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The relationship between Aperiodic Resting-State EEG activity and Cognitive performance is modulated by Education in Aging

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INTRODUCTION

Aging influences the oscillatory (periodic) brain activity in the alpha band (8-12 Hz), as measured in resting state EEG (rsEEG). Studies using standard Fourier methods report that older adults have significantly lower alpha frequency and power than younger adults. Interestingly, the aperiodic component of the rsEEG signal (e.g., exponent) is related to aging: as age increases, the aperiodic slope flattens, possibly reflecting age-related changes in excitatory/inhibitory balance [1]. The oscillatory alpha peak component may correlate with cognitive performance [2]. It is unclear whether accounting for education, known for its modulatory role on cognitive performance, may influence the relationship between periodic and aperiodic activity with performance.

METHODS

Data on N=179 healthy subjects from the LEMON dataset were analyzed [3]. Available information about education was expressed in two levels: high (N=123 young adults, Y_H; N=24 older adults, O_H) and low (N=32 older adults, O_L). Signal was decomposed with the specparam/FOOOF approach. After parameterizing the neural EEG power spectrum into the periodic and aperiodic components, aperiodic components were averaged across all the brain parcels within the occipital region. The fits with the highest power value (PW) were chosen for the Individual Alpha Peak Frequency (IAF), then different occipital ROIs were averaged. The test scores of Processing Speed (i.e., alertness and attention) and Memory (i.e., working and delayed) were entered in multiple regression analyses, with periodic (IAF) and aperiodic values as predictors.

RESULTS

Both O_H and O_L showed lower scores on all cognitive tasks compared to Y_H, as expected. The O_H group had significantly better performance in the working memory task compared to O_L (t=2,86, p<0.01). Significant age effects were shown for the periodic and aperiodic parameters (Figure 1). Moreover, in the regression analyses, the model accounting for both age and education showed a significant effect, of the exponent, on both the Processing Speed tasks (e.g., TAP_A B=1.73, p=0.04), and such effect was modulated by education (e.g., TAP_A B=3.97, p=0.01).

