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# INTRODUCTION

P300 or P3b is the most extensively studied evoked response in EEG/MEG research, and yet the exact mechanism of its generation remains undetermined. P3b is hypothesised to reflect a variety of functions, such as cognitive processing, context updating, memory retrieval, decision-making, etc. Previous research established that P3b coinsides with a decrease in the amplitude of the alpha rhythm that is also triggered by a stimulus onset [1], [2], [3]. Therefore, P3b origin may be due to the baseline-shift mechanism (BSM [4]). Two crucial elements should come together for BSM to succeed. Firstly, the oscillations should have a nonzero mean. In practice, it means that when integrated over several periods oscillations' average value should be shifted away from zero. Taken from another perspective, a non-zero mean implies that average values of the upper and lower half of the oscillatory cycle would be unequal. Secondly, the amplitude of oscillations should be modulated by stimulus presentation. In this study, we examined the compliance of P3b with BSM.

# METHODS

We analysed the data of elderly individuals (N =2308, 60-82 y.o., 1196 females) from the populationbased LIFE-Adult data set (Leipzig Research Center for Civilization Diseases, Leipzig University [5]). Our focus contained the following predictions of BSM - (1) the polarity of P3b is unequivocally determined by the sign of the oscillatory mean together with the direction of alpha amplitude change (the stimulus-induced decrease in the alpha amplitude together with negative non-zero mean dictate the upward deflection of the evoked response), (2) time courses of P3b and alpha envelope are similar, (3) spatial distributions of P3b and alpha modulation are similar.

Figure 1: The prerequisites of BSM. a. If non-zero mean oscillations are modulated by the stimulus, the evoked response will inevitably appear on a summed-over-epochs signal. b. However, if oscillations have zero mean, the evoked response will not be generated. c. Similarly, if the prerequisite of modulation is not fulfilled, the evoked response will not be generated either. The third column represents the baseline-shift index that can be applied to infer the sign of the mean [6]. The sign of the slope is equivalent to the sign of the mean of oscillations. Here,  $V_{\alpha}$  are values of binned alpha amplitude,  $V_{bs}$  are values of binned low-frequency signal.

# Non-zero mean alpha oscillations are involved in P3b generation

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# **RESULTS 1**







# **RESULTS 2**





Figure 4: P3b and alpha amplitude change in sensor and source space. a. The topographies were sampled at the P3b peak. P3b has a parietally distributed positivity. However, due to the massive occipital alpha, possible alpha source that generates P3b is occluded. b. Sources of P3b were estimated with dipole fitting. Sources of alpha oscillations that had the biggest decrease in amplitude were retrieved with eLORETA. The sources of both P3b and alpha amplitude decrease are localized in similar spatial locations along posterior mid-line.

# CONCLUSION

We show that the P3b evoked response is compliant with BSM, which means that, at least partially, P3b is generated due to modulation of non-zero mean alpha oscillations. Consequently, it leads to a general inference that changes in P3b amplitude or latency should be interpreted in conjunction with changes in oscillatory amplitude dynamics.

Figure 2: P3b and the corresponding decrease in alpha amplitude. a. From the stimulusbased data, we retrieved P3b with low-pass-filtering at 3 Hz and subsequent averaging, and alpha rhythm amplitude envelope with filtering  $\pm$  2 Hz around individual peak frequency followed by Hilbert transform. The standard-stimulus response demonstrates neither deflection in P3b time interval nor a prominent modulation of the alpha rhythm. b. The correlation between concatenated-over-epochs time courses of evoked response and alpha amplitude was estimated with the Pearson coefficient both for standard and target stimulus. After, two sets of correlation values were compared with paired t-test for each electrode separately. The figure displays values of t-statistics.

Figure 3: The Baseline-shift index (BSI [6]) serves as an estimation of a sign of nonzero mean and, therefore, as the estimation of the predicted direction of the baseline shift. BSI was computed from the 10-min rest-state recordings. a. The distribution of BSI across the cortex in sensor space. b. The relation of BSI to P3b and alpha amplitude envelope. The BSI from Pz was binned into the following 5 bins -[-.99, -.81), (-.81, -.46), (-.46, .09), (.09, .62), (.62, .98). According to predictions of BSM, if BSI (and the mean) is negative then the attenuation of oscillations would lead to the upward direction of the evoked response. We observed that for bins with negative BSI, the amplitude of P3b is higher in comparison with other bins where BSI is positive. The difference is significant based on paired t-test between averaged amplitudes of evoked response in bin 1 and bin 5 (T = 5.66, p < 0.0001).

## **RESULTS 3**



## REFERENCES

Alpha amplitude Evoked response

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