± 1.0</td>
</tr>
<tr>
<td>Trait Anxiety</td>
<td>43.2 ± 8.9</td>
<td>39.5 ± 5.8</td>
</tr>
<tr>
<td>State Anxiety</td>
<td>35.8 ± 5.9</td>
<td>31.4 ± 7.4</td>
</tr>
<tr>
<td>Beck Depression Inventory</td>
<td>10.2 ± 8.9</td>
<td>3.8 ± 3.1</td>
</tr>
<tr>
<td>Age started drinking (years)</td>
<td>14.1 ± 2.0</td>
<td>15.0 ± 1.7</td>
</tr>
<tr>
<td>Weekly alcohol intake (units)</td>
<td>21.7 ± 27.0</td>
<td>11.5 ± 6.9</td>
</tr>
<tr>
<td>Concerned about own alcohol use</td>
<td>0.5 ± 0.8</td>
<td>0.1 ± 0.3</td>
</tr>
<tr>
<td>Concerned about parental alcohol use</td>
<td>1.7 ± 1.3</td>
<td>0.1 ± 0.3</td>
</tr>
</tbody>
</table>

*aNot at all = 0, slightly = 1, moderately = 2, definitely = 3.

Table 2. Mean correct reaction times (±SD) on the supraliminal and subliminal Stroop tasks after controlling for state anxiety

<table>
<thead>
<tr>
<th>Performance measures</th>
<th>Dependent parents</th>
<th>Non-dependent parents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supraliminal Stroop (ms)</td>
<td>737 ± 169</td>
<td>699 ± 169</td>
</tr>
<tr>
<td>Alcohol words</td>
<td>805 ± 195</td>
<td>711 ± 195</td>
</tr>
<tr>
<td>Congruent colour words</td>
<td>765 ± 163</td>
<td>720 ± 163</td>
</tr>
<tr>
<td>Incongruent colour words</td>
<td>796 ± 190</td>
<td>752 ± 190</td>
</tr>
<tr>
<td>Subliminal Stroop (ms)</td>
<td>719 ± 102</td>
<td>725 ± 102</td>
</tr>
<tr>
<td>Alcohol words</td>
<td>713 ± 114</td>
<td>712 ± 114</td>
</tr>
<tr>
<td>Congruent colour words</td>
<td>704 ± 119</td>
<td>720 ± 119</td>
</tr>
<tr>
<td>Incongruent colour words</td>
<td>710 ± 97</td>
<td>718 ± 97</td>
</tr>
</tbody>
</table>

Performance measures

Awareness check accuracy. On the awareness check (lexical decision) task, mean accuracy was 59% (SD = 10%). A one-sample t-test showed this was reliably greater than expected by chance [t(29) = 4.96, P < 0.001], but there was no difference in awareness scores for the two groups [56 ± 12% vs 62 ± 7%, t(28) = 1.61, P = 0.120].

Subliminal Stroop. Adolescents with dependent parents had equivalent average reaction times (711 ± 721 ms, F < 1) and none of the main effects or interactions approached significance. Overall accuracy was high (99%) and the only effect approaching significance was the marginally higher accuracy in the congruent condition (99.5 vs 95.1%), \( F(1,28) = 3.87, P = 0.059, \eta^2_p = 0.121 \).

Supraliminal Stroop. Adolescents of alcohol-dependent parents and non-dependent parents had equivalent reaction times (776 vs 721 ms, F < 1) and the only significant effect was the group × Stroop task × congruence interaction \[ F(1,27) = 4.71, P = 0.039, \eta^2_p = 0.148 \]. Post-hoc analysis (MSE = 1177.5) showed interference in the alcohol Stroop condition for those with alcohol-dependent parents (\( P < 0.01 \)) but not for those with non-dependent parents. Interference in the colour Stroop condition was not significant for either group (critical difference of 41 ms @ 5%). Overall accuracy was high (99%) and did not vary as a function of group (F < 1), Stroop task (F < 1), or congruence \[ F(1,28) = 3.06, P = 0.091 \], and none of the interactions were significant.

