



Research paper

Heterogeneity of emotional and interpersonal difficulties in alcohol-dependence: A cluster analytic approach

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ABSTRACT

Background: Emotional and interpersonal impairments have been largely reported in alcohol-dependence, and their role in its development and maintenance is widely established. However, earlier studies have exclusively focused on group comparisons between healthy controls and alcohol-dependent individuals, considering them as a homogeneous population. The variability of socio-emotional profiles in this disorder thus remains totally unexplored. The present study used a cluster analytic approach to explore the heterogeneity of affective and social disorders in alcohol-dependent individuals.

Methods: 296 recently-detoxified alcohol-dependent patients were first compared with 246 matched healthy controls regarding self-reported emotional (i.e. alexithymia) and social (i.e. interpersonal problems) difficulties. Then, a cluster analysis was performed, focusing on the alcohol-dependent sample, to explore the presence of differential patterns of socio-emotional deficits and their links with demographic, psychopathological and alcohol-related variables.

Results: The group comparison between alcohol-dependent individuals and controls clearly confirmed that emotional and interpersonal difficulties constitute a key factor in alcohol-dependence. However, the cluster analysis identified five subgroups of alcohol-dependent individuals, presenting distinct combinations of alexithymia and interpersonal problems ranging from a total absence of reported impairment to generalized socio-emotional difficulties.

Conclusions: Alcohol-dependent individuals should no more be considered as constituting a unitary group regarding their affective and interpersonal difficulties, but rather as a population encompassing a wide variety of socio-emotional profiles. Future experimental studies on emotional and social variables should thus go beyond mere group comparisons to explore this heterogeneity, and prevention programs proposing an individualized evaluation and rehabilitation of these deficits should be promoted.

1. Introduction

The deleterious long-term consequences of excessive alcohol consumption on brain and cognition have been documented for decades, and the development of neuroimaging and neuropsychological techniques has allowed to further establish that alcohol-dependence is primarily characterized by large-scale sub-cortical and cortical dysfunctions (Bühler and Mann, 2011), leading to reduced performances in a wide-range of perceptive, attentional, memory and executive abilities (Stavro et al., 2013). Besides these impairments in cerebral and cognitive functions, other lines of researches have revealed the intensity

of the emotional and interpersonal disturbances presented by alcohol-dependent patients (ADP).

On the one hand, the difficulties presented by ADP in the processing of their own emotional signals have been largely established, particularly in studies describing increased alexithymia in this population (Haviland et al., 1988, 1994; Taylor et al., 1990; Cecero and Holmstrom, 1997). Alexithymia, initially conceptualized by Sifneos (1973), is a multi-dimensional construct encompassing three dimensions: (1) a reduced ability to describe and communicate one's own feelings; (2) a difficulty to identify and differentiate one's own emotions, notably on the basis of body signals; (3) an externally-oriented

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thinking style characterized by poor fantasy and imagination. Several studies have described increased alexithymia in recently detoxified ADP (Taieb et al., 2002; Uzun et al., 2003 for review) and more than 50% of ADP can be considered as alexithymic (Evren et al., 2008). Despite ongoing controversies regarding the causal link between alcohol-dependence and alexithymia (Thorberg et al., 2009), the presence of alexithymic traits constitutes a stable personality factor among ADP (de Timary et al., 2008) and is related to increased expectations towards alcohol consumption (Thorberg et al., 2016), thus potentially favoring excessive alcohol use. As a whole, these difficulties to correctly identify, interpret and react to self-experienced emotional states stand as a major factor in alcohol-dependence, which might play a direct role in the development and persistence of uncontrolled alcohol use (Marlatt et al., 1975; Philippot et al., 1999).

On the other hand, difficulties in the identification and interpretation of others' social signals have also been documented, initially by measuring the ability to decode affective signals from others' face or voice (Kornreich et al., 2001; Monnot et al., 2002). These early studies, latterly complemented by works exploring various aspects of emotional interpretation (Donadon and Osório, 2014), have demonstrated that alcohol-dependence is related to an impaired ability in the decoding of others' emotions (D'Hondt et al., 2014). Recent studies have gone beyond these decoding deficits to explore social cognition in alcohol-dependence, identifying intense deficiencies in a large range of social abilities. ADP notably present: (1) maladaptive self-standards in interpersonal contexts, indexed by an overestimation of the interpersonal performance they have to present during social interactions to obtain the desired positive relational outcome (Maurage et al., 2013); (2) impaired empathic abilities, particularly regarding the emotional empathy subcomponent related to the ability to detect and experience others' emotional states in interpersonal situations (Maurage et al., 2011); (3) an inability to efficiently understand irony or humor in complex communicative situations (Amenta et al., 2013); (4) a deficient social-problem solving, i.e. a reduced ability to generate socially sensitive and practically effective answers to complicated social scenarios (Schmidt et al., 2016); (5) a reduced Theory of Mind, namely an impaired ability to infer mental states from others' social signals in order to predict their behaviors or actions (Maurage et al., 2016). The currently dominant proposal is thus that alcohol-dependence is related to a broad deficit in interpersonal stimuli processing, suggesting globally impaired social cognition (Uekermann and Daum, 2008; Thoma et al., 2013). These deficits initially observed in experimental tasks seem to have direct consequences in ADP's everyday life, as alcohol-dependence is related to reduced involvement in social groups and increased social isolation (Chou et al., 2011), weaker social networks (Thompson et al., 2010) and reduced satisfaction and intensity of real-life interactions (Levola et al., 2014). The importance of interpersonal problems in alcohol-dependence is even further illustrated by data showing that: (1) social network density after detoxification is a strong predictor of long-term abstinence (Kelly et al., 2012); (2) difficulties in social interactions is identified as a crucial relapse factor by recently detoxified patients themselves (Zywiak et al., 2003). In line with what has been described for emotional variables, interpersonal problems thus also constitute a key variable involved in the maintenance of alcohol-dependence.

