Preserved Affective Sharing But Impaired Decoding of Contextual Complex Emotions in Alcohol Dependence

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Background: Prior research has repeatedly shown that alcohol dependence is associated with a large range of impairments in psychological processes, which could lead to interpersonal deficits. Specifically, it has been suggested that these interpersonal difficulties are underpinned by reduced recognition and sharing of others' emotional states. However, this pattern of deficits remains to be clarified. This study thus aimed to investigate whether alcohol dependence is associated with impaired abilities in decoding contextual complex emotions and with altered sharing of others' emotions.

Methods: Forty-one alcohol-dependent individuals (ADI) and 37 matched healthy individuals completed the Multifaceted Empathy Test, in which they were instructed to identify complex emotional states expressed by individuals in contextual scenes and to state to what extent they shared them.

Results: Compared to healthy individuals, ADI were impaired in identifying negative (Cohen's $d = 0.75$) and positive (Cohen's $d = 0.46$) emotional states but, conversely, presented preserved abilities in sharing others' emotional states.

Conclusions: This study shows that alcohol dependence is characterized by an impaired ability to decode complex emotional states (both positive and negative), despite the presence of complementary contextual cues, but by preserved emotion-sharing. Therefore, these results extend earlier data describing an impaired ability to decode noncontextualized emotions toward contextualized and ecologically valid emotional states. They also indicate that some essential emotional competences such as emotion-sharing are preserved in alcohol dependence, thereby offering potential therapeutic levers.

Key Words: Alcohol Dependence, Empathy, Affective Sharing, Emotion, Affective Mental States, Context.

ALCOHOL DEPENDENCE IS one of the most common psychiatric disorders worldwide (Harper and Matsumoto, 2005) and leads to cognitive, emotional, and interpersonal deficits (Castellano et al., 2015; Maurage et al., 2011b, 2013a,b; Stavro et al., 2013; Townshend and Duka, 2003; Uekermann and Daum, 2008), the latter being notably related to increased levels of alexithymia (e.g., Taieb et al., 2002), more interpersonal disorders (e.g., Maurage et al., 2009), and lower social responsiveness (Mohagheghi et al., 2015). It has recently been shown that these interpersonal deficits extend to how alcohol-dependent individuals (ADI) decode and respond to others' mental states (e.g., Maurage et al., 2011a,b; Nandrino et al., 2014).

The decoding deficits of ADI are known to be impaired in identifying others' emotional states. With respect to the theory of mind (i.e., inferring other people's mental states; Premack and Woodruff, 1978), ADI present deficits in understanding affective states (e.g., faux pas, irony) (Amenta et al., 2013; Maurage et al., 2016; Thoma et al., 2013) but with a potential preservation of the abilities related to identifying nonaffective states (e.g., false beliefs) (Bosco et al., 2014; Maurage et al., 2016; but for contrasting results, see Maurage et al., 2015), while contradictory results have been found for this ability. On the one hand, ADI are able to correctly understand intentions and thoughts displayed in short videos of social interactions (Maurage et al., 2016) and to correctly perform a short version of the Strange Stories Test (Bosco et al., 2014; Happé et al., 1999), presenting scenarios that require participants to understand characters' nonemotional mental states (e.g., bluffing, lies, persuasion). On the other hand, some ADI seemed to have impaired abilities in tracking the other person's mental state in a false belief task (Maurage et al., 2015), while more than 50% of the ADI did not present any deficit on this task.

