



MEDIAL PREFRONTAL NOGO ACTIVATION DURING AN EMOTION GO/NOGO TASK IS RELATED TO WORRYING IN ADOLESCENTS

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Background

The nogo N2 ERP component (larger when participants refrain from responding to nogo stimuli compared to responding to go stimuli) is proposed to reflect cognitive control processes such as inhibition, effortful attention, the detection of response conflict, and action monitoring [1,2,3]. The N2 has been localized to medial prefrontal brain regions, most notably the anterior cingulate cortex (ACC) [1,4,5]. The nogo N2 has also been related to trait anxiety [6, 7] and anxiety has been related to a negative attention bias [8].

Goal: To examine the influence of emotional valence (induced by happy vs fearful facial expressions) and trait “worrying” on neural activity and behavioral performance during a go/nogo task. We examined the N2 and its underlying current source density in ACC using LORETA.

Method

Participants

- 50 healthy adolescents (29 boys, mean age 13 years).

Self-report measure of worrying

- Penn State Worry Questionnaire for Children (PSWQ-C) [10].

EEG recording and reduction

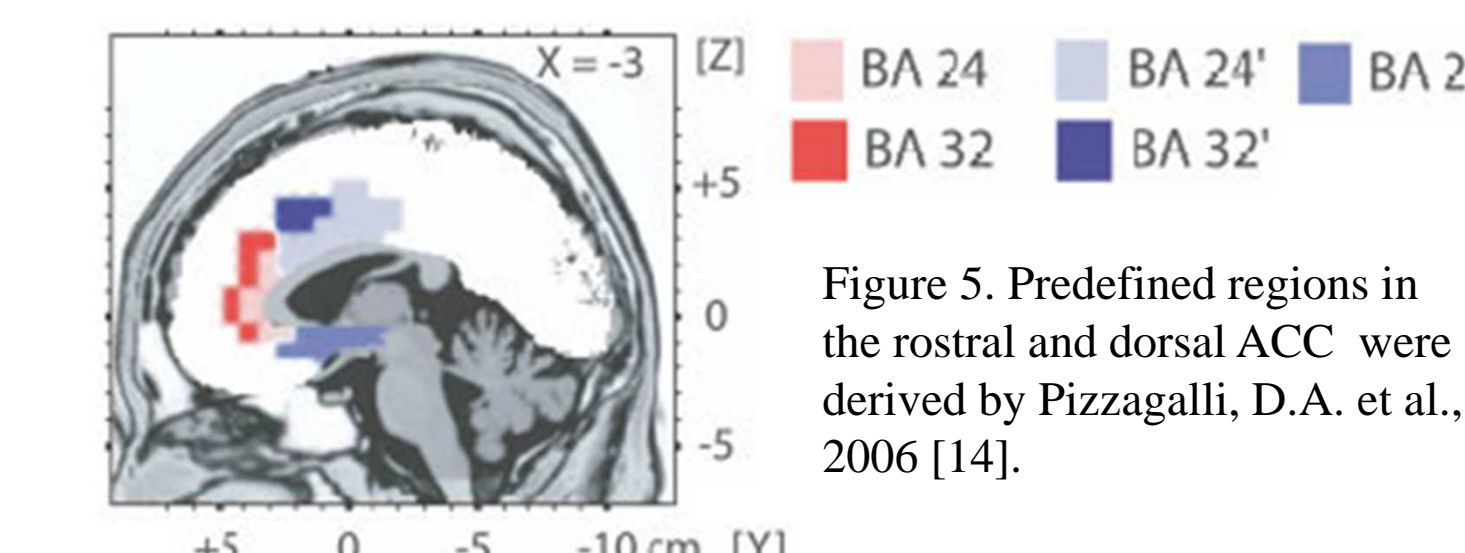
- Recorded continuously during the task using a 128-channel sensor array.
- ERP epochs: -200 to 800 ms for correct Go and Nogo trials at Fz, FCz, and Cz.
- Epochs filtered 1-30 Hz and a -200 to 0 ms pre-response baseline used.

