Impaired Decoding of Fear and Disgust Predicts Utilitarian Moral Judgment in Alcohol-Dependent Individuals

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Background: Recent studies of moral reasoning in patients with alcohol use disorders have indicated a "utilitarian" bias, whereby patients are more likely to endorse emotionally aversive actions in favor of aggregate welfare (e.g., throwing a dying person into the sea to keep a lifeboat of survivors afloat). Here, we investigate the underlying psychological and neuropsychological processes.

Methods: Alcohol-dependent individuals (n = 31) and healthy comparison participants (n = 34) completed a validated moral judgment task, as well as measures of impulsivity, mood symptoms (anxiety and depression), and emotional face recognition.

Results: Alcohol-dependent individuals were more likely to endorse utilitarian choices in personal moral dilemmas compared with controls and rated these choices as less difficult to make. Hierarchical regression models showed that poorer decoding of fear and disgust significantly predicted utilitarian biases in personal moral dilemmas, over and above alcohol consumption. Impulsivity and mood symptoms did not predict moral decisions.

Conclusions: These findings suggest that impaired fear and disgust decoding contributes to utilitarian moral decision-making in alcohol-dependent individuals.

Key Words: Moral Decision-Making, Utilitarian Judgments, Alcohol-Dependent Individuals, Emotional Face Recognition, Fear, Disgust Decoding.

ALCOHOL DEPENDENCE IS characterized by the persistent use of alcohol in the face of physical, psychological, and social consequences for oneself and close others (American Psychiatric Association and Others, 2000). Alcohol-dependent individuals show deficits on decision-making tasks due in part to their impaired ability to attach emotional value to decision prospects (i.e., "myopia for the future") (Fernández-Serrano et al., 2010; Park et al., 2010). Recent work has targeted these decision-making deficits in the domain of moral cognition (De Oliveira-Souza and Moll, 2009; Moran et al., 2012). Typically, participants are instructed to choose between a utilitarian option (i.e., harming one person to save a greater number of people) and a deontological option (i.e., refusing to harm someone and thus allowing a greater number of people to die). Alcohol-dependent individuals have been shown to endorse utilitarian options in response to moral dilemmas (Khemiri et al., 2012). Furthermore, among polysubstance users, severity of alcohol use predicts the degree of utilitarian bias (Carmona-Perera et al., 2012a,b). Together, these prior studies reveal a link between alcohol use and utilitarian moral judgment. This link may be due to the specific neurotoxic effects of alcohol on frontal lobe function (Beck et al., 2012; Stephens and Duka, 2008), associated with co-morbidities and cognitive-affective deficits that contribute to moral judgment deficits. The primary aim of the current study was to identify key predictor variables of moral judgment deficits in alcohol dependence.

Prior work has explored moral judgment deficits. For example, studies have identified traits associated with impaired moral cognition, including antisociality and impulsivity (Bartels and Pizarro, 2011; Marsh et al., 2011). Induction of negative emotional states, such as disgust, has also been shown to reduce utilitarian bias choice in healthy individuals (Harlé and Sanfey, 2010; Schnall et al., 2008; Ugazio et al., 2012), while patients with focal damage to brain regions that support emotional responding tend to endorse utilitarian moral judgments to a greater extent (Koenigs et al., 2007; Moretto et al., 2010). Moreover, depression and anxiety levels in non-clinical samples are positively also associated with utilitarian choice (Bartels and Pizarro, 2011; Starcke et al., 2011; Youssef et al., 2012). Notably,

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Received for publication February 13, 2013; accepted May 29, 2013.

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DOI: 10.1111/acer.12245

A C E R | 1 2 2 4 5 | B | Dispatch: 2.8.13 | Journal: ACER | CE: Liyagat Ali
Journal Name | Manuscript No. | Author Received: | No. of pages: 7 | PE: Karthikeyan

alcohol-dependent patients exhibit depression and anxiety (Lai et al., 2012), impulse control problems (Mitchell et al., 2005; Stephens and Duka, 2008), poor emotion regulation, and emotional expression recognition (Foisy et al., 2007; Uekermann and Daum, 2008).

