

Introduction


As individual differences in social cognition may underlie several Big Five traits we investigated how personality relates to behavioural and electroencephalographic (EEG) correlates of gaze direction perception.

Previous findings give reason to suggest that direct and averted gazes are associated with the brain activity indicative of approach and avoidance, respectively. There is also reason to believe that in order to activate “mentalizing” and self-awareness processes live models have to be used instead of pictures (Hietanen et al., 2008).

In numerous studies frontal alpha asymmetry, presumably an inverse index of underlying cortical activity, has been associated with approach-avoidance motivation. More right sided alpha power has been related to (both trait and state) approach and more left sided alpha to withdrawal tendencies (for reviews see Coan & Allen, 2004; Harmon-Jones et al., 2010).

Recently a new EEG index of motivational tendencies has been proposed – posterior versus frontal delta/theta power, hypothetically an inverse index of rostral anterior cingulate cortex (rACC) activity. The rACC is part of dopaminergic reward circuit. It is also important in the “default network” activated during resting states and deactivated during tasks that require self-relevant mental explorations and provide the means to anticipate upcoming events (Wacker et al., 2011). In several studies positive correlations between resting state posterior-frontal delta/theta index and trait BAS/Agentic Extraversion have been observed (for review see Wacker et al., 2011).

Method

Sample	41 students (13 males); mean age 22,51 years (SD = 2,95). Participants were recruited from a larger sample (N=147) according to their personality profiles. Final sample was balanced for all B5 traits, with Neuroticism and Extraversion as a priority.
Stimuli:	Live faces of two female models with neutral expression were presented through a 40 cm × 30 cm liquid crystal (LC-TEC Displays Ab) shutter that switched between opaque and transparent states. Distance from the shutter: model 30 cm, participant 70 cm; faces levelled (figure 1). The identity of models was approximately counter-balanced across male and female participants as well as personality profiles (no significant differences, in traits or subscales).
Experiment	 <p>Figure 1. Experimental setup.</p> <p>Two conditions:</p> <ol style="list-style-type: none"> Fixed timing: Gaze direction - direct, averted, closed eyes. 3 × 9 presentations for 5 seconds in pseudo-randomized order. No task was required, except to watch the stimuli as naturally as possible. Participant controlled timing: Gaze direction - direct, averted. 2 × 8 presentations. Instruction was to look as long as it felt natural.
Personality	The ‘Short Five’ (S5) - 60-item questionnaire that measures 30 facets of the Five-Factor Model, Finnish version (Konstabel et al., 2012).
Subjective ratings	After second condition model's face was presented again three times (direct and averted gaze, closed eyes) in random order. Each time the participant was asked to recall the experiment and rate accordingly the valence and arousal (9p SAM scales; Bradley & Lang, 1994) of his/her subjective experience, the level of basic emotions (fear, happiness, anger, sadness, surprise, disgust) expressed by and the approachability, dominance and pleasantness of the face (7p scales). Note: There were no significant differences between the models in any scale.
EEG	<p>Recording: 16 scalp electrodes (F3,F4,F7,F8,C3,C4,P3,P4), 4 ocular electrodes (channels HEOG & VEOG), online reference to Cz, offline rereferecne to linked ears (A1, A2). Online 1–200 Hz band-pass filter (50Hz notch filter enabled).</p> <p>Pre-processing: Removal of ocular activity - manually detected independent components corresponding to blinks, vertical and horizontal movements (EGLAB Infomax ICA). Artefact rejection - threshold -75 to 75 μV, movement and muscle artefacts (EGLAB rejspec 20 – 40 Hz). On average 73,53% of trials remained (SD = 8,55%).</p> <p>Event-related spectral perturbations (ERSP) were calculated using wavelet analyses (EGLAB newtimef) with -2500 to -500 ms prestimulus as baseline (10*log10 power). For individual electrodes ERSP-s were averaged within theta (5-7 Hz) and alpha (8-13Hz) bands from 0 to 4500 ms poststimulus. Only fixed timing condition EEG is analysed.</p> <p>Indexes:</p> <p>Frontal alpha asymmetry scores were calculated for midfrontal electrode pair F4/F3 by subtracting the mean power of the left site from the mean power of the right site.</p> <p>Posterior versus frontal theta activity was calculated by averaging the mean power of midfrontal electrodes (F4/F3) and of posterior electrodes (P4/P3) and subtracting the former from the latter.</p>

