Face Processing in Chronic Alcoholism: A Specific Deficit for Emotional Features

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Background: It is well established that chronic alcoholism is associated with a deficit in the decoding of emotional facial expression (EFE). Nevertheless, it is still unclear whether this deficit is specifically for emotions or due to a more general impairment in visual or facial processing. This study was designed to clarify this issue using multiple control tasks and the subtraction method.

Methods: Eighteen patients suffering from chronic alcoholism and 18 matched healthy control subjects were asked to perform several tasks evaluating (1) Basic visuo-spatial and facial identity processing; (2) Simple reaction times; (3) Complex facial features identification (namely age, emotion, gender, and race). Accuracy and reaction times were recorded.

Results: Alcoholic patients had a preserved performance for visuo-spatial and facial identity processing, but their performance was impaired for visuo-motor abilities and for the detection of complex facial aspects. More importantly, the subtraction method showed that alcoholism is associated with a specific EFE decoding deficit, still present when visuo-motor slowing down is controlled for.

Conclusion: These results offer a post hoc confirmation of earlier data showing an EFE decoding deficit in alcoholism by strongly suggesting a specificity of this deficit for emotions. This may have implications for clinical situations, where emotional impairments are frequently observed among alcoholic subjects.

Key Words: Alcoholism, Visuo-Spatial Abilities, Emotional Facial Expression.

THE ABILITY TO build and maintain efficient interpersonal relations is crucial in human life (Feldman et al., 1991). Among the media allowing these interactions, the recognition and production of emotional facial expression (EFE) appear prominent, and have been extensively investigated among normal individuals in the last few decades (e.g., Ekman, 2001). On this basis, EFE decoding abilities have been explored among psychiatric populations (Power and Dalgleish, 1997), and several deficits have been described, notably in chronic alcoholism. Indeed, it has been observed that alcoholic subjects overestimate the intensity of EFE, misinterpret EFE, and are not aware of this impairment (Kornreich et al., 2001). While some contradictory results exist (Uekermann et al., 2005), this impairment in EFE decoding has been repeatedly reported (Frigerio et al., 2002; Oscar-Berman et al., 1990; Philippot et al., 1999; Townshend and Duka, 2003), and its clinical significance highlighted: Indeed, this deficit in decoding EFE, a major means of communication, could participate in the worsening of interpersonal problems among alcoholic subjects and lead to social isolation. This may in turn increase the use of alcohol consumption as a coping strategy to face with this isolation, thus creating a vicious circle (Kornreich et al., 2002). Nevertheless, it should be noted that this vicious circle is still a hypothesis to be confirmed by future studies.

However, although the EFE decoding deficit in alcoholism is now widely accepted, its specificity for the emotional aspects of the stimuli remains unclear. This deficit could in fact be due to impairment in earlier visual processing stages, notably concerning basic visual perception, rather than being an emotional problem per se. Indeed, it is well established that chronic alcoholism is associated with a wide range of cognitive and psychological problems, including general deficits in visual processing (Blusewicz et al., 1977; Kramer et al., 1989). More precisely, visuo-motor deficits have been observed among alcoholic subjects, particularly in tasks where speed is a key to success, for example during basic discrimination between objects (Evert and Oscar-Berman, 1995), slow-motion detection (Wegner et al., 2001), or visuo-motor tasks (Mann et al., 1999). Moreover, this impairment has been confirmed by electrophysiological explorations showing delayed latencies and reduced amplitudes of the waves associated with basic visual and specific face processing (respectively the P100

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and N170 components, e.g., Marco et al., 2005; Maurage et al., 2007). It could thus be that the impaired EFE decoding in alcoholism is only the effect of a more general visuo-motor or face processing deficit.