However, despite the widely-established existence of emotional and interpersonal impairments in alcohol-dependence, and the presence of reliable arguments to propose that these deficits play a key role in the emergence and persistence of this disorder (Thoma et al., 2013; Donadon and Osório, 2014), two main limitations exist regarding earlier studies. First, emotional and social parameters have not been explored simultaneously. Second, previous studies have considered ADP as a unitary group. Indeed, nearly all previous works focusing on affective or social variables in ADP have been exclusively based on the comparison between alcohol-dependent and matched healthy control groups, the differences observed being unequivocally inter-

preted as reflecting global deficits related to alcohol-dependence. However, while socio-emotional impairments at the group level might reflect a coherent pattern of deficits in all ADP, the mere use of simple group comparisons might also have hidden differential profiles, some patients genuinely presenting strongly impaired socio-emotional abilities, while others would actually be unimpaired. The often quite small sample size presented by earlier studies did not allow an in-depth exploration of this possible variability across participants, casting doubts on the generalizability of the results. This proposal that the exclusive focus of earlier works on global group comparisons actually hid a massive heterogeneity across alcohol-dependent individuals is further reinforced by the fact that: (1) while, as underlined above, most studies have described impaired socio-emotional abilities in this population, some contradictory results have also been reported (see for example Donadon and Osório (2014) for a review of the inconsistent data reported for emotional decoding), suggesting an inter-individual variability in the alcohol-dependent population for emotional and interpersonal abilities, and particularly for alexithymia (e.g. Shishido et al., 2013; Thorberg et al., 2011); (2) strong variations have been reported in the general population and in other psychiatric states regarding these emotional and interpersonal functions (e.g., Rocca et al., 2016), clearly suggesting that a similar heterogeneity of socio-emotional profiles might be found in alcohol-dependence. In view of these arguments, it appears urgent to explore the presence and extent of this heterogeneity among ADP.

While no previous exploration has specifically explored this question, this proposal that previous studies might have veiled an important variability across ADP has been reinforced by a recent study exploring Theory of Mind in alcohol-dependence (Maurage et al., 2015). Indeed, these authors showed, using experimental tasks exploring social cognition, that while a strongly significant group effect was observed between ADP and matched controls (suggesting an intense Theory of Mind deficit in alcohol-dependence), less than half of the ADP actually presented a significant deficit when their performances were individually compared with the control group. These preliminary results thus suggest that an important variability might be present in alcohol-dependent populations, this variability usually being masked by the focus on group comparisons.

More globally, a strong complementary argument to underline the usefulness of exploring heterogeneity of socio-emotional factors in the alcohol-dependent population is offered by the numerous earlier typologies and classifications related to this pathological state, clearly underlining that alcohol-dependent patients are not a unitary group on a wide-range of variables. Indeed, starting from the early typology proposed by Jellinek (1960), which differentiated five types of risky alcohol consumers (mostly distinguished according to psychopharmacological factors like tolerance, craving and withdrawal symptoms), many researchers have determined subtypes of ADP. Each of these works focused on a specific combination of variables, encompassing family (e.g., familial alcoholism, childhood environment), demographic (e.g., gender, age, social status), alcohol-related (e.g., age of onset, consumption intensity), personality (e.g., dependent or borderline profiles), cognitive (e.g., impulsivity, intellectual level) or psychopathological (e.g., depression, psychopathy) factors. For example, Cloninger's (Cloninger et al., 1981) and Babor's (Babor et al., 1992) typologies proposed binary distinctions among ADP (Types I-II or A-B, respectively), mostly based on the age of onset, the presence of comorbid personality disorders and the intensity of behavioral control loss. Other classifications separated up to four subtypes (e.g., Del Boca and Hesselbrock, 1996; Lesch et al., 1988), by also taking into account cerebral consequences and depressive-anxious comorbidities. More recently, these classifications have been completed by biological ones, focusing on the determination of endophenotypes by means of combined genetic, neuroimaging and metabolic measures (e.g. Hines et al., 2005; Porjesz and Rangaswamy, 2007). This multimodal biological exploration of alcohol-dependence offers innovative perspectives but is

totally in line with the earlier clinical typologies described above, as it reinforces the proposal that alcohol-dependence is characterized by a massive heterogeneity. However, all these typologies did not explore emotional or interpersonal variability in alcohol-dependence, and did not include these variables as a classification factor. In order to complement earlier classifications, a specific focus on the heterogeneity presented by alcohol-dependent individuals for socio-emotional factors is thus still missing, despite it would potentially complete and enrich these previous typologies.

Our main aim was thus to offer the first direct insights regarding the heterogeneity of the socio-emotional difficulties in alcohol-dependence. In order to propose a joint evaluation of the emotional and interpersonal problems encountered by ADP in their everyday life, we decided to simultaneously use two self-reported measures, one exploring a key emotional variable related to the difficulty to identify and describe one's own emotions, namely alexithymia, and another exploring interpersonal problems (i.e. the extent of difficulties experienced when interacting with others). These two dimensions were explored using well-validated questionnaires, respectively the Twenty-item Toronto Alexithymia Scale-II (TAS-20, Bagby et al., 1994) and the Inventory of Interpersonal Problems (IIP, Horowitz et al., 1988). To precisely explore the role of these two theoretically distinct emotional and social factors in alcohol-dependence and to test the hypothesis of their differential involvement across various ADP's subgroups, we used a cluster analytic approach based on a large sample of recently detoxified patients. In view of preliminary evidence suggesting a variation of socio-emotional deficits in alcohol-dependence (Maurage et al., 2015), we hypothesized that the observed profile will strongly vary across ADP: some would report intense emotional and interpersonal difficulties (as generally reported in studies based on group comparisons) while others would only present difficulties for affective or social abilities, or even a total absence of experienced impairments.

2. Methods

2.1. Participants

The sample included 542 adults, namely 296 patients diagnosed with alcohol-dependence according to DSM-IV criteria (American Psychiatric Association, 2000) and 246 healthy controls (HC). Alcohol-dependence diagnosis was established during an exhaustive interview performed by a trained psychiatrist, which was also used to precisely determine medical history, alcohol consumption characteristics (number of previous detoxifications, alcohol consumption before detoxification in doses per day, duration of alcohol-dependence in years), and psychopathological comorbidities. ADP were recruited during their third week of detoxification (Saint-Luc Hospital, Brussels, Belgium) and had all abstained from alcohol for at least 14 days. They were free of psychotropic medication and of any other psychiatric diagnosis except nicotine dependence (explored by means of the Mini International Neuropsychiatric Interview [MINI]; Sheehan et al., 1998). HC were recruited among the hospital staff, among the relations of the investigators or through the "participant pool" of the Faculty of Psychology (Université catholique de Louvain), containing several hundreds of healthy participants presenting a wide range of demographic characteristics and whom agree to take part in psychological experiments. Variables used for matching were gender and age. Education level was assessed according to the number of years of education completed since starting primary school. Due to missing data for some participants, the sample size finally included in the analyses slightly varied across demographic, alcohol-related and psychological (i.e. anxiety and depression, see "Section 2.2") variables. Participants provided written informed consent to take part in the study, which was approved by the Ethical Committee of the Medical School (Université catholique de Louvain) and carried out according to the Declaration of Helsinki, as revised in 2008.

