Deficits in Recognition of Emotional Facial Expression Are Still Present in Alcoholics after Mid- to Long-Term Abstinence*

CHARLES KORNREICH, M.D.,† SYLVIE BLAIRY, PH.D.,† PIERRE PHILIPPOT, PH.D.,† URSULA HESS, PH.D.,† XAVIER NOËL, EMMANUEL STREEL, OLIVIER LE BON, M.D., BERNARD DAN,† ISY PELC, M.D., AND PAUL VERBANCK, M.D.

Department of Psychiatry, Université Libre de Bruxelles, Brugmann Hospital, Brussels, Belgium

ABSTRACT. *Objective*: Emotional facial expression (EFE) decoding skills play a key role in interpersonal relationships. Decoding errors have been described in several pathological conditions, including alcoholism. The aim of this study was to investigate whether EFE decoding skill deficits persist after abstention from alcohol of at least 2 months. *Method*: Alcoholic patients abstinent for at least 2 months (n = 25) were compared with 25 recently detoxified patients and with 25 normal controls matched for age, gender and educational level. Subjects were presented with 40 photographs of facial expressions portraying happiness, anger, sadness, disgust and fear. Each emotion was displayed with neutral, mild, moderate and strong emotional intensity. Each facial expression was judged successively on eight scales labeled happiness, sadness, fear, anger, disgust, surprise, shame and contempt. For each scale, subjects rated the estimated intensity level. A complementary scale assessed the self-estimated difficulty in performing the task. *Results*: Recently detoxified alcoholics were significantly less accurate than controls, making more EFE labeling errors and overestimating the intensity of the portrayed emotions. Deficits in decoding accuracy for anger and disgust were present in mid- to long-term abstinent patients; intensity overestimation was present in the former and absent in the latter. *Conclusions*: Deficits in decoding accuracy for anger and disgust, and to a lesser degree sadness, persist with an abstinence of 2 months and beyond. Right frontotemporal regions and cingulate could be implicated. These deficits may contribute to the social skills deficits frequently encountered in alcoholic patients. (*J. Stud. Alcohol* **62:** 533-542, 2001)

IN THE LAST DECADE, emotion has emerged as an avenue to the study of psychopathology (Philippot and Rimé, 1998). Several components of emotion have been investigated in various mental disorders; alcohol dependency is one of these pathologies (Lang et al., 1999). The present contribution focuses on emotion communication in alcoholic subjects.

The ability to decode emotional facial expressions (EFEs) constitutes an important social skill facilitating the correct interpretation of the communicating partner's intentions. (Patterson, 1999). Pathological conditions interfering with this ability may produce communication misunderstandings leading to impaired social functioning. Deficits in the ability to decode EFEs have been demonstrated in a large number of conditions. Patients suffering from anxiety disorders (e.g., social phobia) have a selective attention bias for threatening facial expressions (Winton et al., 1995). Depressive patients read sadness inaccurately, amplifying it (Hale, 1998). Huntington's disease patients show a specific inability to decode disgust expressions (Gray et al., 1997). People suffering from disorders characterized by intellectual impairment (e.g., fragile-X syndrome; Turk and Cornish, 1998), autism (Celani et al., 1999) or Alzheimer's disease (Koff et al.,1999) also have difficulties in the processing of emotional clues (e.g., facial expressions). Schizophrenia, a pervasive disorder, induces recognition deficits encompassing all emotional types (Mandal et al., 1998; Mueser et al.,1997).

EFE recognition has also been shown to be impaired in alcoholics. Recently detoxified alcoholics present extended deficits in decoding EFEs (Philippot et al., 1999). They are significantly inaccurate in their perception of anger, sadness, happiness and disgust (Philippot et al., 1999), and they overestimate the emotional intensity of facial stimuli (Oscar-Berman et al., 1990; Philippot et al., 1999). Deficits in affective prosody comprehension have also been described in this population (Monnot et al., 2001). Hence, emotional expression processing in recently detoxified alcoholics, compared with people affected by other disorders, seems severely impaired, as it encompasses many types of emotions.

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†Correspondence regarding this article should be addressed to Charles Kornreich, Centre Hospitalier, Universitaire Brugmann, Institut de Psychiatrie, place Van Gehuchten 4, 1020 Brussels, Belgium. Email may be sent to ckornrei@ulb.ac.be. Sylvie Blairy is with the Department of Psychiatry, Free University of Brussels, Erasme Hospital, Brussels, Belgium. Pierre Philippot is with the Department of Psychology, University of Louvain, Louvain-la-Neuve, Belgium. Ursula Hess is with the Department of Psychology, University of Quebec at Montreal, Montreal, Canada. Bernard Dan is with the Department of Neurology, Free University of Brussels, Queen Fabiola Hospital, Brussels, Belgium.