As the great majority of earlier studies exploring EFE decoding among alcoholic subjects did not use a control task to check the specificity of the deficit for emotional aspects, it has been impossible to conclude that alcoholism leads to a specific emotion processing deficit, which limits the clinical and therapeutic implications of these findings. The present study was designed to clarify this uncertainty by (1) testing the integrity of the basic visuo-spatial and facial processing in alcoholism; (2) testing the differential performance of alcoholics on various tasks necessitating complex processing of faces, namely gender, age, race, and emotion judgments. If the EFE decoding deficit observed in earlier studies is specifically emotional, as has been recently suggested (Foisy et al., 2007), the performance of alcoholic subjects should be relatively preserved for simple and complex nonemotional face processing, and massively impaired for the processing of emotional facial features.

MATERIALS AND METHODS

Participants

Eighteen inpatients (9 women), diagnosed with alcohol dependence according to Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria, were recruited during the third week of their treatment in a detoxification center (Integrated Hepatology Unit, St Luc Hospital, Catholic University of Louvain, Brussels, Belgium). They had all abstained from alcohol for at least 2 weeks (mean: 15.71 days; SD 2.39), were free of any other psychiatric diagnosis as assessed by an exhaustive psychiatric examination (comorbidity with any other psychiatric disease constituted an exclusion criteria), were not receiving any medication and were all right-handed. The mean alcohol consumption among patients just before detoxification was 14.3 alcohol units (an alcohol unit here corresponds to 10 g of pure ethanol) per day (SD 2.7) and the mean number of previous detoxification treatments was 1.8 (SD 1.4). Patients were matched for age, gender, and education with a control group composed of 18 volunteers who were free of any history of psychiatric disorder or drug/substance abuse. The mean alcohol consumption in the control group was 3.3 U/wk (SD 1.9), and control subjects abstained from any alcohol consumption for at least 3 days before testing. Exclusion criteria for both groups included major medical problems, neurological disease (including epilepsy), visual impairment, polysubstance abuse, and nicotine dependence (patients and controls were all nonsmokers). Each participant had a normal-to-corrected vision. Education level was assessed according to the number of years of education completed since starting primary school. Patients and control subjects were assessed using several psychological measures, in order to evaluate the presence of subclinical comorbid psychopathologies and deficits. The following variables were evaluated using validated self-completion questionnaires (mentioned in brackets): State and trait anxiety (State and Trait Anxiety Inventory, form A and B, Spielberger et al., 1983), depression (Beck Depression Inventory, short version, Beck and Steer, 1987), interpersonal problems (Inventory of Interpersonal Problems, Horowitz et al., 1988), and alexithymia (20-item Toronto Alexithymia Scale, Bagby et al., 1994). Participants were provided with full details regarding the aims of the study and the procedure to be followed. After receiving this information, all participants gave their informed consent. The study was approved by the ethical committee of the medical school.

Task and Procedure

Control Measures. In order to take into account the visuo-spatial and motor deficit repeatedly observed among alcoholic subjects, control measures were performed. Namely, 3 tasks were chosen to assess these abilities:

(1) The Birmingham Object Recognition Battery (BORB, Riddoch and Humphreys, 1993), containing 14 subtests evaluating basic visual object recognition. We selected the subtests dedicated to visuo-spatial processing (namely subtests 2 to 5 and 7 to 8).

(2) The Benton Face Recognition Test (Benton et al., 1994), a discrimination and pairing task requiring subjects to select a target face from a set of faces shown (a) full-face (b) in profile or (c) in shadow. This test was used to test the ability to correctly process the identity attributes of emotionally neutral faces, and consisted of 22 items, with a maximal score of 51.

(3) A simple reaction time task (SRTT), used to test the integrity of motor and visual abilities and in which subjects had to detect as quickly as possible the arrival of a human face, among a succession of white crosses. Five neutral faces [selected from the standardized set of Ekman and Friesen (1976) pictures, 2 males] were chosen. This task consisted of 2 blocks of 200 stimuli (40 faces) randomly presented during 700 ms, with an inter-stimulus interval of 1,500 ms.