Concerning pictures of mental state expressions, ADI are impaired in decoding basic (e.g., Kornreich et al., 2013; Maurage et al., 2009; Miller et al., 2015) and complex emotional states (Maurage et al., 2011a; Nandrino et al., 2014; Thoma et al., 2013) but have preserved abilities in decoding complex nonemotional states (Maurage et al., 2011a). Taken

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together, these studies suggest that ADI are impaired in identifying others' emotional states. These abilities usually refer to cognitive empathy, defined as the process of understanding another person's perspective, that is, the ability to take the perspective of others in order to understand and predict their mental states (e.g., Chakrabarti and Baron-Cohen, 2006; Shamay-Tsoory, 2011). However, while they present systematic deficits in decoding pictures of emotional mental states, this only refers to date to emotional mental states expressed in faces, voices, body postures, or eye gazes exclusively, in the absence of any other visual facilitatory cues. In fact, it is still unclear whether ADI could take advantage of information provided by the contextual scene in which the emotion occurs (background, environment, posture), which is frequently present in real-life situations and is known to impact the processing of emotional mental states. Specifically, congruent body posture, prosody, priming sentences, and background images are known to speed up and improve the processing of emotional facial expressions (e.g., Aviezer et al., 2012; De Gelder and Vroomen, 2000; Diéguez-Risco et al., 2015; Ito et al., 2013). Therefore, because preliminary studies indicated that ADI are impaired in identifying emotional body postures (e.g., Maurage et al., 2009) and do not take advantage of congruent prosody when decoding emotional facial expressions (e.g., impaired cross-modal integration) (Maurage et al., 2013a,b; Valmas et al., 2014), we sought to examine whether ADI have lower performances than control individuals (CI) in decoding the emotional states of individuals displayed in contextual scenes (e.g., facial expression of a person being threatened).

In addition to the processes involved in decoding others' emotions, one can also experience an affective response when witnessing someone expressing an emotion. This emotional response can be related to personal distress, emotion-sharing, or sympathy (de Vignemont and Singer, 2006) and is generally referred to as affective empathy, that is, "the capacity to experience affective reactions to the observed experiences of others or share a 'fellow feeling'" (Shamay-Tsoory, 2011, p. 18). One study showed that ADI and CI reported similar emotional responses (i.e., from very negative to very positive) to the facial expressions of basic emotions (Dethier and Blairy, 2012), thus suggesting that ADI and CI do not differ regarding the valence of their emotional responses to others' emotional states. Moreover, using self-evaluative questionnaires, previous studies (Amenta et al., 2013; Ferrari et al., 2014; Maurage et al., 2011b; Thoma et al., 2013) revealed contradictory findings concerning the compassion and personal distress of ADI in response to others' misfortune (i.e., either lower than or similar to CI). Thus, only a few studies have examined the emotional responses of ADI to others' states and have used only self-evaluative reports, which are known to be highly biased by self-perception. Moreover, the only experimental study on this question focused only on the valence of the emotional response. To overcome these limitations (i.e., self-reports, valence-focused evaluation), we evaluated experimentally the emotional responses of ADI to others' emotional states. Specifically, we focused on emotion-sharing, which is the tendency to experience others' emotional states and which has never been investigated in individuals suffering from alcohol dependence. Emotion-sharing is analogous to the conception of empathy suggested by de Vignemont and Singer (2006). In their opinion, empathy occurs when the emotional response is elicited and isomorphic to another person's affective state, together with the awareness that the other person is the source of one's own affective state. It also involves "emotional mirroring," which may be considered as an automatic/implicit form of affective empathy (Oliver et al., 2015).

We aimed to overcome the limitations of previous studies, particularly regarding their lack of ecological validity and their self-perception bias, by examining whether ADI and CI differ in their ability to decode and share the emotional states of individuals in daily life situations (i.e., expressed together with contextual cues). Furthermore, to disentangle the effect of alcohol dependence and confounding factors, we also examined the correlations between experimental results and age, education, depression, and anxiety, as they have a high prevalence in ADI (Gilman and Abraham, 2001) and modulate the decoding and emotional responses to others' states (Naranjo et al., 2011).

