

Both Expectation and Psychopathy Moderate the Neural Response to Fearful Faces: An ERP Study of Successful Female Psychopaths

Katherine Pappas, Colin Quirk, Jane Couperus
Hampshire College

Psychopathy and Psychopathic Traits

- Psychopathy is characterized by pervasive emotional and behavioral traits, such as: glibness, manipulation, callousness, lack of emotion, irresponsibility, impulsivity, and aggression
- Far more is known about psychopathic males than females – due to socialization they manifest differently
 - Male psychopathy presents similarly to both the DSM-IV-TR's Anti-Social Personality Disorder and Narcissistic Personality Disorder, while female psychopathy often looks more similar to Histrionic Personality Disorder or Borderline Personality Disorder. It should be noted that psychopathy is entirely distinct from these indications
- Psychopathy is not a DSM-IV-TR diagnosis, and is instead assessed through other means, two of the most common being:
 - Psychopathy Checklist Revised (PCL-R)**: diagnostic interview, common with incarcerated population
 - Psychopathic Personality Inventory Revised (PPI-R)**: self-report questionnaire, common with community population
- The PPI-R has eight sub-scales, which are:
 - Machiavellian Egocentricity; rebellious nonconformity; blame externalization; carefree nonplanfulness; social influence; fearlessness; stress immunity; coldheartedness

Background

- Viewing fearful, as opposed to neutral, faces has been associated with many different event related potential (ERP) responses, such as enhanced amplitude for the: P1, N1, P2, N3, and P3 components.
- Fearful faces orient attention and can be processed unconsciously, but when an individual expects to see a fearful face then the neural response is smaller.
- Individuals with high levels of psychopathic traits have a deficit in processing the fear of others.
- Most of this research has been conducted on an all-male inmate population, which does not address issues such as potential gender differences or whether there are neural abnormalities seen in a population of successful (non-incarcerated) psychopaths.



Relevant evoked potentials:

- P2 brain wave**: found at central and anterior scalp sites, and is augmented when the target stimuli is observed, particularly when targets are infrequent.
- P3b brain wave**: found at parietal sites, and is augmented when the target occurs less frequently, the participant is directing more attention to the task, and the participant is sure that the target is in fact a target

Study Design

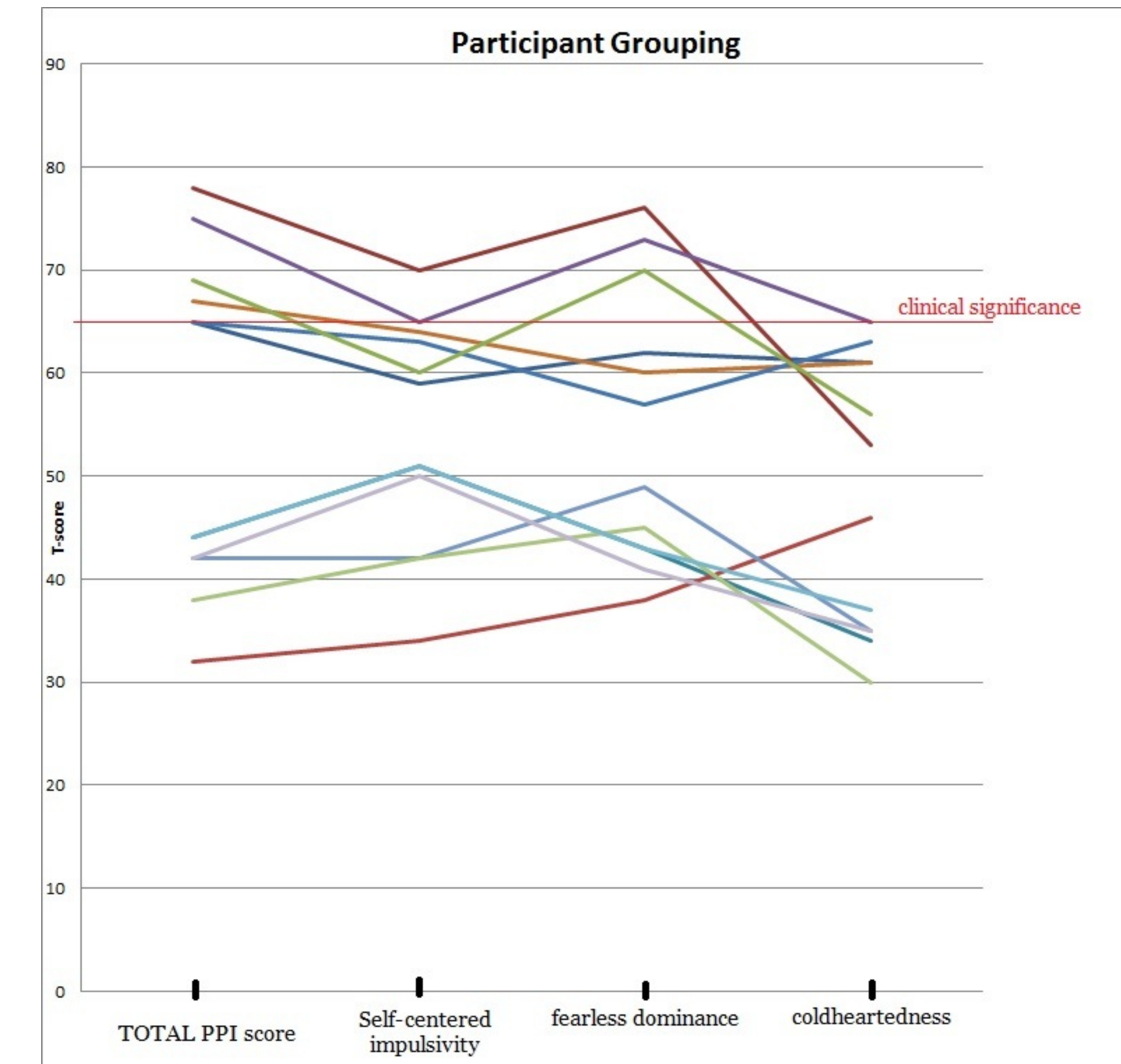
Population: 12 female college students
-6 showing high levels of psychopathic traits
-6 showing low levels of psychopathic traits
Psychopathy was measured using the Psychopathic Personality Inventory Revised (PPI-R)

