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RECOGNITION OF COMPLEX MENTAL STATES IN PATIENTS WITH ALCOHOLISM AFTER LONG-TERM ABSTINENCE

ADRIENNE MÁTYÁSSY[1], OGUZ KELEMEN[1], ZSUZSA SÁRKÖZI[1], ZOLTÁN JANKA[2] and SZABOLCS KÉRI[2]*

[1]Bács-Kiskun County Hospital, Psychiatry Center, [2]Kecskemét, Hungary, Departments of Psychiatry, University of Szeged, Semmelweis u. 6, Szeged, H-6725, Hungary

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Abstract — **Aims:** Previous studies demonstrated that patients with alcoholism display impaired emotional facial expression recognition even after long-term abstinence. These studies focused on basic emotions (happiness, anger, sadness, and disgust). In this study, we investigated the recognition of complex social emotions and mental states in patients with alcoholism after long-term abstinence and healthy control subjects. **Methods:** Thirty patients with DSM-IV alcohol dependence and 30 age-matched, gender-matched, education-matched, and IQ-matched healthy control subjects participated. The patients were abstinent for >6 months. For the assessment of the recognition of complex social emotions and mental states, the Baron-Cohen Eyes Test was used. The experimenter presented 29 photographs of the eye-region of faces of actors and actresses on separate cards. Participants were asked to choose which of the four words (one target and three foils) best described the mental state of the actor/actress (for example, interested, doubtful, flirtatious, and insisting). The primary dependent measure was the number of correctly recognized stimuli. **Results:** Patients with alcoholism correctly identified 22.4 (SD = 3.4) stimuli, whereas control participants identified 22.5 (SD = 2.9) stimuli. The difference was not statistically significant ($P = 0.85$). There was no significant difference in the proportion of patients and controls who correctly recognized each mental state. **Conclusions:** These results are against the hypotheses suggesting long-term adverse effects of alcohol on social cognition or supposing an inherent vulnerability of patients that may manifest before the development of alcohol dependence.

INTRODUCTION

Recent studies raised the possibility that emotional intelligence is impaired in patients with psychoactive substance addiction. Specifically, patients with alcoholism exhibited impaired processing of non-linguistic aspects of language during disclosure (Monnot *et al*., 2001) and deficient emotional facial expression recognition (Phillipot *et al*., 1999; Kornreich *et al*., 2001, 2003; Townshend and Duka, 2003). Interestingly, emotion recognition deficit was more severe in patients with alcoholism as compared with patients with opiate dependence (Kornreich *et al*., 2003) and was detected even after long-term abstinence (Kornreich *et al*., 2001). It has been proposed that facial emotion decoding problems could be present before the development of addiction and chronic alcohol consumption may have an additional detrimental effect on the decoding of social signals. The clinical significance of these findings is that altered social cognitive functions may contribute to the community adaptation failure of many patients, even after long-term abstinence.

The studies cited above investigated the perception of basic emotions such as happiness, anger, sadness, and disgust. However, social adaptation requires the decoding of more complex emotions and mental states, which are related to the observer's hypothesis about the beliefs and intentions of others ('theory of mind', ToM). ToM dysfunctions are related to social and interpersonal problems detected in patients with autism and schizophrenia (Abu-Akel, 2003). Baron-Cohen *et al*. (2001) developed the Eyes Test, which is suitable for the detection of mild impairments in the decoding of facial expressions of social emotions and complex mental states. In the Eyes Test, eye-regions of faces are presented and participants are asked to choose which of four words best describes the mental state of the person whose eyes are depicted on the photograph. During this test, participants match the eyes in each picture to memory representations and make decisions in the context of mental states. This process is dominantly unconscious and automatic, requiring 'gut feelings' rather than effortful verbal or visual processes. Patients with highly functioning autism and Asperger syndrome show impaired performances on the Eyes Test (Baron-Cohen *et al*., 2001). However, ToM dysfunctions, as measured with the Eyes Test, can be observed in several psychiatric disorders, including schizophrenia (Kelemen *et al*., 2005), euthymic bipolar disorder (Bora *et al*., 2005), unipolar major depressive disorder (Lee *et al*., 2005), and presumably certain personality disorders (for a review, see Kéri, 2006).

Results from functional neuroimaging studies revealed test-related activation in brain areas related to ToM (dorsomedial prefrontal cortex and superior temporal cortex) (Calder *et al*., 2002; Platek *et al*., 2004), which is consistent with data from patients with autism-spectrum disorders who perform poorly on the Eyes Test (Baron-Cohen *et al*., 2001). Shaw *et al*. (2005) demonstrated that damage to the amygdala and right prefrontal cortex resulted in an impaired recognition of complex mental states in the Eyes Test.