Interference effects. In common with the convention in literature, the issue of attentional distraction was tested directly using interference scores: alcohol interference (alcohol RT minus neutral RT) and colour interference (incongruent RT minus congruent RT) conditions. The data were analysed using a 2 (interference type) × 2 (group) mixed ANOVA. The analysis confirmed the presence of a group × interference type interaction \[ F(1,28) = 6.12, P = 0.020, \eta^2_p = 0.179 \]. Post-hoc analysis (MSE = 2285.2) showed greater interference on alcohol-related words for those with alcohol-dependent parents (71 ± 60 vs 8 ± 33 ms; \( P < 0.01 \)), but no group differences on the colour Stroop condition (33 ± 75 vs 30 ± 48 ms). This confirms that those with alcohol-dependent parents show a particular sensitivity to interference from alcohol-related words.

Correlations with alcohol interference scores. A series of Spearman correlations examined whether scores on the 10 matching variables correlated with the magnitude of the alcohol interference in the supraliminal condition. For adolescents with alcohol-dependent parents, greater interference was associated with lower weekly alcohol consumption \[ r(11) = -0.862, P < 0.001 \], higher levels of trait anxiety \[ r(13) = 0.788, P < 0.001 \] and state anxiety \[ r(13) = 0.530, P = 0.042 \]. Interestingly, higher concerns about parental alcohol use was related to higher depression \[ r(11) = 0.733, P = 0.002 \] and higher trait anxiety was associated with lower weekly alcohol consumption \[ r(11) = -0.768, P = 0.001 \], higher state anxiety, \[ r(13) = 0.801, P < 0.001 \] and higher depression \[ r(13) = 0.690, P = 0.004 \]. There were no significant associations for concerns about own alcohol use. For adolescents with non-dependent parents, none of the correlations were significant. While suggestive, these findings

age started drinking (\( P = 0.199 \)), weekly alcohol consumption (\( P = 0.308 \)), and trait anxiety (\( P = 0.184 \)). Adolescents with alcohol-dependent parents, however, had higher levels of depression \[ t(28) = 2.63, P = 0.014 \], showed more concern about their own \[ t(28) = 2.07, P = 0.048 \], and their parents’ \[ t(28) = 4.75, P < 0.001 \], alcohol use (see Table 1), and tended to have higher state anxiety scores \[ t(18) = 1.81, P = 0.081 \].

Pearson correlations showed that higher state anxiety was correlated with longer overall reaction times on the subliminal \[ r(28) = 0.414, P = 0.023 \] and supraliminal \[ r(28) = 0.404, P = 0.027 \] Stroop tasks. Reaction times in the supraliminal task had borderline positive correlations with trait anxiety \[ r(28) = 0.352, P = 0.056 \] and depression \[ r(28) = 0.344, P = 0.062 \]. None of the 10 matching variables correlated with accuracy on the Stroop tasks or awareness check task.

The mean correct reaction times to correctly identify the colour patch are shown in Table 2. Data were analysed using a \( 2 \times 2 \times 2 \) mixed ANCOVA with participant group (adolescents with dependent parents vs non-dependent parents) as the unrelated factor, and Stroop task (alcohol vs colour) and congruence (congruent vs incongruent) as the related factors, with state anxiety scores as the covariate. A measure of effect size (partial eta-squared, \( \eta^2_p \)) for significant effects is cited (0.01 = small, 0.06 = medium, 0.15 = large) with the \( F \)-ratio. In all analyses, the sphericity assumption was not violated for any of the main effects or interactions. Post hoc analysis was carried out using the Tukey (HSD) test.
must be treated with caution owing to the small sample size \((n = 15)\).

**DISCUSSION**

The aim of the present study was to examine interference for alcohol-related words in adolescents with a parental history of alcohol dependency using supraliminal and subliminal versions of an alcohol Stroop task. Although caution should be exercised owing to the small sample sizes, this study reports, for the first time, that adolescents with alcohol-dependent parents exhibit greater interference for alcohol-related words than adolescent with non-dependent parents, but only on the supraliminal task.

As those with alcohol-dependent parents were not drinking more alcohol than those with non-dependent parents, the attentional bias for alcohol-related words is not necessarily due to increased ‘expertise’ with drinking alcohol (although it could be related to increased ‘expertise’ with handling alcohol via their parents’ drinking). It seems that adolescents with alcohol-dependent parents do have ‘alcohol schemata’ (Zucker *et al*., 1995) that are more highly developed and accessible than adolescent controls, and this may lead to greater distraction when faced with information that is concerned with alcohol.