Although relationships between ability to decode EFE and social skills in general have been extensively documented (Edwards et al., 1984; Feldman et al., 1991; Patterson, 1999; Philippot and Feldman, 1990), specific implications of these deficits have not yet been established in alcoholics. As social skill deficits have been documented in alcoholics (Eriksen et al., 1986; Hover and Gaffney, 1991; Nixon et al., 1992), deficits in EFE decoding skills could contribute to alcoholics' social functioning impairment. In this context, several explanations of EFE decoding skill deficits can be proposed. The deficits might be related to a more general neurocognitive deterioration, which is known to affect multiple functions in chronic alcoholics (Parsons, 1998). Most of these cognitive impairments remit with abstinence (Parsons, 1998), although sometimes slowly (Grant et al., 1987; Rourke and Grant, 1999); therefore, deficits in decoding EFE could also be expected to decrease with abstinence.

Another explanation might be that emotional decoding deficits in alcoholics are related to a more specific impairment, which could even precede the onset of alcohol dependency. Indeed, social skill deficits in alcoholics have been reported before the onset of alcoholism (Rosenthal et al., 1998). This could represent a vulnerability factor in childhood and adolescence predisposing individuals to high levels of alcohol consumption (Gaffney et al., 1998). Preexisting temperamental dimensions could influence EFE decoding through a particular affective regulation coping style. Furthermore, visuospatial deficits that might interfere with the decoding of EFE have also been documented before the onset of alcoholism (Schandler et al., 1995).

Most of the growing body of literature pertaining to emotional perception in alcoholism is related to the effects of alcohol on emotional perception or on the emotional motivations to drink (Lang et al., 1999). The present article addresses a still underexplored topic: Emotional perception of alcoholics when not under the influence of alcohol. In the present study, we examined whether the EFE decoding deficits persist in abstainers. If they do not persist, it would suggest that they are the consequence of chronic alcohol consumption or of the detoxification process. Therefore, the study of the developmental course of EFE decoding could bring important insights to the understanding of the decoding deficit of EFE in alcoholism.

Method

Participants

Inpatients diagnosed with alcohol dependence according to DSM-IV (American Psychiatric Association, 1994) criteria (n = 25) were recruited in the psychiatric ward of a large university hospital in Brussels, Belgium, in their third week of hospitalization (at the end of the detoxification process). Members of the group had all been abstinent for 2 to 3 weeks and were no longer taking any psychotropic medication. A group of 25 other alcoholics had been abstinent for a minimum of 2 months. They were recruited from a long-term postdetoxification treatment center (n = 16, length of abstinence ranging from 2 to 6 months) and through Alcoholics Anonymous (n = 9, abstinence period of between 1 and 9 years). Abstinence in the subgroup recruited from the long-term postdetoxification treatment center was ensured by the center through usual control procedures, relying mostly on observation by the staff. We consider self-reported abstinence in the Alcoholics Anonymous group, although not perfect, to be reasonably realistic as described previously (Hoffmann and Ninonuevo, 1994; Mundle et al., 1999; Yoshino and Kato, 1995). Participants were provided with full details regarding the aims of the study and the procedure to be followed. Patients were matched for age (±5 years), gender and education level with 25 controls with no psychiatric history. Education level was coded as follows: 1 = elementary school; 2 = high school not completed; 3 = high school completed; 4 = post high school.

The three groups were similar in gender ratio (18 men and 7 women). The two groups of alcoholics (recently detoxified alcoholics [RA] and alcoholics abstinent for at least 2 months [AA]) and the normal control group (NC) were assessed using several control measures: Zung Anxiety Scale (Zung, 1971), Zung Depression Scale (Zung, 1965), the Severity of Alcohol Dependence-Questionnaire (SAD-Q; Stockwell et al., 1983) and the Mini-Mental State Scale (Folstein et al., 1975). As shown in Table 1, anxiety and depression scores were higher in recently detoxified alcoholics (RA) and in abstinent alcoholics (AA) than in controls (NC). The SAD-Q reflects alcohol dependence during the highest consumption period in the life of the subjects. It does not reflect current alcohol dependence. Therefore, the fact that abstinent alcoholics display higher scores than recently detoxified alcoholics could be interpreted as a more realistic judgment of their former alcoholic state. As expected, AA and RA showed higher scores on the SAD-Q than did controls. The history of alcoholism for the RA group is summarized as follows: mean (SD) number of treatments = 2.87 (3.33), range: 10; duration of alcohol dependency (mean years) = 12.17 (7.58), range: 25. History of alcoholism was not recorded for the AA group.

