# Resting - State EEG Indicates Unstable $oldsymbol{U}$ Microstates in Visual Snow Syndrome

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## Visual Snow Syndrome (VSS)

- broad spectrum of positive visual symptoms
- main symptom is the perception of tiny flickering dots throughout the visual field
- More than 2% of the population is affected<sup>1</sup>  $\bullet$

## Findings

- MS explained 78.4% of data and did not differ between groups
- The life span and amplitude (mean global field power; GFP) of MS were significant lower in VSS patients compared to controls
- MA class A demonstrated an aberrant transition probability and
- Cause and pathophysiology of VSS are still largely unknown  $\bullet$
- It's most likely a neural network disorder<sup>1</sup>  $\bullet$

## Microstates (MS)

- account for a significant amount of the variance
  - in resting state EEG activity
- considered the basic building blocks of human neurological processes
- Changes in topographies & dynamics reflect shifts & alterations in underlying neural
  - processes
- Divergent dynamics in migraine, schizophrenia and other disorders<sup>2,3</sup>

**Transition differences** between groups



switched more often to class B (p = .001) and less likely to MS class

C(p = .011) in VSS patients



#### Microstates are weaker in visual snow syndrome

#### Microstates are shorter in visual snow syndrome

4 well replicated canonical microstate classes

correlate with specific neural mechanisms:<sup>2,3</sup>

A (auditory & visual processing, arousal) B (visual processing) C (self-reflection, salience network) D (dorsal attention network)

## Methods

- Comparison of resting state EEG microstate dynamics, eyes closed
- cohort of 21 subjects with VSS (8 females, 33 ± 9.56 years)

& 21 matched control patients (8 females, 33 ± 11.1 years)

- Matching on diagnosed VSS, sex, age, & migraine status
- Two-thirds had migraine; tinnitus not surveyed.



— median, • mean, \* p < .05, \*\*p < .01, \*\*\*p < .001

### Conclusion

We demonstrated that the general manifestation of microstates and specific dynamics differed from those of control subjects. Subjects with VSS had a shorter duration and lower strength of microstates, indicating



Four computed MS classes A – D Top row: mean microstates of control group Bottom row: mean microstates of VSS group

unstable and weaker neural network activity in this cohort. MS class A

showed abnormalities in transition behavior, suggesting an imbalance in

auditory and visual neural processing. Further analyses of microstates

within homogeneous cohorts could lead to differentiated results that can

be used as potential biomarkers for VSS. The present study supports the

existing consensus that seeing tiny flickering dots is not an illusion but

rather due to disturbed large scale networks processes.

1) Klein, A., & Schankin, C. J. (2021a). Visual Snow Syndrome as a Network Disorder: A Systematic Review. Frontiers in Neurology, 12, 724072. https://doi.org/10.3389/fneur.2021.724072 2) Michel, C. M., & Koenig, T. (2018). EEG microstates as a tool for studying the temporal dynamics of whole-brain neuronal networks: A review. NeuroImage, 180, 577–593. https://doi.org/10.1016/j.neuroimage.2017.11.062 3) Tarailis, P., Koenig, T., Michel, C. M., & Griškova-Bulanova, I. (2023). The Functional Aspects of Resting EEG Microstates: A Systematic Review. Brain Topography. https://doi.org/10.1007/s10548-023-00958-9