Impaired emotion recognition is linked to alexithymia in heroin addicts

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Several investigations document altered emotion processing in opiate addiction. Nevertheless, the origin of this phenomenon remains unclear. Here we examined the role of alexithymia in the ability (i.e. number of errors – *accuracy* - and reaction times - *RTs*) of thirty-one heroin addicts and thirty-one healthy controls to detect several affective expressions. Results show generally lower accuracy and higher RTs in the recognition of facial expressions of emotions for patients, compared to controls. The hierarchical multivariate regression analysis shows that alexithymia might be responsible of the between groups difference with respect to the RTs in emotion detection.

Overall, we provide new insights in the clinical interpretation of affective deficits in heroin addicts suggesting a role of alexithymia in their ability to recognize emotions.

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31 **Introduction**

32 Drug addiction is a social-health problem with alarming statistics around the world.

33 From a social standpoint, substance addiction is frequently associated with deficient

34 interpersonal relationships, especially from the interpersonal point of view (Kornreich et al.,

35 2002). This could be due to impaired processing of emotional information related to social

36 interactions (Kornreich, et al., 2003), though other factors such as the degree of dependence and

37 the drug related life style may be also be involved in such impairments.

38 The study of emotional processing has represented a useful tool to explore interpersonal abilities

39 in addicts, given the role of emotion processing in social attitude (e.g., Niedenthal et al., 2005;

40 Vicario & Newman, 2013; Vicario, Rafal & Avenanti, 2015). Emotion recognition difficulties in

41 opiate addicts could affect interpersonal relationships, since the ability to accurately decode

42 facial expressions is an important component of functional/well-adjusted social interactions.

43 The current literature provides contrasting results about emotion recognition performance in this

44 clinical condition (see Kun & Demetrovics, 2010 for a review). Kornreich et al. (2003) studied

45 emotion recognition in four different groups of participants: recently detoxified alcoholics (RA);

46 opiate addicts under methadone maintenance treatment (OM); detoxified opiate addicts (OA);

47 detoxified subjects with both alcohol and opiate dependence antecedents (DAO); Results showed

48 a lower emotion recognition accuracy in all clinical groups, compared to healthy controls. In

49 contrast, Martin et al., (2006) found that opiate users receiving methadone maintenance were

50 more accurate than ex-opiate users in rehabilitation in recognizing facial expressions of disgust.

51 On the other hand, they were generally slower than controls in recognizing all expressions.

52 Finally, the study by Zhou et al. (2012) has shown that abstinent heroin abusers display a

53 heightened detection of negative emotion when searching stimulus displays with a varying

54 number of neutral faces for the positive or negative faces.

55   A psychological construct that could help to understand and disentangle these differences in

56 emotional recognition performance in opiate addicts is alexithymia. The term alexithymia was

57 coined by Sifneos (1973), to indicate "*a deficit in the cognitive processing of emotions*" (see

58 Taylor & Bagby, 2013). Specifically, alexithymia is characterized by a reduced ability to identify

59 and describe feelings, a difficulty to distinguish between different feelings, an externally oriented

60 cognitive approach to reality and a difficulty to modulate feelings (Porcelli et al., Taylor, 2014).

61 Alexithymia has been also associated with an impaired ability to recognize facially expressed

62 emotions (see Grynberg et al., 2012 for a recent review). For example, Prkachin, Casey and

63 PrKachin (2009) found an impaired ability in detecting affective expressions in populations with

64 alexithymia. In particular, the correlational analyses documented higher difficulty in recognizing

65 emotions such as sadness, anger, and fear. In similar fashion, Gil et al., (2009) reported a

66 significant and negative correlation between facial emotion recognition and alexithymia severity

67 in a group of twenty patients with somatoform disorders. Researchers (e.g., Taylor et al., 1997;

68 see also Savov and Atanassov, 2013 for a review) suggest that, in addiction, alexithymia might

69 be due to several typically reported factors such as i) a difficulty in identification and

70 differentiation of feelings and bodily senses in a state of emotional arousal, (ii) a difficulty in

71 describing feelings, (iii) a limited imagination and poor fantasy life, and (iv) a cognitive style