Stimuli

A series of EFEs constructed by Hess and Blairy (1995) was used. The authors selected facial expressions of happiness, anger, sadness, disgust and fear, performed by two white male and two white female actors, from a series of standardized EFEs (Matsumoto and Ekman, 1988). A series was constructed of intermediate expressions differing in emotional intensity by 10% steps that were based on the neutral face (0% of emotional intensity) and the full-blown emotional facial expression (100% of emotional intensity) of the same actor, and using the computer program Morph 1.0. A set of 4 (intensity: 0%, 30%, 70%, 100%) × 5 (emotions: happiness, anger, sadness, disgust and fear) × 2 (actors) stimuli constituted the stimulus material. These stimuli were presented in a random order on an Apple Macintosh PowerBook 160.

Procedure

The experimenter explained to the participants that their task was to judge the emotion(s) portrayed on the presented photographs. In order to accustom the participants with the procedure and the use of the computer, they were asked to complete two practice trials, during which the experimenter helped them if they did not understand the terms used or use of the computer. Participants then completed the procedure individually. After completion of the decoding task, participants were asked to fill in anxiety, depression and alcohol dependency questionnaires. Last, they completed the Mini-Mental State test administered by the experimenter.

TABLE 1. Characteristics of abstinent alcoholics (AA), recently detoxified alcoholics (RA) and normal controls (NC)

	AA (n = 25)	RA (n = 25)	NC (n = 25)
Age			
Mean (SD)	44.64 (6.66)	43.00 (6.44)	43.83 (6.37)
Range	34	21	28
Education			
Mean (SD)	2.96 (1.05)	2.95 (1.04)	2.91 (.94)
Range	3	3	3
Mini-Mental State Scale			
Mean (SD)	25.60 (2.69)	25.20 (4.04)	28.37 (1.40)
Range	10	14	4
SAD-Q[a]			
Mean (SD)	34.36 (14.46)	24.33 (12.58)	2.83 (3.54)
Range	53	43	13
Zung Anxiety Scale			
Mean (SD)	40.36 (9.79)	38.50 (9.44)	32.00 (6.27)
Range	35	33	26
Zung Depression Scale			
Mean (SD)	41.56 (10.73)	42.79 (10.83)	31.30 (6.07)
Range	41	43	24

Notes: Significant differences ($p < .01$) were found (1) between controls and the two groups of alcoholics for alcohol dependency, anxiety, depression, and Mini-Mental State scores and (2) between the two groups of alcoholics for alcohol dependency, anxiety and depression. [a]Severity of Alcohol Dependence-Questionnaire.

Dependent measures

Target emotions, as stated in the stimuli part of the method, comprise five emotions (happiness, anger, sadness, disgust and fear) with different intensities, constituting 40 expressions. For each stimulus (target emotions with different intensities), participants answered on seven-point intensity scales labeled “happiness,” “sadness,” “fear,” “anger,” “disgust,” “surprise,” “shame” and “contempt.” This procedure was chosen to provide the participants with the possibility of having as much of an open choice as possible and not to restrain them with a choice limited to the five target emotions. Statistics reflect the accuracy and intensity evaluation for target emotions (based on answers given for all the intensity scales).

The scales were presented successively in random order on the computer screen. For each facial expression, subjects rated the intensity scores from 1 to 7 on each scale described above. After completion of emotion rating of each expression, participants also rated the difficulty in assessing the corresponding EFE. This additional measure was used to evaluate the subjects’ awareness of eventual deficits in decoding EFEs. All scales were anchored by “not at all” at one end and “very intensely” at the other. Decoding accuracy was defined as the observer’s ability to correctly infer the portrayed emotion. An expression was considered as accurately identified when the emotion scale rated with the highest intensity corresponded to the target emotion. An accurately identified expression received a score of 1 and a misidentified expression received a score of 0. Decoding accuracies were computed for all stimuli except those of 0% emotional intensity.