The study consisted of a gender discrimination task, with the latent purpose of looking at the neural correlates of viewing fearful and neutral faces under validly cued and uncued conditions. The participant responded with the gender of the face displayed in the target image, and the P2 and P3 waves in response to the target image were analyzed in response to the four different cueing conditions.

Stimuli Used: The pictures used for cues were from the International Affective Picture System, and the target pictures were from the “facial expressions of emotions: stimuli and tests”

CONDITION	CUE IMAGE	TARGET IMAGE
Cued Fearful	Fear-Inducing Image	Fearful Face
Uncued Fearful	Fixation Cross	Fearful Face
Cued Neutral	Neutral Image	Neutral Face
Uncued Neutral	Fixation Cross	Neutral Face

Four conditions:
cued fearful, uncued fearful, cued neutral, and uncued neutral
-4 blocks of 64 trials each, with 16 of each condition in each block randomly presented,
-Each trial: presentation of a fixation cross; blank white screen; then either a cue image or fixation cross; blank white screen; face stimulus.



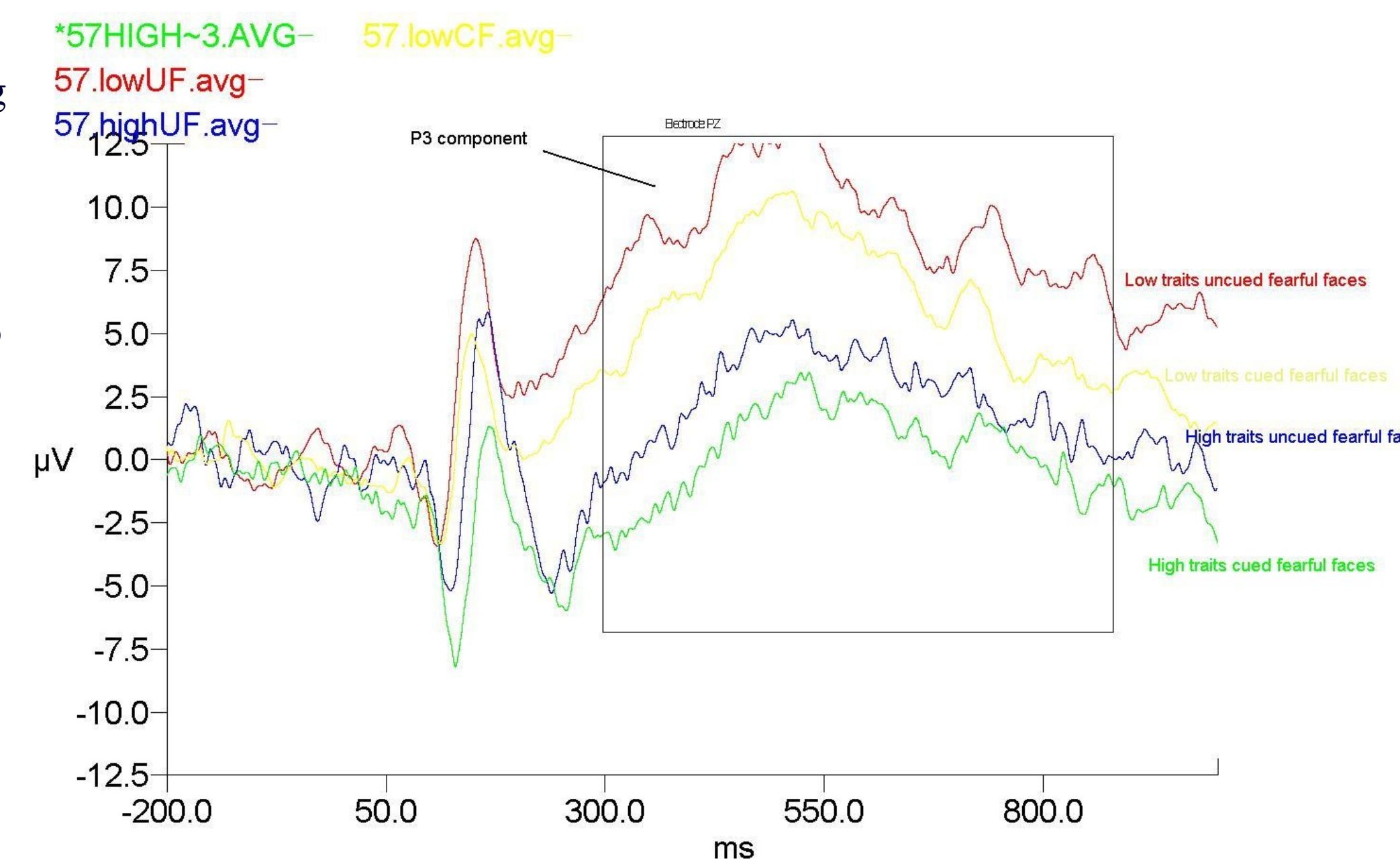
Participant grouping:
PPI-R total and subfactor scores are shown to the left, with each line being one participant. A T-score of 65 constitutes clinical significance; each participant used in the high trait group had a PPI total score of clinical significance or higher.