Stimuli and Experimental Tasks. The experimental phase consisted of binary decisions concerning the identification of specific features in human faces. Four experimental tasks were chosen, each containing 2 conditions and respectively based on the identification of: (1) Gender (male or female face); (2) Age (young or old face); (3) Race (Caucasian or Asian face); (4) Emotion (positive or negative emotional expression).

For the first 3 tasks, 40 faces (20 males-20 females, 20 young-20 old, and 20 Caucasian-20 Asian) were selected on the Internet, leading to 5 stimuli for each possible combination (e.g., young male Caucasian). For the emotional task, 40 stimuli (20 males, 20 young, and all Caucasian) were selected from the Ekman and Friesen (1976) and Hess and Blairy (1995) validated sets. The stimuli classified as "happy" in these sets were chosen to depict the positive emotion in our experiment, and those classified as "angry" were chosen to depict the negative emotion. These stimuli are illustrated in Fig. 1.

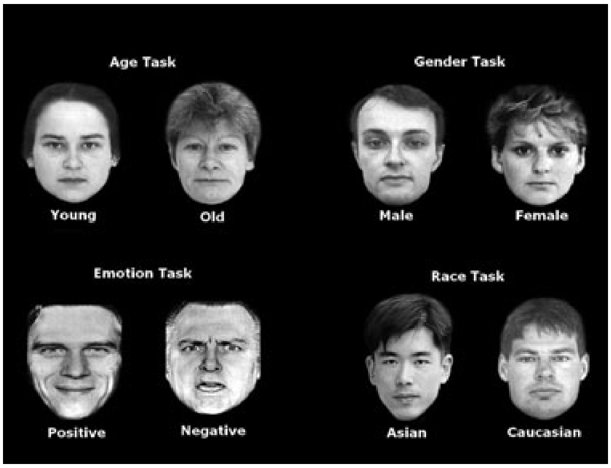

Fig. 1. Illustration of the stimuli used in this study, for the age, emotion, gender, and race tasks.

All the stimuli were then standardized using Photoshop 6.0 (Adobe Systems, Inc., San Jose, CA). They were placed on a black background, resized to a 6.5 × 5.5 cm format (stimuli subtended a visual angle of 3 × 4°), and the contrast-luminosity was controlled. Each task was divided into 5 blocks containing 40 trials. Participants were thus confronted with a total of 20 blocks of 40 stimuli, so that the study consisted of 800 stimuli (100 per condition). Each block contained 20 faces by condition (e.g., 20 young and 20 old faces for the age task), each face appearing one time by block, and the stimuli were randomly distributed among the block. An identical procedure was used in the different experimental tasks: Each trial was composed of a white fixation cross appearing for 300 ms and immediately followed by the facial stimulus appearing for 1,500 ms. For each face, the subject had to decide as quickly as possible if the face was, depending on the task, male-female (gender task), young-old (age task), Caucasian-Asian (race task), or positive-negative (emotion task) by pressing the corresponding button on a response pad with their right forefinger. The response laterality (e.g., left for Caucasian and right for Asian) was counterbalanced, and the order of the blocks and tasks were randomized across subjects. Subjects were reminded of the task instructions before each block. Participants were told that speed was important but not at the cost of accuracy. Response time and error rate were recorded. Only correct responses were considered for analysis of response times.

RESULTS

Psychological Measures

As shown in Table 1, alcoholic individuals and controls were similar in terms of age [$F(1,34) = 0.64$, NS], gender, and education [$F(1,34) = 0.03$, NS]. Moreover, the 2 groups did not differ significantly for interpersonal problems [$F(1,34) = 2.44$, NS] or alexithymia [$F(1,34) = 0.26$, NS]. Nevertheless, the 2 groups did differ significantly for anxiety state [$F(1,34) = 4.71$, $p < 0.05$], anxiety trait [$F(1,34) = 6.25$, $p < 0.05$], and depression [$F(1,34) = 7.11$, $p < 0.05$], showing higher scores for alcoholics compared with controls. Nevertheless, these differences are unlikely to have influenced the experimental results, as (1) no significant Pearson's correlations were shown between any psychological measure and any behavioral data ($p > 0.05$ for every correlation), and (2) a complementary analysis was conducted, including the depression and anxiety scores as covariables in our ANOVA statistical analyses, and showing no significant influence of these factors on the results ($p > 0.05$ for every test).