This study aimed first to replicate the prior finding that alcohol-dependent patients show a utilitarian bias and second to determine which psychological and neuropsychological factors previously associated with utilitarian bias (severity of alcohol use, impulsivity, mood symptoms, and cognitive-affective processes) predict moral judgments in alcohol-dependent patients. First, we hypothesized that alcohol-dependent individuals would deliver more utilitarian moral judgments on personal (emotionally salient) moral scenarios. Second, as utilitarian moral judgments of moral personal scenarios have been previously associated with impulsivity, altered mood states, and decoding affective deficits that are closely linked to alcohol dependence problems (Foisy et al., 2007; Lai et al., 2012; Stephens and Duka, 2008), we also hypothesized that high impulsivity, negative mood elevations, and poor affective decoding would significantly predict utilitarian choices in alcohol-dependent individuals. Specifically, based on our previous neural findings linking emotional processing with moral judgment (Koenigs et al., 2007; Verdejo-Garcia et al., 2012), we expected poor affective decoding to be the most significant predictor of utilitarian choices in alcohol-dependent individuals.

Table 1. Descriptive Scores for the Sociodemographic and Alcohol use Characteristics of Alcohol-Dependent Individuals and Healthy Control Individuals

	Alcohol-dependent Mean (SD)/ Proportion	Control Mean (SD)/ Percentage	t/χ^2	*p*-value
Age	52.06 (6.48)	48.77 (10.66)	-1.49^a	0.141
Educational level (years)	13.74 (1.98)	17.12 (2.75)	5.63^a	0.000
Handedness				
Right-handed	87.1%	88.2%	1.42^b	0.889
Left-handed	12.9%	11.8%		
Socioeconomic level				
Low	25.8%	14.7%	0.02^b	0.492
Middle	64.5%	70.6%		
High	9.7%	14.7%		
Quantity alcohol per month (units)	565.79 (462.26)	21.38 (12.50)	-6.87^a	0.000
Duration alcohol consumption (years)	26.50 (8.53)	20.66 (9.67)	-2.55^a	0.013
Total alcohol consumption (units)	188026.78 (167376.61)	5076.99 (4358.61)	-6.38^a	0.000

[a]Value of Student's *t*-test.
[b]Value of chi-squared test.
Socioeconomic status was collected from clinical history reported by clinical staff.

MATERIALS AND METHODS

Participants

Alcohol-dependent individuals (n = 31) and healthy control individuals (n = 34) participated in the study. The 2 groups did not differ significantly in terms of gender, age, handedness, socioeconomic status (see Table 1). All participants were of European-Caucasian origin. The alcohol-dependent group reported significantly fewer years of formal education, $t(63) = 5.63$, $p < 0.001$; therefore, this variable was entered as a covariate in all subsequent analyses.

Alcohol-dependent individuals were recruited from the detoxification unit of Nostra Senyora de Meritxell Hospital between October 2010 and June 2011. All subjects met DSM-IV criteria for alcohol dependence and did not meet criteria for abuse or dependence of other substances, with the exception of nicotine. For eligibility, participants needed to have been abstinent for at least 15 days (mean 2.56 month, SD = 3.44), as confirmed by urine analyses performed approximately every 3 days, and not have comorbid diagnoses of Axis I or Axis II disorders, assessed by clinical reports. Controls were recruited from the community through word-of-mouth communication. The main criterion for inclusion in the control group was the absence of significant alcohol use patterns, defined as fewer than 10 standard units of alcohol per week, taking a glass of whisky or other liquor to equal one unit, and a glass of wine or beer to equal 0.5 units. All participants scored at least 27 (i.e., normal cognitive state baseline) on the Spanish version of the Mini mental state examination (MEC; Lobo et al., 1979).