72 focused on external reality. For these reasons, one could hypothesize a key role of alexithymia in

73   the emotional recognition deficit of addicts, given the relevance of this disorder in this clinical

74   condition (Craparo, 2014; Craparo et al., 2014a; Faraci et al., 2013; Torrado, Ouakinin &

75   Bacelar-Nicolau, 2013; Craparo et al., 2014b; Craparo et al., 2014c). Indeed, as reported by

76   Farges et al., (2004), the prevalence of alexithymia in addicts is 43.5%, compared to 24.6% in

77   healthy controls, as documented by using the TAS-20. The study of alexithymia in heroin

78   addiction is important, because it can provide insights about the origin of the emotional

79   processing deficit in this clinical population, as reported by the literature.

80   The research on addicts has also provided evidence of neurobiological alterations in addicts,

81   which might explain the emotional recognition deficit in this clinical population. For instance,

82   Kornreich et al. (2003) proposed that the origin of this deficit might be due to the chronic abuse

83   of drugs, which might cause deleterious effects on brain functions involved in decoding facial

84   expressions. This suggestion appears likely, given the evidence of the impaired activity of

85   several key regions for emotion (and reward) processing such as the insula, the cingulate cortex,

86   and the amygdale in addicts (Naqvi & Bechara, 2009; Di chiara et al., 1999; Vicario et al., 2014).

87   However, these dysfunctions should not be conceived as separate from alexithymia, rather as

88   possible neural substrates. In fact, research has linked alexithymic features to abnormal activity

89   of the amygdale (Kugel et al., 2005) and the frontocingulate cortices (Berthoz et al., 2002).

90   In the current research we addressed, for the first time, the impact of alexithymia in the

91   emotional processing deficits of heroin addicts. Indeed, despite previous studies having shown

92   that these two phenomena are closely linked in other clinical populations such as adults with

93   somatoform disorders (Pedrosa et al., 2009), this remains to be investigated in heroin addicts.

94   Thus, we measured participants' accuracy (i.e., proportion of correct answers) and reaction times

95   (RTs) in detecting affective expressions. According to previous studies documenting a role of

96   alexithymia in emotional recognition deficits, we expect to detect a positive relationship between

97   alexithymia severity and the difficulty in detecting negative emotions.

98

99   **Methods**

100   *Participants*

101   Sixty-two participants were selected for the current study. The drug addiction group was

102   composed of thirty-one participants (4 cocaine/heroin addicts, 25 males, average age 34.83 ±

103   8.6); The thirty-one healthy participants (control group) was composed by 25 males, average age

104   33.83 ± 8.70). No between group difference has been detected with respect to the age (t=0.45,

105   p=0.65). The four participants consuming both cocaine and heroin were excluded from the

106   analysis in order to have a homogeneous clinical group. The clinical group was selected in two

107   special sanitary treatment centers for drug addictions in Enna and Florence (Italy). All patients

108   were undergoing methadone treatment. Inclusion criteria were: i) diagnosis of heroin addiction;

109   ii) no previous experience of psychotherapy; iii) no diagnosis of severe mental illness (e.g.

110   psychosis, schizophrenia, major depression, anxiety, post-traumatic stress disorder); iv) absence

111   of other forms of addiction (according to the Addictive Behaviour Questionnaire, Caretti in

112   press). The clinical diagnosis was made by a psychiatrist, according to the DSM V criteria, by

113   clinical interview. Moreover, all patients underwent blood and urine tests to confirm the type of

114   drug addiction and exclude any further comorbidity.The period of drug-taking ranged between 5

115   and 8 years. The healthy group was selected among university students and patients' relatives.

116   They were screened through a clinical interview, aiming to mainly exclude any form of

117   addiction. This study was conducted in accordance with the requirements of the Helsinki

118   convention and approved by the local ethical committee of Kore University. Informed consent

119   was obtained from all participants.