2.2. Procedure and materials

Validated self-completion questionnaires were used to assess:

- *Depressive state*, using the Beck Depression Inventory (BDI, Beck and Steer, 1987), measuring the level of current depressive symptoms. This questionnaire includes 21 assertions for which participants have to choose among four possible options related to how they felt over the past two weeks (scores range for each item: 0–4) Higher scores indicate higher levels of depressive symptoms.
- *Trait anxiety*, using the trait subscale of the State and Trait Anxiety Inventory (STAI, Spielberger et al., 1983), measuring the general presence of anxiety symptoms. This questionnaire includes 20 items with a 4-point Likert scale. Higher scores indicate higher level of anxious symptoms.
- *Emotional abilities and alexithymia*, using the TAS-20 (Bagby et al., 1994), measuring three dimensions related to intrapersonal emotion processing, namely the difficulty to describe one's own emotions, the difficulty to identify one's own emotions and the externally-oriented way of thinking. This questionnaire is the most widely used to assess alexithymia and consists of 20 items for which participants are asked to indicate their level of agreement on a five-point Likert scale. A score is computed for each dimension by averaging the participants' responses to associated items and a total score is also computed by averaging the participants' responses to the 20 items. Higher scores correspond to higher alexithymia and emotional problems. The present study used a validated French translation of the scale (Cronbach's $\alpha = .79$; Loas et al., 1995).
- *Interpersonal problems*, using the IIP (Horowitz et al., 1988), measuring the difficulties encountered in interpersonal relations. This questionnaire includes 127 items that participants have to rate on a four-point Likert scale ranging from 1 ("this problem does not apply to me at all") to 4 ("this problem totally applies to me"). The questionnaire has two sections: The first 78 items begin with the sentence "it is difficult for me to...". The other 49 items evaluate the behaviors "that the participant uses too much". This questionnaire contains six subscales, respectively related to difficulties in assertiveness/self-confidence (21 items), sociability (18 items), submissiveness to others (10 items), intimacy (capacity to establish and maintain intimate relations, 12 items), responsibility (excessive feeling of responsibility or culpability, 12 items), and controlling (being too controlling towards others, 10 items). A score is computed for each of the six subscales, by averaging the participants' responses to associated items. A total score is also computed by averaging the participants' responses to the 127 items. Higher scores correspond to more interpersonal problems. The present study used a French translation of the scale (Nef & Simon, unpublished data).

2.3. Data analysis

Analyzes were performed using IBM-SPSS Statistics (Version 23.0, IBM Corp., Armonk, NY). First, independent-samples *t*-test explored differences in demographic (age, educational level, gender), psychological (depression, trait-anxiety) and socio-emotional (subscales and total scores for TAS-20 and IIP) variables between ADP and HC. Second, data clustering techniques were used to identify subgroups of ADP. Data grouping was achieved through a combination of hierarchical and nonhierarchical procedures (Hair et al., 2010): optimal clustering solution was found using a hierarchical analysis employing Ward's method with a squared Euclidean distance measure; cluster membership was then determined through subsequent nonhierarchical K-means analysis. Subgroups of ADP were identified in consideration of two types of highly prevalent socio-emotional difficulties: alexithymia (three TAS-20 subscales' scores) and interpersonal problems (six IIP subscales' scores). Before being included in the analysis, TAS-20 and IIP

scores were Z-scored (to have the same metric properties). Furthermore, as collinear variables have a higher impact on the cluster creation process, which may lead to spurious grouping solutions (Hair et al., 2010), variance inflation factors (VIF) were calculated for each variable prior to cluster analysis. VIF, which indexes the severity of multicollinearity, can be obtained by performing linear regressions of each variable on all the other variables. All VIF were lower than 2.685, which constitute acceptable levels according to the literature (Hair et al., 2010). Third, we constituted one control group for each ADP cluster by pseudo-randomly assigning HC to one of the five control groups, so that they did not significantly differ from ADP clusters or between them regarding age or gender. Then, independent-samples *t*-tests were performed to assess differences in psychological (depression, trait-anxiety) and socio-emotional variables (subscales and total scores for TAS-20 and IIP) between ADP from each obtained cluster and its associated HC group. We also explored the differences across HC groups for each of these variables using analyses of variance (one-way ANOVAs). Finally, the ADP clusters were compared on the basis of alexithymia, interpersonal problems and external correlates (demographic, alcohol consumption, psychological variables) using analyses of variance (one-way ANOVAs). Post-hoc pairwise comparisons (corrected for multiple comparisons using the Bonferroni procedure) were performed in case of significant differences yielded by ANOVAs. Gender differences were also assessed using chi-square analyses.

3. Results

3.1. Comparison between ADP total sample and HC

One-way ANOVAs revealed statistically significant group differences for all measures except age and gender (Table 1). As compared to HC, ADP had lower educational level, but higher depression and trait anxiety. ADP also reported higher alexithymia and interpersonal problems (with higher scores for each subscale) than HC, confirming the global intensity of socio-emotional problems in this population when considered as a unitary group.

3.2. Cluster analysis on ADP

Results from the hierarchical cluster analysis indicated an optimal five-factor solution, illustrated in Fig. 1. The five clusters respectively

encompassed 18.92%, 24.66%, 10.81%, 24.32%, and 21.28% of the sample, each cluster being beyond the recommended 10% threshold (Hair et al., 2010) and presenting specific characteristics: Cluster 1 ("socio-emotionally self-unregulated ADP") combined emotional and social self-reported deficits, as it was centrally characterized by high impairment in identifying and describing feelings, together with significant difficulties to be assertive and sociable, as well as with an excessive feeling of responsibility or culpability towards others. Cluster 2 ("socially dominant ADP") did not report strong emotional difficulties but was associated with intense difficulties to accept other's authority or constraints, and with a tendency to be too controlling towards others. Cluster 3 ("socio-emotionally unregulated ADP") presented moderate intensity of difficulties in describing feelings and externally oriented thinking, but was crucially related to large-scale interpersonal problems encompassing every subscale. Conversely, Cluster 4 ("socio-emotionally regulated") did not report any significant difficulty, presenting low scores for every emotional and interpersonal variable. Finally, Cluster 5 ("alexithymic ADP") did not report intense interpersonal problems but was characterized by strong alexithymic traits.

3.3. Comparison between ADP clusters and HC subgroups

Two hundred and twenty from the 246 HC were pseudo-randomly assigned to one of the 5 HC groups that were constituted to allow comparison with the 5 ADP clusters. HC groups did not differ between each other regarding socio-emotional variables or external correlates (see Supplementary Table). Fig. 2 illustrates significant differences between ADP clusters and HC groups in emotional (subscales and total scores for TAS-20; Fig. 2A) and social (subscales and total scores for IIP; Fig. 2B) variables.

3.3.1. ADP cluster 1 vs HC group 1

Regarding emotional variables, independent-sample *t*-tests revealed that ADP had significantly higher alexithymia total scores than HC [$t(100)=4.673, p < .001$]. They reported more difficulty in describing emotions [$t(100)=6.401, p < .001$] and difficulty in identifying emotions [$t(100)=2.466, p = .016$] but did not differ from HC in externally-oriented thinking [$t(100)=.376, p = .708$]. Regarding interpersonal problems, independent-sample *t*-tests revealed that ADP had significantly higher interpersonal problems' total scores [$t(100)=12.876, p < .001$]. ADP had also significantly higher scores than HC in each IIP

Table 1

Comparisons between alcohol-dependent patients (ADP) and healthy controls (HC) on demographic, psychological and socio-emotional variables: Mean (S.D.) [Range].

