Personality and Individual Differences 50 (2011) 398–403

Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

Interaction of anger with anxiety and responses to emotional facial expressions

Andrey V. Bocharov *, Gennady G. Knyazev

Institute of Physiology, Siberian Branch of the Russian Academy of Medical Sciences, Novosibirsk 630117, Russia

ARTICLE INFO

Article history:
Received 12 May 2010
Received in revised form 13 October 2010
Accepted 2 November 2010
Available online 23 November 2010

Keywords:
Anger
Anxiety
Joint-subsystems hypothesis
Emotional facial expressions
EEG
Event-related spectral perturbations

ABSTRACT

In this study, effects of interaction of anger with anxiety on the perception of emotional facial expressions and associated with this perception oscillatory dynamics of cortical responses elicited by presentation of angry, neutral, and happy faces were investigated. Subjects filled out the Buss–Perry aggression scales and the Spielberger's State Trait Anxiety Inventory. Anxiety moderated the effect of anger both on estimates of angry and happy faces and on face presentation-related spectral perturbations. In the low anxiety group, anger scores were positively related to the extent of face presentation-related theta synchronization. In the high anxiety group this effect was not significant. The results are discussed in light of Corr's "joint subsystems" hypothesis (Corr, 2002).

1. Introduction

The ability to understand emotional information conveyed by facial expressions of other people is crucial for building interpersonal relationships, career, and, sometimes, even survival (Ellis & Young, 1998). The human face provides the most salient cue to another person's emotional state. Facial expressions are the unique source of information having social meaning (Bruce & Young, 1986). Existing empirical research shows that some personality traits such as anger and anxiety are associated with biases in the perception of emotionally loaded stimuli, particularly such socially significant stimuli as emotional facial expressions. Individuals scoring high on trait anger showed an attentional bias for angry faces (Putnam, Hermans, & van Honk, 2004; van Honk, Tuiten, de Haan, van den Hout, & Stam, 2001). High anger subjects attributed more hostility to characters of situations (Epps & Kendall, 1995) or more negativity to explanations of events (Wenzel & Lystad, 2005). Participants high on trait anxiety show attentional biases toward threatening information (Derryberry & Reed, 2002; Fox, 2002; Weinstein, 1995). High as opposed to low anxiety subjects show larger negative emotional reaction during presentation of angry faces and rate these faces as more unpleasant and as expressing more disgust (Dimberg & Thunberg, 2007). Previously we have shown that anger and anxiety were associated with a tendency to perceive all facial expressions as more hostile (Knyazev, Bocharov, Slobodskaya, & Ryabichenko, 2008b; Knyazev, Bocharov, & Slobodskoj-Plusnin, 2009). These perceptional biases are bound to have some psychophysiological manifestation. However, until recently, few studies took into account personality-related individual differences in the face presentation-related cortical oscillatory responses. We have shown recently that anxiety and anger show opposite effects on face presentation-related oscillatory responses. Anger is associated with increased theta band synchronization and decreased alpha band desynchronization (Knyazev et al., 2009), whereas anxiety shows the opposite pattern of relations (Knyazev, Bocharov, Levin, Savostyanov, & Slobodskoj-Plusnin, 2008a). This is puzzling, because, as we discussed earlier, at perceptional level these traits show similar biases (i.e., exaggeration of aggressiveness and hostility in the facial expressions). From a theoretical perspective, the observed differences in oscillatory dynamics seem more corresponding to behavioural manifestations, because in terms of behavioural outcome, anger and anxiety underlie opposite behavioural tendencies – approach and avoidance behaviour, respectively. One way to try to resolve this puzzle would be to more scrupulously investigate the effects of different combinations of anger and anxiety on the perception of different facial expressions and associated cortical oscillatory responses. The majority of published studies investigated isolated effects of anger or anxiety and, to the best of our knowledge, no studies investigated effects of different combinations of these traits. This is unfortunate, because in reality each individual has some combination of anger and anxiety and his or her behaviour depends on their interaction. Therefore, in this study we aimed to investigate the interaction between anger and anxiety in their influence on the perception of emotional facial expressions and on associated with this

* Corresponding author. Tel.: +7 383 333 48 65; fax: +7 383 332 42 54.
E-mail address: bocharov@physiol.ru (A.V. Bocharov).

0191-8869/$ - see front matter
doi:10.1016/j.paid.2010.11.003

perception oscillatory cortical responses. Theoretically, there could be two possibilities: (1) the two traits do not interact with each other (i.e., effects of, e.g., anger would be similar on different levels of anxiety); (2) the two traits interact with each other. In the latter case, effects of one trait on the outcome variable would be different on different levels of another trait.

2. Methods

2.1. Subjects

The sample included 84 students (41 men and 43 women; age range 17–32 years, mean age 20.9, SD = 2.7) with normal or corrected to normal vision, who received a sum equivalent to about 5% of the living wage for participation. For checking the general health status we used an item from the Achenbach and Rescorla's (Achenbach & Rescorla, 2003) checklist: "Whether you have any diseases, physical defects or health infringements? If you have please, describe". All included participants reported no diseases. All applicable subject protection guidelines and regulations were followed in the conduct of the research in accordance with the Declaration of Helsinki. All participants gave informed consent to the study. The study has been approved by the Institute of Physiology ethical committee.