Instruments

1. *Interview for Research on Addictive Behavior,* IRAB (Verdejo-García et al., 2005). This instrument evaluates the average amount of alcohol consumption per month and the duration of use in years. A combined quantity x duration variable was calculated for total alcohol consumption (i.e., alcohol units over lifetime) to illustrate group differences in alcohol exposure, despite the relative similarity in duration of alcohol use.
2. *Barratt Impulsiveness Scale*, BIS-11 (Patton et al., 1995); Spanish version (Oquendo et al., 2001). This scale was used as a measure of impulsive personality traits. Participants were asked to rate a set of impulsivity manifestations on frequency: never or rarely, occasionally, often and always or almost always (scoring from 0 to 4). The main dependent variable was the total impulsivity score, and 3 subscale scores: cognitive, motor, and non-planning impulsiveness.
3. *Hamilton Depression and Anxiety Rating Scales* (Hamilton, 1960, 1969); Spanish version (Ramos-Brieva and Cordero Villafáfila, 1986). These scales assess depression and anxiety symptoms. The interviewer assigns a score between 0 and 4, depending on frequency and intensity of symptoms (maximum depression and anxiety scores are 52 and 56, respectively). In addition, the anxiety scale can assess psychic and somatic anxiety separately. We used depression and anxiety total scores and anxiety partial scores (psychic and somatic) as dependent variables.
4. *Facial Expressions of Emotion: Stimuli and Tests,* FEEST (Young et al., 2002). This cognitive-affective decoding task assesses recognition of facial emotional expressions. Participants must identify which emotion (anger, disgust, fear, happiness, sadness, and surprise) best describes the facial expression displayed. A set of 60 faces was presented, in random order, for 5 seconds each; there was no time limit for responding. The number of correct identifications for each emotion (ranging from 0 to 10) was collected as a dependent measure.
5. *Moral Judgment task* (Greene et al., 2001). We used 32 hypothetical dilemmas selected in a prior work through Rasch analysis (Carmona-Perera et al., 2012a). The Spanish version was derived

through back-translation, and its psychometric properties were adequate in an independent community sample (Cronbach's alpha = 0.78, Spearman Brown coefficient = 0.76; (Carmona-Perera et al., 2012a). Participants chose if they *would perform* ("yes") or *refuse to perform* ("no") an action to resolve each moral dilemma. Participants also rated the subjective difficulty of the decision using a Likert scale ranging from 1 (very low) to 10 (extreme). For moral dilemmas, affirmative answers ("yes") were considered "utilitarian". Dilemmas were classified into 3 types: nonmoral dilemmas in a control condition (involving a cost-benefit decision without moral or emotional content; $n = 8$), moral impersonal (involving a moral decision of low emotional salience; $n = 8$), and moral personal (moral decisions of high emotional salience; $n = 16$). Personal dilemmas were further classified as low conflict (shorter response latencies and high intersubject agreement) versus high conflict (longer responses latencies and low intersubject agreement) (Koenigs et al., 2007). The dependent variables were the proportion of affirmative choices, the difficulty rating, and the decision latencies, for each of the dilemma categories.

Procedure

Participants provided written informed consent, before completing 2 individual test sessions lasting 1 hour each. In the first session, we administered the assessments of drug use, impulsivity, mood, and emotional decoding. In the second session, we administered the moral judgment task, in a computerized format. Individual dilemmas were presented over 3 phases on successive screens: The first screen described the scenario; the second screen prompted the response; the third screen prompted the difficulty rating on a Likert scale (with no time limits imposed).

Data Analyses

Performance differences on the moral judgment task were compared between groups using a series of 2 (Group) × 4 (Type of dilemma) mixed-model ANCOVAs, with years of education entered as a covariate, on the 3 dependent measures (affirmative choices, difficulty ratings, and decision latencies). Significant Group × Type of dilemma interactions were decomposed using t-tests on each of the 4 dilemma categories. Additional analyses were conducted to determine the influence of education, by comparing 2 subsets ($n = 20$) matched on education. Group differences in emotion recognition, impulsivity, depression, and anxiety were tested using univariate ANCOVAs (with years of education entered as a covariate).