Results

Statistical analyses did not reveal any significant correlation between depression, anxiety or Mini-Mental State scores, on the one hand, and decoding accuracy or intensity scores, on the other hand. Therefore, it was not necessary to control for their effects (e.g., with analysis of covariance). Neither was there a relationship between performance on the emotional test and the score on SAD-Q; the differences between the groups persisted when the SAD-Q scores were used as a covariate. Furthermore, these preliminary statistical analyses did not reveal any correlation between duration (over 2 months) of abstinence and performance in the emotional test. They did not demonstrate any significant differences within the AA group between the short-term abstinent subgroup (2 to 6 months) and the long-term abstinent subgroup (1 to 9 years). Neither was main significant gender effect or interaction observed. Therefore, all subsequent analyses were collapsed across these factors. For recently detoxified alcoholics, no significant

TABLE 2. *F* values for MANOVA

Sources	*F*	df	Power	η^2
Group	9.37‡	2/72	0.974	.207
Emotion	47.66‡	4/69	1.000	.734
Intensity	76.68‡	2/71	1.000	.684
Emotion × Group	3.15†	8/140	0.960	.152
Emotion × Intensity	6.11‡	8/65	1.000	.430
Group × Emotion × Intensity	1.76*	16/132	0.921	.204

*$p < .05$; †$p < .01$; ‡$p < .001$.

correlation emerged between history of alcoholism and decoding accuracy or intensity scores.

Decoding accuracy

In order to assess whether the AA group showed a difference in the ability to decode EFE compared to RA and NC, a repeated measure analysis of variance using a multivariate approach was conducted on the accuracy scores, with Emotion (happiness, anger, sadness, disgust and fear) and Intensity (30%, 70% and 100%) as within-subject factors and Group (AA, RA and NC) as the between-subjects factor. The results are shown in Table 2. Post hoc analyses were conducted to investigate the Group × Intensity × Emotion interaction. The AA accuracy scores were significantly lower than the NC accuracy scores for anger and disgust facial expressions ($F = 7.80$, 1/48 df, $p = .007$ and $F = 9.32$, 1/48 df, $p = .004$, respectively). No significant differences were found between RA and AA. Figure 1 shows means for these results. Significant differences between RA and NC (Philippot et al., 1999) are also represented.

Intensity

Repeated measure analysis of variance using a multivariate approach was conducted on the intensity scores with Emotion (happiness, anger, sadness, disgust and fear), Intensity (0%, 30%, 70% and 100%) and Scales (happiness, sadness, fear, anger, disgust, surprise, shame and contempt) as the within-subject factors and Group (AA, RA, NC) as the between-subjects factor. Table 3 displays the results for all significant main effects and interactions. However, in the context of the present article, only main effects or interactions involving Group are of interest and we shall limit our presentation and discussion to these results. As can be seen in Table 3, among the interactions involving Group, the Group × Emotion interaction accounted for the largest percentage of variance (as indicated by η^2). Therefore, we