MATERIALS AND METHODS

Participants

Forty-six inpatients (19 women, 27 men) diagnosed with alcohol dependence according to DSM-IV criteria (American Psychiatric Association, 1994) were recruited in 3 detoxification centers (St Luc Hospital, Brussels, Belgium; Boulogne Sur Mer Hospital and Somain Hospital, France). Participants were tested during their third week of detoxification and had all been abstinent for at least 14 days. Participants were selected only if they did not present severe cognitive impairments (i.e., higher than 26 out of 30 on the Montreal Cognitive Assessment; Nasreddine et al., 2005). Based on this criterion, 5 patients were excluded from the analyses. The final ADI sample was thus composed of 41 inpatients (18 women, 23 men). All patients were free of any other psychiatric disorder (as assessed by an exhaustive psychiatric examination). Demographic and alcohol consumption characteristics are presented in Table 1. Patients were matched for age and gender with 51 (30 women, 21 men) CI who were free of any history of psychiatric disorder or drug/substance abuse (as assessed by an exhaustive psychiatric examination). Healthy participants were excluded from the analyses if they presented cognitive impairments (i.e., lower than 26 out of 30 on the Montreal Cognitive Assessment; Nasreddine et al., 2005), a clinical level of depression (i.e., score higher than 17 on the Beck Depression Inventory [BDI]), and/or any problematic alcohol consumption (maximum of 3 units of alcohol per day). Because 4 participants had scores higher than 17 on the BDI and 10 participants had a problematic consumption, the final CI sample was composed of 37 participants (24 women, 13 men). Exclusion criteria for both groups included major medical problems, neurological disease (including Korsakoff's syndrome, dementia, strokes, and epilepsy), visual impairment, serious chronic disease requiring medication, and polysubstance abuse (e.g., nicotine).

Table 1. Alcohol History, Demographic, Psychopathological, and Experimental Measures for Alcohol-Dependent (ADI) and Healthy Control (CI) Individuals: Mean (SD) [Range]

	ADI (n = 41)	CI (n = 37)
Alcohol consumption characteristics		
Number of previous detoxifications	3.55 (6.63) [0 to 30]	–
Duration of alcohol dependence (in years)	14.26 (10.67) [0.31 to 40]	–
Alcohol consumption per day (in alcohol units[a])*	33.33 (18.53) [9.71 to 97.14]	0.82 (0.80) [0.06 to 2.57]
Demographic measures		
Age[NS]	48.07 (9.85) [29 to 64]	48.07 (8.86) [27 to 65]
Gender ratio (female/male)[NS]	18/23	24/13
Educational level (primary/college/high school/higher education) **	1/9/13/18	0/0/4/43
Montreal Cognitive Assessment (MoCA)	27.51 (1.39) [26 to 30]	28.59 (0.90) [27 to 30]
Psychopathological measures		
Beck Depression Inventory (BDI) **	18.76 (8.93) [1 to 39]	5.35 (5.13) [0 to 16]
State and Trait Anxiety Inventory (STAI-B) **	48.36 (11.88) [22 to 70]	38.72 (7.99) [20 to 52]
Outcome measures		
Multifaceted Empathy Test-core		
Decoding: total score (%)**	64.63 (9.59) [43 to 80]	71.28 (8.11) [45 to 85]
Decoding: negative mental states (%)**	63.90 (12.58) [30 to 85]	72.30 (9.55) [50 to 90]
Decoding: positive mental states (%) *	65.37 (11.69) [50 to 90]	70.27 (9.35) [40 to 85]
Sharing: total score[NS]	6.70 (1.43) [3.48 to 8.85]	6.32 (1.33) [3.15 to 8.80]
Sharing: negative mental states[NS]	6.78 (1.45) [3.55 to 8.81]	6.24 (1.55) [2.55 to 9.00]
Sharing: positive mental states[NS]	6.62 (1.55) [2.70 to 9.00]	6.39 (1.25) [3.45 to 8.60]

[NS]Nonsignificant.
[a]A unit corresponding to 10 g of pure ethanol.
*$p < 0.05$, **$p < 0.001$.

