ELECTRO-CORTICAL CORRELATES OF INDIVIDUAL DIFFERENCES IN ASSOCIATIVE LEARNING

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Introduction

Attentional processes are reported to correlate to learning[1,2] and could underlie the consistent variations reported between individuals in learning ability[3]. Early attentional components including P1 have been linked to differences in learning between stimuli or between healthy and clinical population, but it remains unclear whether early attentional processes and their related ERP vary in accordance with individual difference in learning in a healthy population.

Are attentional processes, their related ERP and underlying cerebral regions linked to individual differences in associative learning?

To test how attentional processes and individual differences in learning relate, we devised an associative learning task and measured performance with SDT index *d'*. We hypothesize a covariation of early attentional components with performance to the task.

Methods

Participants

- 38 healthy participants (7 men)
- Aged 22.3 years ± 3.96

Task description

Participants performed trials of an associative learning task composed of 12 abstract shapes in four colors until they reach the criterion of more than 95% correct responses in the last 48 trials (with a maximum of 504 trials). Participants learnt the correct associations by trial-and-error: they endorse or reject the presented color-shape association by pressing a button and feedback screen informed the participant whether his response was correct, incorrect or too slow.

Task Design

EEG recording

- 64-channel Biosemi ActiveTwo system
- Average reference
- Epochs from -100 to 1000ms post-stimulus onset.

ERP analyses

- Topographic analyses of covariance (TANCOVA) with *d'* and GFP analyses, using RAGU
- Source localization of generators with sLORETA

Results

Topographic analyses of covariance

Analyses showed topographic covariations with performance to the task measured by *d'* at 126-148 ms and 573-638 ms

Higher presence of the presented topographies was associated with higher *d'*.

The map between 126-148ms displays a topography coinciding with a P1 component. The map between 573-638ms displays a topography coinciding with a P3 component.

Source estimation

Underlying sources of the covariance maps showing activation in the precuneus (BA 7) for 126-148 ms and the superior frontal gyrus (BA 11) for 573-638 ms.