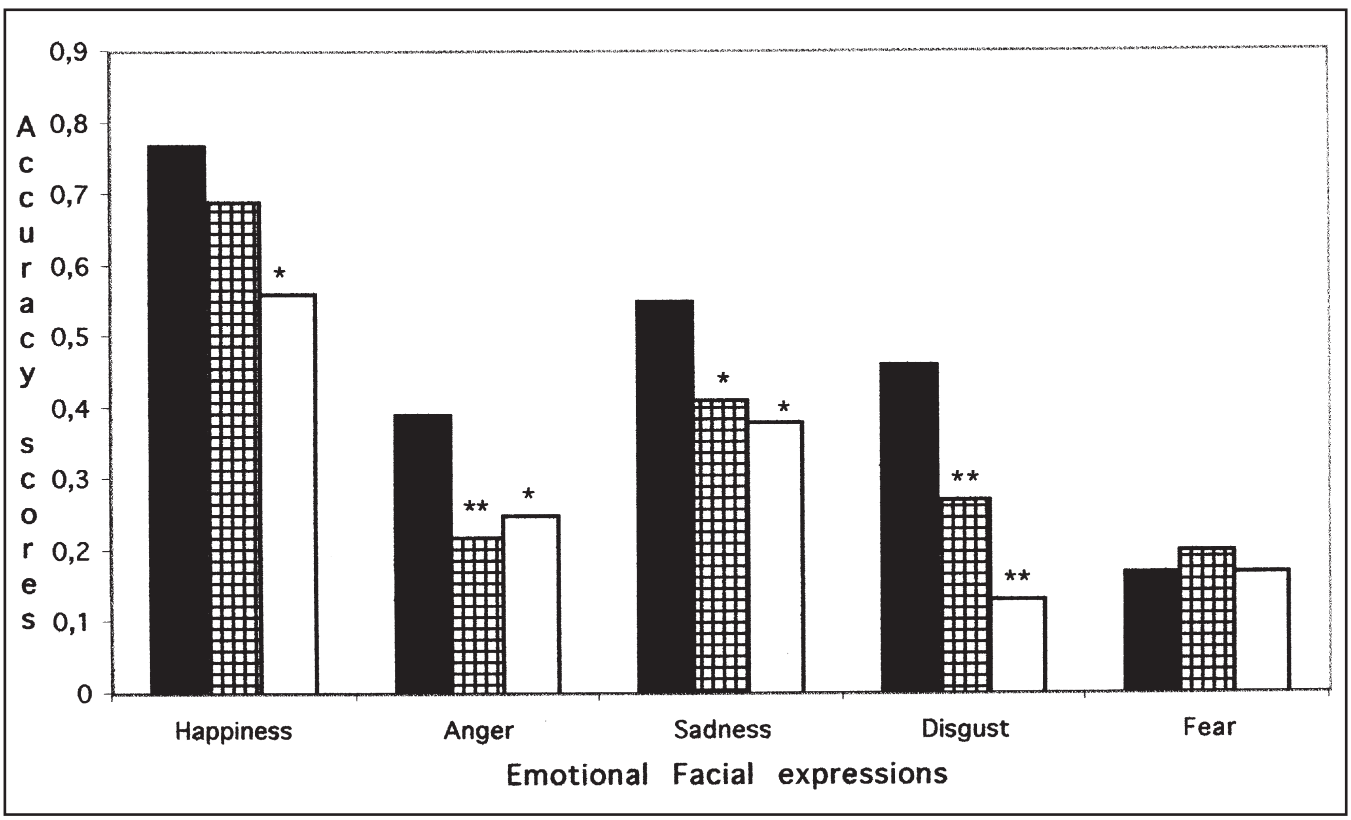

FIGURE 1. Accuracy scores as function of group and facial expressions (■ NC, ⊞ AA, □ RA; significant differences compared with controls: *$p < .05$, ** $p < .01$)