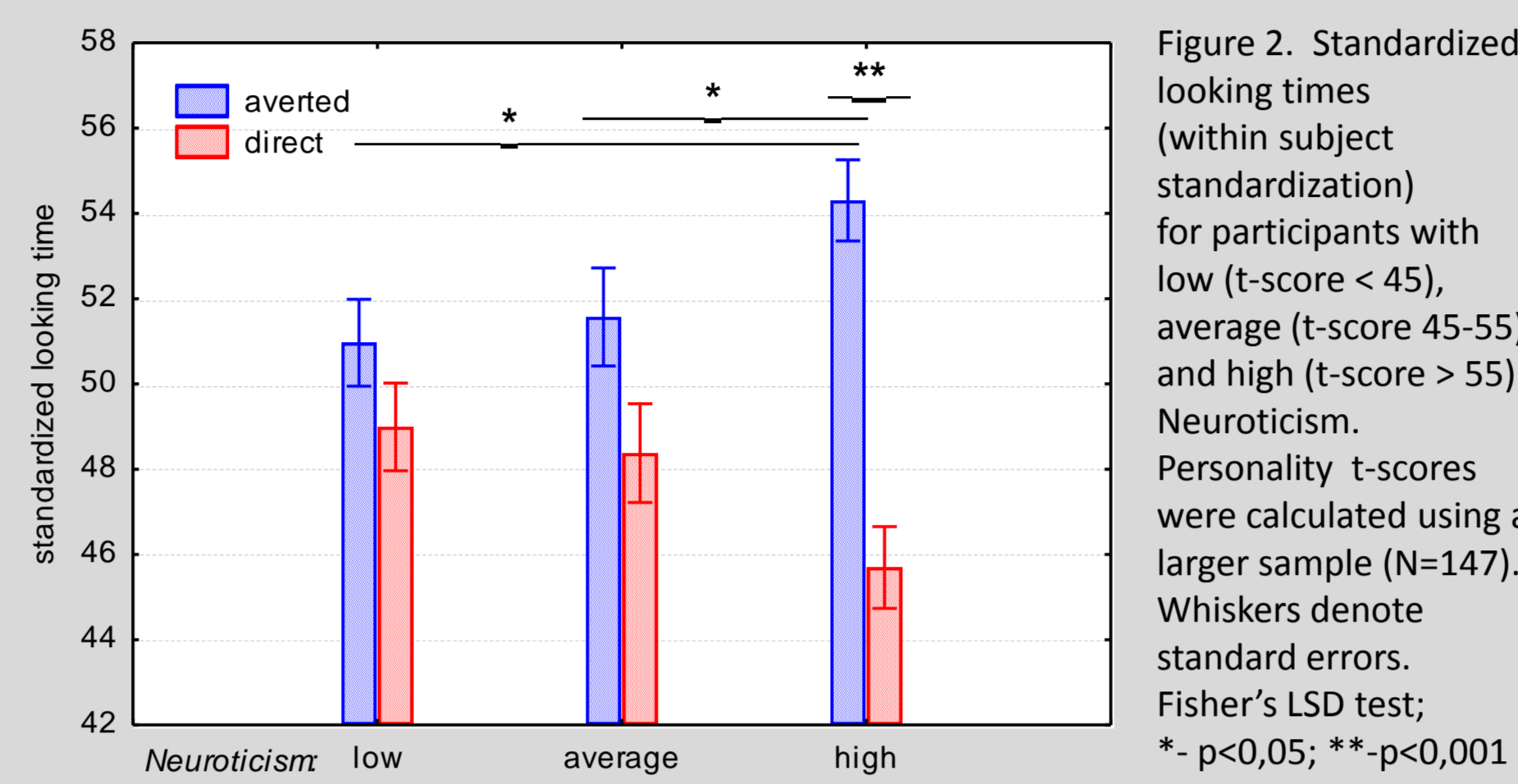
Results

Behavioural and self-report measures

Participant controlled looking times

On average participants looked at the model for 8,67 seconds (SD=7,52). Average looking times for averted and direct gaze were 9,59 (SD= 8,78) and 7,74 (SD=6,89) seconds respectively.