Control Measures

These results are shown in Table 2. One-way ANOVA were conducted to test the group differences concerning the BORB, Benton, and SRTT results. No significant differences were observed between controls and alcoholics for the different BORB subscales [$F(1,34) < 3.18$, NS] or on the Benton test [$F(1,34) = 2.38$, NS]. Nevertheless, alcoholic subjects were significantly slower than controls in the SRTT [$F(1,34) = 32.72, p < 0.001$].

Accuracy

These results are shown in Table 3. A 4 × 2 ANOVA with task (age, gender, emotion, and race) as within-factor and group (alcoholic individuals and controls) as between-factor was carried out. A main effect of group [$F(1,34) = 15.31$, $p < 0.01$] was found: alcoholic subjects actually made about twice as many errors as the controls. No main effect for task [$F(3,102) = 2.69$, NS] and no interaction effect [$F(3,102) = 0.41$, NS] were found. In order to explore the potential differences in accuracy between the 2 conditions in each task, paired-sample *t*-tests were conducted globally and among each group.

Globally, no accuracy differences were found between the 2 conditions in the race and age tasks, but (1) in the gender

Table 1. Patients and Controls Characteristics: Mean (SD)

Group	Age	EL[a]	MAC[b]	BDI[c]	Stai[d] A	Stai[d] B	IIP[e]	TAS-20[f]
Controls (*n* = 18)	48.00 (10.62)	13.22 (2.13)	0.47 (0.22)	2.94 (2.46)	33.24 (8.60)	35.59 (10.08)	0.98 (0.44)	49.12 (17.52)
Alcoholics (*n* = 18)	50.72 (9.78)	13.39 (3.18)	14.3 (2.71)	7.71 (6.94)	42.76 (12.58)	46.59 (13.06)	1.33 (0.71)	48.31 (15.52)

[a]EL, Education Level (in years); [b]MAC, mean alcohol consumption just before detoxification (number of doses per day); [c]BDI, Beck Depression Inventory (Beck and Steer, 1987); [d]STAI, State and Trait Anxiety Inventory (Spielberger et al., 1983); [e]IIP, Inventory of Interpersonal Problems (Horowitz et al., 1988); [f]TAS-20, Twenty-item Toronto Alexithymia Scale-II (Bagby et al., 1994).

Table 2. Control Measures Results: BORB, Benton Test, and Simple Reaction Time Task [mean (SD)]

Group	BORB[a] subtest 2	BORB subtest 3	BORB subtest 4	BORB subtest 5	BORB subtest 7	BORB subtest 8	BFRT[b]	SRTT[c]
Controls (*n* = 18)	26.89 (1.53)	26.83 (1.68)	25.57 (2.38)	36.91 (1.86)	24.94 (0.24)	24.22 (0.87)	46.78 (2.58)	391 (38.4)
Alcoholics (*n* = 18)	26.95 (1.34)	27.53 (1.65)	26.01 (2.31)	35.64 (2.9)	24.95 (0.2)	24.32 (1.29)	45.39 (2.81)	469 (43.3)

[a]BORB, Birmingham Object Recognition Battery (Riddoch and Humphreys, 1993); [b]BFRT, Benton face recognition test (Benton et al., 1994); [c]SRTT, Simple reaction time task (ms).