120

121   *Measures and Stimuli*

122   The 20-item Toronto alexithymia scale (TAS-20) is a self-report scale used to measure

123   alexithymia. It is composed of three subscales: 1) Difficulty identifying feelings (DIF); 2)

124   Difficulty describing feelings (DDF); 3) Externally oriented thinking (EOT). Bagby et al. (1994)

125   proposed three cut-off scores in order to discriminate alexithymic (≥ 61), borderline (score range

126   between 51 to 60), and non alexithymic individuals (≤ 50). A set of pictures were used,

127   representing the six basic emotions: happiness, sadness, fear, disgust, contempt and anger. For

128   our sample we used an Italian validated version made by Bressi et al. (1996). The scale was

129   administered, in a multicenter research project, in a nonclinical sample of 206 adults and a

130   nonclinical sample (medical and psychiatric disorders) of 642 subjects, showing good

131   psychometric properties (high reliability and validity; Bressi et al., 1996). We used photos of

132   easy emotional intensity level from the Facial Action Coding System (Ekman, Friesen & Hager,

133   1978). Stimuli were presented in a random order via Personal Computer.

134

135   *Procedure*

136   Participants were invited to fill out the TAS-20 questionnaire, evaluate and categorize facial

137   emotion expressions elicited from the photos representing the basic emotions (fear, anger,

138   disgust, happy, sadness, surprise, contempt). They were asked to name the emotion displayed in

139   each photo, presented in a random order and in absence of specific cues. Accuracy and reaction

140   times (RT) (using an electronic chronometer) were recorded. The administration of both

141   questionnaire and pictures was done in a silent room of the center for drug addicts, by using a

142   face-to-face method. The average time of each session was about 45 minutes.

143
144   *Data analysis*

145   We first used the two tailed t-test to compare the TAS-20 scores of our heroin addicts vs. control

146   participants. Data including group and emotion as main factors were entered in a repeated-

147   measures ANOVA to detect any between group difference with respect to the examined

148   variables (Accuracy and RTs). Following this, we performed a hierarchical multivariate

149   regression analysis using alexithymia (i.e., the TAS-20 score) as a predictor and emotional

150   recognition performance (i.e., the overall average for both RTs and accuracy) as an outcome,

151   controlling for the age of participants and the years of exposure to heroin. Finally, we performed

152   a Pearson correlation analysis to investigate whether the exposure to heroin predicts alexithymia

153   severity.

154   For all tests, the level of statistical significance was set at $p< 0.05$. Data analyses were performed

155   using the Statistica software, version 8.0, StatSoft, Inc., Tulsa USA and IBM SPSS Statistics 20.

156

157   **Results**

158   *Alexithymia index*: As expected, we detected a significant between groups difference (t=4.36,

159   p<0.001) comparing TAS-20 scores of addicts (M=57.6 ± 16.7 SD) with respect to controls

160   (M=41.83 ± 10.5 SD). This shows that control participants are, on the average, not affected by

161   alexithymia (i.e., TAS-20 score ≤ 50), while addicts participants can be classified in the

162   borderline category with respect to the alexithymia index (i.e., TAS-20 score > 50 and < 60). No

163   gender difference is reported in both groups with respect to the TAS-20 scores (p>0.131).

164   Further analyses show significant difference between the three subscales, in both the clinical

165 [F(2,52)=18.52, p<0.001] and the control [F(2,52)=19.49, p<0.001] samples. In particular, we

166 documented a lower score in the DIF sub-scale, compared to the DDF (p<0.001) and the EOT

167 (p<0.001) scales in the clinical sample; Moreover, we documented higher scores in the EOT sub-

168 scale, compared to the DIF (p<0.001) and DDF (p<0.001) subscales of the control sample.

169 *Emotions recognition accuracy:* The repeated measure ANOVA detected a significant main

170 effect for the Group factor [F(1,60)=5.68, p=0.021], documenting a lower accuracy (i.e.,

171 proportion of correct responses) for the clinical sample (M=0.650 ± 0.037) in detecting

172 emotional stimuli compared to the control sample (M=0.774 ± 0.035). We also detected a

173 significant main effect of the Emotion factor [F(6,354)=18.0, p< 0.001]. However, the Group x

174 Emotion interaction term was not significant [F(6,354)=1.47, p=0.189]. No gender difference

175 was reported in emotion accuracy (p=0.851). The figure 1A shows details concerning the

176 participants' performance with respect to the accuracy in the detection of the seven emotions.