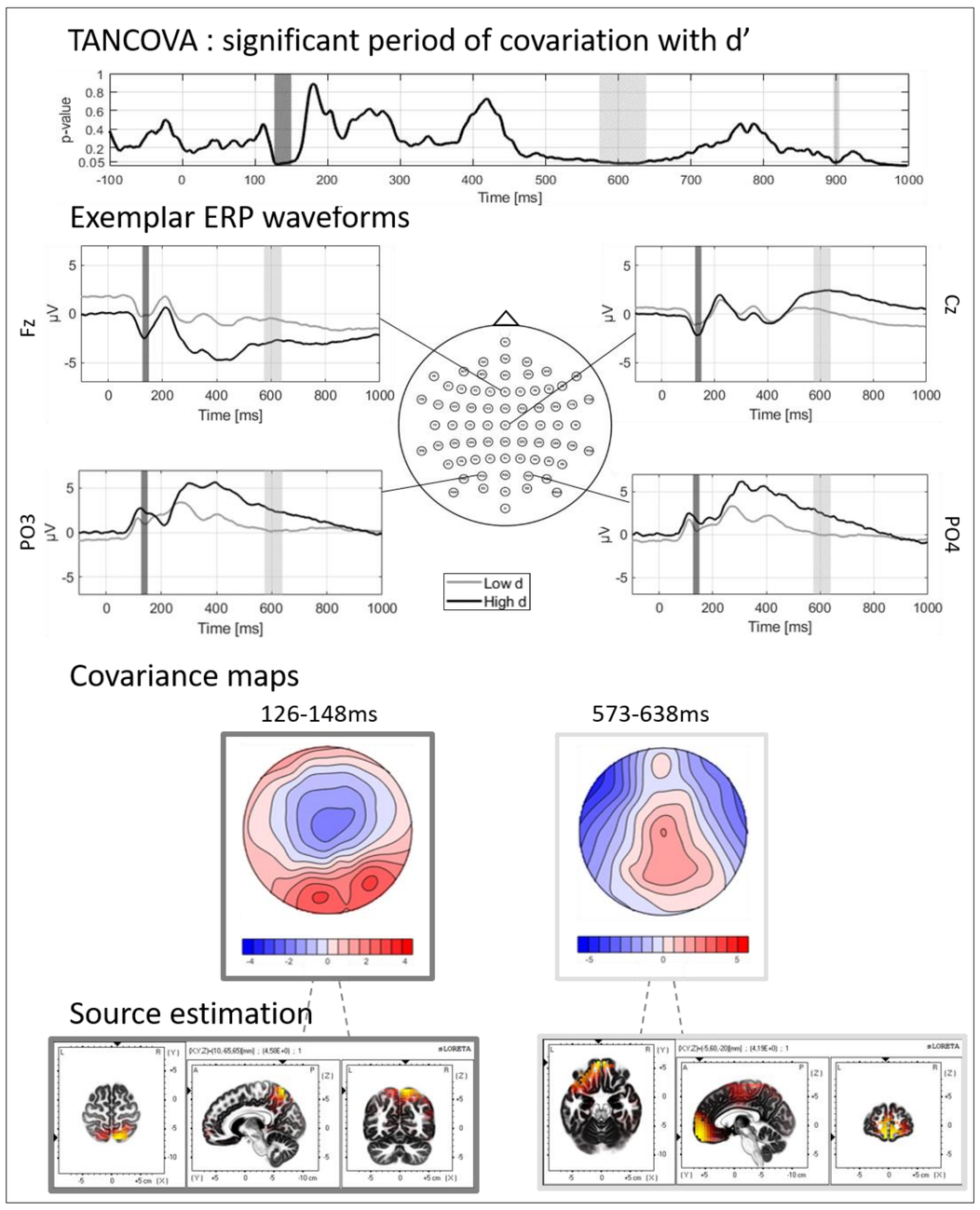
Global field power analyses

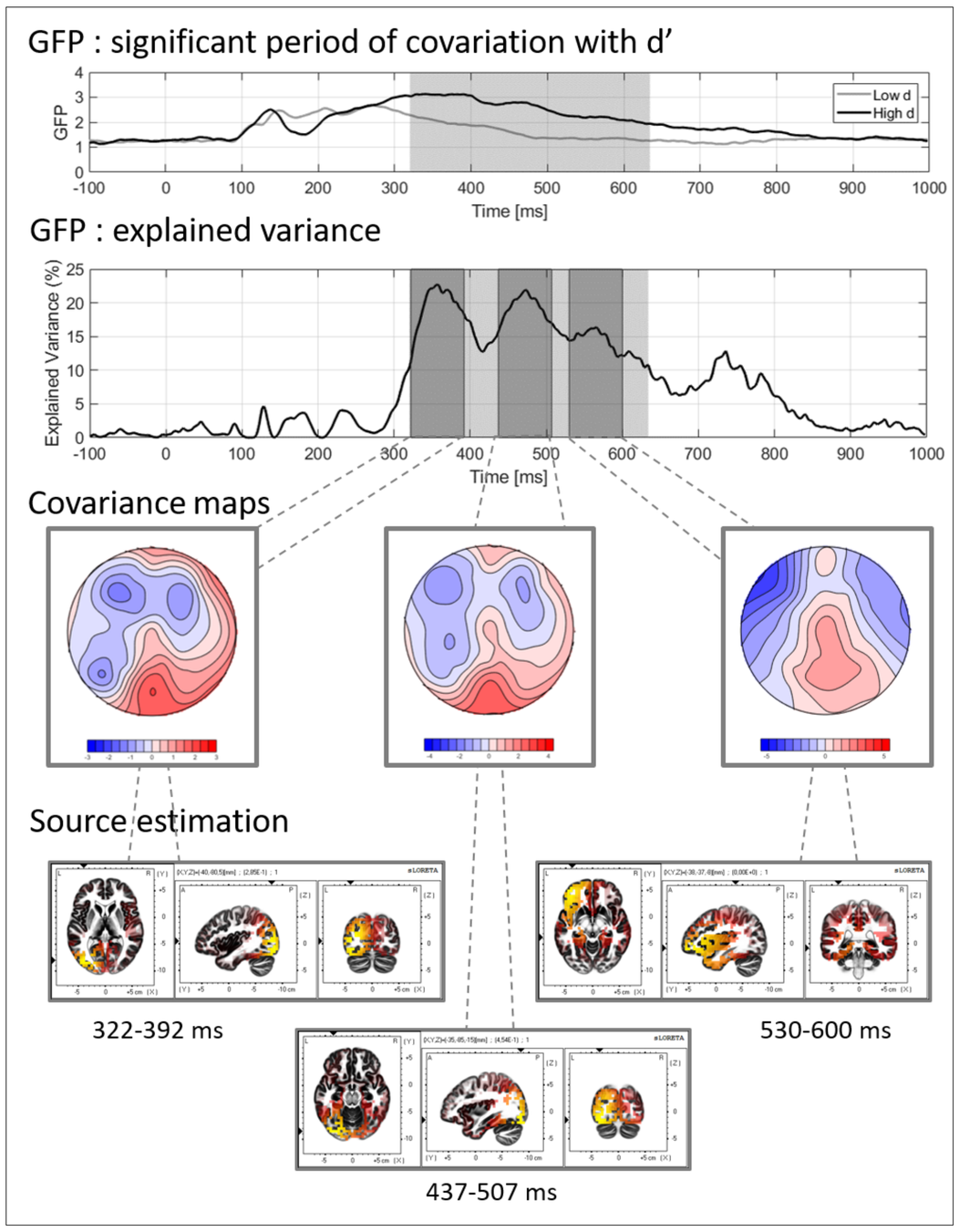
Analyses showed GFP covariations with performance to the task measured by *d'* at 320-634 ms

Higher GFP was associated with higher *d'*. The large period of significant covariation was divided in three periods of 70 ms around the explained variance peaks.

Source estimation

Underlying sources of the covariance maps showed activation in the middle occipital gyrus (BA 18 and 19) for the periods 322-392 ms and 437-507 ms and in the middle frontal gyrus (BA 11 and 47) for the 530-600 ms period.





Conclusions

These findings suggest that **better learners make more resources available and display more functional activity in areas involved in early attentional processes (BA7) and decision-making processes (BA11)** during an associative learning task, than weaker learners.

Literature

1. Logan, G. D., & Etherton, J. L. (1994). What is learned during automatization? The role of attention in constructing an instance. Journal of Experimental Psychology: Learning, Memory, and Cognition, 20(5).
2. Wills, A. J., Lavric, A., Croft, G. S., & Hodgson, T. L. (2007). Predictive Learning, Prediction Errors, and Attention: Evidence from Event-related Potentials and Eye Tracking. Journal of Cognitive Neuroscience, 19(5).
3. Le Pelley, M. E., Mitchell, C. J., Beesley, T., George, D. N., & Wills, A. J. (2016). Attention and associative learning in humans: An integrative review. Psychological Bulletin, 142(10),