Measures

Condensed and Revised Multifaceted Empathy Test (MET-Core; Edele et al., 2013). The MET is an ecological tool that measures the ability to decode affective mental states and affective sharing. During the task, photographs of people in an affective state are presented. The test includes 20 negative and 20 positive pictures of adults and children of both genders, mostly represented within a certain social context (Fig. 1). To assess abilities in decoding these mental states, each picture is presented with 4 labels. Participants are asked to select the label that best corresponds to the affective state depicted in the picture (e.g., serene, enthusiastic, curious, in love). To assess emotion-sharing, participants are asked to evaluate on a scale ranging from 0 (not at all) to 9 (strongly) whether they share the affective state of the person in the picture (e.g., how sad they feel in response to a person expressing sadness). The test started with 1 trial to familiarize participants with the task. Afterward, 8 blocks of 10 pictures were presented in a random order, which alternated between decoding and emotion-sharing. During the decoding subtask, participants received no feedback on their performance. Each picture was thus presented twice, once during the decoding block and once during the emotion-sharing block, in a random manner. The task was translated from German into French by 2 German–French bilingual researchers in psychology. The sensitivity of the MET has been supported by previous findings in fronto-temporal dementia characterized by social deficits (Oliver et al., 2015). Moreover, its predictive validity has also been established, as its emotion-sharing subtask predicted altruistic behaviors in a dictator game (Edele et al., 2013). In this task, 1 player, the dictator, owns a certain amount of money and proposes a certain percentage of it to the receiver. The amount of money offered by the dictator to the receiver is considered as a measure of altruistic behavior. Edele and colleagues (2013) showed that greater emotion-sharing (i.e., MET scores) was correlated with more altruistic offers.

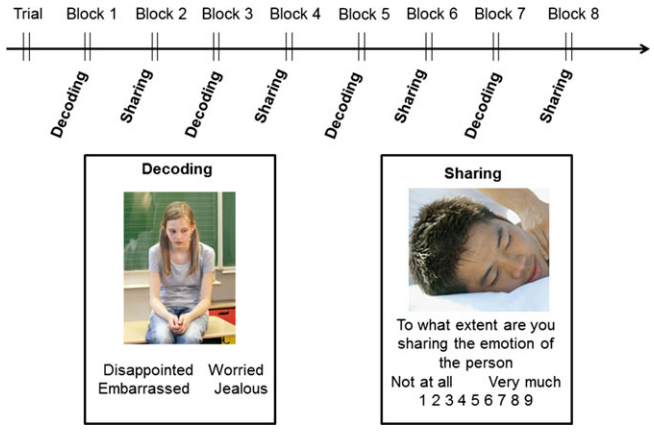

Fig. 1. Multifaceted Empathy Test procedure and alternating Decoding and Sharing blocks.

State and Trait Anxiety Inventory (STAI-T; Spielberger et al., 1983). The STAI-T includes 20 items measuring general level of anxiety (i.e., trait anxiety) on a 4-point Likert scale (e.g., "I feel nervous and agitated"). Higher scores indicate a higher anxiety level.

The 21-Item BDI (Beck, 1978). The BDI measures the level of current depressive symptoms. It includes 21 assertions for which participants are asked to choose from 4 possible options related to how they have felt over the past 2 weeks (scores ranging from 0 to 4) (e.g., "I am not particularly discouraged about the future"; "I feel discouraged about the future," "I feel I have nothing to look forward to," or "I feel the future is hopeless and that things cannot improve"). Higher scores indicate a higher level of depression.

Procedure

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 written informed consent and completed the questionnaires and the task without receiving compensation for their participation. The study was approved by

the Local Ethics Committees and was carried out according to the Declaration of Helsinki.