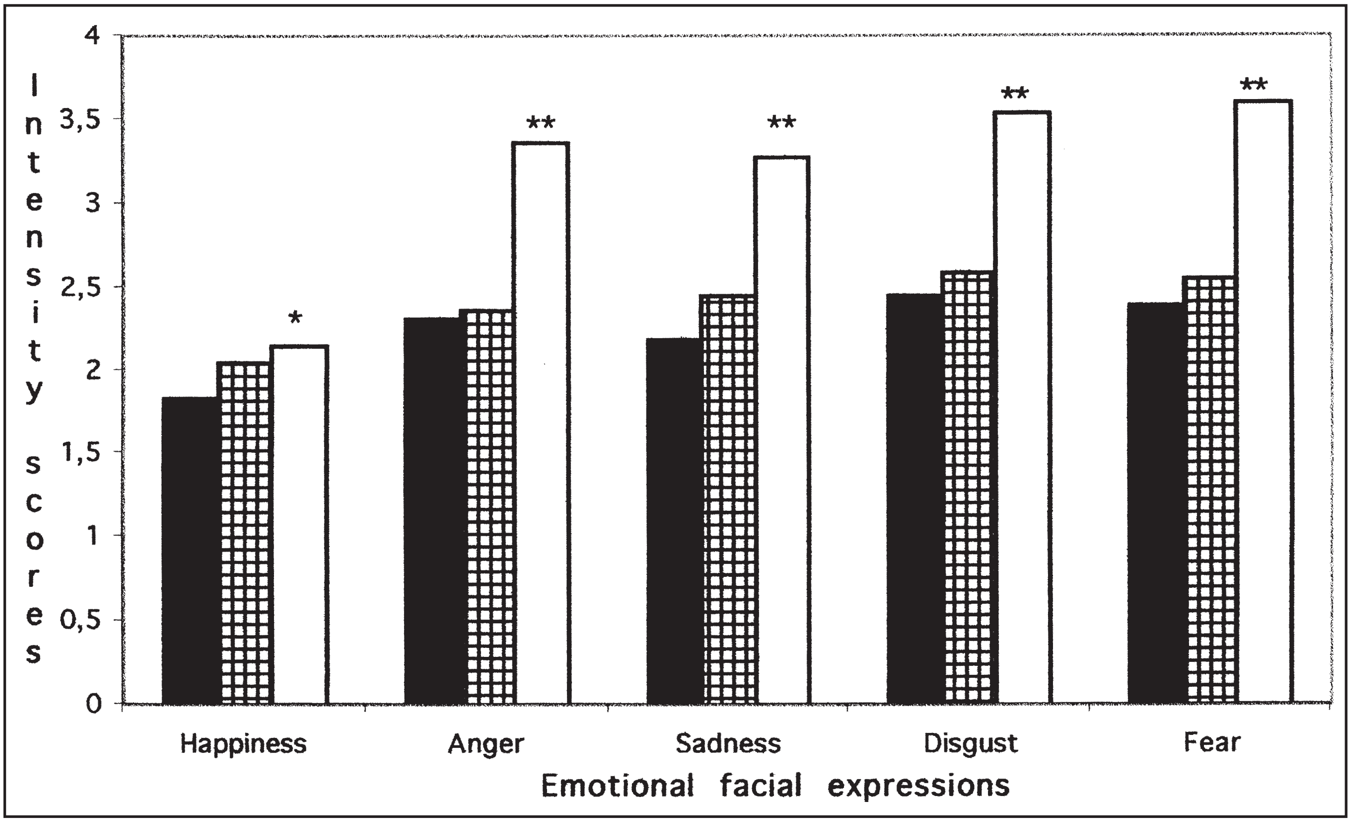

FIGURE 2. Intensity scores as function of group and facial expressions (■ NC, ⊞ AA, □ RA; significant differences compared with controls: * $p < .05$, ** $p < .01$)

focused the analysis on the Group × Emotion interaction and not the subsequent second and third order interactions, which explain less variance. Post hoc analysis revealed that, when judging all EFEs except happy expressions, abstinent alcoholics (AA) rated the expressions as less emotionally intense than did the recently detoxified alcoholics (RA). No significant differences emerged between the ratings of AAs and controls (NC). Figure 2 shows means for these

TABLE 3. *F* values for MANOVA

Sources	*F*	df	Power	η^2
Group	11.99‡	2/72	0.994	.250
Emotion	61.92‡	3.02/217.81	1.000	.462
Intensity	85.39‡	1.80/129.64	1.000	.543
Scales	26.13‡	5.30/382.19	1.000	.266
Group × Emotion	8.47‡	6.05/217.81	1.000	.191
Group × Scales	3.38‡	10.61/382.19	0.994	.086
Emotion × Intensity	13.84‡	8.26/595.11	1.000	.161
Emotion × Scales	146.02‡	8.74/629.19	1.000	.670
Intensity × Scales	20.53‡	11.15/803.01	1.000	.222
Group × Emotion × Scales	2.26†	17.47/629.19	0.991	.059
Group × Emotion × Intensity	2.15†	16.53/595.11	0.983	.056
Emotion × Intensity × Scales	44.73‡	25.10/1,807.35	1.000	.383
Group × Emotion × Intensity × Scales	1.73†	50.20/1,807.35	1.000	.046

† $p < .01$; ‡ $p < .001$.

results. Significant differences between RA and NC (Philippot et al., 1999) are also represented.

Difficulty

Repeated measure analysis of variance using a multivariate approach was conducted on difficulty ratings with Emotion (happiness, anger, sadness, disgust and fear) and Intensity (0%, 30%, 70% and 100%) as within-subjects factors, and Group (abstinent alcoholics [AA], recently detoxified alcoholics [RA] and controls [NC]) as the between-subjects factor. The results revealed neither significant main effects nor interactions involving Group.

Discussion

Our results show that EFE decoding deficits do improve with abstinence, as is the case with numerous other cognitive functions (Parsons, 1998). Intensity overestimation is not present and decoding accuracy (correctly labeling the displayed emotion) is better in the AA group compared with the RA group. However, deficits in decoding accuracy for anger, disgust, and, to a lesser degree sadness, EFEs are similar in the AA and RA groups. The most difficult emotion for the controls to decode (i.e., fear) was also the only emotion for which no differences were observed among the three groups. In this case, our results are likely to be influenced by a floor effect. Improvements are present in alcoholics abstaining for a minimum of 2 months and do not seem to be further modified by the duration of abstinence. Moreover, alcoholics, whether recently detoxified or abstinent, do not seem to be aware of their deficits, as reflected by the fact that their perception of the task difficulty is the same as that of the controls.

EFE decoding deficits may be the consequence of deficits in cognitive and perceptual functions required for these EFE decoding processes. Many aspects of cognitive dysfunction have been described in alcoholics, including deficits in learning, memory, abstraction, verbal problem solving, perceptual analysis and synthesis, perceptual-motor speed, and speed and accuracy of information processing (Parsons, 1998). Some of these cognitive deficits may contribute to impaired decoding of EFE. Alcoholics exhibit mild impairment in the processing of a broad range of visuospatial information (Beatty et al., 1996), which includes not only elementary functions (e.g., scanning, attention allocation, processing and using information from simple visual images) but also complex operations (e.g., manipulating, storing and retrieving visuospatial information) (Beatty et al., 1996). This means that numerous factors may give rise to visuospatial deficits, not only dysfunction in the visuospatial system per se.

