УДК 616.89-008.454:616.89-008.434
https://doi.org: 10.20538/1682-0363-2021-1-90-97

Attachment style and accuracy of facial expression recognition in depression

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ABSTRACT

Aim. To investigate links between the attachment style and ability to detect facial emotions using a functional magnetic resonance imaging (fMRI) paradigm in depressed patients.

Materials and methods. Participants diagnosed with mild to moderate depression or dysthymia (19 patients) and healthy volunteers (20 individuals) were to identify one of eight basic emotions on 48 photos by choosing the appropriate answer from two options. Attachment was measured using the Experience in Close Relationships Scale. In addition, depression, alexithymia, and rumination were estimated as other possible correlates.

Results. In the group of patients with depression, anxious attachment score had a negative correlation with the accuracy of angry facial expression detection ($\rho = –0.65$, $p < 0.01$) and a positive correlation with the accuracy of sad facial expression recognition ($\rho = 0.48$, $p < 0.05$). Patients with high total rumination ($\rho = –0.48$, $p < 0.05$) and depressive rumination ($\rho = –0.53$, $p < 0.05$) scores also detected angry facial expression less accurately. None of the mentioned relationships were present in healthy people, however, they demonstrated a correlation of the total number of portraits tagged as “sad” with the brooding rumination score ($\rho = 0\ .53$, $p < 0.05$).

Conclusion. Attachment disruptions in depressed patients may be related to aggravation of the deficit in the ability to detect emotions of others.

Key words: mood disorders, emotions, emotional intelligence, empathy.

Conflict of interest. The authors declare the absence of obvious or potential conflict of interest related to the publication of this manuscript.

Source of financing. The study was supported by the Russian Science Foundation (project No. 16-15-00183).

Conformity with the principles of ethics. All individuals were notified of the objectives of the study and signed an informed consent to participate in the study. The study was approved by the Ethics Committee at the Research Institute of Molecular Biology and Biophysics, Federal Research Center of Fundamental and Translational Medicine (Protocol No. 1 of 08.06.2016).

For citation: Melnikov M.Ye., Bezmaternykh D.D., Kozlova L.I., Natarova K.A., Shtark M.B. Attachment style and accuracy of facial expression recognition in depression. *Bulletin of Siberian Medicine.* 2021; 20 (1): 90–97. https://doi.org: 10.20538/1682-0363-2021-1-90-97.

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Стиль привязанности и распознавание эмоциональной мимики при депрессии

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РЕЗЮМЕ

Цель. Изучить связи между стилем привязанности и способностью к распознаванию эмоциональной экспрессии в условиях эксперимента с использованием функциональной магнитно-резонансной томографии у пациентов с депрессией.

Материалы и методы. Испытуемые с легким, умеренным депрессивным эпизодом или дистимией (19) и здоровые добровольцы (20) должны были определить одну из восьми базовых эмоций на 48 фотографиях, выбрав из двух вариантов верный. Для оценки стиля привязанности использовался Опросник привязанности к близким людям. Дополнительно оценивался уровень депрессии, алекситимии и руминации как другие возможные корреляты.

Результаты. В группе депрессии выраженность тревожного стиля привязанности обратно коррелировала с точностью определения мимики гнева ($\rho = –0,65$, $p < 0,01$), а положительно – с качеством распознавания печальных лиц ($\rho = 0,48$, $p < 0,05$). Экспрессия гнева также хуже распознавалась пациентами с высоким баллом по шкале руминации в целом ($\rho = –0,48$; $p < 0,05$) и подшкале депрессивной руминации ($\rho = –0,53$; $p < 0,05$). У здоровых людей не выявлены упомянутые связи, однако число портретов, определенных как печальные, было ассоциировано с подшкалой навязчивых мыслей шкалы руминации ($\rho = 0,53$, $p < 0,05$).

Заключение. Нарушения привязанности при депрессии могут быть связаны с усугублением дефицита способности к определению эмоций других людей.

Ключевые слова: аффективные расстройства, эмоции, эмоциональный интеллект, эмпатия.

Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

Источник финансирования. Работа выполнена при поддержке Российского научного фонда (проект № 16-15-00183).

Соответствие принципам этики. Все пациенты подписали информированное согласие на участие в исследовании. Проект одобрен этическим комитетом НИИ молекулярной биологии и биофизики, Федеральный исследовательский центр фундаментальной и трансляционной медицины (протокол № 1 от 08.06.2016).