Low Resolution Electromagnetic Tomography (LORETA)

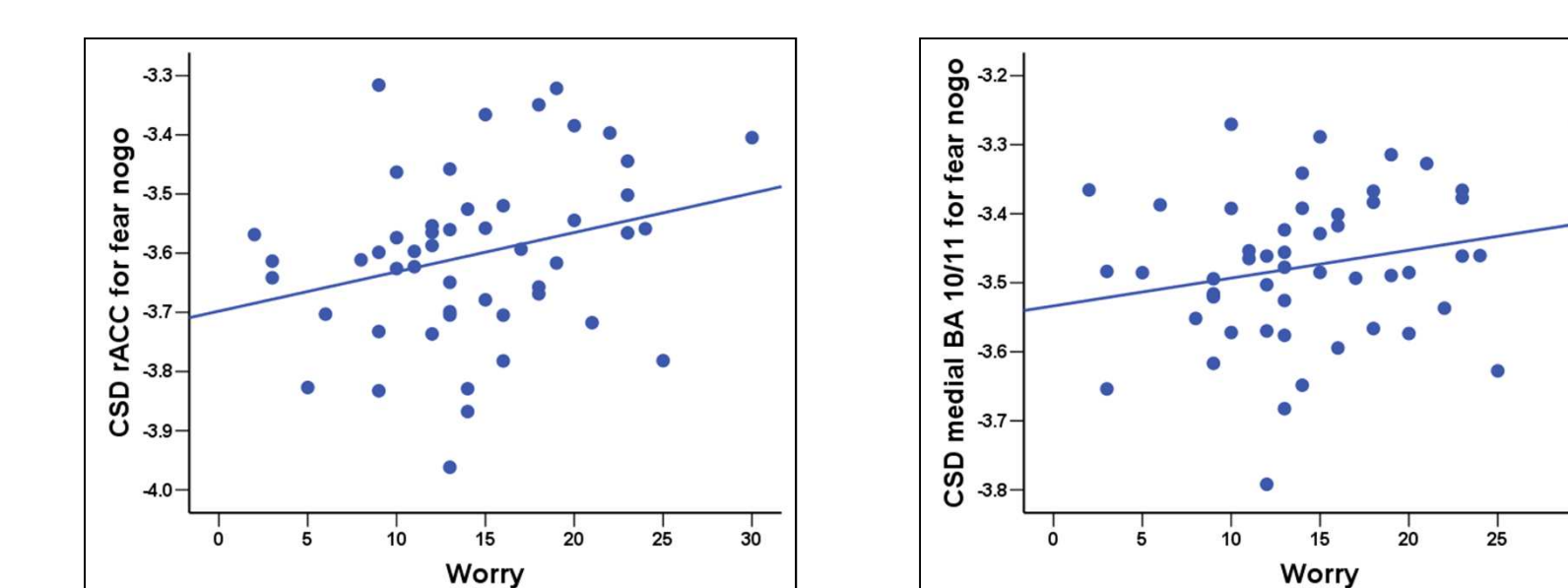
- The intracerebral current density underlying the N2 was examined using LORETA in predefined regions of interest in the rostral and dorsal ACC [11].
- Current density computed during 30 ms window around the N2 mean latency (309 ms).

LORETA Results

- Higher worry scores were related to greater activity in the rostral ACC (BA 24/32, indicated by pink and red in Figure 5) during the fear condition on nogo trials ($r = .34, p = .02$), Figure 6.



- Higher worry scores were related to greater activity in the medial orbital frontal cortex (OFC; BA 10/11) during the fear condition on nogo trials ($r = .28, p = .05$), Figure 7.



- Worry was not related to brain activity during happy go or nogo trials ($r_s < .21, p_s > .14$).