Data Analysis

Statistical analyses were performed using the SPSS software package (SPSS Inc., Chicago, IL). Group comparisons were based on ANOVA. Pearson correlations were used to investigate the association between age, education, duration of alcohol dependence, number of detoxifications, depression, anxiety, and MET responses (i.e., the average of emotion-sharing for positive and negative emotional states and the percentage of correct decoding responses). The significance level was set at $p < 0.05$.

RESULTS

Control Measures

As shown in Table 1, ADI and CI did not significantly differ in age, $F(1, 77) = 0.00$; $p = 1.00$, or gender ($\chi^2 = 3.44$; $p = 0.06$), but ADI had a lower educational level ($\chi^2 = 19.02$; $p < 0.001$). Furthermore, ADI showed higher scores than CI for depression, $F(1, 69) = 60.93$; $p < 0.001$, and trait anxiety, $F(1, 71) = 16.30$; $p < 0.001$.

Experimental Measures

MET-Core. Affective Mental State Decoding (Fig. 2)—ADI presented lower performances than CI when decoding affective mental states, $F(1, 77) = 10.80$; $p = 0.002$; Cohen's $d = 0.75$. When focusing on valence, ADI had lower performances for both positive, $F(1, 77) = 4.13$; $p = 0.046$; Cohen's $d = 0.46$, and negative mental states, $F(1, 77) = 10.85$; $p = 0.002$; Cohen's $d = 0.75$.

Emotion-Sharing—There was no group effect for emotion-sharing in general, $F(1, 77) = 1.51$; $p = 0.22$. Specifically, there was no group effect on positive, $F(1, 77) = 0.51$; $p = 0.48$, or negative mental states, $F(1, 77) = 2.54$; $p = 0.12$.

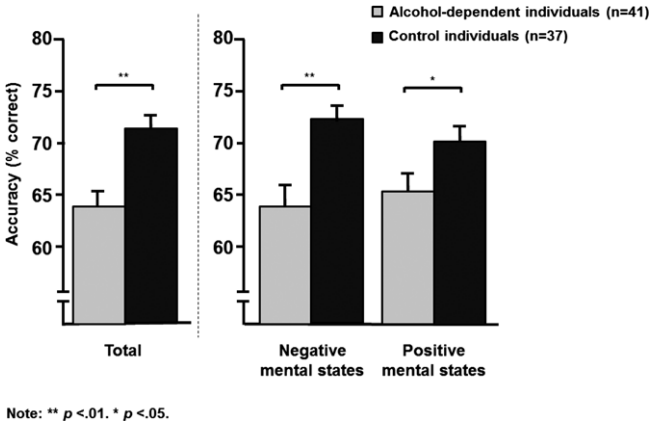

Fig. 2. Percentage (mean and SE) of accurate responses at the Multifaceted Empathy Test-core cognitive empathy task for total, positive, and negative affective states in alcohol-dependent and healthy control individuals. $^{**}p < 0.01$, $^{*}p < 0.05$.

Complementary Analyses. As several confounding variables could have influenced the results, Pearson correlations were computed between the control measures (group characteristics and psychopathological questionnaires) and the experimental results. Analyses revealed that there was no influence of education on the responses in CI (ps > 0.05). However, age was significantly correlated with reports of higher affective sharing ($r = 0.33$; $p = 0.045$). In ADI, there was no influence of age or education (ps > 0.08) or of the duration of alcohol dependence and number of detoxifications on the responses (ps > 0.25). However, alcohol consumption before detoxification was negatively correlated with affective sharing ($r = -0.38$; $p = 0.038$). Concerning the gender effect, the distribution of men and women was uneven: 65% of female CI and 44% of female ADI. While not significant ($p = 0.06$ by chi-square test), female ADI may have had better ability than male ADI to decode mental states. However, the results showed no gender effect for positive mental state, $F(1, 40) = 3.61$; $p = 0.07$, or negative mental state-decoding abilities, $F(1, 40) = 3.22$; $p = 0.08$, suggesting that female and male ADI did not differ in terms of their accuracy in decoding mental states. Furthermore, the performances of healthy women and healthy men were also compared and showed a similar pattern of results for positive, $F(1, 36) = 0.18$; $p = 0.68$, and negative mental state decoding, $F(1, 36) = 0.13$; $p = 0.72$. It can thus be concluded that the results do not seem to have been influenced by the uneven gender distribution between the groups. Finally, there was no significant correlation between the psychopathological measures (depression and anxiety) and the experimental results in the ADI group (ps > 0.37), except for a significant correlation between anxiety and affective sharing ($r = -0.39$; $p = 0.019$).