To analyze the predictive capacity of the different psychological variables on utilitarian moral judgments, hierarchical multiple regression analyses were performed. The hierarchical regression approach was chosen to estimate the relative increase in the percentage of explained variance (and the statistical significance of the prediction change) provided by each of the consecutive sets of predictors. The 4 sets of predictors were entered in reverse sequence relative to our hypothesis: Affective decoding measures were included last. Therefore, the affective decoding set had to increase the percentage of variance explained by the other predictors to attain significant. We included the dependent measures from the moral judgment task that showed significant group differences: proportion of affirmative (utilitarian) judgments for high-conflict dilemmas, proportion of affirmative (utilitarian) choices for low-conflict dilemmas, and self-reported difficulty assessments for high-conflict dilemmas. The predictor variables were the sociodemographic and psychological variables that elicited significant group differences, which were grouped on 5 theoretically driven sets and introduced in this order: (i) years of education, (ii) total alcohol consumption (composite estimate of amount and duration of alcohol use), (iii) impulsivity (BIS-impulsivity total score), (iv) mood (combined Hamilton depression and anxiety score), (v) emotional decoding (number of hits in the decoding of facial expressions of fear and disgust). To determine the differential contribution of each set of predictors, we estimated the R^2 change associated with the entrance of each new set and its statistical significance.

RESULTS

Group Differences

Table 2 shows descriptive statistics and between-group comparisons for the psychological variables. The alcohol-dependent group showed significantly higher levels of impulsivity, depression, and anxiety, and significantly poorer recognition of fear and disgust compared with control participants, controlling for the effect of education. We found no significant differences in the perception of expressions of sadness, happiness, surprise, and anger. Cohen's d coefficients for the group differences exceeded 1, indicating large effect sizes (Zakzanis, 2001).

On the moral dilemmas task, a significant Group (Alcohol-dependent individuals vs. Healthy controls) × Category of dilemma interaction was observed for affirmative (utilitarian) answers, $F(3, 186) = 10.32$, $p < 0.001$. The main effects for Group, $F(1, 62) = 6.26$, $p = 0.015$, and Dilemma category, $F(3, 186) = 11.37$, $p < 0.001$, were also significant. The alcohol-dependent group was more likely to endorse utilitarian options for low-conflict personal dilemmas, $t(63) = -5.23$, $p < 0.001$, and high-conflict personal dilemmas, $t(63) = -4.35$, $p < 0.001$. No significant differences

Table 2. Descriptive Scores, Univariate Analyses of Covariance (ANCOVAs), and Effect Sizes on the Psychological Variables for Alcohol-Dependent Group and Control Group

	Alcohol-dependent Mean (SD)	Control Mean (SD)	F-value	p-value	Cohen's *d*
Impulsivity (total)	51.77 (15.71)	28.38 (10.69)	32.66	0.000*	1.76
Cognitive	15.77 (4.58)	11.35 (4.14)	9.84	0.003*	1.02
Motor	17.87 (7.69)	8.09 (3.99)	27.07	0.000*	1.62
Nonplanning	18.03 (7.41)	9.59 (5.88)	19.22	0.000*	1.27
Depression	12.32 (8.88)	2.12 (2.32)	27.68	0.000*	1.61
Anxiety (total)	15.32 (12.46)	3.56 (3.95)	18.86	0.000*	1.30
Somatic	6.71 (5.76)	1.62 (2.26)	13.69	0.000*	1.19
Psychic	8.61 (7.61)	1.94 (2.39)	18.08	0.000*	1.21
Emotional Perception (total)	43.13 (5.69)	50.03 (5.52)	11.85	0.001*	1.23
Anger	7.09 (1.99)	8.18 (1.59)	2.17	0.146	0.60
Disgust	6.58 (1.84)	8.62 (1.58)	9.69	0.003*	1.19
Fear	4.32 (2.21)	6.65 (2.39)	10.30	0.002*	1.01
Happiness	9.71 (0.46)	9.85 (0.44)	1.19	0.280	0.32
Sadness	7.35 (2.27)	7.53 (1.79)	0.01	0.910	0.09
Surprise	8.52 (1.52)	9.18 (1.34)	1.61	0.210	0.46

**p*-value <0.05.

For the emotional perception task, we obtained the number of correct identifications for each emotion (ranging 0 to 10), and the sum score of total correct identifications (ranging 0 to 60).

were observed on the nonmoral scenarios, $t(63) = 1.95$, $p = 0.064$, or impersonal dilemmas, $t(63) = 0.08$, $p = 0.936$ (Fig. 1).