	ADP (N = 296)	HC (N = 246)	Group comparison
Age (in years)	48.70 (10.92) [18–75]	47.17 (11.55) [21–75]	$t(539) = 1.580^{ns}$
Gender (men/women)	(216/105)	(173/110)	$X^2(1, N = 539) = 3.116^{ns}$
Education level (in years)	13.75 (3.29) [6–23]	14.86 (2.90) [6–27]	$t(508) = 4.022^*$
Beck Depression Inventory	10.28 (7.73) [0–46]	2.92 (3.66) [0–29]	$t(436) = 14.515^*$
Trait Anxiety Inventory	48.71 (11.95) [22–75]	36.76 (9.97) [20–67]	$t(538) = 12.669^*$
<i>Toronto Alexithymia Scale (TAS-20)</i>			
Difficulty Describing Emotions	18.60 (5.57) [6–35]	13.72 (5.02) [7–30]	$t(540) = 10.629^*$
Difficulty Identifying Emotions	15.20 (4.14) [5–28]	13.72 (5.02) [1–24]	$t(540) = 5.248^*$
Externally-Oriented Thinking	19.09 (4.78) [7–33]	17.39 (4.31) [1–24]	$t(540) = 4.295^*$
Total score	52.95 (10.58) [20–83]	44.46 (10.13) [24–77]	$t(540) = 9.475^*$
<i>Inventory of interpersonal problems (IIP)</i>			
Assertiveness	1.63 (.66) [0–3.52]	1.26 (.69) [0–3.50]	$t(540) = 6.321^*$
Sociability	1.55 (.70) [0–3.94]	1.08 (.73) [0–3.89]	$t(540) = 7.744^*$
Submissiveness	1.48 (.69) [0–3.50]	.95 (.64) [0–3.50]	$t(540) = 9.142^*$
Intimacy	1.44 (.87) [0–3.50]	.88 (.73) [0–3.50]	$t(540) = 8.173^*$
Responsibility	1.83 (.73) [0–3.92]	1.18 (.71) [0–3.50]	$t(540) = 10.478^*$
Controlling	1.15 (.62) [0–3.40]	.72 (.57) [0–3.50]	$t(540) = 8.346^*$
Total score	1.50 (.55) [0.06–2.95]	1.02 (.57) [0–3.47]	$t(540) = 10.084^*$

^{ns} = Non-significant.
* $p < .001$.



Fig. 1. Subgroups of alcohol-dependent patients determined by cluster analysis according to self-reported measures of emotional (TAS-20, alexithymia: difficulties in describing emotions; difficulties in identifying emotions; externally-oriented thinking) and interpersonal (IIP, interpersonal problems: difficulties in assertiveness, sociability, submissiveness, intimacy, responsibility and control of others) impairments.

subscale: difficulties in assertiveness [t(100)=7.546, p < .001], sociability [t(100)=10.055, p < .001], submissiveness [t(100)=6.393, p < .001], intimacy [t(100)=10.536, p < .001], responsibility [t(100)=10.536, p < .001] and excessive controlling [t(100)=10.782, p < .001]. Groups did not differ regarding age [t(100)=.158, p = .875],

educational level [t(95)=1.103, p = .196] or gender [$\chi^2(1, N=101) = .175, p = .675$]. Regarding psychological variables, independent-sample t-tests revealed that ADP had significantly higher depression [t(100)=7.533, p < .001] and anxiety [t(100)=8.475, p < .001] levels than HC.

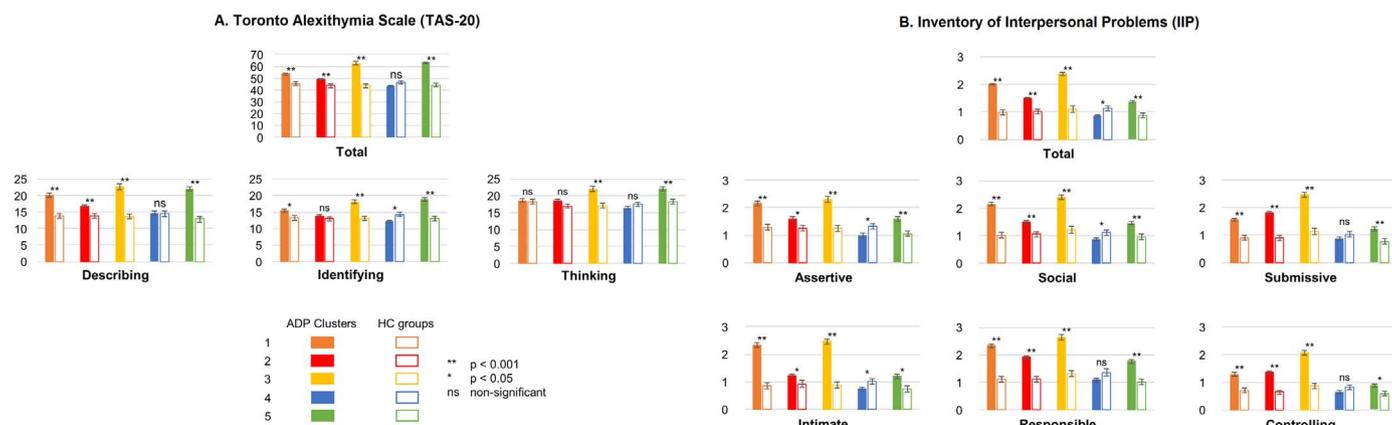


Fig. 2. Comparison between each of the five alcohol-dependent clusters and each matched healthy control group regarding total score and subscales on emotional (TAS-20) and interpersonal (IIP) measures.

3.3.2. ADP cluster 2 vs HC group 2

Regarding emotional variables, independent-sample *t*-tests revealed that ADP had significantly higher alexithymia total scores [$t(119) = 3.273, p = .002$] and reported more difficulty in describing emotions [$t(119) = 3.494, p = .001$] than HC. However, groups did not differ in difficulty in identifying emotions [$t(119) = 1.302, p = .195$] and in externally-oriented thinking [$t(119) = 1.877, p = .063$]. Regarding interpersonal problems, independent-sample *t*-tests revealed that ADP had significantly higher interpersonal problems' total scores [$t(119) = 5.581, p < .001$] than HC. ADP had also significantly higher scores than HC in each IIP subscale: difficulties in assertiveness [$t(119) = 2.889, p = .005$], sociability [$t(119) = 3.730, p < .001$], submissiveness [$t(119) = 8.171, p < .001$], intimacy [$t(119) = 2.261, p = .027$], responsibility [$t(119) = 7.222, p < .001$] and excessive controlling [$t(119) = 8.024, p < .001$]. Groups did not differ regarding age [$t(119) = .819, p = .414$], educational level [$t(119) = 1.266, p = .208$] or gender [$\chi^2(1, N = 118) = 3.467, p = .063$]. Regarding psychological variables, independent-sample *t*-tests revealed that ADP had significantly higher depression [$t(109) = 9.897, p < .001$] and anxiety [$t(119) = 6.271, p < .001$] levels than HC.

