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Brief Report

Neuroticism and facial emotion recognition in healthy adults

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Abstract

Aim: The aim of the present study was to examine whether healthy individuals with higher levels of neuroticism, a robust independent predictor of psychopathology, exhibit altered facial emotion recognition performance.

Methods: Facial emotion recognition accuracy was investigated in 104 healthy adults using the Degraded Facial Affect Recognition Task (DFAR). Participants' degree of neuroticism was estimated using neuroticism scales extracted from the Eysenck Personality Questionnaire and the Revised NEO Personality Inventory.

Results: A significant negative correlation between the degree of neuroticism and the percentage of correct answers on DFAR was found only for happy facial expression (significant after applying Bonferroni correction).

Conclusions: Altered sensitivity to the emotional context represents a useful and easy way to obtain cognitive phenotype that correlates strongly with inter-individual variations in neuroticism linked to stress vulnerability and subsequent psychopathology. Present findings could have implication in early intervention strategies and staging models in psychiatry.

Key words: facial emotion recognition, healthy adult, neuroticism.

INTRODUCTION

Facial emotion recognition is considered to be one of the crucial vectors of non-verbal communication as most of our social interactions involve perception of emotional information from the faces of others. Although impaired facial emotion recognition is well documented in depressed patients[1] and to some extent in patients recovered from depression,[2] it remains insufficiently clarified whether these impairments are present before the first depressive episode in depression-vulnerable groups.

In search for the cognitive causes of vulnerability to emotional disorders, facial emotion recognition has received little attention in relation to neuroticism. Neuroticism is a personality trait that is considered to be a risk factor associated with many forms of psychopathology,[3] including depression anxiety spectrum,[4] substance use[5] and psychosis spectrum disorders.[6] It is associated with negative bias in attention, interpretation and recall of information, increased reactivity and ineffective coping.[3] The data from cognitive psychology have shown that individuals scoring high on neuroticism tend to have negative interpretation bias,[7,8] which represents the tendency to interpret ambiguous information in a threatening way. Cognitive theories suggest that this biased information processing is common among depression anxiety spectrum disorders and might contribute to the risk of developing aforementioned disorders.[8] Attending less to positive than to negative facial feedback might lead one to appraise social interactions in a more negative manner, which can further elicit depressive

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symptoms.[9,10] Previous studies examining the association between neuroticism and facial emotion recognition in healthy individuals have found that certain emotion processing biases preceded the first depressive episode and could in part mediate the vulnerability to depression.[11,12] However, it remains unclear whether individuals scoring high on neuroticism show decreased processing of positive or increased processing of negative emotional information, or perhaps both. It is noteworthy that these studies often had moderate sample sizes and investigated only those subjects with the highest and lowest neuroticism scores (i.e. extreme groups approach), which limits generalizability of the results.

The present study aimed to reconcile uncertainties seen in previous studies investigating the relationship of neuroticism and facial emotion recognition[11,12] and to clarify the pattern of facial emotion recognition alterations related to neuroticism through measures applied in a large sample of randomly selected healthy adults. Thus, in line with the previous findings,[11,12] we hypothesized that healthy individuals with higher degrees of neuroticism would exhibit poorer recognition of happy facial expression and/or better recognition of fearful facial expression (i.e. bias away from positive towards negative) than matched group scoring low on neuroticism.

METHODS

Participants

One hundred four healthy adults from a larger 'European Network of Schizophrenia Networks for the Study of Gene-Environment Interactions (EUGEI)'[13] sample were enrolled in this study. Inclusion criteria were age > 18 years, IQ > 70, normal vision (or corrected to normal), no evidence of current/past history of psychiatric disorder and no recent history of alcohol or drugs abuse as verified by Mini International Neuropsychiatric Interview.[14] The study was conducted in accordance with the Declaration of Helsinki and its design was approved by the Medical Ethics Committee of the School of Medicine, University of Belgrade. All participants gave their written informed consent and received compensation (vouchers) for their study participation.

Measures

To estimate participants' degree of neuroticism we used two neuroticism scales: a 30-item scale extracted from the Eysenck Personality Questionnaire (EPQ-103)[15] and a 48-item scale extracted from the Revised NEO Personality Inventory (NEO-PI-R).[16] Both scales were administered to overcome methodological differences in neuroticism assessment seen in previous studies exploring the associations of neuroticism and facial expression recognition.[11,12] All participants completed EPQ neuroticism scale during a testing session and afterwards, on the same day, the NEO-PI-R neuroticism scale was sent to them by email to be returned within 7 days (because the testing sessions were time limited). The total number of 72 participants (70.59%) completed and returned NEO-PI-R neuroticism scale.