Table 3. Behavioral Results: Reaction Times [RTs; ms (SD)] and Performance [Perf.; percentage of errors (SD)]

		Control subjects (*n* = 18)		Alcoholic subjects (*n* = 18)	
Task	Condition	RTs	Perf.	RTs	Perf.
Age	Old	680 (73.7)	2.56 (2.43)	775 (70.3)	5.50 (5.09)
	Young	687 (78.7)	3.39 (2.11)	837 (85.4)	6.72 (3.89)
Emotion	Negative	684 (91.8)	5.17 (3.56)	855 (81.1)	9.94 (8.37)
	Positive	675 (91.6)	3.39 (2.30)	853 (79.8)	8.06 (8.54)
Gender	Female	670 (74.4)	5.89 (4.53)	819 (98.4)	12.22 (8.98)
	Male	656 (77.5)	3.94 (1.55)	773 (90.5)	6.06 (6.65)
Race	Caucasian	701 (80.1)	2.11 (2.24)	832 (93.8)	5.33 (3.39)
	Asian	678 (75.3)	4.01 (3.59)	789 (78.4)	5.94 (4.19)

task, there were significantly more errors for the female than for the male stimuli [$t(35) = 4.19$, $p < 0.001$], and (2) in the emotion task, there were significantly more errors for the negative than for the positive stimuli [$t(35) = 3.09$, $p < 0.01$]. Moreover, the difference in the gender task was significant in the alcoholic group [$t(17) = 4.05$, $p < 0.001$] but not among controls [$t(17) = 1.65$, NS], while the reverse pattern was observed in the emotion task (alcoholics: [$t(17) = 1.95$, NS] and controls [$t(17) = 2.49$, $p < 0.05$]).

Latencies

A 4 × 2 ANOVA with task (age, gender, emotion, and race) as within-factor and group (alcoholic individuals and controls) as between-factor was first carried out. These results are shown in Fig. 2 (Part *A*) and Table 3. As expected, a main effect of group [$F(1,34) = 32.81$, $p < 0.001$] was found: alcoholic subjects were globally slower than controls, and this difference was significant for the 4 tasks. Moreover, we found (1) a significant main effect of task [$F(3,102) = 5.49$,