Conclusions

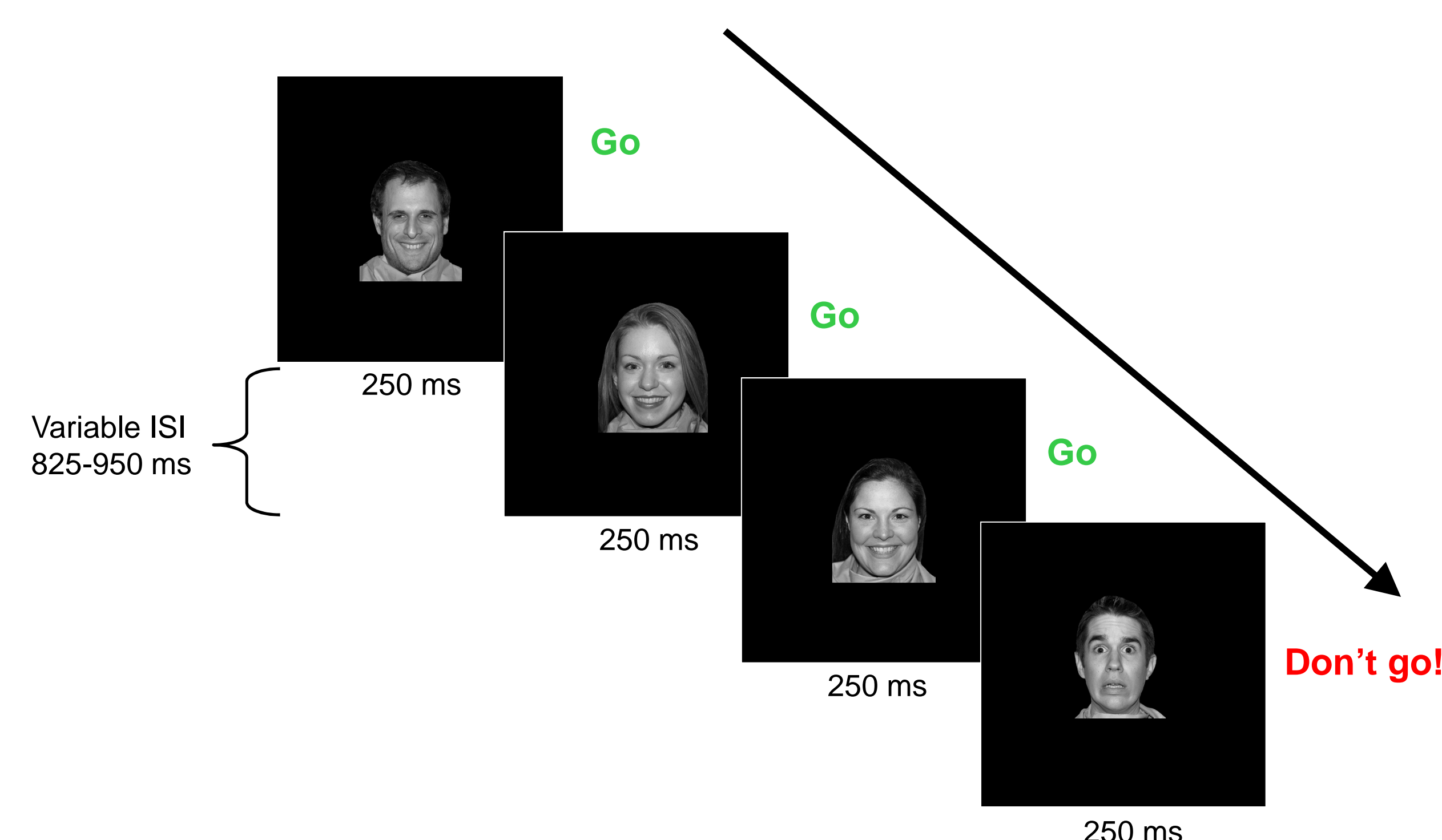
- As expected, participants were slower to respond to fearful faces [9] and exhibited larger N2s for nogo compared to go stimuli.
- Adolescents characterized as “worriers” had larger nogo N2s for fearful faces, consistent with enhanced N2s in anxious individuals [6,7] and after negative mood induction.
- “Worriers” also had greater activity in the rostral ACC and OFC in response to fearful faces on nogo trials, consistent with reports of negative affect relating to hyperactivity in the rostral ACC and orbital frontal regions [12,13].
- The present findings support the well-documented link between negative attention bias in anxious and/or worried individuals to altered ACC-related cognitive control and extends these findings to adolescents.

References

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Emotional Go/Nogo Task



Based on Hare, T.A., et al. (2005). Biol Psychiatry.

- Participants were asked (in Happy-Go condition) to respond as quickly as possible to the happy face and to not respond to the fear face, and vice-versa in Fear-Go condition [9].
- Two blocks of 320 trials (Happy-Go, Fear-Go) counter-balanced across participants.
- Face stimuli consisted of an equal number of male and female gray-scaled happy and fearful NimStim faces (www.macbrain.org).

Behavioral and ERP Results

- Main effect for Response: Nogo error RTs faster than correct go RTs ($F_{1,49} = 47.2, p < .01$).
- Response X Emotion interaction ($F_{1,49} = 4.2, p = .05$): Fearful face go RTs slower than happy face go RTs ($t_{49} = 2.9, p < .01$); fearful nogo errors faster than happy nogo errors ($t_{49} = 3.9, p < .01$), Figure 1.