A significant Group × Category interaction also emerged for the difficulty ratings, $F(3, 186) = 6.56$, $p = 0.003$, such that the alcohol-dependent group reported lower difficulty on the high-conflict dilemmas, $t(63) = 3.07$, $p = 0.003$, but not the other 3 categories (nonmoral, $p = 0.467$; impersonal, $p = 0.163$; low-conflict, $p = 0.565$). No significant main effects were found for Group, $F(1, 62) = 2.01$, $p = 0.162$, or Dilemma category, $F(3, 186) = 1.79$, $p = 0.150$.

In addition, no significant Group × Category interaction was observed for decision latencies, $F(3, 186) = 0.55$, $p = 0.648$. The main effects for Group and Category were also nonsignificant ($p > 0.05$).

Additional analysis was conducted to further examine the influence of education. We selected subgroups from the alcohol-dependent group and healthy control group, which did not differ on years of education (AD subgroup, $n = 20$, mean = 14.84, SD = 1.80; HC subgroup $n = 20$, mean = 15.30, SD = 2.08), $t(37) = 0.73$; $p = 0.468$. These matched subgroups nevertheless showed significant differences in utilitarian responding for personal moral dilemmas, low conflict, $t(37) = -3.24$, $p = 0.003$; high conflict, $t(37) = -2.89$, $p = 0.006$. These groups also differed on difficulty ratings for high-conflict dilemmas, $t(37) = 2.47$, $p = 0.018$. We found no significant differences between subgroups on the other 3 categories (all $p > 0.05$).

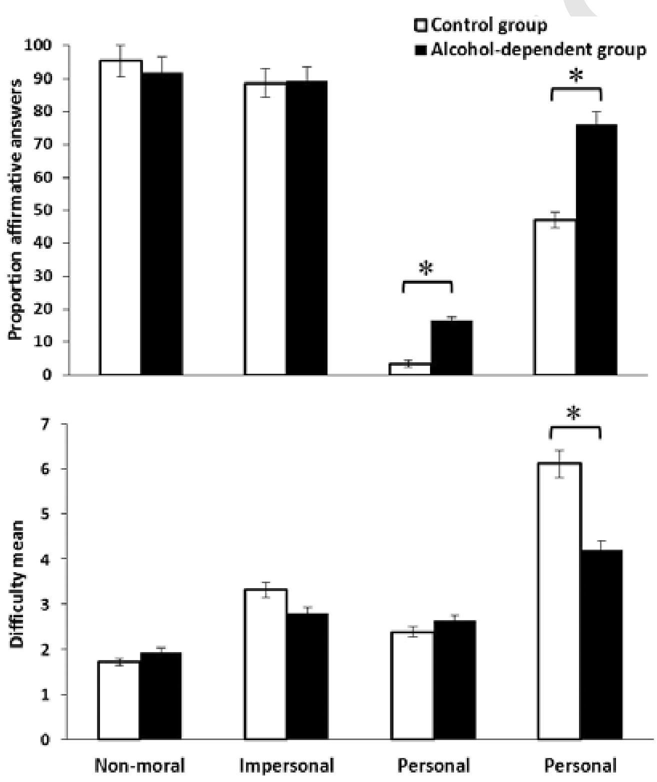

Fig. 1. Proportion of affirmative answers and difficulty of judgment across scenario categories for alcohol-dependent individuals and controls.

Moral Decision-Making Predictors

The regression model for utilitarian choices for high-conflict personal dilemmas showed significant effects of the first and second blocks that entered the education and total alcohol consumption variables. Impulsivity and mood variables did not significantly improve the prediction level. However, inclusion of the emotional decoding block, including fear and disgust recognition, did significantly add to the model (see Table 3 for regression values). The global model predicted 23.8% of total variance and the best individual predictor was the fear recognition score, which was inversely correlated with utilitarian choices ($\beta = -0.311$, $p = 0.018$).

For utilitarian choices on low-conflict personal dilemmas, the blocks of education and total alcohol consumption were significant predictors of utilitarian choices. Impulsivity and mood variables were not significant predictors. Entering the block of emotional decoding variables again significantly increased the predictive value, with 27.7% of total variance explained in the global model. Total alcohol consumption ($\beta = 0.354$, $p = 0.026$) and disgust recognition ($\beta = -0.252$, $p = 0.072$) were the variables that were individually significant predictors. Total alcohol consumption was positively correlated with utilitarian choices, while disgust recognition correlation was inversed. For difficulty ratings on the high-conflict personal dilemmas, none of the blocks was significantly predictive.