Для цитирования: Мельников М.Е., Безматерных Д.Д., Козлова Л.И., Натарова К.А., Штарк М.Б. Стиль привязанности и распознавание эмоциональной мимики при депрессии. *Бюллетень сибирской медицины.* 2021; 20 (1): 90–97. https://doi.org: 10.20538/1682-0363-2021-1-90-97.

INTRODUCTION

Emotional intelligence disruptions defined as difficulties in understanding emotions of other people are frequent in depression. Patients with a current depressive episode are worse at deducing emotions from facial expressions than remitted ones, and those with a history of depression perform poorer in this task than people with no lifetime history of depression [1]. This feature is partly related to a dysfunction at the late stage of the perceptual processing leading to a more negative evaluation of the external stimuli [2]. However, a deficit in emotion recognition may be influenced

by other, more specific factors, namely an attachment disruption, which develops and is manifested in the early mother-infant relationships, according to J. Bowlby's original theory [3]. M. Ainsworth et al. defined three main attachment styles, namely secure, anxious, and avoidant; the latter including the dismissive and the fearful subtypes [4].

C. Hazan and P. Shaver [5] hypothesized that the attachment style determines adult behavior in romantic relationships. While people with the secure attachment style expect reliability and safety, those with the anxious style use relationships as a means to cope with a feeling of a threat and are afraid of losing a social bond perceived as defense. The avoidant attachment style is related to suppression of both a feeling of a threat and social needs [6, 7]. People with anxious and avoidant attachment styles, compared to those with the secure style, demonstrate selective attention to social stimuli [6, 7]. Associations between the attachment style and responses to facial expressions in adults are established in a number of studies [1, 6, 8–10]. In depressed patients, the anxious attachment style is frequent [11]. However, both dysfunctional attachment styles are related to a risk of depression [12] and the presence of a comorbid social phobia aggravating the affective symptoms [13].

Multiple studies have focused on neuroimaging correlates of attachment. In such studies, simple tasks aimed at uncovering some features of the attachment style are performed during fMRI scanning [7, 14–16] or EEG recording of event-related potentials [8, 9].

The aim of the study was to explore the associations between the prominence of pathological attachment styles and the accuracy of recognizing basic emotions in healthy participants and in patients with depression using fMRI.

MATERIALS AND METHODS

The study was a part of the project devoted to neuroimaging and psychological markers of depression and evaluation of the effectiveness of its non-pharmacological treatment. The experimental group included individuals aged 18–65 years with the first documented episode of unipolar depression. The participants received no pharmacological treatment and were unwilling to undergo any antidepressant therapy, which seems reasonable, since most patients had mild depression. Exclusion criteria were major psychiatric and neurological disorders as well as MRI contraindications. The experimental group consisted of 21 patients (6 men, 15 women, the average age was 34.3 ± 9.0 years, Beck Depression Inventory (BDI) score was 18.7 ± 10.5) who were diagnosed with a mild depressive episode (F32.0), moderate depressive episode (F32.1), or dysthymia (F34.1) according to ICD-10.

The control group comprised 21 healthy volunteers (6 men, 15 women, the average age was 33.8±8.5 years, BDI score 4.6 ± 4.5). The same set of exclusion criteria was applied, including the absence of a current affective disorder and affective disorders in the medical history. All variables presented as the mean ± standard deviation were normally distributed (Kolmogorov – Smirnov test, $p < 0.4$). The groups had no significant differences in gender ratio and the mean age. No data were obtained for two individuals from the depression group and one healthy volunteer, which resulted in their exclusion from the study.

All the participants signed an informed consent prior to their inclusion in the study. The study was approved by the Ethics Committee at the Research Institute of Molecular Biology and Biophysics, a division of the Federal Research Center of Fundamental and Translational Medicine (Protocol No. 1 of 08.06.2016).

The patients from the experimental group were invited by a licensed private therapist who verified the diagnosis of affective disorder and compliance with other inclusion criteria. The control group was recruited via an advertisement in the social network and by word of mouth from previous participants. Each control matched a patient from the experimental group in gender and age ± 5 years. Those who had given their consent to participate in the study first visited a licensed neurologist to rule out any major neurological disorder and then the International Tomography Center, Siberian Branch of Russian Academy of Sciences, for an imaging session. A reference MRI and a combined EEG-fMRI acquisition were performed with a few emotional paradigms. The behavioral data from one of them are analyzed in the current study. After the scanning session, a brief attention check was done. Namely, the participants looked at a number of photos and indicated those that they had seen during the scan-

ning session. After that, psychological questionnaires were completed. The Experience in Close Relationships and the Ruminative Response Scales were in a paper-and-pencil form, while other questionnaires were filled in via the BOS-Test (Comsib Ltd, Russia) software for psychological assessment. Upon completion of data collection, the participants received a small monetary reward and a CD with the reference structural image.