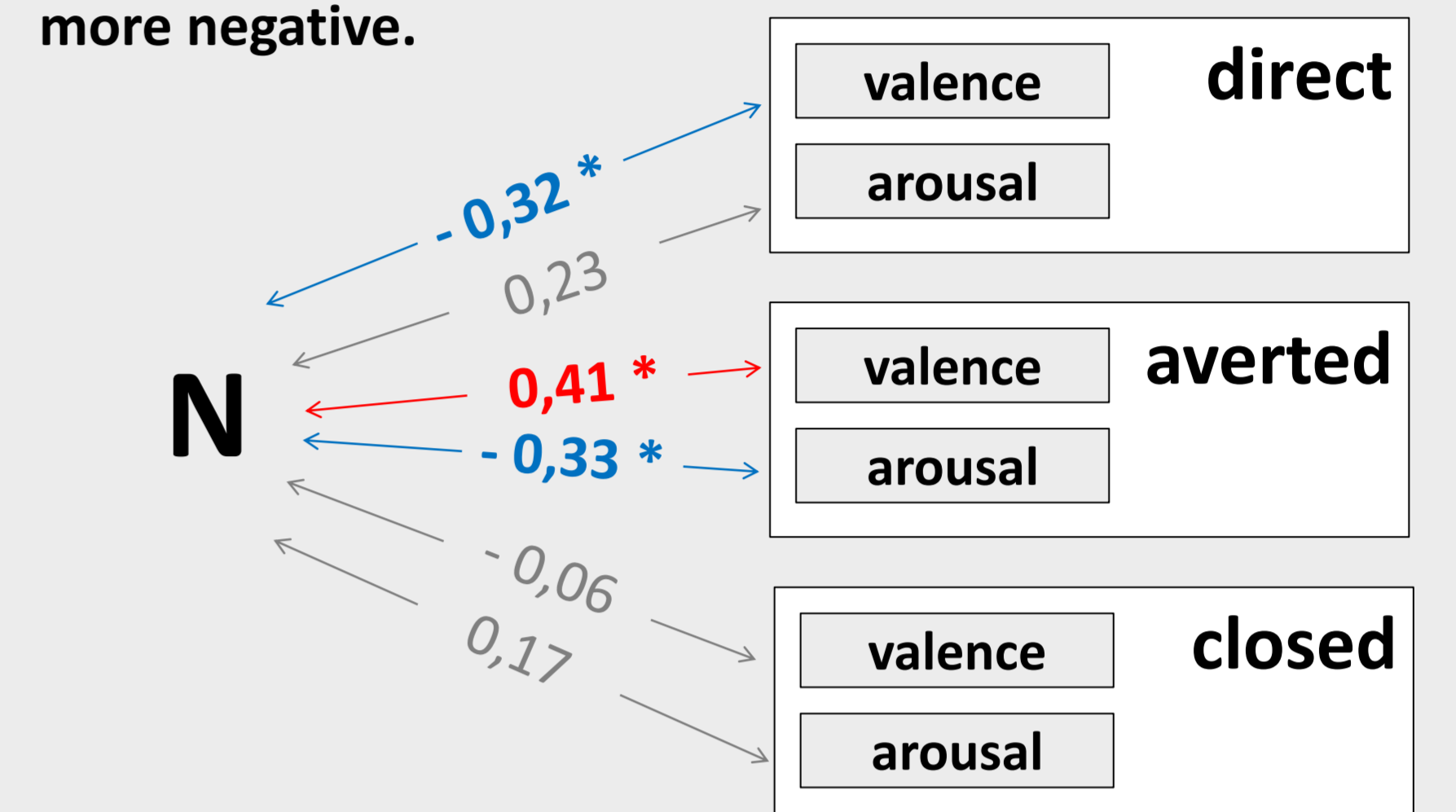
Because of large variations relative differences in looking times were analysed. For that within subject Cohen's d's were calculated. They correlated negatively with Neuroticism ($r=-0,34$; $p<0,05$) indicating that **people with high Neuroticism looked at averted gaze longer than direct gaze.**



