EEG Microstates are Shortened in Schizophrenia

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Introduction Young, first-episode, never-treated schizophrenics showed EEG microstates of shorter duration than age-matched healthy controls in several studies, but only Koukkou et al. (1994) and Kinoshita et al. (1998) reported significant differences. On the other hand, Koenig et al. (1999) and Lehmann et al. (2001) reported significant microstate shortening for one of 4 microstate classes in such patients. The present report concerns the question whether a comparable microstate shortening also exists in middle-aged, chronic schizophrenics presenting with positive schizophrenic symptomatology.

Method 14 male patients presenting with productive schizophrenia (at least 7 days off medication, age: 36.1±10.2) and 13 male controls (age: 35.1±8.2) were recorded during eyes closed resting (10-channel EEG from the 10-20 system locations F3/4, C3/4, T3/4, P3/4, O1/2; digitized at 128/sec). After artifact editing, 31.1±6.0 two-second EEG-epochs/subject were avaible. They were digitally band-passed (2-20 Hz) and transformed into sequences of momentary maps of potential distribution on the scalp. All maps at times of maximal Global Field Power (i.e., times of optimal signal/noise ratio) were further analyzed using the software EMMA (2001): for each subject, k-means clustering computed 4 individual model maps (classes) that accounted optimally for all individual maps. From the individual model maps, mean model maps across subjects were computed separately for groups: controls and patients, using a permutation procedure (with Monte Carlo-randomization) that assigned each subject's 4 model maps to one of 4 common classes with minimal variance across subjects. From these 4 mean model (class) maps of each group, 4 grand mean model maps were computed based on minimal map dissimilarity. Employing the group mean model maps as templates, successive maps belonging to the same class in each subject were recognized as forming a "microstate" whose duration was computed, yielding a mean microstate duration for each class and subject. ANOVA and post-hoc t-tests were used.

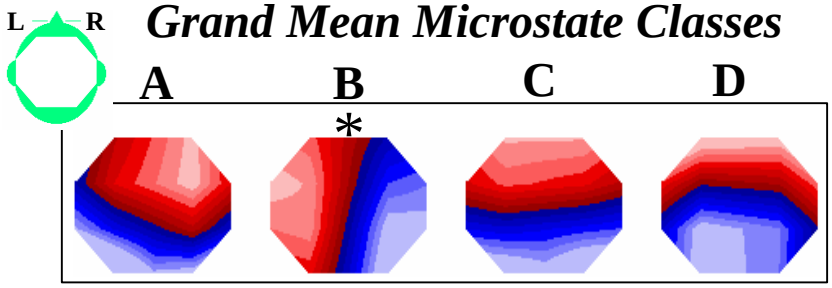

Fig.1. Equipotential-area scalp maps of the four microstate classes. Head seen from above, nose up (see inset). Note that polarity (blue, red) is irrelevant for result interpretation. ∗ = Duration of the microstates of class B was shorter in the patients than the controls, at p =0.03

Results All 4 microstate classes had shorter durations in patients than controls (signif. ANOVA), but for only one class (class 'B' in Fig.1, with left anterior to right posterior orientation of its brain electric field), this difference was significant in post-hoc tests (68.5 ± 10.7 msec versus 76.2 ± 6.0 msec, p=0.03). When disregarding the class assignments of the microstates, patients showed a shorter general mean microstate duration than controls (81.5 ± 11.9 versus 88.4 ± 10.7 msec), but only at p<0.15.

Conclusions Shorter microstate durations in young, untreated schizophrenics compared with controls were reported repeatedly; and in 2 studies this shortening preferentially concerned only 1 of 4 microstate classes (see Introduction). The present study agrees with these latter results, yielding a comparable finding in older patients. In fact, the same microstate class (with left anterior to right posterior brain electric field orientation) as in the two other studies showed this difference in duration. Functionally, this class of microstates was associated with visual imagery (concrete thoughts) in an earlier study (Lehmann et al. 1998). - The present results suggest that in schizophrenics, information processing in one class of mental operations, putatively concrete thoughts, terminates prematurely, thereby causing deviant mental constructs.

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