Psychological variables were assessed using the Experience in Close Relationships Scale [17] (an adaptation of the Experience in Close Relationships Scale [18]), the Ruminative Response Scale [19] (an adaptation of the Ruminative Response Scale [20]), the 26-item Toronto Alexithymia Scale, Beck Depression Inventory [21] (an adaptation of the Beck Depression Inventory [22]), and Zung Self-Rating Depression Scale [23] (in an adaptation [24]). The levels of rumination, alexithymia, and general depression were estimated in order to find out whether results of correlation analysis were related primarily to attachment or to more general variables. Age was also included in the analysis in order to check its possible influence on the main results.

The facial expression recognition paradigm was prepared using the Millisecond Inquisit software. Forty-eight photos of facial expressions (six photos for each basic emotion) from the Face-Place database (M.J. Tarr, Center for the Neural Basis of Cognition and Department of Psychology, Carnegie University, http://www.tarrlab.org/) were presented in a pseudorandom order. There were eight basic emotions, namely anger, confusion, disgust, fear, happiness, sadness, surprise, and a neutral facial expression. Each photo was accompanied by two possible answers, and the participant had to choose the correct one by pressing the corresponding button. The participants saw the photo and the answers on the monitor screen; they were reflected in the head coil mirror of the scanner. We recorded 1) the number of answers in each category, regardless of their correctness and 2) the number of accurate responses in each category which was a sum of correct positive (sensitivity) and correct negative (specificity) answers for all photos which had this answer as an option. Associations between the participants' psychological features and facial expression recognition parameters were established by the Spearman's rank correlation coefficient ρ separately for each group using the IBM SPSS 21.0 software. Due to a small sample size, the statistical power of the analyses in the current study allowed to discover correlations with $\rho = 0.45$ and above.

Thus, the cutoff score for significant correlations is nearly equivalent to an accepted border between weak and moderate correlations ($r = 0.4$) [25]. Since the study is aimed at highlighting prominent links, this obstacle does not seem to be a serious restriction. However, the negative results of the study should be interpreted with caution.

RESULTS

Depressed patients did not differ from healthy volunteers in the general accuracy of facial expression recognition (on average, 73% of correct answers in each group). The correlation analysis demonstrated that depressed participants exhibited a negative correlation between the anxious attachment score and the quantity of correct answers in the "anger" category (see Table 1 and Figure). A positive correlation between the anxiety attachment score and the quantity of correct answers in the "sadness" category was also established in this group.

Table 1

Spearman's rank correlation coefficient of the quantity of correctly recognized portraits for each emotion and attachment scores in depressed and healthy participants

Scale	Facial emotion							
	Anger	Confusion	Disgust	Fear	Happiness	Surprise	Sadness	Neutral
Depressed patients, $n = 19$:								
– anxious;	–0.30	–0.36	–0.14	0.045	–0.22	–0.08	0.19	0.19
– avoidant	–0.65[b]	–0.5	–0.09	0.14	–0.10	0.06	0.48*	–0.11
Healthy volunteers, $n = 20$:								
– anxious;	0.07	0.10	–0.26	–0.17	–0.30	–0.17	0.22	–0.35
– avoidant	0.21	0.14	0.15	0.18	0.14	–0.16	0.14	0.19

Note. * $p < 0.05$; b – $p < 0.05$ with the Bonferroni correction.

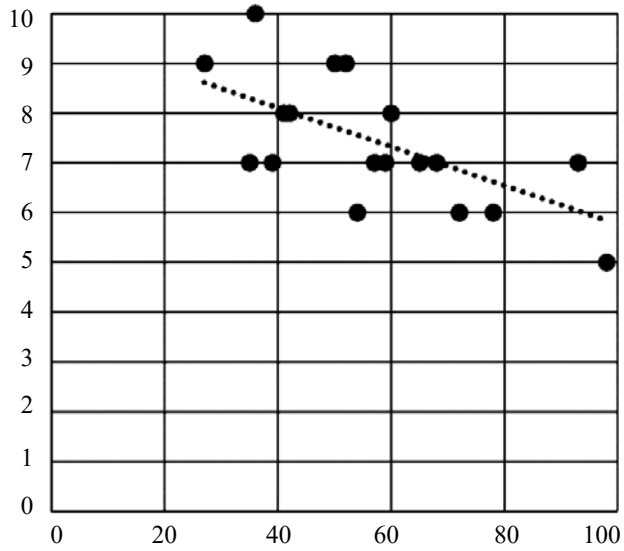

Figure. A scatter plot for anxious attachment score (abscises) and the quantity of correctly recognized anger expressions on photos (ordinates) in the group of depressed patients, ρ = –0.65.