DISCUSSION

This study aimed both to replicate prior work revealing utilitarian bias in alcohol-dependent individuals and to determine the predictors of this bias, for example severity of alcohol use, impulsivity, mood symptoms, and emotional decoding. Our findings demonstrate a utilitarian bias on personal moral scenarios in individuals with alcohol dependence. In addition, alcohol-dependent individuals rated these decisions as less difficult, compared with controls. Critically, poor recognition of facial expressions of fear and disgust predicted utilitarian bias on personal moral dilemmas, over and above the impact of total alcohol consumption and years of education. Specifically, impaired fear decoding emerged as the main predictor of utilitarian choices for *high-conflict* dilemmas, whereas impaired disgust decoding emerged as the main predictor of utilitarian choices for *low-conflict* dilemmas. Although future work is required to explore these effects, we suggest that the perception of fear in specific individuals may lead to an aversion to harming those individuals even when doing so may lead to saving other people, as in high-conflict scenarios (Crockett et al., 2010). On the other hand, low-conflict scenarios (e.g., causing harm for selfish benefit) may trigger moral disgust (Ugazio et al., 2012; Wheatley and Haidt, 2005).

Notably, impulsivity and mood symptoms were not significant predictors of moral decision-making, although they differed significantly between groups. Nevertheless, future work

Table 3. Multiple Hierarchical Regression Models of the Association of Education, Total Alcohol Consumption, Impulsivity, Mood, and Emotional Decoding With Moral Judgments Performance

	Education R^2 change (*p*-value)	Tot alcohol R^2 change (*p*-value)	Impulsivity R^2 change (*p*-value)	Mood R^2 change (*p*-value)	Em Decod R^2 change (*p*-value)	Full model R^2 adjusted (*p*-value)	Main contributors (*p*-value)
Variable 1	0.119 (0.005)*	0.075 (0.020)*	0.005 (0.551)	0.018 (0.655)	0.107 (0.017)*	0.238 (0.002)*	Fear Rec (0.018)*
Variable 2	0.122 (0.005)*	0.143 (0.001)*	0.000 (0.941)	0.015 (0.543)	0.077 (0.042)*	0.277 (0.001)*	Tot Alcohol (0.021)* Disgust Rec (0.072)
Variable 3	0.044 (0.096)	0.006 (0.554)	0.000 (0.993)	0.033 (0.354)	0.013 (0.677)	−0.017 (0.554)	

*p-value <0.05.
Variable 1: Proportion of utilitarian choices in high-conflict personal dilemmas; Variable 2: Proportion of utilitarian choices in low-conflict personal dilemmas; Variable 3: Mean of judgment difficulty in high-conflict personal dilemmas; Tot Alcohol, Total Alcohol Consumption; Em Decod, Emotional Decoding; Fear Rec, Fear Recognition; Disgust Rec, Disgust Recognition.

should use neuropsychological measures of impulse control or biological markers of affective disturbance such as salivary cortisol (Dallman, 2005).

The current demonstration of utilitarian responding in alcohol-dependent individuals is consistent with prior work, including a previous study in a Swedish sample (Khemiri et al., 2012). The utilitarian bias observed in the current sample also appears to be broader than the pattern observed in our prior work in a polysubstance-dependent group (Carmona-Perera et al., 2012a,b), in which the bias emerged only high-conflict personal dilemmas. In the current sample, utilitarian bias extended to low-conflict personal dilemmas, which elicit deontological judgments in healthy subjects and even patients with impaired emotional processing (Koenigs et al., 2007; Moretto et al., 2010). Thus, the current sample of alcohol-dependent individuals appears to show relatively severe cognitive-affective deficits (Foisy et al., 2007; Stephens and Duka, 2008; Uekermann and Daum, 2008).