Dysfunction in alcoholics of some specific cognitive functions, including EFE recognition, could be explained by differences in regional sensitivity, in the brain, to alcohol. Differences among brain regions in the rate of recovery from chronic alcohol exposure may explain differences in the time course of cognitive functions recovery during alcohol detoxification (Volkow et al., 1994). Differential recovery of brain regions implicated in the EFE recognition process could explain why some emotions lead to less decoding errors after abstinence than others. Neural pathways underlying the processing of EFEs are still not completely understood, due to the complexity of this specific task, the numerous cerebral structures implicated and the variety of techniques and paradigms used to investigate this topic. Neural pathways implicated can be analyzed along two lines that are not mutually exclusive. The first relates to structures involved in the action of decoding an EFE along an occipitofrontal axis. The second is related to the valence dimension and may be discussed in term of hemispheric specialization. Structures commonly believed to be implicated along an occipitofrontal axis (Streit et al., 1999) are the following: mesial occipital cortex (Adolphs et al., 1996) and inferior occipitotemporal cortex (Streit et al., 1999), middle temporal cortex (Blair et al., 1999; Streit et al., 1999), anterior cingulate (Blair et al., 1999; Hornak et al., 1996; Streit et al., 1999) and orbitofrontal cortex (Blair et al., 1999; Hornak et al., 1996; Nakamura et al., 1999; Streit et al., 1999). Possible functions of these structures can be related to EFE processing. Occipital cortex would process the primary visual input. The right temporal cortex would serve as a putative nonverbal lexicon comprising prototypical EFE (Bowers et al., 1991) and affect-laden autobiographical memories (Blair et al., 1999), the verbal lexicon being based in the same regions in the left hemisphere (Bowers et al., 1991). Inferior portions of the temporal lobes have been associated with object recognition in general (Kosslyn et al., 1994) and face recognition (Sergent et al., 1992) in particular.The cingulate, a structure implicated in attentional processes, would direct attention to relevant emotional stimuli and prepare appropriate behavioral responses. The orbitofrontal cortex is associated with working memory, a function that would be necessary to appraise the EFEs, comparing them to the prototypical representations stored elsewhere (Streit et al., 1999).

In addition, specific structures seem related to specific emotions. The amygdalae are especially concerned with the processing of fear (Adolphs et al., 1996; Morris et al., 1998); the caudate nucleus and the insula seem to be implicated in the recognition of disgust (Gray et al., 1997; Philipps et al., 1997; Sprengelmeyer et al., 1996). These apparent discrepancies can be resolved by regarding the recognition of EFE as a multiple-stage process, in part based on emotion-specific separate neural pathways working in parallel, and in part based on neural structures that all emotions investigated have in common (Sprengelmeyer et al., 1998). It is difficult at this stage to implicate a particular structure in the EFE abnormalities seen in our study. We suggest that the implicated structures are not those of visual processing input at the first-stage levels. It is well known that cerebral lesions in the parietal and occipital lobes can lead to disturbances in visual perception (McCarthy and Warrington, 1990). However, such deficits have a broad impact on visual abilities and therefore seem unlikely to account satisfactorily for the loss of recognition of particular emotions (Sprengelmeyer et al., 1996). Good candidates would then be frontotemporal or cingulate regions. This is consistent with data showing that chronic alcohol consumption can specifically induce problems in these regions (Harper, 1998; Kril et al., 1997; Pfefferbaum et al., 1997; Schweinsburg et al., 2000; Tutus et al., 1998; Volkow et al., 1992, 1997).

EFE decoding may also be analyzed in terms of hemispheric specialization, particularly regarding the emotional valence. Overall, right hemisphere advantage in the processing of EFE seems well established (Adolphs et al., 2000; Bowers et al., 1991; Nakamura et al., 1999; Streit et al., 1999, 2000). The right hemisphere seems especially implicated in the processing of negative emotions (Adolphs et al., 2000; Davidson, 1992; Davidson and Fox, 1982;

Grafman et al., 1986; Ley and Bryden, 1979; Mandal and Singh, 1990; McDowell et al., 1994; Natale et al., 1983; Sackeim et al., 1978; Suberi and McKeever, 1977), whereas positive emotions seem to be prefrentially processed by the left hemisphere (Harrison and Gorelczenko, 1990; Reuter-Lorenz et al., 1983; Suberi and McKeever, 1977).