177 *Emotion recognition reaction times (RTs):* We detected a significant main effect for the Group

178 factor [F(1,55)=4.85, p=0.032], documenting higher RTs for the clinical sample (M=7.74 ±

179 0.608) in detecting emotional stimuli compared to the control sample (M=5.90 ± 0.567). In

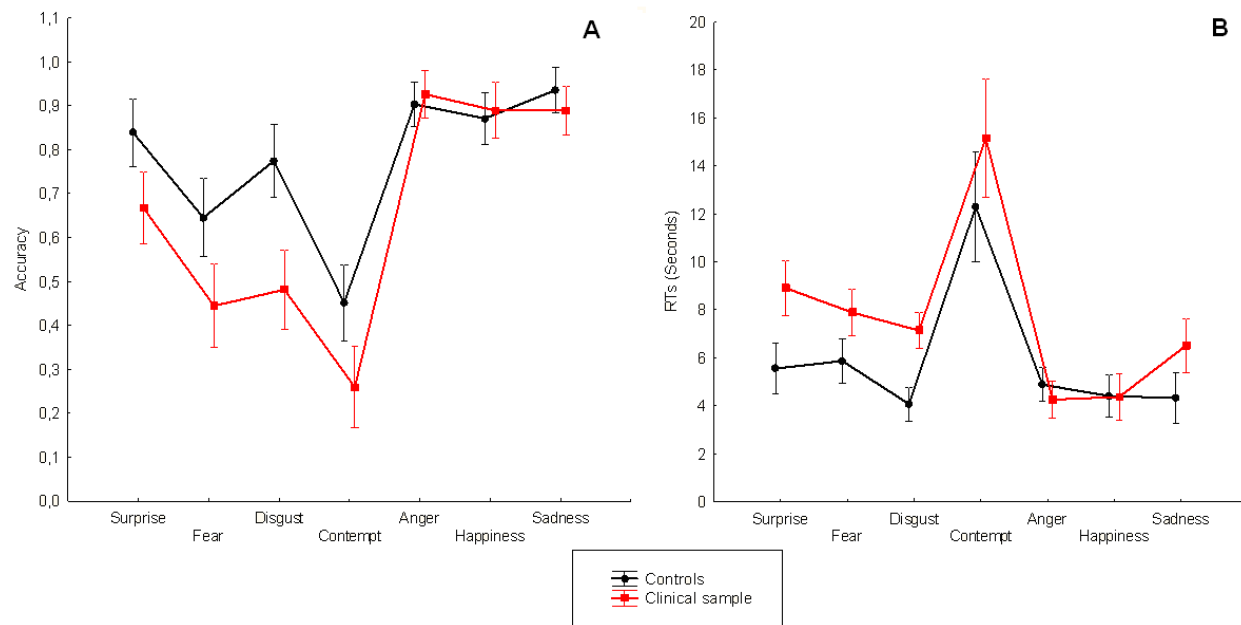
180 similar fashion, we documented a significant main effect for the Emotion factor [F(6,156)=14.7,

181 p<0.001]. In contrast, no significant difference has been reported for the Group x Emotion

182 interaction term [F(6,156)=0.86, p=0.522]. The figure 1B shows details concerning the

183 participants' performance with respect the RTs in the detection of the seven emotions. No gender

184 difference is reported in emotion RTs (p=0.639)

185

186 **Figure 1.** *A*. The figure shows the proportion of correct responses (i.e. accuracy) for healthy

187 controls and heroin addicts (i.e. clinical sample) in the recognition of the facial expressions of

188 emotions. The figure shows relevant differences for the recognition of Surprise, Fear, Disgust

189 and Contempt. *B.* The figure shows RTs of healthy controls and heroin addicts (i.e. clinical

190 sample) in the recognition of the facial expressions of emotions. The figure shows relevant

191 differences only for the detection of Surprise, Fear, Disgust, Contempt and Sadness. Vertical

192 Bars indicate standard error.

193 *Hierarchical multivariate regression analysis:* With respect to the RTs variable, the initial

194 analysis (model 1, i.e. including the age and the years of exposure to heroin as predictors)

195 provides significant results [$F_{(2,57)}$=4.97, p=0.010], with no effect of age on performance

196 (p=0.153), while the years of exposure to heroin was significant (p=0.036). This model explain

197 15% of the variance. The inclusion of the alexithymia (TAS-20 score) variable as predictor (i.e.