Subjective ratings

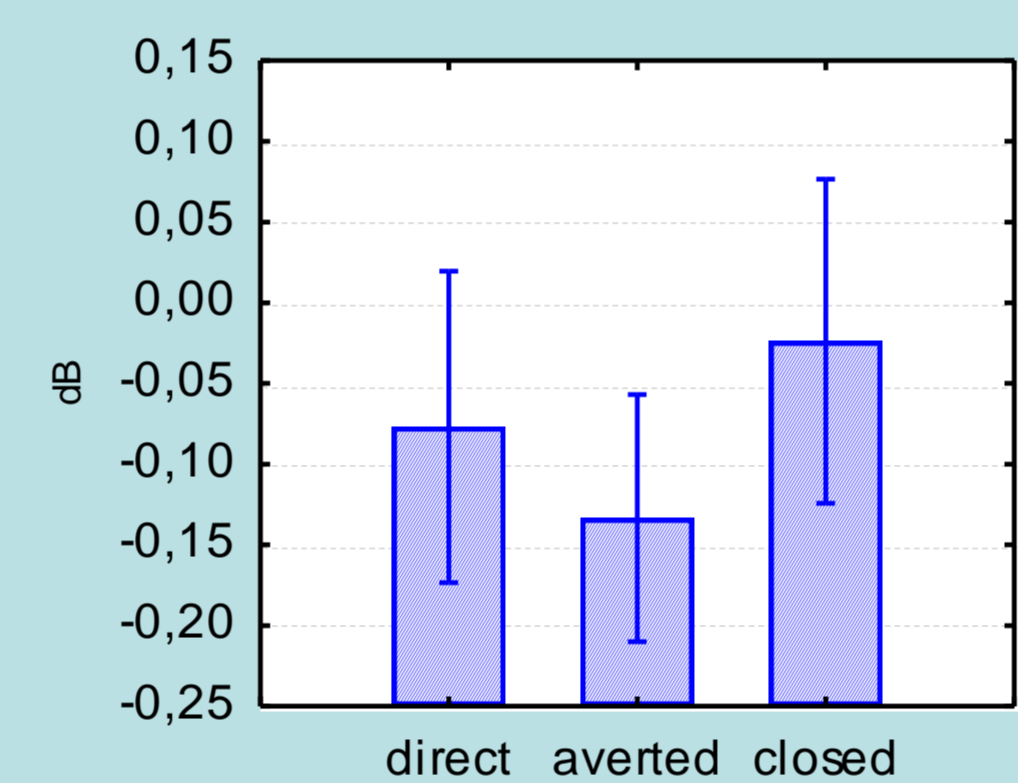
Subjective ratings of valence and arousal as well as dominance, approachability and pleasantness were analysed using within subject standardization to reveal relative preferences.

Several correlations with Neuroticism emerged (figure 3). **People with high Neuroticism rated averted gaze to be more pleasant and less arousing and direct gaze to be more negative.**