DISCUSSION

The present research used the MET-core to determine whether ADI are impaired in terms of affective mental state decoding and affective sharing. Compared to CI, ADI were impaired in accurately recognizing both negative and positive affective mental states. With respect to affective responses, ADI and CI reported the same level of affective sharing with the other's state, independently of its positive or negative valence.

Regarding decoding abilities, these results thus support our initial hypothesis that ADI present deficits in identifying affective mental states, even when a complementary social context is available. They thus agree with prior findings suggesting that ADI have impaired abilities in mentalizing affective mental states (Amenta et al., 2013; Maurage et al., 2016; Thoma et al., 2013) and lower performances in recognizing uncontextualized basic and complex emotional states (Maurage et al., 2008, 2011a; Nandrino et al., 2014) compared to CI. Specifically, the present study provides new information by showing that when participants have more visual information (i.e., not limited to eye gaze), ADI are still impaired

in recognizing the facial expressions of complex affective mental states. Furthermore, this deficit was also found to be present for positive affective mental states, supporting recent findings that ADI are impaired for both negative and positive items (Maurage et al., 2011a; Nandrino et al., 2014).

Importantly, these deficits were present despite contextual information being available such as body posture or situational information, which has been shown to facilitate (i.e., improve accuracy and reaction times) the processing of emotional facial expressions (e.g., Aviezer et al., 2012; Diéguez-Risco et al., 2015). With regard to alcohol dependence, these results are in line with previous findings that ADI have deficits in decoding emotional states expressed by postures (Maurage et al., 2009) and that they do not present a cross-modal facilitation effect (increased performance for congruent bimodal stimulations; i.e., emotional facial expression and prosody) compared to unimodal ones (e.g., Maurage et al., 2013a,b). Therefore, their impaired performances may result from deficits in (i) processing the complexity of affective mental states and/or (ii) integrating congruent contextual information. Indeed, although this study only presented contextualized complex affective mental states, it provides the first evidence that ADI may not be able to use contextual cues efficiently to compensate for their emotional decoding impairment. Future studies should thus examine whether ADI present similar impairments for affective mental states of high and low complexity depending on the contextual cues. For instance, one could manipulate the background by presenting affective mental states with either congruent or incongruent affective scenes (e.g., Ito et al., 2011). If ADI have difficulty in taking contextual information into account, they may present a reduced congruency effect (i.e., better performances with congruent than with incongruent information) compared to CI.

The reliability of the ADI impairments reported here is reinforced by the following: (i) the absence of a significant correlation between depression–anxiety levels and ADI decoding performances, thus excluding the explanation that this deficit is due to subclinical psychopathological comorbidities; (ii) the independence between decoding deficits and acute or recent alcohol consumption, as all the ADI had been abstinent for at least 14 days (Adinoff et al., 1991; Jesse et al., 2017; Volkow et al., 1994); (iii) the absence of significant correlations between impairment and demographic characteristics such as age, educational level, or alcohol-dependence characteristics; and (iv) the quite well-preserved cognitive abilities of ADI.