198 model 2, including age, years of exposure to heroin, alexithymia) cancels the effect of exposure

199 to heroin (p=0.420), while the effect of the alexithymia variable was significant (p=0.048). This

200   model explains 21% of the variance. With respect to accuracy parameters, both the model 1

201   [F(2,57)=2.68, p=0.077] and the model 2 [F(2,57)=2.40, p=0.078] were not significant.

202

203   Discussion

204   Several studies have linked alexithymia to addiction. Moreover**,** alexithymia has been associated

205   with deficits in emotion recognition performance. However, the literature documents contrasting

206   results while examining emotion recognition performance in addicts, with evidence of both

207   lower (e.g., Kornreich et al., 2003) and higher (e.g., Martin et al., 2006; Zhou et al., 2012)

208   accuracy in this population. Nevertheless, no research has directly investigated the link between

209   alexithymia and emotion recognition performance in heroin addicts.

210   Overall, in the current research we show that heroin addicts are less accurate and slower in the

211   recognition of facial expressions of emotions, compared to healthy controls. This result

212   corroborates the research of Kornreich et al. (2003) which reported a similar pattern of results,

213   whilst appearing to contrast with the study of Zhou et al. (2012) who documented better

214   performance in the recognition of negative emotions and also with the study of Martin et al.

215   (2006), who reporting higher accuracy in disgust recognition. However, our data corroborates the

216   results of Zhou et al. (2012), documenting slower RTs of heroin addicts in the overall emotion

217   recognition, although only for the recognition of the expressions of negative emotions.

218   A novel result emerging from the hierarchical multivariate regression analysis, which fits with

219   our main research hypothesis, is that alexithymia explains the between groups difference with

220   respect to the RTs. This suggests that the poor performance of heroin addicts documented in our

221   study can be explained, at least in part, by referring to their alexithymia traits. This is also in

222   agreement with the research on somatoform disorder patients (Pedrosa Gil et al., 2009) and on

223   Asperger syndrome (Kätsyri et al., 2008). Finally, we detected a positive correlation trend

224   between years of exposure to heroin and TAS-20 scores, suggesting that the progressive use of

225   this drug might increase alexithymia severity.

226   The slower performance in emotion recognition, as reported in our work, which depends on

227   alexithymia, might originate from the effect of heroin exposure to the neural circuits that appear

228   to be critical in emotion processing, such as the insula, the amygdala, orbitofrontal cortex, the

229   anterior cingulated cortex and the basal ganglia (e.g., see Adolphs, 2002 for a review). In fact,

230   there is evidence (Liu, et al., 2011; Li et al., 2003) of functional dysregulation of these regions in

231   heroin abusers. Interestingly, these neural regions have been reported to be impaired in people

232   with alexithymia (Berthoz et al., 2002; Mantani et al., 2005). Therefore, according to our

233   correlation analysis, one could hypothesize that the long term exposure to heroin might

234   exacerbate, if not even trigger, alexithymia, resulting in this effect on the neural system.

235   Alexithymia has been well documented across different disorders, including autism and eating

236   disorders. This may explain, at least in part, the emotional difficulties across these populations.

237   This leads to speculation that alexithymia intervention programs may lead to improvements in

238   social and emotional abilities across a wide range of clinical conditions.

239   Future works investigating emotion processing in addiction might expand the current

240   investigation by exploring the links between alexithymia, psychopathic traits, withdrawal

241   symptoms and emotion recognition.

242

243   **Limitations**

244   The distribution of alexithymia scores and the gender variable was not balanced between our two

245   groups of participants. A further limitation is the absence of information about the psychopathic

246   traits in our clinical sample. In similar fashion, we did not investigated psychopathologic

247   symptoms in relation to alexithymia. Finally, RTs were detected by using a stopwatch rather than

248   a computerized system.

249

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