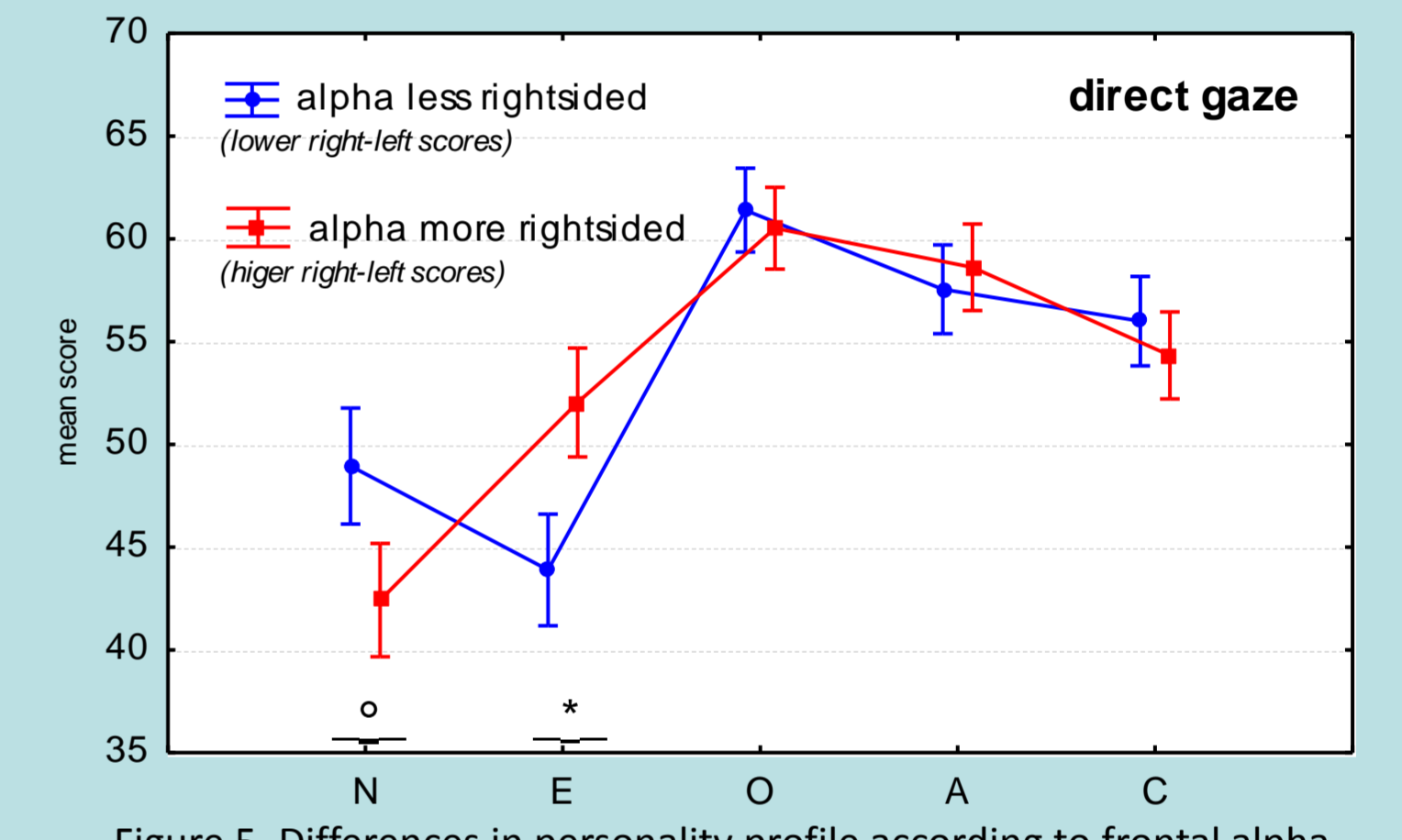
EEG indexes - fixed timing condition

Frontal alpha asymmetry

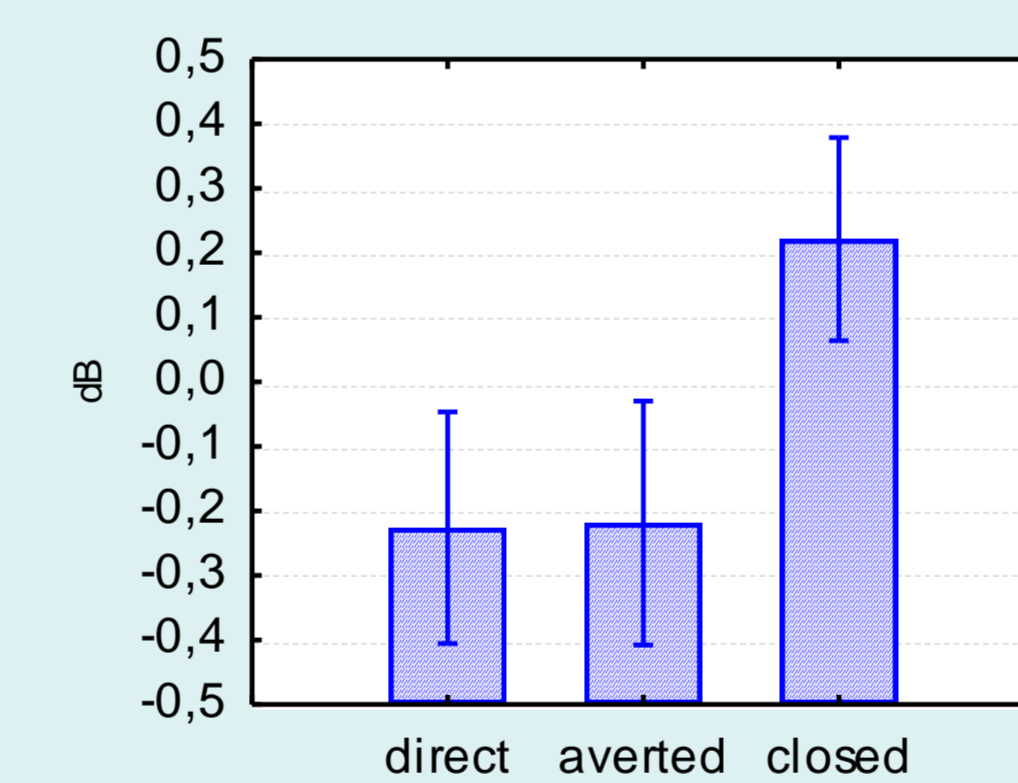


There was no main effect of gaze direction on frontal alpha asymmetry scores ($F=0,37$; $p=0,69$). On trend level averted gaze elicited most negative and closed eyes most positive asymmetry (figure 4).

Participants who had more positive asymmetry (more alpha on the right side) in response to direct gaze had significantly higher Extraversion and lower Neuroticism (figure 5).



Posterior vs. frontal theta

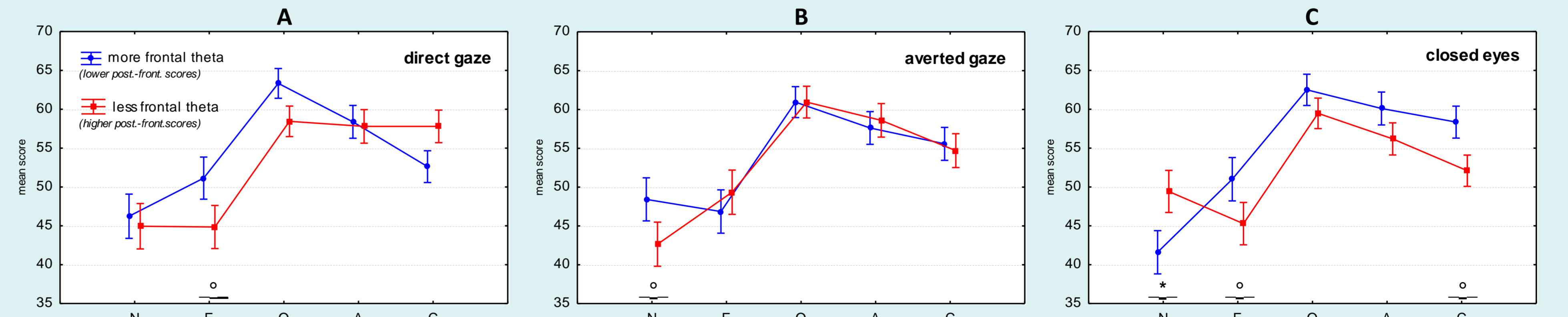


There was no main effect of gaze direction ($F=2,14$; $p=0,12$). Post hoc comparison using the Fisher's LSD test revealed a difference between closed eyes and direct gaze ($p<0,1$). Theta during closed eyes was significantly more posterior (figure 6).

There was a positive correlation between Neuroticism and posterior vs. frontal theta during closed eyes ($r=0,44$; $p<0,05$), indicating more posterior theta. Also the analysis of personality profiles of median split groups for three gaze directions was performed.

Participants with more frontal theta (smaller posterior-frontal index) in response to ...

- ... direct gaze had higher Extraversion (figure 6A).
- ... averted gaze had higher Neuroticism (figure 6B).
- ... closed eyes had lower Neuroticism but also higher Extraversion and higher Conscientiousness (figure 6C).



Conclusions

People with higher Neuroticism are prone to avoid social contact - they prefer to look at averted gaze and they rate it to be more positive and less arousing.

As indicated by frontal alpha asymmetry, in response to eye contact emotionally stable and extraverted people have stronger approach response (reciprocal to partners motivation), while more neurotic and introverted people tend to withdrawal.

Considering the hypothetical relationship between posterior vs. frontal theta and the “default network”, it can be speculated that for emotionally stable, extraverted and conscientious people seeing face with close eyes provides an opportunity to rest while neurotic, introverted and impulsive people see the situation as ambiguous and engage in more mental exploration. Alternative explanation is that for the latter reduced contact is pleasant.

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