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, the addiction to drugs is frequently associated with deficient

34 interpersonal relationships (Kornreich et al., 2002). This could be due to impaired processing of

35 emotional information related to social interactions (Kornreich, et al., 2003), though other factors

36 such as the degree of dependence and the drug related life style may be also be involved in such

37 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. The research by Lindsay and Ciarocchi

68   (2009) proposes 2 different potential explanations. One might refer to the mood, which is more

69   negative in substance abusers (Lindsay and Ciarocchi, 2009), compared to controls. In fact,

70   Haviland et al. (1994) found that negative mood (i.e., depression) predicts alexithymia. The

71   alternative explanation might refer to the inaccurate belief / low-motivation of addicts. As

72   explained by the authors, if people believe that they are not able to deal effectively with their

73 emotions, they may be less motivated to do so. Less motivation, in turn, may lead to more

74 alexithymic behaviour. For these reasons, one could hypothesize a key role of alexithymia in the

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

99 alexithymia severity and the difficulty in detecting negative emotions.

100

101 **Methods**

102 *Participants*

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

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

105 8.6); The thirty-one healthy participants (control group) was composed by 25 males, average age

106 33.83 ± 8.70). No between group difference has been detected with respect to the age (t=0.45,

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

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

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

110 were undergoing methadone treatment. The methadone dosage ranged between 20 a 80 mg per

111 day. No psychosocial treatment was provided. Inclusion criteria were: i) diagnosis of heroin

112 addiction; ii) no previous experience of psychotherapy; iii) no diagnosis of severe mental illness

113 (e.g. psychosis, schizophrenia, major depression, anxiety, post-traumatic stress disorder); iv)

114 absence of other forms of addiction (according to the Addictive Behaviour Questionnaire, Caretti

115 in press); v) the use of other drugs. The clinical diagnosis was made by a psychiatrist, according

116 to the DSM V criteria, by structured clinical interview. Moreover, all patients underwent blood

117 and urine tests to confirm the type of drug metabolites. The urine test were negative for cannabis

118 use. The period of drug-taking ranged between 5 and 8 years. The healthy group was selected

119   among university students and patients' relatives. They were screened through a clinical

120   interview, aiming to mainly exclude any form of addiction. This study was conducted in

121   accordance with the requirements of the Helsinki convention and approved by the local ethical

122   committee of Kore University. Informed consent was obtained from all participants.

123

124   *Measures and Stimuli*

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

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

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

128   proposed three cut-off scores in order to discriminate alexithymic ($\geq$ 61), borderline (score range

129   between 51 to 60), and non alexithymic individuals ($\leq$ 50). A set of pictures were used,

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

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

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

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

134   psychometric properties (high reliability and validity; Bressi et al., 1996). In particular, as

135   reported by the authors, the goodness-of-fit was evaluated using four criteria recommended by

136   Cole (1987) and Marsh et al. (1988) viz., goodness-of-fit (GFI) $\geq$ 0.85; adjusted goodness-of-fit

137   (AGFI) $\geq$ O.BO; the root-mean-square residual (RMSR) $\leq$0.10; and the Tucker-Lewis index

138   (TLI) $\geq$ 0.80. For the normal adult sample, the (GFI) (0.88), the (AGFI) (0.84), RMSR (0.07),

139   and TLI (0.80) all met the criteria standards, thus indicating adequacy of fit. Similar results were

140   obtained with the clinical out-patient sample, with the GFI (0.95), AGFI (0.93) RMSR (0.05),

141   and TLI (0.90) all meeting the criteria standards.

142 We used photos of easy emotional intensity level from the Facial Action Coding System

143 (Ekman, Friesen & Hager, 1978). Stimuli were presented in a random order via Personal

144 Computer.

145 *Procedure*

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

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

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

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

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

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

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

153
154 *Data analysis*

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

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

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

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

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

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

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

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

163 severity.