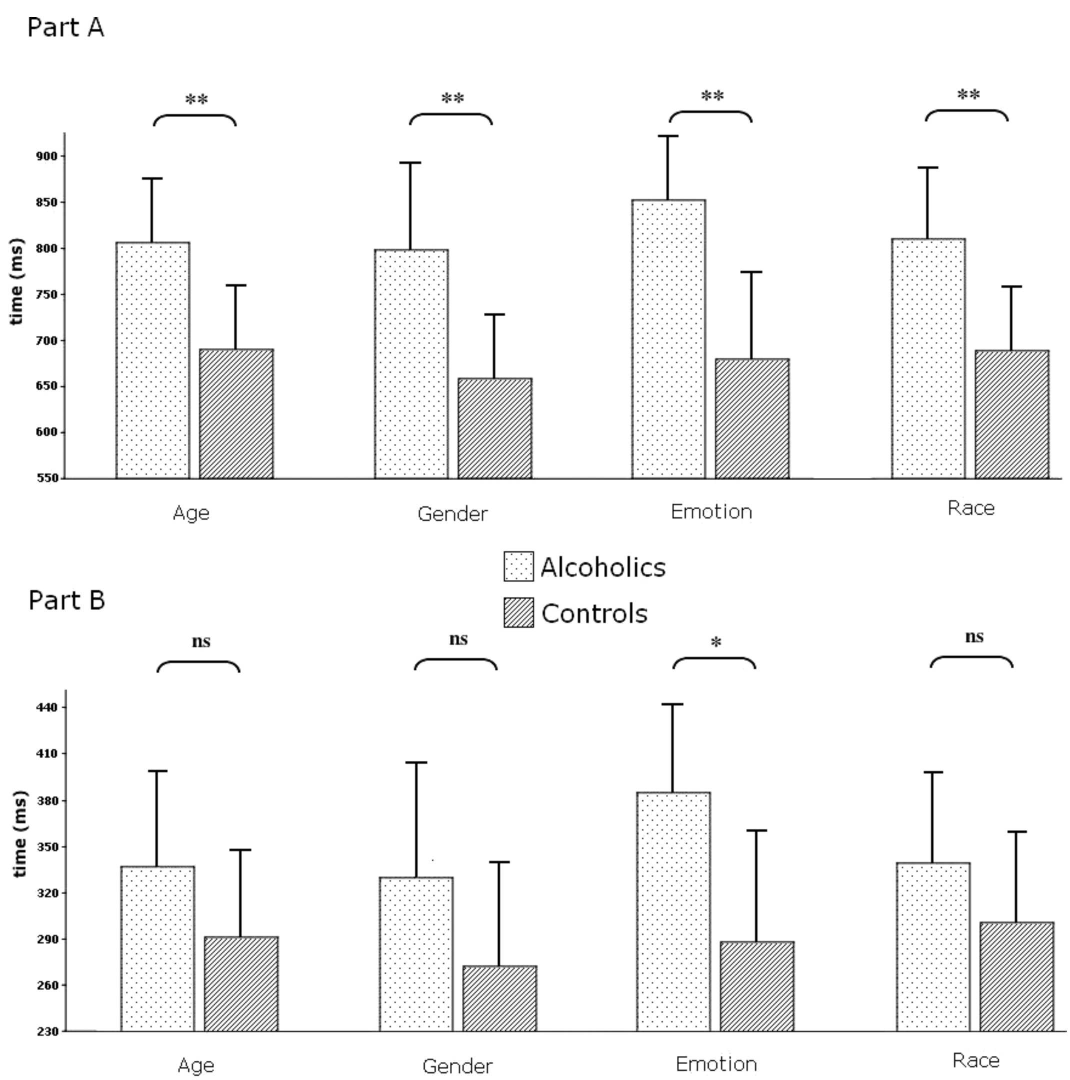

Fig. 2. Reaction times observed among control and alcoholic subjects for each task. This figure illustrates the global deficit for each task in alcoholism in terms of the rough reaction times (part **A**), and the specific emotional deficit when the visuo-motor aspects are controlled for, namely the subtracted reaction times (part **B**). *$p < 0.01$; **$p < 0.001$.

$p < 0.01$]: Gender task was associated with faster response times than race [$t(35) = 2.40$, $p < 0.05$], age [$t(35) = 2.16$, $p < 0.05$], and emotion [$t(35) = 3.32$, $p < 0.01$] tasks, which did not differ significantly and, more interestingly, (2) a significant interaction effect between group and task [$F(3,102) = 3.64$, $p < 0.05$]: In the control group, the only significant result was the faster response times in the gender task compared with race [$t(17) = 2.91$, $p = 0.01$] and age [$t(17) = 2.32$, $p < 0.05$], while in the alcoholic group, the emotion task was associated with longer response times than gender [$t(17) = 3.10$, $p < 0.01$], race [$t(17) = 2.96$, $p < 0.01$], and age [$t(17) = 2.99$, $p < 0.01$] tasks, which did not differ, thus showing a specific difficulty for detection of emotion.

In order to confirm this specific emotional deficit among alcoholics, a complementary analysis was performed. Indeed, the results presented above, based on the rough data, include the global visuo-motor slowing observed among alcoholics. In order to exclude this global deficit and to specifically explore the differences due to the facial discrimination tasks, the mean response time for the SRTT (see Table 2) was, for each subject, subtracted from the response time for each task. The influence of the global slowing in alcoholism was thus excluded for these subtracted response times.