2.2. Instruments and procedures

Anger (Cronbach's $\alpha = 0.74$) was measured by the respective scale of the Buss–Perry aggression questionnaire (Buss & Perry, 1992; Knyazev et al., 2008b). Anxiety (Cronbach's $\alpha = 0.88$) was measured by the Spielberger's State Trait Anxiety Inventory (Hanin, 1989; Spielberger, Gorsuch, & Lushene, 1970). As stimulation we used an ensemble of the photographs presented by Ekman and Friesen (1976). We selected 30 photographs, specifically, 5 different females and 5 different males with 3 different facial expressions (angry, happy, and neutral). The pictures were presented black and white (17 × 17 cm) and displayed on a screen at a distance of 120 cm from the subjects.

The subjects sat in a soundproof and dimly illuminated room. They were instructed to evaluate emotional expression of each presented face on an analogue scale ranging from −100 (very hostile) to 100 (very friendly). First, a fixation cross appeared at the centre of the screen for 1 s. Then a face picture was presented for 4 s, which was followed by presentation of the evaluative scale (Fig. 1).

Angry, happy, and neutral faces were delivered randomly, and inter-stimulus-interval randomly varied between 4 and 7 s. The number of face stimulations was 120 for each subject, including 40 faces of each category. In 44 subjects (22 men and 22 women) EEG was recorded during the procedure of faces presentation. Four subjects were excluded, because their EEG was heavily contaminated by movement artifacts. From the remaining 40 subjects (21 females; age range 17–32 years, mean age = 21.3 SD = 3.8) all were right-handed.

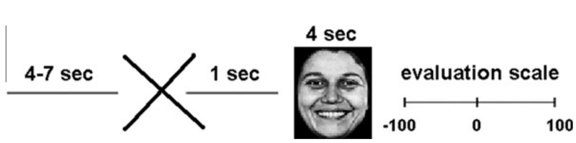

Fig. 1. Scheme of one trial. After a fixation cross appeared for 1000 ms, a target stimulus (i.e., angry, neutral, or happy face picture) was presented for 4000 ms. Thereafter an evaluation scale appeared, which was present until the subject marked the degree of hostility-friendliness of the presented face. Between-stimuli interval randomly varied between 4 and 7 s.

2.3. EEG recording

EEG was recorded using a 32-channel PC based system via silver-silver chloride electrodes. A mid-forehead electrode was the ground. The signals were amplified with a multichannel biosignal amplifier with bandpass 0.05–70 Hz, −6 dB/octave and continuously digitized at 300 Hz. The electrodes were placed at 30 head sites according to the International 10–20 system and referred to linked-mastoids. The horizontal and vertical EOG was registered simultaneously. EEG data contaminated with artifact were visually detected and rejected off-line. 1000 ms after face presentation were used as the test interval; 1000 ms prior to the fixation cross presentation served as the pre-stimulus baseline.

2.4. Psychophysiological data reduction

2.4.1. Event-related spectral perturbations (ERSP)

To assess face-evoked changes in spectral power, event-related spectral perturbations (ERSP) were calculated using *timef* function of EEGLAB toolbox. The ERSP (Makeig, 1993) shows mean log event-locked deviations from baseline-mean power at each frequency. The mean value of the spectral power E in a frequency f during the 1000 ms prior to fixation cross presentation was considered as the baseline level and was subtracted from the E(time, f) after face stimulus onset. Method of ERSP calculation realized in EEGLAB toolbox is described in Delorme and Makeig (2004). Time–frequency representations were calculated using Morlet wavelets.

2.5. Data analyses and statistics

For each subject, the estimates of faces' hostility/friendliness were averaged across all face presentations representing face's gender (i.e., male vs. female faces) and each emotional category (angry vs. neutral vs. happy). Median split was applied to divide subjects into high and low anger and anxiety groups. General Linear Model analysis was used to test the effects of interaction of anger and anxiety as between-subject factor, and emotional category and face's gender as within-subject factors. Age was entered as a covariate.

It is known that multivariate approaches have low sensitivity to regionally specific effects (Friston, 1997). Due to this fact, an alternative to the conventional analysis of variance (ANOVA), the so-called mass-univariate approach is most frequently used for the analysis of neuroimaging data (Worsley et al., 1996). Here we use both the conventional ANOVA analysis and the mass-univariate approach implemented in the *statcond* function of EEGLAB toolbox.

The one-sample Kolmogorov–Smirnov test was used to test that EEG variables were normally distributed. This test showed no deviations from normality for ERSP measures. That enabled us to use parametric tests for hypotheses testing. For conventional ANOVA, for each subject, the net ERSP values were averaged across individual frequency bands of 1–4, 4–8 and 8–12 Hz (to provide the time-varying measures of delta, theta and alpha activities, respectively) and time points of 0–100, 100–200, 200–300, 300–400, and 400–500 ms after stimulus onset. The ERSP values from 30 derivations were averaged for 9 regions to reduce the number of statistical comparisons. These regions were the left frontal (Fp1, F7, F3, FT7, FC3), midline frontal (Fz, FCz), right frontal (Fp2, F8, F4, FT8, FC4), left central (T7, C3, TP7, CP3), midline central (Cz, CPz), right central (T8, C4, TP8, CP4), left posterior (P7, P3, O1), midline posterior (Pz, Oz), and right posterior (P8, P4, O2). Repeated measures ANOVA was conducted to test the effects of interaction of anger and anxiety as between-subject factor, age as covariate, and condition (angry vs. neutral vs. happy