The Benton Facial Recognition Test (BFRT),[17] an accurate measure of the ability to match non-emotional unfamiliar faces, was used to assess general facial recognition ability.

The Degraded Facial Affect Recognition Task (DFAR)[18] was used to measure participants' ability to recognize emotional facial expressions: neutral, happy, fearful and angry. The photographs presenting facial expressions were passed through a filter resulting in a reduced visual contrast by 30% to increase difficulty and to enhance the contribution of interpretation. The percentages of correct answers per facial expression served as the main outcome parameters of DFAR.

A brief version of the Wechsler Adult Intelligence Scale-III[19] was used as a screening device of general intellectual ability.

Statistical analyses

The SPSS version 19 (Armonk, NY: IBM Corp). package was used for all calculations. As previous research have shown that age,[20] gender[21] and IQ[22] have impact on facial emotion recognition performance, partial correlation analyses were used to assess the relationship between the participants' degree of neuroticism and facial emotion recognition performance while controlling for their potential confounding effect. All analyses on DFAR performance were adjusted for general facial recognition ability (BFRT). After applying Bonferroni correction for multiple comparisons (four pairwise comparisons), P level 0.05 was set at the 0.0125 value (two tailed).

RESULTS

Demographic and sample characteristics of 104 study participants are displayed in Table 1.

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TABLE 1. Subjects' characteristics (n = 104)

		n (%)
Gender (female)		60 (57.70%)
		Mean ± SD
Age (years)		29.18 ± 6.65 (range 18–45)
IQ		106.33 ± 15.91
Neuroticism scores	EPQ neuroticism scale	7.81 ± 4.42
	NEO-PI-R neuroticism scale	70.53 ± 20.66

EPQ, Eysenck Personality Questionnaire; NEO-PI-R, Revised NEO Personality Inventory; SD, standard deviation.

Participants who completed and returned NEO-PI-R neuroticism scale (n = 72) did not differ from the subjects who dropped out at this point of study (n = 32) in terms of age (z = –0.94, P = 0.35), gender (z = –1.05, P = 0.29), IQ (z = –0.12, P = 0.91), EPQ neuroticism scores (z = –0.41, P = 0.68) and facial emotion recognition performance (neutral z = –0.82, P = 0.41; happy z = –0.01, P = 0.99; fearful z = –0.05, P = 0.96; angry z = –0.32, P = 0.75).

Participants most accurately recognized happy facial expression (mean 88.36%, standard deviation (SD) 11.25), followed by neutral (mean 80.85%, SD 16.73), angry (mean 76.05%, SD 17.31) and fearful facial expression (mean 65.05%, SD 17.10) with the lowest rate of correct answers.

There were no significant gender differences for the participants' general facial recognition ability (t = –1.08, P = 0.28), facial emotion recognition performance (neutral t = –1.55, P = 0.13; happy t = 1.79, P = 0.08; fearful t = 0.09, P = 0.93; angry t = –0.87, P = 0.39), EPQ neuroticism scores (t = –1.62, P = 0.11) or NEO-PI-R neuroticism scores (t = 0.10, P = 0.92). No significant correlations were found between age and participants' emotion recognition performance (neutral r = –0.08, P = 0.44; happy r = –0.18, P = 0.08; fearful r = –0.08, P = 0.44; angry r = –0.09, P = 0.36) nor between age and scores on EPQ and NEO-PI-R neuroticism scales (r = –0.01, P = 0.90 and r = –0.10, P = 0.39, respectively). Participants' IQ was significantly correlated with their facial emotion recognition performance (neutral r = 0.23, P = 0.02; happy r = 0.17, P = 0.09; fearful r = 0.26, P = 0.01; angry r = 0.19, P = 0.06), but correlations between IQ and neuroticism scores were non-significant (EPQ neuroticism scale: r = 0.03, P = 0.80; NEO-PI-R neuroticism scale: r = 0.12, P = 0.30).

P-values for the age and gender differences regarding happy facial expression recognition performance were close to significance, and IQ has been shown to correlate significantly with facial emotion recognition performance. Therefore, we controlled for the potentially confounding factors: age, gender and IQ.

Associations between facial emotion recognition performance and the degree of participants' neuroticism are shown in Table 2.

A significant negative correlation between the degree of neuroticism and the percentage of correct answers on DFAR (controlled for age, gender, IQ and general facial recognition ability) was found only for happy facial expression (EPQ neuroticism scale: r = –0.32, P = 0.00; NEO-PI-R neuroticism scale: r = –0.37, P = 0.00). Correlation remained significant after applying Bonferroni correction for the number of comparisons.