3.3.3. ADP cluster 3 vs HC group 3

Regarding emotional variables, independent-sample *t*-tests revealed that ADP had significantly higher alexithymia total scores than HC [$t(71) = 8.456, p < .001$]. ADP had also higher scores than HC in each TAS-20 subscale: difficulty in describing emotions [$t(71) = 7.778, p < .001$], difficulty in identifying emotions [$t(71) = 5.445, p < .001$] and externally-oriented thinking [$t(71) = 4.707, p < .001$]. Regarding interpersonal problems, independent-sample *t*-tests revealed that ADP had significantly higher interpersonal problems' total scores than HC [$t(71) = 10.707, p < .001$]. ADP had also significantly higher scores than HC in each IIP subscale: difficulties in assertiveness [$t(71) = 6.829, p < .001$], sociability [$t(71) = 7.253, p < .001$], submissiveness [$t(71) = 8.171, p < .001$], intimacy [$t(71) = 2.261, p < .001$], responsibility [$t(71) = 9.274, p < .001$] and excessive controlling [$t(71) = 10.292, p < .001$]. Groups did not differ regarding age [$t(71) = .192, p = .848$], educational level [$t(68) = 1.783, p = .079$] or gender [$\chi^2(1, N = 73) = 2.120, p = .145$]. Regarding psychological variables, independent-sample *t*-tests revealed that ADP had significantly higher depression [$t(71) = 8.347, p < .001$] and anxiety [$t(71) = 10.154, p < .001$] levels than HC.

3.3.4. ADP cluster 4 vs HC group 4

Regarding emotional variables, there were no significant group differences either on alexithymia total score [$t(116) = 1.870, p = .064$] or difficulty in describing emotions [$t(116) = .189, p = .850$] or externally-oriented thinking [$t(116) = 1.362, p = .176$]. However, ADP re-

ported significantly less difficulty than HC in identifying emotions [$t(116) = 3.021, p = .003$]. Regarding interpersonal problems, independent-sample *t*-tests revealed that ADP had significantly lower interpersonal problems' total scores [$t(116) = 2.862, p = .009$] than HC. ADP reported less difficulties in assertiveness [$t(116) = 2.949, p = .004$], sociability [$t(116) = 2.111, p = .030$], intimacy [$t(116) = 2.214, p = .030$]. However, groups did not differ on difficulties in submissiveness [$t(116) = 1.419, p = .158$], responsibility [$t(116) = 1.984, p = .051$] and excessive controlling [$t(116) = 1.764, p = .080$] subscales. Groups did not differ regarding age [$t(115) = 1.212, p = .228$], educational level [$t(107) = 1.452, p = .150$] or gender [$\chi^2(1, N = 118) = .155, p = .694$]. Regarding psychological variables, independent-sample *t*-tests revealed that ADP had significantly higher depression levels than HC [$t(116) = 3.216, p = .002$] but groups did not differ for anxiety [$t(116) = 1.766, p = .080$].

3.3.5. ADP cluster 5 vs HC group 5

Regarding emotional variables, independent-sample *t*-tests revealed that ADP had significantly higher alexithymia total scores than HC [$t(100) = 10.462, p < .001$]. ADP had also higher scores than HC in each TAS-20 subscale: difficulty in describing emotions [$t(100) = 8.762, p < .001$], difficulty in identifying emotions [$t(100) = 6.945, p < .001$] and externally-oriented thinking [$t(100) = 4.305, p < .001$]. Regarding interpersonal problems, independent-sample *t*-tests revealed that ADP had significantly higher interpersonal problems' total scores than HC [$t(100) = 5.672, p < .001$]. ADP had also significantly higher scores than HC in each IIP subscale: difficulties in assertiveness [$t(100) = 4.616, p < .001$], sociability [$t(100) = 3.918, p < .001$], submissiveness [$t(100) = 4.301, p < .001$], intimacy [$t(100) = 3.359, p < .001$], responsibility [$t(71) = 6.374, p < .001$] and excessive controlling [$t(100) = 2.878, p = .005$]. Groups did not differ regarding age [$t(100) = .188, p = .851$], educational level [$t(95) = 1.488, p = .140$] or gender [$\chi^2(1, N = 101) = .422, p = .516$]. Regarding psychological variables, independent-sample *t*-tests revealed that ADP had significantly higher depression [$t(100) = 6.296, p < .001$] and anxiety [$t(98) = 4.757, p < .001$] levels than HC.

3.4. Comparisons across ADP clusters

Descriptive statistics for each cluster and the differences between clusters for socioemotional variables (alexithymia, interpersonal problems) and external correlates are reported in Table 2.

3.4.1. Socioemotional variables

Analyses revealed a significant effect of cluster membership for alexithymia and interpersonal problems' total scores. Concerning alexithymia, significant differences between clusters was evidenced,

Table 2
Descriptive statistics and mean comparisons between the five clusters regarding the variables used for clustering (i.e. alexithymia and inventory of interpersonal problems) and the external correlates: Mean (S.D.) [Range].