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

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

166

167   **Results**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

189   0.608) in detecting emotional stimuli compared to the control sample (M=5.90 ± 0.567). In

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

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

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

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

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

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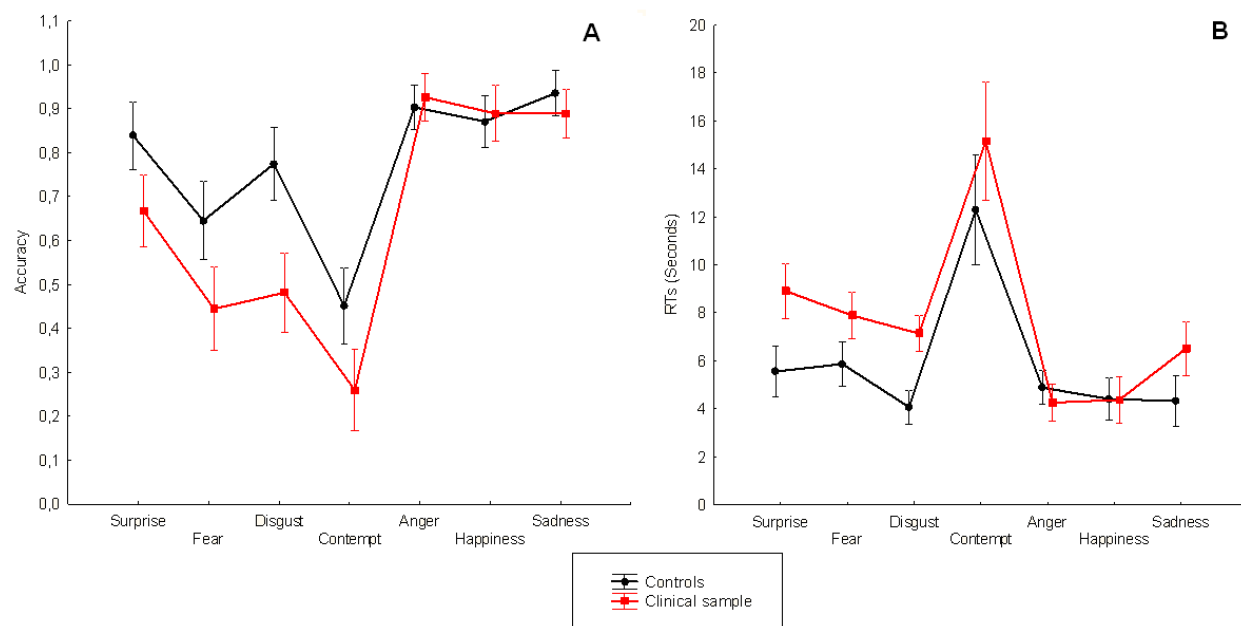
196   **Figure 1.** *A*. The figure shows the proportion of correct responses (i.e. accuracy) for healthy

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

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

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

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

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

202   Bars indicate standard error.

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

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

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

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

207 15% of the variance. The inclusion of the alexithymia (TAS-20 score) variable as predictor (i.e.

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

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

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

211 [$F_{(2,57)}=2.68$, $p=0.077$] and the model 2 [$F_{(2,57)}=2.40$, $p=0.078$] were not significant.

212

213 **Discussion**

214 Several studies (Craparo, 2014; Craparo et al., 2014a; Faraci et al., 2013; Torrado, Ouakinin &

215 Bacelar-Nicolau, 2013; Craparo et al., 2014b; Craparo et al., 2014c) have linked alexithymia to

216 addiction. Moreover**,** alexithymia has been associated with deficits in emotion recognition

217 performance (e.g., see Taylor & Bagby, 2013). However, the literature documents contrasting

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

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

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

221 alexithymia and emotion recognition performance in heroin addicts.

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

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

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

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

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

227   (2006), who reporting higher accuracy in disgust recognition. However, our data corroborates the

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

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

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

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

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

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

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

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

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

237   this drug might increase alexithymia severity.

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

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

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

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

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

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

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

245   correlation analysis, one could hypothesize that the long term exposure to heroin might at least

246   exacerbate alexithymia, resulting in this effect on the neural system.

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

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

249   This leads to speculate that alexithymia intervention programs may lead to improvements in

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

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

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

253   symptoms and emotion recognition.

254

255   **Limitations**

256   Several limitations should be mentioned with respect to the current study. Firstly, the distribution

257   of alexithymia scores and the gender variable were not balanced between our two groups of

258   participants. The clinical sample has been reduced because four participants were consuming

259   both cocaine and heroin. Further limitations might be referred to the absence of information

260   about the years of scholastic education; the methadone dosage and the presence of psychopathic

261   traits. In similar fashion, we did not investigate psychopathological symptoms in relation to

262   alexithymia. Finally, RTs were detected by using a stopwatch rather than a computerized system.

263

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