DISCUSSION

The present study demonstrated that healthy individuals with higher levels of neuroticism showed altered processing of positive emotional information. To our best knowledge, this is the first study that examined the association between neuroticism and facial emotion recognition in a large sample of randomly selected healthy adults by applying the two most commonly used neuroticism scales, and reported a highly significant negative correlation between neuroticism and happy facial expression recognition.

Happiness is considered to be the most easily recognized facial expression approaching up to 100% accuracy even at low-intensity levels.[23] However, higher threshold for identifying happy facial expression has been reported in patients suffering from depression (both in acute phase and symptomatically remitted),[23,24] healthy volunteers undergoing a negative mood induction[25] and healthy students scoring high on neuroticism compared with a matched group scoring low on neuroticism.[11] On a larger and more representative sample of healthy adults, our study confirmed the results obtained by Chan *et al.*[11] on student population related to the negative correlation between neuroticism and happy facial expression recognition.

Moreover, it has been previously shown that patients recovered from depression tend to show an increased perception of negative facial expressions.[4] Doty *et al.*[12] have also found a heightened sensitivity for detection of fearful faces in healthy adults scoring high on neuroticism, a finding that we did not replicate. The most likely explanation for the lack of correlation between fearful faces recognition and neuroticism in our data are methodological differences between the studies, as the results of Doty

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TABLE 2. Partial correlation analysis†‡ between facial emotion recognition performance and the degree of participants' neuroticism

Facial expression	Mean % of the correct answers on DFAR (SD)	Range (% of the correct answers on DFAR)	Correlation with neuroticism *r* (*P*)	
			EPQ neuroticism score	NEO-PI-R neuroticism score
Neutral	80.85 (16.73)	6.30–100.00	0.11 (0.28)	0.17 (0.16)
Happy	88.36 (11.25)	43.80–100.00	**–0.32 (0.00)**	**–0.37 (0.00)**
Fearful	65.05 (17.10)	25.00–93.80	0.02 (0.84)	0.02 (0.85)
Angry	76.05 (17.31)	31.30–100.00	–0.01 (0.91)	0.07 (0.57)

†Controlled for age, gender, IQ and general facial recognition ability.
‡After applying Bonferroni correction *P* level 0.05 is set at the 0.0125 value (two tailed).
DFAR, Degraded Facial Affect Recognition Task; EPQ, Eysenck Personality Questionnaire; NEO-PI-R, Revised NEO Personality Inventory; SD, standard deviation. Boldfaced are statistically significant values, $p < 0.01$.

et al.[12] were based on a small sample (22 subjects, mostly females) and did not included any data after controlling for the potential confounding factors (age, gender and IQ).

Tendency to 'look on the bright side of life' might be at least partially genetically driven.[26–28] Lesch *et al*.[29] have shown that neuroticism is significantly associated with the allelic variation in the serotonin transporter gene promoter region (5-HTTLPR): individuals with long allele (LL) had less neuroticism in comparison with short allele (SS or SL) genotype carriers. Interestingly, when recent research evaluated 5-HTTLPR in relation to emotional processing biases,[26] long allele (LL) was also associated with potentially protective pattern of emotional processing (vigilance for positive material/avoidance of negative material) that was absent among short allele (SS or SL) genotype carriers. Alongside with individuals' inherent vulnerability, association between neuroticism and emotional processing could be evaluated further through environmental–contextual frameworks,[30] which implies that individuals with high neuroticism scores tend to self-select situations likely to lead to adversity and distress. In a predictable and safe environment high thresholds for positive contextual information are probably disadvantageous.[31]

The present finding should be considered in light of its limitations and strengths. For example, generalizability to older population may be limited as we primarily focused on younger adults (age range 18–43 years). However, it has been shown that even though emotion recognition performance decreases with age, the decrease is less for happiness than for other facial expressions.[20] Also, by applying Bonferroni correction we constrained the risk of a type I error, which represents the strength of our study.

CONCLUSIONS

Present findings could have implication in early intervention strategies and staging models that are increasingly applied in psychiatry.[32] For the presymptomatic vulnerability phase, altered sensitivity to emotional context represents a useful and easy way to obtain cognitive phenotype. This phenotype correlates strongly with inter-individual variations in neuroticism linked to subsequent psychopathology. A reduced ability to translate positive social signs for self-regard might increase susceptibility to negative affective states; therefore, biased processing of positive emotions should be a target for preventive strategies.

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