Our main question was whether patients with alcoholism who are abstinent for a long period of time display dysfunctions on the recognition of social emotions and complex mental states. We hypothesized that as a part of general social cognitive dysfunctions related to alcoholism, our patients would show impaired performances on the Eyes Test.

MATERIALS AND METHODS

Subjects

Participants were 30 patients with DSM-IV alcohol dependence (American Psychiatric Association, 1994) and 30 healthy control subjects who *were social drinkers*. Inclusion criteria were abstinence for >6 months and scores <10 on the

*Author to whom correspondence should be addressed: Tel.:+36 62 545 363; E-mail: szkeri@phys.szote.u-szeged.hu

Beck Depression Inventory (BDI) (Beck, 1987). General psychosocial functions were assessed with the Global Assessment of Functioning (GAF) scale (American Psychiatric Association, 1994). Patients also received the Addiction Severity Index (ASI) semi-structured interview (McLellan *et al*., 1980) and the International Neuropsychiatric Interview Plus (Sheehan *et al*., 1998). General intellectual functions (IQ) were assessed with the Wechsler-scale (Wechsler, 1981). Subjects with concurrent DSM-IV Axis I disorders and history of brain injury and neurological disorders were excluded from the study. The demographic details are shown in Table 1. After a full description, subjects gave their informed consent to participate in the study.

Eyes Test

Each participant received the revised version of the Eyes Test in a quiet room. The experimenter presented 29 photographs of the eye-region of faces of actors and actresses. Each stimulus was presented on separate cards. Participants were asked to choose which of the four words (one target and three foils) best described the complex mental state of the actor/actress (for example, interested, doubtful, flirtatious, and insisting). The four words were depicted on the cards, and the participant read aloud the chosen word. The experimenter signed the response on a separate sheet of paper. As a control task, each participant was asked to judge the gender of the person shown on the photograph. Before the test, subjects were asked to read through a glossary, which contained the meaning of the words describing each mental state. If necessary, participants were allowed to use the glossary during the test. The dependent measure was the number of correctly identified mental states from the 29 photographs (for a detailed description, see Baron-Cohen *et al*., 2001).

Table 1. Demographic data, IQ, and Eyes Test scores in patients with alcoholism (ALC) and healthy control participants (HC)

	ALC (n = 30)	HC (n = 30)
Age (years)	37.6 (11.7)	36.3 (10.1)
Education (years)	12.1 (3.2)	11.4 (3.8)
Male/female	18/12	20/10
IQ	108.5 (10.9)	112.7 (14.2)
Global Assessment of Functioning (GAF)	71.1 (14.6)	74.4 (10.7)
Eyes Test	22.4 (3.4)	22.5 (2.9)
Duration of illness (years)	6.2 (4.5)	–
ASI substance use	0.24 (0.36)	–
ASI personal health (medical)	0.11 (0.24)	–
ASI personal health: psychiatric	0.12 (0.30)	–
ASI social functioning: employment	0.42 (0.53)	–
ASI social functioning: family/social	0.09 (0.15)	–
ASI social functioning: legal	0.10 (0.12)	–

Data are mean (SD). ASI, addiction severity index composite scores, past 30-day data before the onset of abstinence period; Student's t-tests revealed no significant differences for these measures ($P > 0.2$).

Table 2. Number (percentage) of patients with alcoholism (ALC) and healthy control participants (HC) who chose the correct target description of mental states

Mental state	ALC (n = 30)	HC (n = 30)
Playful	10 (33%)	12 (40%)
Upset	16 (53%)	15 (50%)
Desire	22 (73%)	21 (70%)
Insisting	24 (80%)	25 (83%)
Worried	28 (93%)	27 (90%)
Fantasizing	21 (70%)	25 (83%)
Uneasy	25 (83%)	24 (80%)
Despondent	26 (87%)	26 (87%)
Preoccupied	17 (57%)	19 (63%)
Cautious	19 (63%)	20 (67%)
Regretful	26 (87%)	27 (90%)
Sceptical	15 (50%)	13 (43%)
Anticipating	22 (73%)	21 (70%)
Accusing	19 (63%)	23 (77%)
Contemplative	23 (77%)	25 (83%)
Thoughtful	23 (77%)	23 (77%)
Doubtful	24 (80%)	26 (87%)
Decisive	27 (90%)	24 (80%)
Tentative	27 (90%)	26 (87%)
Friendly	17 (57%)	19 (63%)
Defiant	27 (90%)	25 (83%)
Pensive	22 (73%)	22 (73%)
Interested	25 (83%)	24 (80%)
Hostile	21 (70%)	23 (77%)
Flirtatious	19 (63%)	17 (57%)
Distrustful	11 (37%)	13 (43%)

RESULTS

Patients with alcoholism and healthy control subjects displayed nearly identical performances on the Eyes Test (Table 1). Student's t-tests revealed no significant differences between the two groups ($t(58) = 0.19$, $P = 0.85$).