A new 4 × 2 ANOVA with task (age, gender, emotion, and race) as within-factor and group (alcoholic individuals and controls) as between-factor was then carried out. As the same value (namely the mean response time for the SRTT) was subtracted in each condition, the same effects were found: main effect of group [$F(1,34) = 5.33$, $p < 0.05$], main effect of task [$F(3,102) = 5.57$, $p < 0.01$], and significant group × -task interaction [$F(3,102) = 3.61$, $p < 0.05$]. But the interesting result concerning these subtracted response times is, as illustrated in Fig. 2 (Part *B*) and Table 4, that the difference between groups (which was significant in each task for the rough response times) was only significant for the emotion task [$F(1,34) = 11.85$, $p < 0.01$], and no longer for gender [$F(1,34) = 3.21$, NS], age [$F(1,34) = 2.81$, NS], or race [$F(1,34) = 2.42$, NS] tasks, thus confirming the specific emotional impairment in alcoholism when basic visuo-motor deficits are controlled for.

Table 4. Mean Subtracted RTs for Each Group on Each Task (namely RTs for the task minus RTs for the simple reaction time task), and *F*-Values and *p*-Values for the Comparison Between Control and Alcoholic Groups in Each Task on These Subtracted RTs

Group Task	Controls (n = 18)	Alcoholics (n = 18)	*F*-value (1,34)	p-value
Age	292 (76.6)	336 (80.3)	2.806	0.103
Emotion	**288 (91.7)**	**385 (75.3)**	**11.857**	**0.002**
Gender	272 (87.1)	327 (95.9)	3.218	0.082
Race	298 (84.9)	341 (83.2)	2.418	0.129

Significant results are indicated in bold text. The only significant difference between groups for the subtracted RTs concerns the emotion task.

Complementary Analyses

Finally, as age and gender variations could have influenced the results, these potential biases were explored. Indeed, gender and age were introduced as covariables in our ANOVA statistical analyses, and Pearson's correlations were computed between the results and these variables. There was no significant influence of gender or age on the results ($p > 0.05$ for every test and correlation).

DISCUSSION

Psychological and Control Measures

First, while no differences were observed between groups for interpersonal problems or alexithymia, alcoholic individuals had significantly higher levels of depression and anxiety (state and trait) than controls, which is in line with previous studies (e.g., Di Sclafani et al., 2007; Driessen et al., 2001) describing a frequent comorbidity between chronic alcoholism and other psychiatric states. Nevertheless, complementary analyses showed that these differences in psychological measures did not influence the experimental results. This may explained by the fact that depression and anxiety levels were subclinical, as no alcoholic subject was diagnosed as depressive or anxious according to DSM-IV criteria. The control of depression-anxiety levels is thus crucial to ensure that the potential deficit observed among patients is due to alcoholism in itself and not biased by comorbidity.

Concerning the control measures, we found no deficit concerning basic visual processing or the recognition of identity attributes in faces (as indexed by the preserved performance of alcoholic subjects in the BORB and Benton tests). Nevertheless, alcoholic subjects were significantly slower than controls in the SRTT. This confirms earlier results showing: (1) preserved visual processing in alcoholism (for simple objects as well as faces), when no time limit is present, as for the BORB and Benton tests (e.g., Kornreich et al., 2002; Parsons and Nixon, 1993); (2) general visuo-motor slowing among alcoholic subjects, leading to slower response times in visual tasks (e.g., Mann et al., 1999; Sullivan et al., 2000). Our results thus confirm that alcoholism is associated with a visuo-motor deficit when speed is important to perform the task and that this slowing down is still present when comorbidity is controlled for and when patients are not taking any medication.

Experimental Data

While a ceiling effect was observed among controls (more than 96% of correct responses on average), the percentage of errors was more than twofold higher in alcoholic subjects compared with controls (without significant differences according to the experimental task), confirming the general impairment in the identification of face features among alcoholics when rapid processing is needed. For the response times, it should be noted that the gender task was performed fastest in both groups, which is in line with earlier results (e.g., Krolak-Salmon et al., 2001). More importantly, the alcoholic subjects were globally slower than controls at performing the 4 tasks. Nevertheless, as alcoholism was also associated with general visuo-motor slowing (indexed by the SRTT), it could be that the deficit observed for the latencies in the 4 experimental tasks was linked to this general slowing rather than being associated with a specific deficit in complex face processing.