	Cluster 1 (N = 56, 18.92%)	Cluster 2 (N = 73, 24.66%)	Cluster 3 (N = 32, 10.81%)	Cluster 4 (N = 72, 24.32%)	Cluster 5 (N = 63, 21.28%)	Cluster comparison
Cluster profilenk						
<i>Toronto Alexithymia Scale (TAS-20)</i>						
Difficulty Describing Emotions	20.11 (4.92) [9–30] ^{2,4}	16.70 (4.20) [9–30] ^{1,3,5}	22.59 (4.81) [15–31] ^{2,4}	14.65 (4.62) [6–26] ^{1,3,5}	21.95 (5.04) [11–35] ^{2,4}	F(4,291) = 31.020**
Difficulty Identifying Emotions	15.27 (3.40) [8–24] ^{3,4,5}	13.71 (3.22) [5–21] ^{3,4,5}	18.06 (3.70) [9–27] ^{1,2,4}	12.15 (3.13) [5–18] ^{1,2,3,5}	18.90 (3.09) [13–28] ^{1,2,4}	F(4,291) = 45.984**
Externally-Oriented Thinking	18.48 (4.23) [9–28] ^{3,5}	18.38 (3.73) [9–26] ^{3,4,5}	21.97 (4.42) [14–33] ^{1,2,4}	16.38 (4.67) [7–29] ^{2,3,5}	22.08 (4.35) [14–32] ^{1,2,4}	F(4,291) = 19.394**
Total score	53.68 (7.07) [37–71] ^{2,3,4,5}	49.00 (6.08) [36–64] ^{1,3,4,5}	62.63 (8.32) [41–83] ^{1,2,4}	43.19 (8.11) [20–58] ^{1,2,3,5}	63.10 (7.31) [52–80] ^{1,2,4}	F(4,291) = 81.927**
<i>Inventory of interpersonal problems (IIP)</i>						
Assertiveness	2.15 (4.40) [1.38–3.14] ^{2,4,5}	1.60 (4.43) [1.38–2.67] ^{1,3,4}	2.30 (5.56) [1.14–3.52] ^{2,4,5}	.97 (4.50) [0–2.52] ^{1,2,3,5}	1.59 (5.56) [1.24–2.80] ^{1,3,4}	F(4,291) = 64.456**
Sociability	2.15 (5.53) [1.17–3.94] ^{2,4,5}	1.48 (4.47) [1.44–2.70] ^{1,3,4}	2.39 (5.53) [1.78–3.67] ^{2,4,5}	.86 (4.43) [0–1.89] ^{1,2,3,5}	1.45 (4.46) [1.61–2.39] ^{1,3,4}	F(4,291) = 85.543**
Submissiveness	1.56 (4.48) [1.60–3.1] ^{3,4,5}	1.80 (4.48) [1–3.20] ^{3,4,5}	2.46 (5.53) [1.40–3.50] ^{1,2,4,5}	.87 (4.48) [0–2.1] ^{1,2,3,5}	1.23 (5.51) [1.20–2.60] ^{1,2,3,4}	F(4,291) = 71.914**
Intimacy	2.33 (7.70) [1.50–3.42] ^{2,4,5}	1.23 (5.50) [1.33–2.17] ^{1,3,4}	2.46 (6.60) [1.08–3.50] ^{2,4,5}	.74 (5.54) [0–2.67] ^{1,2,3,5}	1.19 (6.64) [0–2.58] ^{1,3,4}	F(4,291) = 85.030**
Responsibility	2.33 (5.52) [1.33–3.83] ^{2,4,5}	1.91 (4.47) [1.33–3.08] ^{1,3,4}	2.63 (5.56) [1.67–3.92] ^{2,4,5}	1.09 (5.58) [0–2.58] ^{1,2,3,5}	1.77 (5.56) [1.33–3.08] ^{1,3,4}	F(4,291) = 64.759**
Controlling	1.28 (4.47) [1.40–2.50] ^{3,4,5}	1.37 (4.48) [1.50–3.10] ^{3,4,5}	2.07 (5.50) [1.30–3.40] ^{1,2,4,5}	.65 (4.40) [0–1.70] ^{1,2,3,5}	.88 (4.43) [0–1.90] ^{1,2,3,4}	F(4,291) = 66.406**
Total score	1.99 (2.21) [1.59–2.50] ^{2,3,4,5}	1.49 (2.22) [1.94–1.84] ^{1,3,4}	2.37 (3.36) [1.64–2.95] ^{1,2,4,5}	.87 (3.31) [0.6–1.55] ^{1,2,3,5}	1.37 (2.29) [1.54–1.86] ^{1,3,4}	F(4,291) = 222.184**
External Correlates						
Age (in years)	48.73 (9.75) [27–68]	49.55 (9.29) [27–71]	46.71 (11.29) [18–68]	50.23 (11.07) [24–74]	47.00 (13.05) [22–75]	F(4,290) = 1.107 ^{ns}
Education level (in years)	13.92 (3.28) [6–20]	14.17 (3.72) [6–23]	12.17 (3.24) [6–20]	14.21 (3.00) [6–20]	13.45 (2.97) [6–20]	F(4,259) = 2.434
Gender (% of total sample, M/W)	15.00/26.88	27.00/19.35	10.00/12.90	28.50/16.13	19.50/24.73	χ^2 (4,N = 293) = 11.549*
Previous detoxifications	2.31 (3.11) [0–12]	1.78 (2.40) [0–14]	1.67 (2.15) [0–8]	2.03 (3.12) [0–15]	1.68 (2.17) [0–10]	F(4,170) = .349 ^{ns}
Alcohol consumption (doses/day)	17.26 (8.01) [3–40]	19.55 (14.00) [6–80]	21.42 (17.52) [4–74]	16.83 (11.65) [4–50]	20.29 (12.46) [5–60]	F(4,185) = 7.45 ^{ns}
Years of alcohol-dependence	10.45 (8.73) [1.50–31]	13.42 (11.24) [0–42]	9.19 (9.38) [0–32]	12.65 (11.30) [1.50–51]	11.74 (11.38) [0–39]	F(4,170) = .809 ^{ns}
Beck Depression Inventory	12.14 (8.25) [1–46] ⁴	10.10 (6.58) [0–29] ^{3,4}	15.97 (8.62) [1–39] ^{2,4,5}	5.94 (4.50) [0–17] ^{1,2,3,5}	10.89 (8.42) [0–38] ^{3,4}	F(4,290) = 12.649**
Trait Anxiety Inventory	53.59 (10.37) [31–75] ⁴	49.38 (10.21) [29–74] ^{3,4}	57.59 (9.74) [36–75] ^{2,4,5}	40.81 (11.62) [22–70] ^{1,2,3,5}	48.10 (11.17) [23–74] ^{3,4}	F(4,289) = 18.163**

^{ns} = Non-significant;

* p < .05 ;

** p < .001 ;

¹ Statistically different from Cluster 1 (p < .05);

² Statistically different from Cluster 2 (p < .05);

³ Statistically different from Cluster 3 (p < .05);

⁴ Statistically different from Cluster 4 (p < .05);

⁵ Statistically different from Cluster 5 (p < .05).

with Clusters 3 and 5 (non-significantly different from each other) showing the highest scores followed by Clusters 1, 2, and 4. Actually, considering TAS-20 normative cutoffs (Bagby et al., 1994), ADP from Clusters 3 and 5 showed alexithymia, those from Cluster 1 presented possible alexithymia, while individuals from Clusters 2 and 4 did not present alexithymia. Regarding interpersonal problems, Cluster 3 showed the highest score, followed by Clusters 1, 2, 5 and 4 (Cluster 2 and 5 being non-significantly different from each other). Significant effects of cluster membership were also found for each alexithymia and interpersonal problems' subscales: Cluster 1 was mainly characterized by high values in assertiveness, sociability, intimacy and responsibility difficulties as well as in difficulty in describing emotions, Cluster 2 by moderate emotional disturbances but high values in submissiveness difficulties and excessive controlling, Cluster 3 by high values for every interpersonal problems' and alexithymia subscales, Cluster 4 by low values for every interpersonal problems and alexithymia subscales, and Cluster 5 by moderate interpersonal problems values but high values for every alexithymia subscale.