Table 2 shows the percentage of patients and controls who chose the correct mental state for each stimulus. Chi-square tests indicated that the distribution of patients and controls who chose the correct target word or one of the foils did not differ ($P > 0.2$).

DISCUSSION

Our results indicate intact recognition of social emotions and complex mental states in patients with alcoholism after long-term abstinence. These data do not support the assumption suggesting long-term adverse effects of alcohol on social cognition or supposing an inherent vulnerability of patients that may manifest before the development of alcohol dependence.

The main limitation of the present study is that only a single test was used, and, therefore, more general conclusions on the social cognitive abilities of patients with alcoholism cannot be drawn. Normative scores of healthy participants on the Eyes Test have been replicated and validated by several studies (Baron-Cohen *et al*., 2001; Lawrence *et al*., 2004; Kelemen *et al*., 2005; Shaw *et al*., 2005). Our previous analysis revealed that the reliability of the Eyes Test is sufficient (Cronbach's alpha = 0.81).

Kornreich *et al*. (2001) investigated 25 patients with alcoholism who were abstinent at least for 2 months and found lower emotion decoding accuracy for anger and disgust. In 14 patients who were abstinent only for 2 weeks,

Townshend and Duka (2003) also demonstrated impaired emotion recognition for anger and disgust. Fear response was enhanced for all types of emotions. In contrast to these studies, which investigated a restricted range of basic emotions, we aimed to look at the recognition of a wide range of social emotions and complex mental states that contribute to the representation of others' beliefs and intentions. In contrast to our expectations, patients with alcoholism showed intact performances. There are several possible explanations for these seemingly discrepant findings. First, it is possible that patients with alcoholism show selective recognition dysfunctions for specific primary emotions and intact decoding of more complex facial emotion expressions with social relevance. Innate primary emotions (e.g. anger, fear) and associated displays are believed to be modulated by the right hemisphere. In contrast, social emotions (e.g. guilt, jealousy) and associated 'display rules' are thought to be modulated by the left hemisphere. Display rules can modulate primary emotional displays for social purposes. Evidence suggests that upper facial displays are processed by the right hemisphere, as part of the primary emotional system, while lower facial displays are processed by the left hemisphere, as part of the social emotional system (Prodan *et al*., 2001). We speculate that these mechanisms may be differentially impaired in patients with alcoholism. Further studies are necessary to explicitly test this hypothesis.

Second, long-term abstinence, lack of co-morbid conditions and depressive symptoms, and relatively high psychosocial functioning suggest that our patients exhibited a less severe form of alcohol addiction. Our sample is characterized by a relatively late onset of addiction (Table 1), which may have prevented the patients form a toxic effect of alcohol on the developing brain. Third, previous studies used entire faces depicting different intensities of emotions (Kornreich *et al*., 2001, 2003; Townshend and Duka, 2003), whereas in the Eyes Test subjects view eye-regions and are asked to choose the appropriate word for the mental state. It is possible that patients with alcoholism are not able to synthesize many emotion cues in a face, but they are able to comprehend a few details such as the eye region. Further studies are warranted to test this hypothesis.

Cognitive deficits related to the abnormal functioning of the prefrontal cortex are recognized in alcoholism, independently from co-morbid conditions such as depression (Uekermann *et al*., 2003). Kornreich *et al*. (2001) suggested the impairment of right fronto-temporal and cingulate cortex, whereas Townshend and Duka (2003) emphasized the role of amygdala as a neural substrate of enhanced fear response. Interestingly, the impairment of facial emotion recognition can be observed in patients who display normal performances on tests of prefrontal functions (Townshend and Duka, 2003). The Eyes Test evokes a unique pattern of brain activity, including dorsomedial prefrontal and superior temporal cortex (Calder *et al*., 2002), and damage to the amygdala and right prefrontal cortex leads to impaired performances on the Eyes Test (Shaw *et al*., 2005). These areas are important in the processing of social information and in the recognition and attribution of complex mental states. Our data suggest that the functional capacity of this social cognitive brain network is spared in patients with alcoholism after long-term abstinence.

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