The top cluster of six lines constitutes the high traits group, while the lower cluster is the low traits group.

There was a significant overall effect of group on P2 amplitude ($p=.023$), and also a significant effect of group on P3 amplitude ($p=.043$); in both cases the high traits group exhibited an attenuated response. This group difference suggests that this participant grouping based on PPI-R scores is valid.

P3 Component: To the right, the top (red) average wave seen is from the low traits group when viewing uncued fearful faces. The second (yellow) average wave is the low traits group when viewing cued fearful faces. The third (blue) average wave is the high traits group viewing uncued fearful faces. The bottom (green) average wave is the high traits group when viewing cued fearful faces.

- There is a significant difference in amplitude between the bottom and top lines – high traits viewing cued fearful faces, and low traits viewing uncued fearful faces ($p=.007$)
- There was a significant effect of cueing in the P3 component ($F(1,10)=6.983, p=.025$)



Electrophysiological Recordings

- EEG was recorded from 32 scalp sites using an Electro-cap.
- The mastoids were used for reference placement, allowing for better comparisons between the collected data.
- All of the impedances on the cap were kept below 5k ohms.
- We used a Synamps amplifier, and Scan software in order to electronically record the data
- this was done at a rate of 500 Hz, using a bandpass filter of .01 to 100 Hz.