In the depression group, the accuracy of recognizing the angry expression was also associated with general rumination (ρ = –0.48; $p = 0.04$) and depressive rumination (ρ = –0.53; p = 0.02). No such correlations for depression or alexithymia scores were discovered in any group. Correlations between age and facial emotion recognition were observed (Table 2). However, they were unrelated to the results mentioned above. An interesting general trend may be a decline in the facial expression recognition accuracy in healthy volunteers with age.

The correlations listed above did not work for the total number of answers (irrespective of correctness) identifying an emotion on the photo. No such significant correlations were present in the depressed group, while in the healthy group brooding rumination scores had a negative correlation with the total number of answers in the "sadness" category (ρ = 0.53; $p = 0.02$).

Table 2

Spearman's rank correlation coefficient of the quantity of correctly recognized portraits for each emotion and age in depressed and healthy participants

Group	Facial emotion							
	Anger	Confusion	Disgust	Fear	Happiness	Surprise	Sadness	Neutral
Depressed patients, $n = 19$	10	–0.22	0.01	–0.00	0.03	–0.51*	–0.09	–0.03
Healthy volunteers, $n = 20$	0.25	–0.60**	–0.09	–0.39	–0.62[b]	–0.33	–0.39	–0.58**

* $p < 0.05$; ** $p < 0.01$; [b] $p < 0.05$ with the Bonferroni correction.

Lastly, the number of answers in the "happiness" category had a positive correlation with the participants' age in the control group (ρ = 0.61; $p < 0.01$).

DISCUSSION

The most important and the only statistically significant result of the study following multiple comparison corrections is the link between the anxious attachment style and decreased accuracy of angry facial expression recognition established specifically in the depressed group. This association is of special interest because of higher prevalence of the anxious attachment style in depressed patients [11]. An additional correlation analysis demonstrated the absence of a correlation between angry facial expression recognition and age (ρ = 0.1, which would be a negligible association even if it became significant due to a larger sample [25]). The presence of weak yet significant correlations with the rumination scores allows to suppose a role of a more global cognitive style driven mostly by a reaction to social stimuli embodied in the term "attachment".

We found no published results on the relationship between the attachment style and facial expression recognition in depression. In social phobia, which is a frequent condition in depression, individuals with the anxious attachment style show faster reactions to emotional stimuli than to neutral ones [26]. However, this result is unspecific to certain emotions and most likely reflects increased emotional vulnerability, a trait related to anxious attachment [6].

The data previously collected from healthy volunteers of different age differ from ours to a large extent. In an event-related potential study, the differences in the early (50–120 ms) signal components during observation of aggressive and neutral facial expressions were registered only in participants with the avoidant attachment style [8]. In another study, participants with secure and anxious styles reacted more strongly to aggressive body language

than to neutral one [9]. Anxiety which was associated with the anxious attachment style was unrelated to emotion recognition in photos demonstrated subliminally and to corresponding shifts in the brain activity [15].

In a study on priming effects, an avoidant but not anxious attachment style was related to suppression of reactions to angry and sad facial expressions [6]. In adolescents, the secure attachment style was associated with correct facial expression recognition based on both the whole face and eye area alone [27], which implies a deficit in the corresponding ability in abnormal attachment styles, though with no relation to a certain expression kind.

Thus, in healthy volunteers, reactions to angry facial expressions are determined primarily by the prevalence of the avoidant attachment style, while the role of anxious attachment seems to be independent of certain emotions. However, according to our data, in depression, the anxious style interferes with correct recognition of the angry facial expression. It is worth noting that people with anxious attachment use social interactions as a means to fulfil their need for the subjective safety [6, 7], which is why ignoring aggressive facial expressions is considered reasonable, for it reduces social anxiety and may prevent conflicts. In a naturalistic environment, healthy people also interpret angry facial expressions as an aversive stimulus [28]. However, it is possible that only with a combination of depression and anxious attachment the need to avoid aggression becomes strong enough to justify perceptual defense against this category of stimuli.