The main interest of this study was thus to test whether the deficit usually observed in the processing of EFE among alcoholic subjects is (1) general for every task requiring a fast decision, (2) present when complex facial processing is needed (e.g., age, race, or gender detection), or (3) specific for the processing of EFE. In order to test this, we separated the visuomotor aspects from the processing of complex facial features on the basis of the subtraction method (Donders, 1868), widely used to isolate specific processing pathways in the cognitive stream. Namely, we computed for each subject and each task the following subtraction: "mean response time for the experimental task" minus "mean response time for the SRTT." The results are clear: When the visuo-motor aspects were controlled for, the deficit was still present in the alcoholic group for the emotion task but disappeared for the 3 other experimental tasks (namely gender, age, and race). This result constitutes to our knowledge the first strong suggestion, based on firm methodology, that the EFE decoding deficit repeatedly observed in alcoholism appears as specifically due to impairment in processing emotions. Moreover (1) these results cannot be explained by a greater difficulty of the emotion task, as this task did not lead to lower accuracy or higher latencies than control tasks (except the gender task for the response times), for control or for alcoholic subjects; (2) complementary analyses showed that this specific emotional deficit did not seem to be modulated by age or gender of the alcoholic subject. It should be noted that earlier studies (notably Foisy et al., 2007) have already suggested the existence of a specific deficit for emotion processing among alcoholics. Nevertheless, these studies had methodological limits, notably the use of different tasks to evaluate control (gender, age, and race) and emotional aspects, and the fact that other high-level cognitive abilities (e.g., reading skills) were required to perform the tasks. The subtraction method used in our study is an efficient and proven tool (e.g., Gottsdanker and Shragg, 1985; Dehaene, 1995) to evaluate the specific emotional deficit. Indeed, this method, very frequently used in neuroscience and neuropsychology (e.g., Pesenti et al., 2000; Szameitat et al., 2002), allows a complex mental process to be divided into parts, and the specific influence of each subprocess on the global response times to be explored (see for example Sternberg, 2001 for a review). In this study, the rough response times did not allow the emotional processing to be explored per se, as it was mixed up with sensori-motor aspects. The subtraction method, by controlling for the influence of the potential deficit observed in the SRTT (mainly linked to sensorial and motor abilities), led to the isolation of the processes specifically implicated in each experimental task. On this basis, we showed that only the emotional deficit was still significant among alcoholics when the global visuo-motor slowing down was controlled for. It should be noted that this subtraction method has to be used cautiously as it is based on strong assumptions, particularly concerning the absence of overlap or mutual influence between successive processing stages (e.g., Tietz and Gottsdanker, 1992). Nevertheless, this method was based on the identical subtraction of basic visuomotor stages across the 4 experimental tasks. We thus assume that the use of this subtraction method, already performed in earlier studies on psychiatric populations (Brown and Eyler, 2006), is valid in our experiment.

In conclusion, the main implication of our results is to dissipate doubt concerning earlier studies on EFE decoding in chronic alcoholism. Indeed, as earlier studies did not control for visuo-motor abilities, they were unable to prove the specificity of the deficit for EFE. The use of the subtraction method allowed us to isolate the deficit and to strongly suggest that it is specific for emotions (when compared with other complex processing of facial features). Moreover, the use of relatively short presentation times (1,500 ms) ensures that our experimental conditions were near to those of daily life, where the spontaneous facial expression of emotions is often short and has to be processed rapidly. The results observed here thus (1) offer a post hoc confirmation of earlier studies exploring the EFE decoding deficit and (2) corroborate the frequent clinical observation of impaired emotional processing, and particularly of EFE decoding, in chronic alcoholism.

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