These findings are also consistent with prior evidence showing that alcohol-dependent individuals are impaired in their decoding of fear and disgust (Foisy et al., 2007; Uekermann and Daum, 2008). In the current study, these decoding deficits emerged as the key predictors of utilitarian choice on a subset of moral dilemmas. Poor emotional decoding is typically associated with deficits in aversive conditioning (Borlikova et al., 2006; Stephens and Duka, 2008) and may render alcohol-dependent individuals less sensitive to the emotional consequences (e.g., causing personal harm) of utilitarian responding (Birbaumer et al., 2005; Gao et al., 2010). Indeed, individuals with difficulty identifying fear-inducing behaviors tend to judge these behaviors as more morally acceptable (Marsh and Cardinale, 2012). More generally, interpersonal interactions are based in large part on our ability to perceive other emotions (Riggio et al., 2003); thus, emotional decoding deficits in alcohol dependence may lead to social impairments observed in this population (Kornreich et al., 2002; Maurage et al., 2008).

The present research can be understood in the context of dual-process models of moral judgment; alcohol-dependent individuals show reduced ability to integrate social-emotional inputs and therefore endorse utilitarian moral judgments (Greene, 2007). As such, the current results are also consistent with the proposed role of emotion in deontological judgments (Schnall et al., 2008; Van Dillen et al., 2012; Wheatley and Haidt, 2005). More specifically, the successful induction of avoidance-related emotions (e.g., disgust or fear) may lead to deontological moral judgments (Harlé and Sanfey, 2010; Ugazio et al., 2012). Furthermore, according to the somatic-marker theory of addiction, the medial prefrontal cortex is the key brain region for generating and integrating emotional signals (somatic-markers), which arise in anticipation of the affective and social consequences of different courses of action (e.g., utilitarian vs. deontological), crucially guiding decision-making (Verdejo-García and Bechara, 2009).

We should acknowledge that our 2 groups were not closely matched for background education. We therefore included this variable as a covariate in our analyses; although, given some of the caveats raised about the use of ANCOVA (Grove and Meehl, 1996; Waller et al., 2006), we also note that our group effects were substantiated both in the ANOVA models without the covariate term included and in the sensitivity analysis using subsets matched for education. Our regression models also directly investigated any influence of education, with the psychological variables entered after education. We think that the correlation with alcohol consumption reflects a consequence of alcoholism, but other explanations are possible, and future work should explore alternative premorbid factors including, especially, psychopathic traits (Bartels and Pizarro, 2011; Harenski et al., 2009) or altered attentional control (Van Dillen et al., 2012), which may also partially account for these findings. In sum, our study not only replicates the association between alcohol dependence and utilitarian moral judgment but also reveals that defective fear and disgust decoding are key predictors of utilitarian choices in personal moral dilemmas. These findings have important clinical implications, given that poor decision-making is a well-validated predictor of alcohol and drug relapse (Allsop et al., 2000; Bechara and Damasio, 2002). Furthermore, the impairments in fear and disgust recognition could be related to clinical observations in alcohol-dependent individuals, such as the lack of disgust of vomit, and poor personal hygiene (Hazelton et al., 2003; Johnson et al., 2008).

Specific interventions directed at improving emotional decoding as well as transferring these emotional capacities into real-life decisions, for example the Micro Expression Training Tool (Ekman, 2003; Matsumoto and Hwang, 2009), and Multimodal Affective Systems (Duric et al., 2002; Lisetti and Nasoz, 2002; Zeng et al., 2009) may prove useful.

ACKNOWLEDGEMENTS

This work is supported by the "Red de Trastornos Adictivos", RETICS Program, Instituto de Salud Carlos III, Spanish Ministry of Health (PI: AVG) and the Junta de Andalucía under the Research Project P07.HUM 03089 (PI: MPG). MCP is funded by FPU predoctoral research grant (AP 2008-01848) from Spanish Ministry of Education and Science. We would like to thank X. Sumarroca-Hernández and A. Santolaria-Rossell for his help with clinical screenings and "detoxification unit of Nostra Senyora de Meritxell Hospital" for his collaboration. The authors report no conflict of interests associated with the tobacco, alcohol, pharmaceutical, or gaming industries, and no funding from any associated organizations.

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