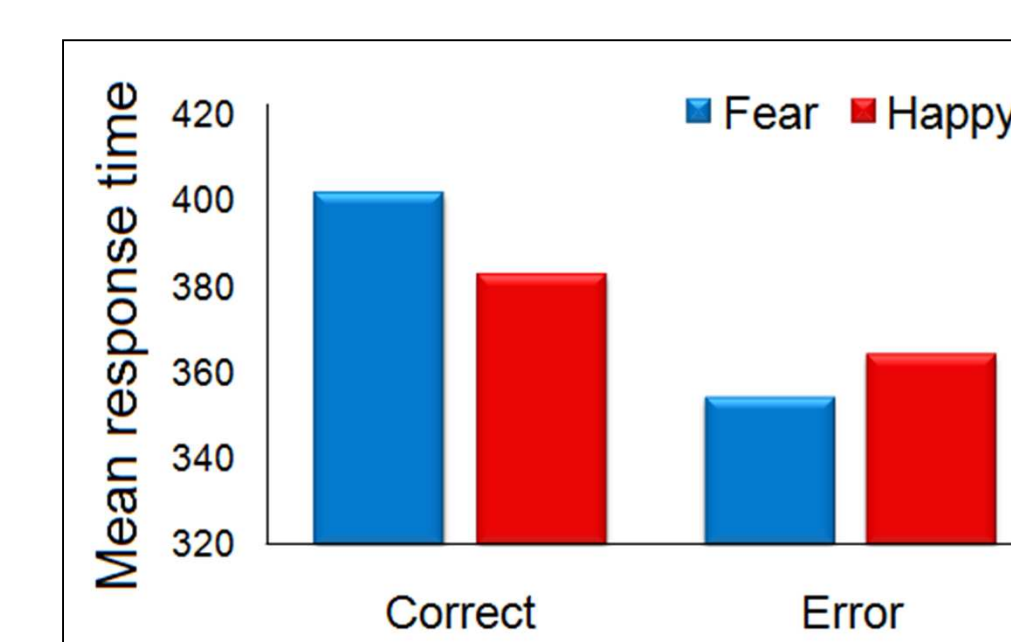


Figure 1. Mean RT for correct and error fearful and happy condition.

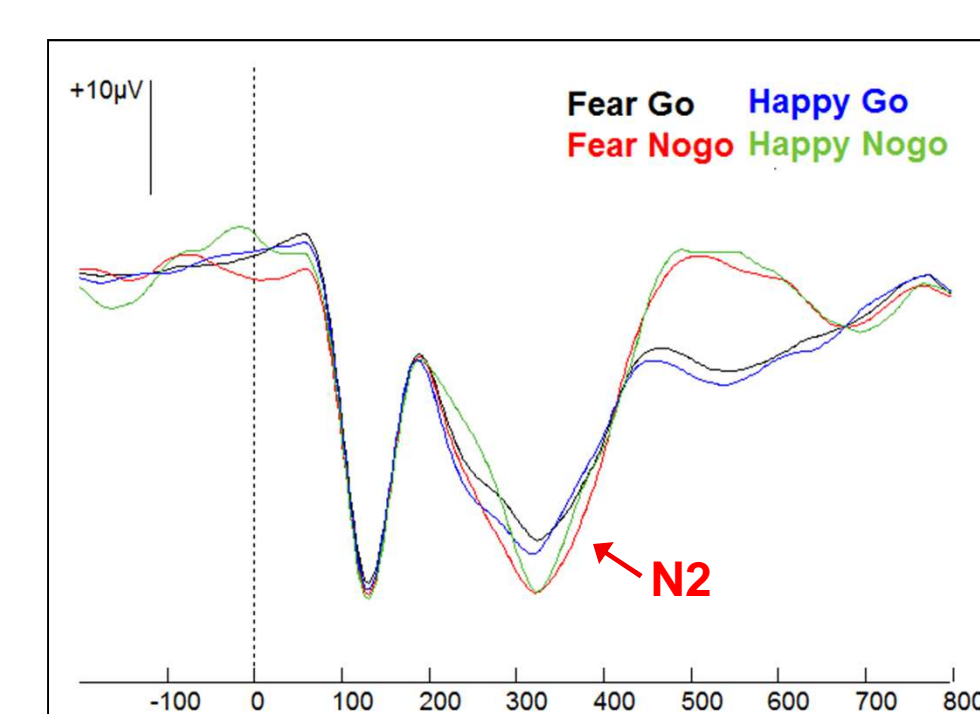


Figure 2. Grand average ERP waveform at Fz.

- Nogo N2 larger than go N2 ($F_{1,49} = 49.0, p < .01$) at Fz
- No difference between fearful and happy N2 ($p = .13$) for either go or nogo, Fig 2.

