EEG microstates and the schizophrenia spectrum: evidence for compensation mechanisms

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Introduction

Electroencephalogram (EEG) microstates are on-going scalp potential configurations that remain stable for around 80 ms (1). Four recurrent and dominant classes of microstates (labeled A-D) are observed in resting-state EEG, explaining around 65-84 % of the global variance of the data (2). Several studies have reported abnormalities in the dynamics of EEG microstates in schizophrenia patients (3). Similar abnormalities have also been observed in adolescents with 22q11.2 deletion syndrome, a population that has a 30% risk of developing psychosis (4). These results prompted researchers to suggest that the abnormal dynamics of EEG microstates is a potential endophenotype for schizophrenia. For endophenotypes, it is important that unaffected relatives also show the abnormal dynamics (5). To the best of our knowledge, no study analyzed the resting dynamics of these four EEG microstate classes in relatives of schizophrenia patients.

Methods

We examined 5 minutes resting-state EEG data of 260 participants collected across experiments, and we estimated the dynamics of the four canonical EEG microstates using Cartool (6). In experiment 1, to investigate whether unaffected siblings of schizophrenia patients show EEG microstates abnormalities, we tested 38 unaffected siblings of schizophrenia patients, 89 schizophrenia patients, and 69 healthy controls. In experiment 2, to assess whether these abnormalities are also present in people with high schizotypal traits, we tested 42 healthy students scoring either high (n=22) or low (n=20) in schizotypal traits. In experiment 3, to investigate

whether microstates abnormalities are already present at the beginning of the disorder, we tested 22 patients with first episodes of psychosis (FEP). We also tested the FEP patients two more times throughout one year to assess whether the microstates dynamics change with disease progression. For each group of participants, we identified four microstates classes and labeled them A-D according to their similarities to the previously reported microstate class topographies (2). For each subject, three per-class microstate parameters were computed: mean duration (in ms), time coverage (in %), and frequency of occurrence (occurrence).

Results

In line with previous studies, schizophrenia patients showed increased presence of the microstate class C and decreased presence of the microstate class D compared to controls (**Figure 1**). Siblings showed similar patterns of microstates classes C and D as patients. Surprisingly, siblings showed increased presence of the microstate class B compared to patients and controls. A similar result was also found in students scoring high in schizotypal traits compared to the ones scoring low (**Figure 2**). No difference was found between FEP and matched chronic patients. Moreover, the microstates dynamics remained stable throughout one year.

Conclusions

Our findings suggest that the dynamics of resting-state EEG microstates not only meet most of the requirements for an endophenotype for schizophrenia (5), particularly classes C and D, but they also reveal a potential compensation mechanism that unaffected siblings and healthy people with high schizotypal traits have that might prevent them to develop the disorder. We associate this compensation mechanism with the increased presence of microstate class B. Only little is known about microstate class B. It has been related to the resting-state visual network in fMRI (7), and in healthy participants it is the shortest and least frequent microstate from adolescence on (8, 9). This suggests that the temporal dynamics of microstate class B might be an early marker to discriminate people that are at risk to develop schizophrenia from people that might compensate for their vulnerability.

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References

9 references (**max 10**)

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Figures

2 figures (**max 2**)