The core result of the study (a negative correlation of the accuracy of angry facial expression recognition and anxious attachment score specific for the depressed group) should be considered with respect to the limited sample of our study. A bootstrap of the correlation analysis involving 1,000 iterations showed a 95% confidence interval for the correlation coefficient in the group of depressed patients $-0.86 \leq \rho \leq -0.27$. A part of the confidence interval lies in the area of insignificant correlations; however, the entire interval is characterized by negative values. The absolute magnitude of the correlation lies in the range from weak to high / very high [25]. A similar analysis in the group of healthy participants revealed a confidence interval of $-0.27 \leq \rho \leq 0.68$. The fact that the confidence intervals for this correlation do not overlap may be a finding supporting the association specificity.

A positive correlation between the anxious attachment score and the accuracy of sad facial expression recognition also contradicted the data in the group of healthy volunteers. Anxious attachment was associated with a need for close relationships along with a doubt in object accessibility that led to a greater interest in emotional expression recognition [7]. Individuals with the anxious attachment style were less likely to suppress their reactions to sad faces [6]. However, fMRI data suggested that people with this attachment style demonstrated increased cerebral responses to happy and not to sad facial expressions [7]. Responses to sad mimics and, probably, the accuracy of sadness recognition may reflect readiness to interact with a person who is experiencing emotional discomfort and needs support [2].

Thus, the anxious attachment style in depression shapes imperative social needs and requires greater tolerance to a partner's state and readiness to share his or her discomfort. The core characteristics of the sad emotion in depression may also have some influence, making the perception of others' sadness a less negative stimulus. The two core findings of the study discussed above are in full compliance with J. Gray's motivational theory in its current edition (see [29] for theory evolution and its current provisions and [30] for its link with frontal cortical asymmetry and a special role of anger). In the depressed participants, this theory predicts a deficit in the behavioral activation system of the right hemisphere which is responsible for actions aimed at fulfilling person's needs. On the contrary, the fight–flight–freeze system (prevention of external threats) and the behavioral inhibition system of the left hemisphere (behavioral regulation in a motivational conflict) are expected to have increased activity.

Anxious attachment is related to a similar imbalance with a focus on the behavioral inhibition system, and the same is typical of proneness to rumination. Observation of another person's angry facial expression may cause either an angry response or a reaction of fear and anxiety, or both. Thus, any combination of the three motivational systems within a single response is possible, which emphasizes individual differences and creates a favorable environment for studying correlations between the attachment style and the accuracy of facial expression recognition.

Recognition of sadness which is characterized by lesser involvement of the behavioral activation system complies with the aforementioned depression features. However, full compliance of the data with this model would require additional positive correlations of the anxious attachment score with the accuracy of recognizing disgust, fear, confusion, and possibly surprise, and its negative correlations with the correctness of recognizing happiness. The influence of the insufficient sample size in this case is questionable, for the magnitude of ρ in the majority of mentioned correlations is close to zero, while the direction of the relationship in confusion is opposite to an expected one ($\rho = -0.35$). To test a hypothesis that associations of the attachment style and rumination scores with the accuracy of angry and possibly sad facial expression recognition demonstrate an individual case showing the influence of J. Gray's systems on emotional variables, further studies are required with larger samples and inclusion of relevant scales to measure J. Gray's system activity in moderation analysis and in analysis of causal relationships between the variables as regressors / factors.

Our data on the declining ability to detect emotionsof happiness and confusion with age may be of interest for the research on emotional intelligence and empathy in healthy people. It is reflected in a tendency to treat expressions that are hard to recognize as happy ones. It may be explained by a decreased interest in the emotional state of other people (similar to the data on sadness in [2]). Our results are in contrast with the previously published findings [31] stating that recognition of facial expressions of fear and anger worsens with age, while the accuracy of recognizing happiness does not change.

CONCLUSION

The study allowed to obtain novel data on the associations between the attachment style and the accuracy of facial expression recognition by healthy and slightly depressed people. In addition to previously published results on the predominant role of avoidant attachment in the development of atypical reactions to angry facial expressions in healthy participants, a negative correlation between the prominence of anxious attachment and the accuracy of angry facial expression recognition, typical of depression, was identified. The findings point at the need to consider the attachment style as a factor influencing disruptions of emotional intelligence and empathy in depression.

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Authors contribution

Melnikov M.Ye. – conception and design, drafting of the manuscript. Shtark M.B. – conception and design. Bezmaternykh D.D. – development of software for image demonstration and answer collection, collection of corresponding data. Kozlova L.I. – collection of data for psychological testing. Natarova K.A. – selection of patients according to the clinical criteria. All authors participated in discussion on the draft of the manuscript and approved the final version of the manuscript for publication.

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Received 28.07.2020
Accepted 30.04.2020