- Worry was related to the fearful nogo N2 ($r = -.35, p = .01$) but only marginally related to the happy nogo N2 ($p = .06$), Figure 3.
- The residual N2 (nogo N2 with the go N2 partialled) for fear was also related to worry ($r = -.29, p = .04$), Figure 4.

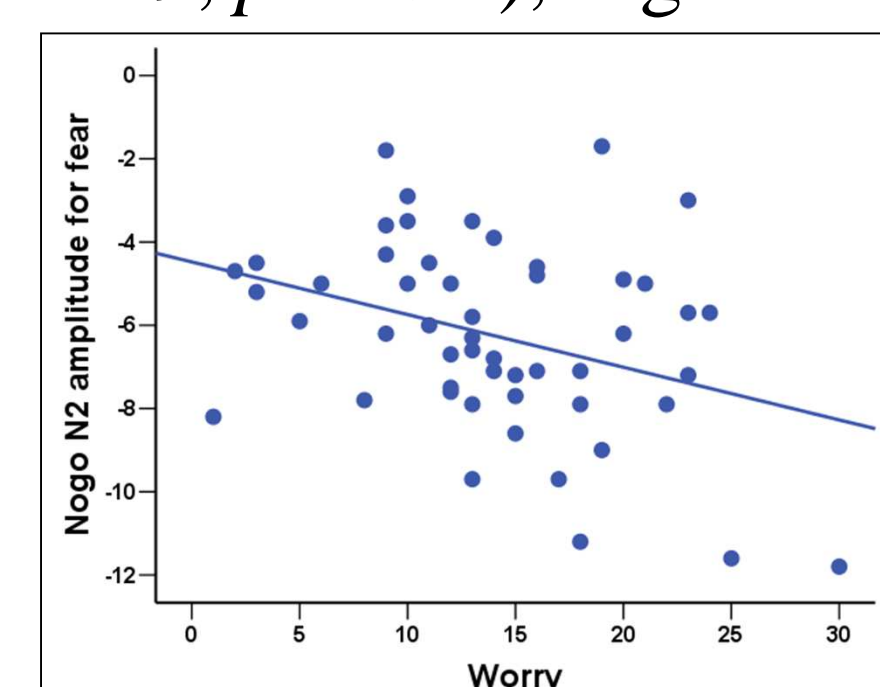


Figure 3. Scatterplot of the nogo N2 and worry for the fear condition.

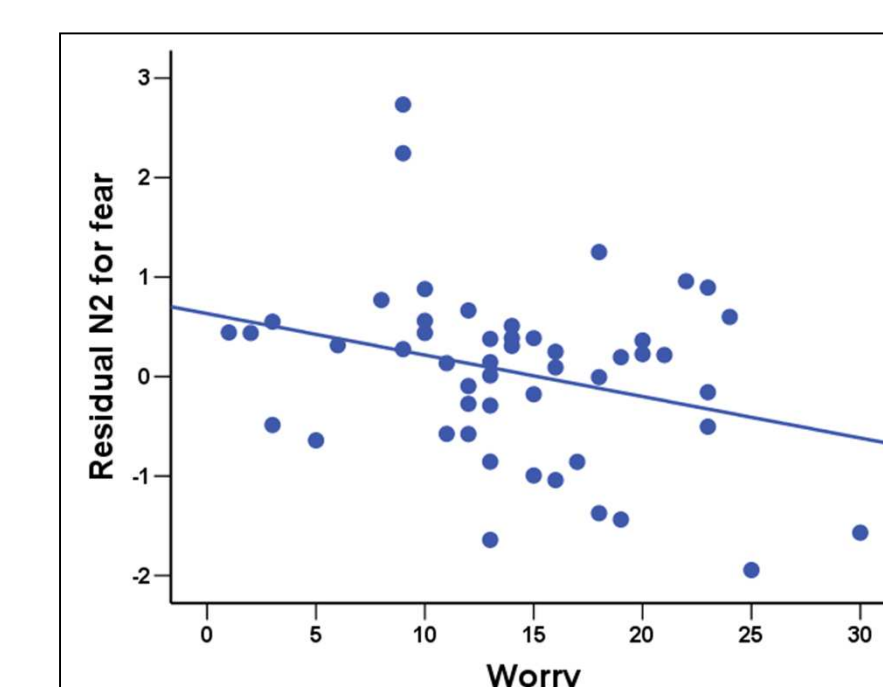


Figure 4. Scatterplot of the residual N2 and worry for the fear condition.