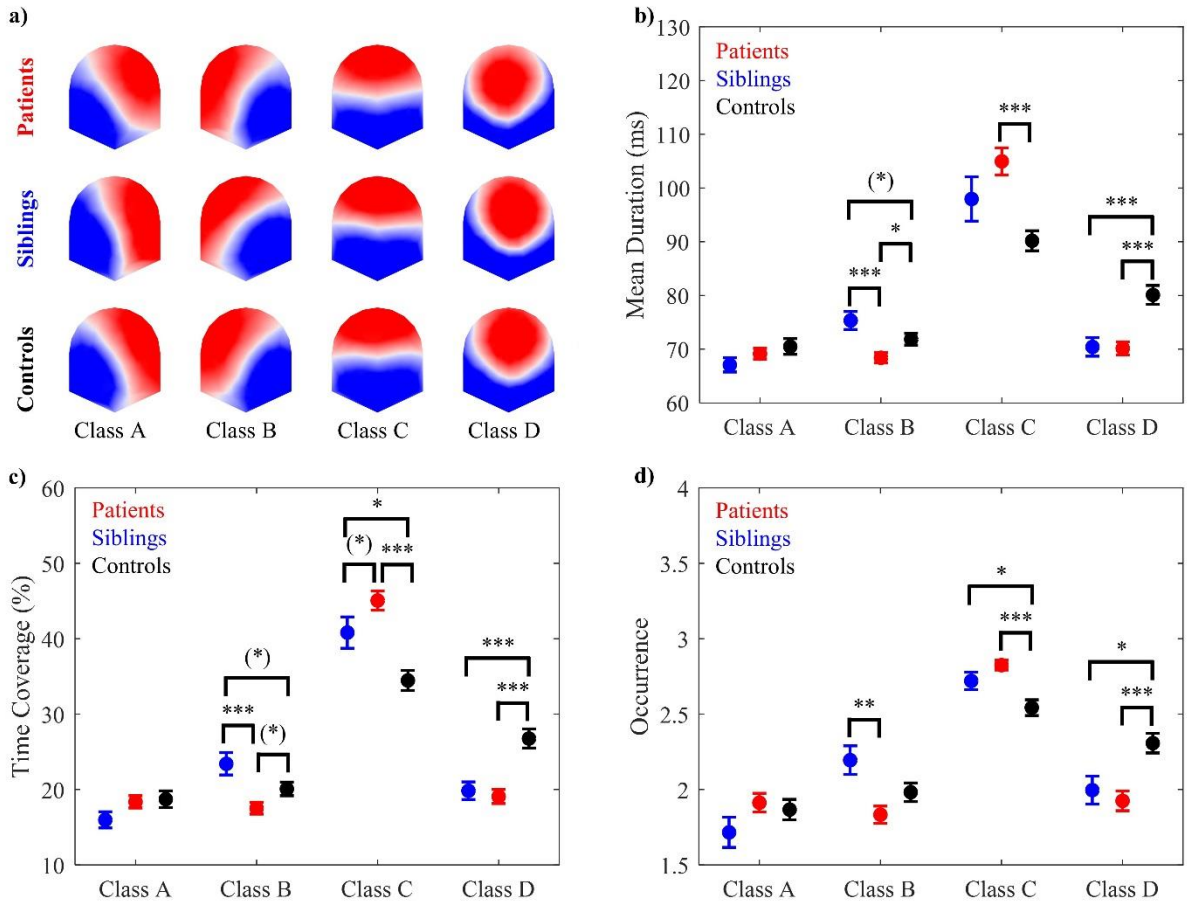

Figure 1 - Results of the EEG microstate analysis for schizophrenia patients (red), siblings (blue) and controls (black). a) The spatial configuration of the four microstate classes (A, B, C, D) for the three groups. Statistically significant group differences, Bonferroni-Holm corrected, were found for all computed microstates parameters: b) mean duration, c) time coverage, and d) occurrence. Error bars indicate standard error of the mean. ((*) p<0.08, * p<0.05, ** p<0.01, *** p<0.001).

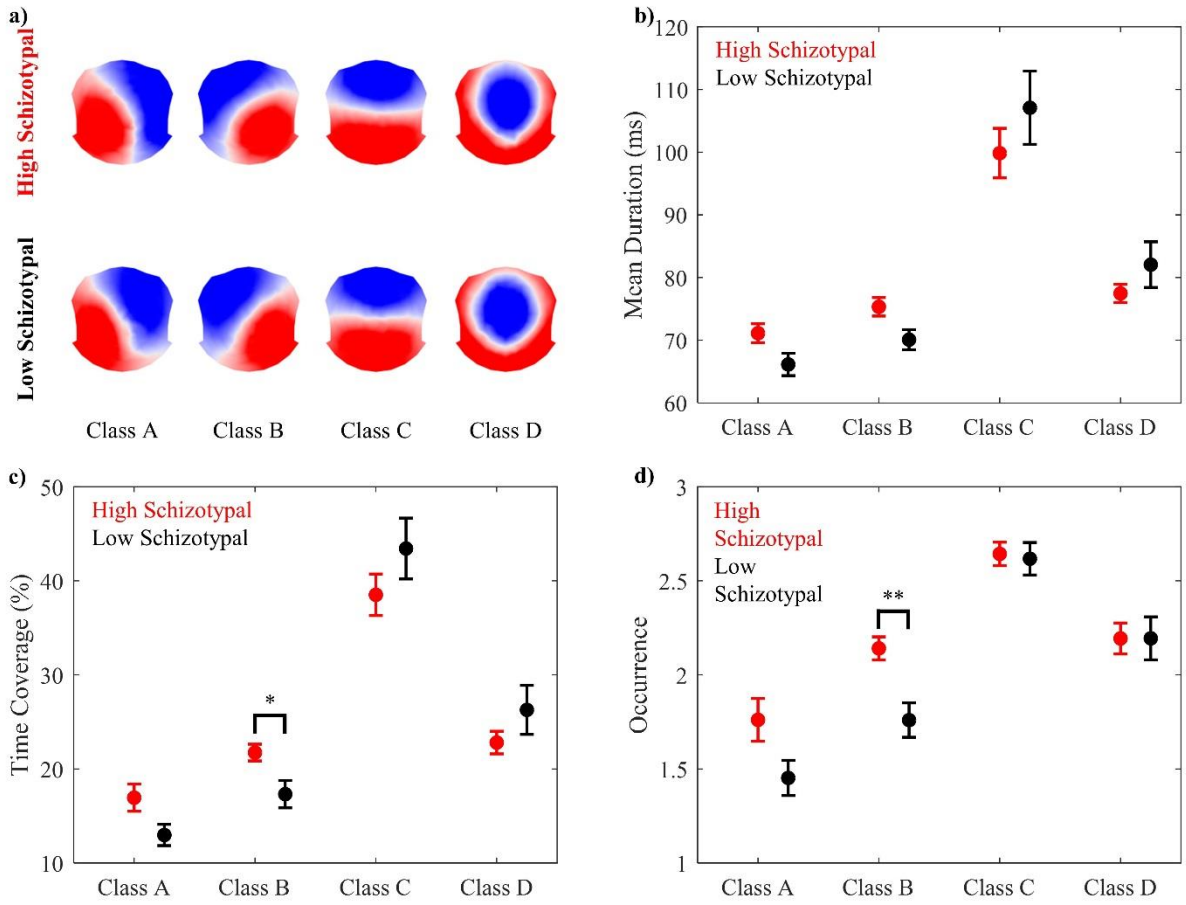

Figure 2 - Results of the EEG microstate analysis for High Schizotypal (red) and Low Schizotypal (black) groups. a) The spatial configuration of the four microstate classes (A, B, C, D) for the two groups. Statistically significant group differences, Bonferroni-Holm corrected, were found in microstate class B for c) time coverage, and d) occurrence. No group differences were found for a) mean duration. Error bars indicate standard error of the mean. (* p<0.05, ** p<0.01).