3.4.2. External correlates

Analyses revealed significant differences for educational level, gender, anxiety and depression, but not for age and alcohol-related variables. Regarding educational level and gender, post-hoc comparisons did not reveal any significant difference between Clusters. Concerning depression, mean BDI scores suggested that ADP presented minimal to mild depression levels, with particularly lower values for Cluster 4 than other clusters, intermediate values for Clusters 1, 2, and 5, and slightly higher values for Cluster 3 (the mean BDI score indicating mild depression only in this subgroup). Concerning anxiety, mean STAI scores suggested that ADP presented low to elevated anxiety levels, group comparisons suggesting lower anxiety for Cluster 4 in comparison to other clusters while individuals from Cluster 3 were the most anxious, all other subgroups presenting moderate anxiety.

4. Discussion

This study centrally aimed at investigating the presence of differential socio-emotional profiles in a population of recently detoxified alcohol-dependent individuals. More precisely, we wanted to determine whether a cluster analytic approach on a large group of patients would allow to distinguish distinct subgroups according to combined alexithymia (a measure of one's own emotion handling difficulties) and interpersonal problems measures. Before conducting cluster analysis, we checked that the instruments selected to evaluate emotions and interpersonal difficulties were clearly distinct, which was confirmed by the low variance inflation factors when testing the colinearity of alexithymia and interpersonal problem measures. We were then in appropriate conditions to implement cluster analysis, allowing to go beyond the classical diagnosis-based group comparison by using a data-driven approach which leads to the creation of subgroups presenting homogeneous profiles on the explored variables. From a sample of 296 recently detoxified alcohol-dependents, we identified five clusters showing specific patterns of emotional and interpersonal difficulties. These results centrally suggest that the alcohol-dependent population is heterogeneous regarding socio-affective problems, and that the classical group comparison approach can be misleading and should be systematically completed by subgroup explorations.

Our initial analysis, based on the classical group comparison between ADP and age- and gender-matched controls, confirmed the results provided by numerous earlier studies: on the one hand, alcohol-dependence is related to a strong presence of alexithymic traits, as measured by the TAS-20. When considered as a unitary group, recently detoxified ADP thus present increased alexithymia, which is in line with previous studies (Taieb et al., 2002; Uzun et al., 2003) and supports the proposal of a reliable link between alexithymia and excessive alcohol consumption (Cleland et al., 2005). This link is significantly found for

the total score of the TAS-20, but also for the three subscales, showing that emotional difficulties in ADP encompass the identification of personal feelings, their description, but also an externally-oriented thinking mode neglecting inner emotional states and sensations. On the other hand, the interpersonal problems associated with alcohol-dependence appear intense and generalized, as ADP report significantly more difficulties in their social interactions. These reports are in line with earlier results suggesting strongly deficient social cognition in this population (Uekermann and Daum, 2008; Thoma et al., 2013) as well as difficulties in real-life interactions (Chou et al., 2011; Levola et al., 2014) which might play a critical role in relapse (Zywiak et al., 2003). As a whole, these first analyses confirmed and extended on a larger sample the results repeatedly described earlier: group comparisons show that socio-emotional difficulties are at the heart of alcohol-dependence, thus confirming the pertinence of the variables measured in the present study. However, while earlier works limited their data exploration to this first step related to group comparison, our cluster analysis allowed to go further and to explore the variability among ADP profiles, leading to an in-depth reinterpretation of these general results.

Indeed, cluster analytic approach led to the identification of five distinct clusters in our alcohol-dependent sample, characterized by various combinations of socio-emotional factors. A dissociation between emotional and interpersonal problems was observed in two clusters, as Cluster 5 ("alexithymic ADP") was characterized by intense alexithymic traits with limited reported interpersonal problems compared to other clusters, while Cluster 2 ("socially dominant ADP") was conversely associated with intense interpersonal problems but moderate emotional disturbances. Two clusters presented a combination of socio-emotional impairments: Cluster 1 ("socio-emotionally self-unregulated ADP") combined difficulties in describing feelings with impaired assertiveness, sociability, intimacy and increased culpability, and Cluster 3 ("socio-emotionally unregulated ADP") presented generalized interpersonal problems joined to intense alexithymic traits. Finally, Cluster 4 ("socio-emotionally regulated") reported a total absence of emotional or interpersonal problems. This heterogeneity in clusters' characteristics undoubtedly show that alcohol-dependence is far to be a homogeneous group regarding socio-emotional characteristics, but is rather a constellation of subgroups presenting very various profiles: some patients actually report no socio-emotional deficit while others combine alexithymia and interpersonal problems, or present quite specific impairments for emotional or social functioning. Our cluster analysis thus offers the first experimental confirmation that the exploration of socio-emotional deficits in alcohol-dependence should no further be based on mere group comparisons as these analyses actually hide a diversity of profiles and leads to erroneous conclusions.

The comparison with the gender and age-control subgroups further reinforces the need to take this heterogeneity into account. Indeed, our results show that, while earlier studies concluded to the general presence of alexithymia and interpersonal problems in alcohol-dependence, nearly 25% of the patients (Cluster 4) did not report any socio-emotional deficit, and actually presented sometimes even lower scores than matched controls. This "hyper-normality" could be explained by a social desirability bias (e.g., Crowne and Marlowe, 1960) even though the fact that patients' scores are not significantly lower for each subscale slightly nuances this interpretation. Moreover, even if the four other clusters reported significantly higher scores than controls for total scores, subscales also nuanced these global results, as a quite high proportion of patients actually presented preserved specific emotional abilities (identifying emotions for Cluster 2, preserved internally-oriented thinking in Cluster 1 and Cluster 2). As a whole, these subscales' results thus urge future studies to go beyond the total score to explore the complexity of ADP profiles.

A crucial strength of our study is the optimal distribution of the alcohol-dependent population in the five clusters, as the size difference between the smallest (Cluster 3, 10.81%) and the largest (Cluster 2, 24.66%) clusters is less than 14%. Moreover, the heterogeneity of the

reported profiles cannot be explained by demographic factors, as clusters did not differ for age, gender or education. Regarding psychopathological measures, while clinical depression and anxiety constituted exclusion criteria (thus avoiding a massive influence of comorbidities on the results), depressive states and trait anxiety were stronger in Clusters 1 and 3, both characterized by a combination of emotional and interpersonal problems. The specific influence of co-occurring psychopathological states was not our central focus, but it can be hypothesized that higher depression and anxiety levels might favor the intensification of joint affective and interpersonal difficulties. Finally, Clusters did not differ on alcohol-related variables, which suggests that both the intensity of alcohol consumption before detoxification and the duration of alcohol-dependence do not allow distinguishing between the socio-emotional profiles identified among patients. While the cross-sectional nature of the study does not allow to conclude regarding the evolution of the difficulties during the course of the pathology, this absence of influence related to alcohol-dependence intensity suggests that socio-emotional profiles might represent a quite stable pattern among ADP, relatively independent from the variations in the duration and intensity of alcohol-related disorders.