As adolescents with alcohol-dependent parents have often (but not always) experienced distress and difficulties as a result of their parents’ drinking, alcohol-related words may be more emotionally salient and draw attention more successfully. Positive expectancies related to personal drinking may be another source of the bias towards alcohol stimuli, but these were not assessed. In order to control for the emotional content of alcohol words, Bauer and Cox (1998) used sets of positive and negative words as well as alcohol-related words. They found that the magnitude of the alcohol interference was greater than that for positive and negative words in both alcohol abusers and non-abusers. They, therefore, proposed that alcohol stimuli might be inherently more likely to attract attention than equal valence stimuli not related to alcohol.

In the present study, adolescents with non-dependent parents showed no alcohol interference and the findings offer more support for the idea advocated by Riemann and McNally (1995) that emotional Stroop effects occur for material, positive or negative, of strong personal relevance. As those with alcohol-dependent parents reported greater concern about their parents’ drinking behaviour than their adolescent controls, the interference effect may reflect this increased level of concern, as well as the activation of more complex alcohol schemata. Here it may be important to note that participants completed the questions about alcohol concerns before undertaking the Stroop tasks. It is possible, therefore, that alcohol-related schema may have been primed, particularly negative alcohol schema, and that this may have had a differential impact for those with dependent parents. While there was no evidence that the alcohol-related interference was correlated with levels of concern, it was associated with measures of negative affect. The findings are, therefore, also consistent with work showing that participants with a parental history of alcohol dependence show enhanced priming effects following moderate doses of alcohol (Sayette *et al*., 2001) and a reduction in visual P300 amplitude, reflecting attention attraction, in selective attention tasks (Van Der Stelt, 1999; Iacono *et al*., 2002; Ehlers *et al*., 2003).

Other studies support the idea that it is the emotional, rather than semantic, connotations of words that underlie interference in emotional Stroop tasks (Richards and Blanchette, 2004). Given the predominantly neutral alcohol words used in the present study, it is possible that an alcohol bias may have been stronger if more negative words had been included. For example, alcohol schema seems to be more activated when primed by negative mood phrases (Zack *et al*., 2003) and alcohol cues are associated with desirable effects in youths who drink more and undesirable effects in youths who drink less (Dunn and Goldman, 1998). Together this suggests that examining the degree of attentional bias for positive (merry, tipsy), neutral (beer, bar), and negative (drunk, hangover) alcohol-related words might be a useful line of inquiry in relation to alcohol dependency. The findings of Dunn and Goldman (1998) may also provide a basis for the counterintuitive finding of greater alcohol interference with lower weekly alcohol consumption in those with alcohol-dependent parents and is consistent with the idea that they might derive less reward from drinking alcohol (Munafò *et al*., 2005). Alternatively, it might suggest that the biases have a protective function, perhaps by increasing the opportunity to use avoidant coping strategies in relation to personal alcohol use that may reflect concerns about potential for addiction. Future studies are needed to determine the utility of these two explanations.

The failure to observe a reliable colour interference effect requires some comment. Most studies use words written in a particular colour, but the current version presented the word superimposed on a colour background and this could have decreased the ‘attention-grabbing’ effect of the stimuli. Waters *et al*.(2003) have also shown that randomized presentation of words can also reduce the magnitude of Stroop interference due to carry-over effects.

Finally, as no interference effects were found on the subliminal condition of the alcohol Stroop, no pre-attentive bias for alcohol-related information appears to be present. Rather, the interference occurs after more elaborate processing has taken place (see also Franken *et al*., 2000; Mogg and Bradley, 2002). It seems plausible that the attentional bias towards alcohol stimuli reflects their personal emotional significance arising from the negative cognitive and emotional impact of parental problem drinking. It would be of interest, therefore, to examine the variables that may mediate the relationship between having an alcohol-dependent parent and showing alcohol Stroop interference (e.g. whether the individual lived with their alcohol-dependent parent, the treatment status of the parent, the degree of family discord, and so on). Although the selective processing of alcohol cues may only be one of the many factors underlying the development of alcohol dependency, the idea that this is related to future vulnerability remains speculative because there is a lack of relevant data that attentional biases are indicative of the development of future psychological disorders. Longitudinal studies are needed to address this important issue.

Adolescent children of alcohol-dependent parents are at high risk for future alcohol dependency (Russel, 1990). It is also worth considering that the cognitive biases we have demonstrated here might play a role in that vulnerability in
some adolescents, relating in some to an attraction to alcohol as well as protecting some others, such as those where the cues cause anxiety.

REFERENCES