Regarding affective sharing, prior research on the emotional responses of ADI to others' emotions has revealed mixed results in terms of the valence of their emotional responses, empathic concern, and personal distress in response to others' misfortune (Dethier and Blairy, 2012; Maurage et al., 2011b, 2015; Thoma et al., 2013). The present results show that when participants were instructed to indicate whether they shared the emotional state of the person, ADI and CI did not differ. Although one could argue that these results (i.e., no effect on affective sharing) contradict previous ones, the present study used an experimental design to evaluate emotional responses in ADI, thus reducing the influence of recall bias, social desirability, and overestimation. Furthermore, while all these affective responses are generally gathered under the term "affective empathy," they do not refer to the same mechanisms. In fact, affective sharing as measured in the MET could rather refer to the definition of empathy of de Vignemont and Singer (2006) in which empathy is an isomorphic but regulated emotional response. Therefore, affective sharing differs from empathic concern and distress as the former is not an isomorphic response and the latter may not involve a self–other distinction. The dissociation between these emotional components has been tested by Oliver and colleagues (2015) who asked healthy and fronto-temporal dementia participants to what extent they were concerned by (empathic concern) and shared the emotion of another person depicted in a picture (affective sharing) and how positive/negative (valence) and calm/aroused (arousal) the picture made them feel. Their results revealed that for negative affective states, the groups differed in what they called "emotional mirroring" (i.e., affective sharing, arousal, and valence) but reported similar levels of empathic concern. Oliver and colleagues' (2015) study thus suggests that although they are gathered under the same qualifier, these different emotional responses may not measure the same mechanism. For example, emotional mirroring might consist of an automatic/implicit measure of affective empathy, while empathic concern could refer to a more conscious/explicit measure of affective empathy (Dziobek et al., 2008; Oliver et al., 2015). Therefore, the present study suggests that ADI may have preserved their automatic affective responses (e.g., affective sharing). This is also in line with Dethier and Blairy (2012) who found no difference between ADI and CI for valence ratings in response to emotional pictures. To examine the possible dissociation between automatic and conscious affective responses, future research should test experimentally whether these subdimensions of affective responses are impaired differently in ADI.

Although the present results need to be extended in future work, they already have several implications. First, the impaired decoding of complex emotional facial expressions observed here could play a role in the social disturbances reported in ADI (Kornreich et al., 2002; Maurage et al., 2009, 2011a). Furthermore, this deficit may also contribute to their interpersonal difficulties in real-life situations as we observed for the first time that contextual information does not improve their performances. However, the study did not measure interpersonal problems, so we still do not know whether decoding deficits are associated with interpersonal problems. Moreover, as this study was cross-sectional, it could not confirm whether the observed deficits preceded the

development of a drinking problem and/or whether they resulted from prolonged alcohol abuse. Longitudinal studies are thus necessary to disentangle these possibilities. Future studies should also consider the history of psychiatric disorders and polysubstance abuse in addition to current disorders as well as the effect of the duration of abstinence. In addition, the patients included in the present study were tested at the beginning of their treatment. Future studies should thus examine whether short durations of abstinence have a different impact from longer durations such as months or years, which are known to have beneficial effects on cognition and brain structures (e.g., Pfefferbaum et al., 1995; Rosenbloom et al., 2007). At the clinical level, this study underlines the importance of taking deficits in decoding others' mental states into account in the remediation of alcohol-related impairments. Second, it is the first to test experimentally the affective responses of ADI to others' states and to reveal their preserved emotional (implicit) sharing abilities. A limitation is that emotion-sharing abilities are measured independently of decoding accuracy in the regular MET procedure. To overcome it, we conducted additional analyses that revealed that the group effect for emotion-sharing remained nonsignificant for correctly identified positive and negative mental states ($ps > 0.38$).

In conclusion, this study offers a better understanding of the interpersonal abilities of ADI and provides food for thought regarding the rehabilitation of their emotional competences. It underlines the need to take the decoding deficits of ADI into account and to evaluate their role in the maintenance and relapse risks of alcohol dependence, for example, by proposing therapeutic programs specifically dedicated to improving decoding abilities.

CONFLICT OF INTEREST

No conflict declared.

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