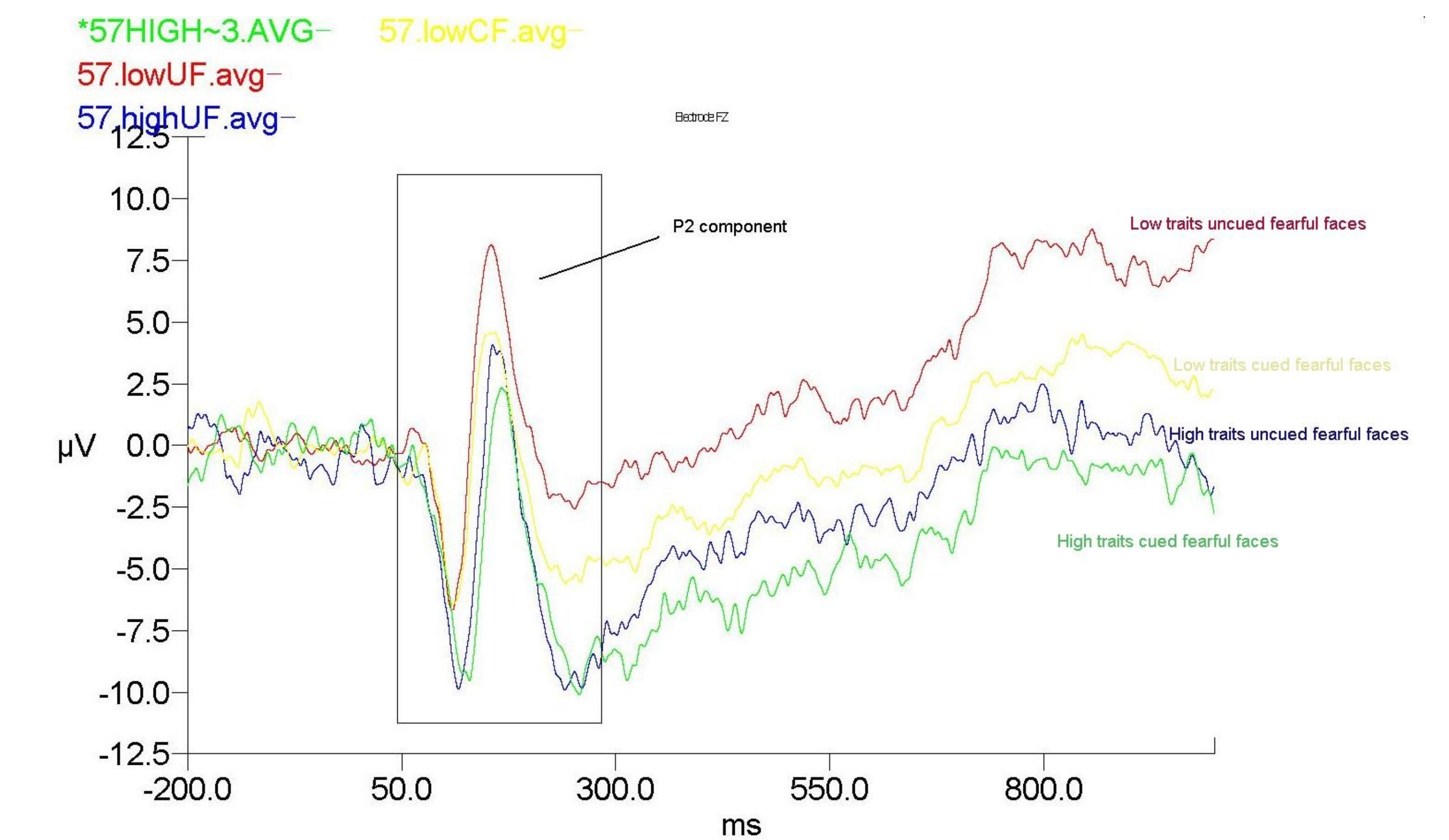
Statistical Analyses

- In order to investigate the P2 and P3 components, each were analyzed independently using repeated measures ANOVA.
- The P2 component** was found in the time window of 125-175ms, and was analyzed by the within-subject factors of cue condition, electrode, and emotion, with the between-subjects factor of psychopathy group (high psychopathic traits versus low psychopathic traits). The electrodes included in this analysis were: C4, CZ, C3, FCZ, FZ.
- The P3 component** was analyzed using the same between- and within-subject factors (psychopathy group, cueing, electrode, and emotion), but with the time window of 400-600ms, and the electrodes: PZ, CP4, CP3, and CPZ.
- Due to significant findings from the ANOVA's, paired-samples T-tests were run for P2 amplitude, comparing emotion and condition across the groups, as well as one for P3 amplitude that compared cueing conditions.

P2 component:

Below, the top (red) average wave seen is from the low traits group when viewing uncued fearful faces. The second (yellow) average wave is the low traits group when viewing cued fearful faces. The third (blue) average wave is the high traits group viewing uncued fearful faces. The bottom (green) average wave is the high traits group when viewing uncued fearful faces.

- There was a significant effect of cueing on the P2 amplitude ($F(1,10)=9.069, p=.013$)
- Uncued fearful expressions elicited augmented neural responses when compared to the cued fearful expressions ($t(11)=-4.809, p=.001$)



Discussion

- This information is compelling – there is a significant difference in the neural activity of females with high levels of psychopathic traits compared to the neural activity of females with low levels of psychopathic traits, specifically when viewing pictures of faces.
- Within and across groups, there is a difference in neural response to seeing a fearful face that is expected as opposed to unexpectedly viewing a fearful face.
- More research needs to be done on female psychopathy – particularly ERP research, as there is a considerable dearth
- This study should be followed up with a larger scale study following a similar paradigm, and perhaps controlling for anxiety-level, as much psychopathy research suggests that people with high levels of psychopathic traits can differ greatly depending on how anxious they are.

References and Acknowledgements

fearful face image on poster retrieved from: <http://www.sott.net/image/image/1138/brain9-11.jpg>
Experiment design modeled off of: Yang, J.M., Yuan, J.J., Li, H. (2010). Emotional expectations influence neural sensitivity to fearful faces in humans: an event-related potential study. *Life Sciences*. 53(11), 1361-1368
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