By exploring the heterogeneity of socio-emotional profiles in alcohol-dependence, the present study offers new insights regarding previous typologies of alcohol-dependence. Indeed, as we focused on a specific category of variables, our aim was not to propose a new comprehensive classification of alcohol-related disorders, but rather to insist on the usefulness of taking into account these affective and interpersonal abilities, and to potentially include them in the existing or upcoming typologies. Classical typologies (see Leggio et al., 2009 for a review) mostly based their subtyping on demographic, alcohol-related, personality or psycho-cognitive factors, and thus globally neglected socio-emotional impairments. This lack of interest is even more obvious in the recent emergence of alcohol-dependence endophenotypes (Hines et al., 2005), exclusively based on biological and genetic factors. As these models focused on variables unrelated to those explored here, it is difficult to compare the present results with earlier ones. However, potential connections can be suggested, for example regarding the influence of depression and anxiety on socio-emotional profiles, these comorbidities being at the heart of several earlier typologies (e.g., Del Boca and Hesselbrock, 1996; Lesch et al., 1988). It can be postulated that, within these typologies, socio-emotional deficits might be particularly intense in the subtypes characterized by depressive or anxious symptoms. Conversely, the absence of influence of alcohol-related factors on socio-emotional profiles observed here suggests that some factors identified as crucial for subtyping in earlier works (e.g. age of onset or consumption intensity, Babor et al., 1992; Cloninger et al., 1981) might not have a significant impact on affective and interpersonal difficulties. Nevertheless, as the present study focused on specific factors unexplored in previous classifications, future studies are needed to specifically work on these connections and on the integration of socio-emotional factors in earlier typologies.

It should be noted that, in this study, we used alexithymia as an index of intrapersonal emotional functioning, instead of other emotional regulation measures which would also have evaluated the emotional processes resulting from others' emotions (e.g., emotional intelligence). This choice was justified to avoid an overlap with the IIP, targeting interpersonal functioning. Further explorations are however needed to confirm the generalizability of our results to other affective and interpersonal abilities, but also beyond by applying cluster analyses to other cognitive abilities. This could notably be achieved by extending the present cluster exploration to other key emotional and interpersonal abilities that have been found to be impaired in alcohol-dependence, for example emotional intelligence (Mohagheghi et al., 2015), emotional decoding (Donadon and Osório, 2014), empathy (Martinotti et al., 2009) or Theory of Mind (Maurage et al., 2016). Conducting cluster analyses on experimental data (e.g. emotional identification task or social cognition tasks) rather than on self-reported questionnaires, as

recently done in other psychiatric states (Rocca et al., 2016) might also constitute a promising perspective. Our analysis was moreover conducted on recently-detoxified ADP, and upcoming works should explore the evolution of the reported profiles with prolonged abstinence, or conversely among patients presenting uninterrupted alcohol-dependence. Future studies should also evaluate the predictive value of these socio-emotional profiles regarding relapse risk, as Clusters might differ regarding their vulnerability following the detoxification process, which could be of great interest in the follow-up of ADP. Moreover, the present study did not include any assessment of visuospatial, memory or executive functions impairments, which have been frequently reported among ADP (e.g., Bernardin et al., 2014; Stavro et al., 2013). It is possible that the heterogeneity observed here for emotional and interpersonal abilities extends to these cognitive impairments, and future studies should consider both cognitive and affective deficits' variability to explore their mutual influence and to offer refined ADP profiles. Finally, in order to explore the specific influence of alcohol-dependence on socio-emotional profiles, and while subclinical anxiety and depressive states were taken into account, psychopathological comorbidities presented at clinical levels constituted exclusion criteria, thus potentially creating a selection bias in our sample. Upcoming works should thus determine the joint influence of alcohol-dependence and comorbid psychiatric states on the socio-emotional profiles determined here.

Despite these limitations, we clearly show that alcohol-dependence can no more be investigated as a homogeneous group constituted on the basis of a common diagnosis, but has rather to be envisaged as a gathering of distinct and sometimes opposed profiles of socio-emotional abilities. The present results thus have crucial implications for future works at theoretical and experimental levels. Indeed, as they clearly show that considering alcohol-dependent individuals as a unitary cluster is misleading, they should lead: (1) to reconsider and re-explore earlier results, particularly by going back to the individual data to determine, beyond the group results usually reported, the variability of the alcohol-dependent sample and the subtypes that can be identified for the explored emotional, social or cognitive variables. This individual investigation of previous results will give further insights regarding their actual heterogeneity, and might explain the discrepancies reported across studies [e.g. regarding the variability of emotional decoding deficits in alcohol-dependent individuals (Donadon and Osório, 2014), which might be related to inter-studies variations on the selected sample, earlier studies presenting a varying proportion of patients from the clusters identified here, which de facto led to incoherent results]. As a whole, the present data suggest that earlier results, particularly those related to affective or interpersonal abilities, should be reconsidered to explore the presence of alcohol-dependent subgroups, ranging (as suggested here) from participants presenting preserved performance to strongly impaired individuals; (2) to deeply modify the exploration of socio-emotional factors in future works. Indeed, following our identification of dissimilar subtypes regarding these factors in alcohol-dependence, upcoming explorations cannot merely continue to focus on group comparisons, as these analyses obviously hide the huge heterogeneity characterizing this pathological state, thus leading to misrepresentative (if not wrong) results' description. We thus urge future studies on this topic to go beyond these classical "alcohol-dependent versus controls" group comparisons and to take into account the heterogeneity of alcohol-dependent patients, either by pre-selecting a specific subgroup of patients to be included in their experiment (e.g., using pre-tests or screening) or by exploring the variations observed in their sample by means of complementary analyses performing subgroup explorations (e.g., cluster analyses) and/or individual profiles description [e.g., using a multiple single-case approach like the Crawford method (Crawford and Garthwaite, 2012)]. The identification of dissociated socio-emotional patterns is also crucial at the therapeutic level, where practitioners should individually evaluate socio-emotional abilities in alcohol-dependent patients and

adapt clinical settings accordingly. There is indeed an urgent need to propose a tailored rehabilitation based on the precise determination of the specific impairments presented by each patient (as it is classically done in clinical neuropsychology), and thus to go beyond the indistinct application of standardized remediation programs.

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Conflict of interest

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Ethical standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.jad.2017.04.005>.

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