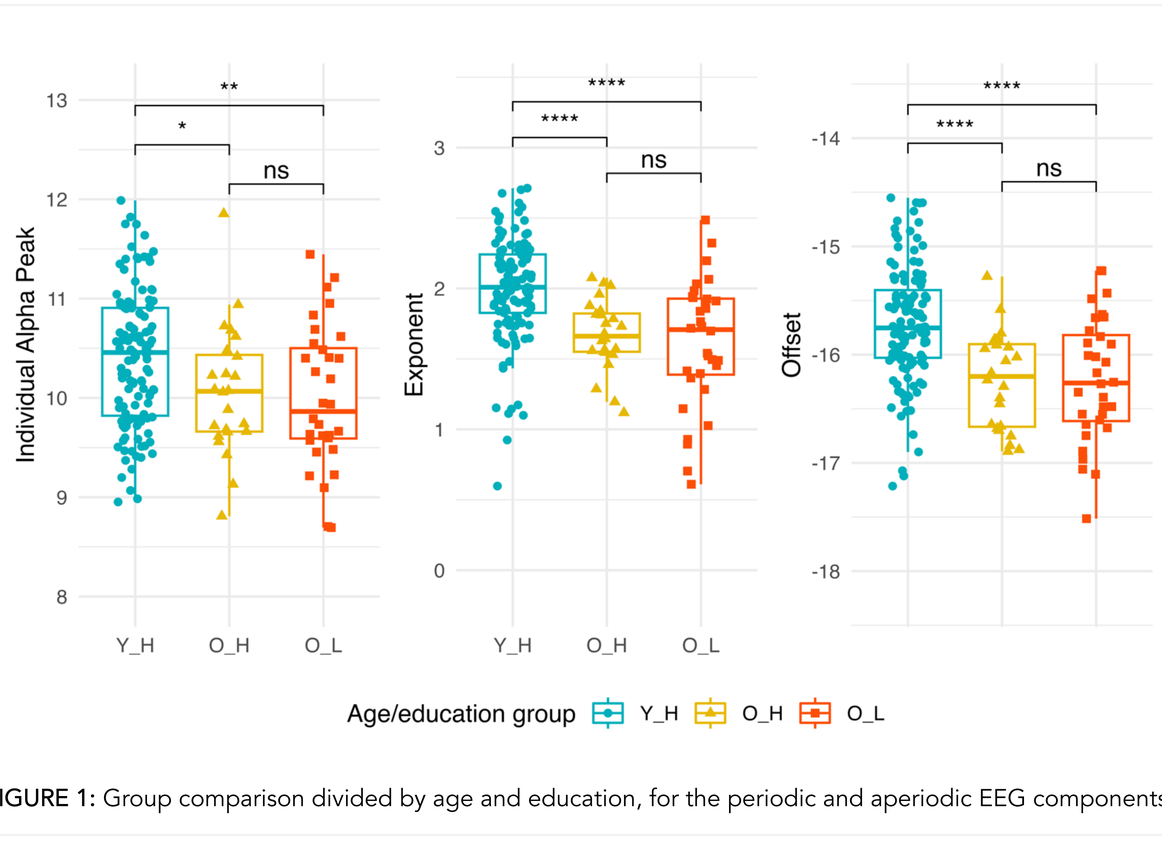

FIGURE 1: Group comparison divided by age and education, for the periodic and aperiodic EEG components

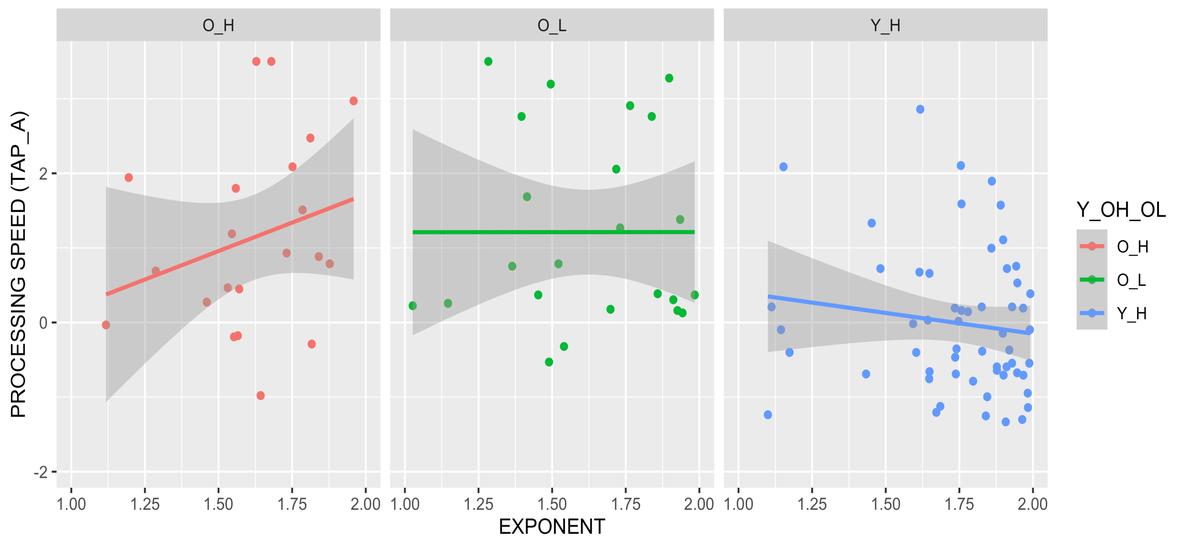

FIGURE 2: Generalized Regression Model analysis including TAP_A [3] as a dependent variable and the exponent of resting state EEG signal as a predictor.

CONCLUSION

Education, which has been shown to possibly contribute to compensatory cognitive processes, seems to modulate the relationship between aperiodic activity and cognitive efficiency in older adults. Interestingly, a potential compensatory process associated with the level of education seems to emerge when processing speed is considered in an aging population.

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