# BRAIN HIERARCHY AND EEG COMPLEXITY IN OUT-OF-BODY EXPERIENCES AND OTHER ALTERATIONS OF THE BODILY SELF

Teresa Campillo-Ferrer[1], Tomas Berjaga-Buisan[1], Antonella Iadarola[2,3], Jakub Vohryzek[1,4,5], Ramona Cordani[2,3], Marco Veneruso[2,3], Yonatan Sanz Perl[1,4,6], Lino Nobili[2,3], Robert Oostenveld[7,8] & Gustavo Deco[1,4,9]

[1]Center for Brain and Cognition, Computational Neuroscience Group, Department of Engineering, Universitat Pompeu Fabra, Barcelona, Spain; [2]Department of Neurosciences, Rehabilitation, Ophthalmology, Genetics, Maternal and Child Health (DINOGMI), University of Genoa, Italy; [3]Child Neuropsychiatry Unit, IRCCS Istituto Giannina Gaslini, Genoa, Italy; [4]International Centre for Flourishing (multisite at Oxford, Aarhus and Barcelona), Oxford, UK; [5]Centre for Eudaimonia and Human Flourishing, Linacre College, University of Oxford, UK; [6]Department of Engineering, University of San Andrés, Buenos Aires, Argentina; [7]Donders Institute for Brain, Cognition and Behaviour, Radboud University, Nijmegen, The Netherlands; [8]NatMEG, Karolinska Institutet, Stockholm, Sweden; [9]Institució Catalana de la Recerca i Estudis Avançats (ICREA), Barcelona, Spain

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**Background:** Experiences in which the sense of the body becomes altered (unusual bodily experiences or UBEs) provide a valuable opportunity to investigate how large-scale brain dynamics shape the bodily self. While UBEs are clinically relevant in conditions such as depersonalization and body-image disturbances, their underlying neural dynamics remain insufficiently characterized.

**Aims:** We aim to identify the neural correlates of UBEs reported across wakefulness and sleep, focusing on measures of neural irreversibility and hierarchy as markers of whole-brain hierarchical organization and non-equilibrium.

**Methods:** We analyzed a previously collected high-density EEG dataset comprising UBEs reported during REM sleep, non-REM sleep, arousals from non-REM sleep, and meditative wakefulness. The dataset included vestibular-motor experiences, tactile sensations, distortion of body boundaries, lack of bodily sensations and/or bodily position, out-of-body experiences, and sleep paralysis, all grouped together as the “UBE” condition. The UBE condition was compared with periods of eyes-closed wakefulness and non-UBEs (i.e., either sleep or meditation) following a within-subject design. Neural irreversibility and hierarchy were estimated using the INSIDEOUT framework described in Deco et al. (2022) and were complemented using Lempel-Ziv complexity. Statistical significance was assessed using generalized linear mixed models including both subject number and conscious state as random effects.

**Preliminary Results:** Across states of consciousness, we found that UBEs (*n*=36 UBEs from *N*=20 participants) were associated with a global reduction in irreversibility and hierarchy relative to non-UBEs, as well as a global increase in complexity approaching levels observed during wakefulness. These effects were robust across sensitivity analyses, and similar patterns were observed when restricting the analyses to out-of-body experiences (*n*=10 episodes from *N*=7 participants). Taken together, these preliminary findings suggest that altered bodily self-experiences may involve a brain state combining increased EEG signal diversity (high complexity) with a transient flattening of cortical hierarchy (low irreversibility and hierarchy), a combination that resembles patterns previously reported in psychedelic states.

**Keywords:** Altered states of consciousness, Out-of-body experiences, Self-perception, Sleep, Meditation

**E-mail contact:** teresa.campillo@upf.edu