Hemispheric valence hypothesis is consistent with EEG and fMRI studies that suggest that the right hemisphere may be specialized for processing negative but not positive emotions (Canli et al., 1998; Davidson, 1992). Right frontotemporal regions would be more involved in withdrawal-related emotions, which implicate negative emotions, whereas left frontotemporal regions would be more involved in approach-related emotions, which include positive emotions. Right hemisphere dysfunction has been amply described in alcoholics (Berglund et al., 1987; Ellis and Oscar-Berman, 1989; Hutner and Oscar-Berman, 1996; Tsagareli, 1995; Tutus et al., 1998), consistent with our results showing persistent impairment in the processing of negative EFE in alcoholics.

We suggest that the neural structures underlying EFE recognition dysfunctions in alcoholics are likely to involve mostly right frontotemporal or cingulate regions. As the EFE for joy does not seem to be processed by the same regions as the negative emotions, it would explain the preferential recovery of this positive EFE decoding with abstinence. Moreover, positive emotions are more easily decoded than other emotions (Philippot and Feldman, 1990). Improvements are therefore likely to first affect the emotions that are easier to decode.

Alcoholics abstinent for a minimum of 2 months display normal emotion intensity judgment, in contrast with the severe impairment of recently detoxified alcoholics. This is in accordance with the notion that most cognitive dysfunction rapidly improves with abstinence (Parsons, 1998). However, some neurocognitive tests normalize only after several years of abstinence (Fabian and Parsons, 1983; Glenn et al., 1994). The remaining EFE decoding accuracy deficits in the AA group could be related to long-term effects of chronic alcohol consumption. Another explanation is that these deficits could represent irreversible sequelae of chronic alcohol consumption.

We cannot exclude the possibility that EFE decoding deficits may have antedated the onset of alcoholism. Visuospatial information processing abnormalities are known to be present before alcoholism develops (Schandler et al., 1995). Visuospatial deficits that, as stated earlier, include not only the visuospatial system per se but also the structures necessary to process complex visual stimuli, could be increased by alcohol consumption and remit partially with abstinence, explaining our results (i.e., persistence of some abnormalities and total remission of others). In summary, persisting deficits in decoding accuracy for anger, disgust and, to a lesser degree, sadness could be due to insufficient abstinence or to an only partially remissible effect of chronic alcohol consumption. They could also be due to abnormalities preceding the onset of alcoholism and enhanced by alcohol consumption.

Whether deficits are present before chronic alcohol consumption and increased by it, or developed exclusively as a consequence of alcohol consumption, clinical implications should be considered. Persistence of emotional information decoding deficits is likely to play a part in the future interpersonal relationships of abstinent alcoholics. Misjudging anger and disgust, and to a lesser degree sadness, in social partners may lead to misinterpretation and conflicts susceptible to be a relapse factor. The efficacy of social skills training, specifically targeted at the misattribution of aggression and reject, should be tested as a prevention to relapse.

Three limitations of the present study should be discussed. First, the heterogeneity of the AA group regarding length of abstinence (2 months to 9 years) does not allow us to draw firm conclusions as to the impact of long abstinence periods on persisting EFE decoding skills deficits. We cannot exclude the possibility that long abstinence periods might lead to total remission of these deficits. Further studies with larger samples of long-term abstinent patients are needed to clarify this issue. However, we are able to state that abstinence, even recent abstinence, is beneficial regarding this particular function.

Second, gender differences in EFE recognition might introduce a bias; our group is composed of both male and female subjects. Women are described as being better than men at reading nonverbal cues (Hall, 1984; Hoffman, 1977), although there does not seem to be an absolute consensus regarding this matter (De Paulo et al., 1993; Zuckerman et al., 1981). Even if women are credited with better performance than are men, this would not change the main conclusion of our study, which is that alcoholism is associated with EFE decoding abnormalities that remit partially, if not completely, with abstinence. No main significant gender effect or interaction was observed regarding the results on the emotional test; this finding, however, precludes any firm conclusions regarding the respective susceptibility of male and female alcoholic subjects having impaired EFE processing, since the samples are too small to make comparisons worthwhile.

Third, the AA group we have used is not composed of the same patients as the RA group. This may constitute a limitation because long-term abstinent alcoholics are a select population among chronic alcoholics. Alcoholics in the RA and AA groups could differ in such dimensions as duration of illness, usual consumption, familial antecedents, treatment history and personality characteristics. We cannot exclude that these differences could account for the observed differences, even if these factors do not seem to be essential when long-term abstinent populations are considered (Adams and Grant, 1986). Only a longitudinal study could provide certainty about the differences observed; in comparisons between different groups even a careful historic record will be subject to doubt regarding the role of other variables. However, the fact that we still find the same abnormalities in the two AA subgroups (chronic alcoholics coming from a long-term postdetoxification treatment center and long-term Alcoholics Anonymous abstainers) gives more strength to our results.

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