The origin of the sublime power in the brain:
An integrated EEG-TMS study

ABSTRACT:

Background
The sublime, or awe, has been defined as the strongest emotion one can experience, exerting a transformative power on those who experience it. To access knowledge of awe potential in promoting wellbeing, a deeper understanding of its neural correlates is needed.

Aims
SUBRAIN's goal was to provide knowledge of emotional and neural mechanisms of awe. These specific aims were pursued: (i) test the feasibility of a multimodal experimental approach for investigating the brain correlates of awe, (ii) explore brain responses to different VR experiences of awe, and (iii) identify brain mechanisms linked with awe type and intensity.

Method
Young healthy volunteers ($n = 44$) took part in the study. Brain's activity was recorded using electroencephalography (EEG) at rest and during navigation in 3 awe-inducing VR scenarios and a neutral one. Cortical excitability was investigated via a transcranial magnetic stimulation (TMS)-EEG session after each VR scenario. Questionnaires were used to assess the VR-induced emotional changes. Linear and nonlinear EEG metrics were compared among scenarios and contrasted against subjective awe intensity.

Results
The new VR-TMS-EEG experimental protocol was successfully implemented, tested, and refined. Awe induced EEG activity and connectivity changes that were mainly scenario-specific, apart from a shared increase of fronto-central EEG power. TMS-evoked potentials, EEG complexity and directional connectivity patterns were found to reflect the subjective awe feeling.

Conclusions
SUBRAIN has provided an innovative, quantitative, and multimodal experimental and analytical approach that has contributed to our limited knowledge of the neural bases of the powerful and self-transformative awe experience.

Keywords
Virtual reality, Sublime, Brain connectivity, EEG-TMS

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