T-18. Visual consciousness tracked with direct intracranial recording from early visual cortex in humans

Naotsugu Tsuchiya[1] NAOTSU@GMAIL.COM

Jeffrey Chung[2] JEFFREY.CHUNG@CSHS.ORG

Dawn Eliashiv[2] DAWN.ELIASHIV@CSHS.ORG

Ralph Adolphs[3] RADOLPHS@HSS.CALTECH.EDU

Adam Mamelak[2] ADAM.MAMELAK@CSHS.ORG

[1]RIKEN Brain Science Institute

[2]Cedars-Sinai Medical Center

[3]California Institute of Technology

A fundamental question in cognitive neuroscience is how neuronal representations are related to conscious experience. Two key questions are: where in the brain such representations are located, and at what point in time they correlate with conscious experience. In line with this issue, a hotly debated question is whether primary visual cortex (V1) contributes to visual consciousness, or whether this depends only on higher-order cortices. Here we investigated this issue by recording directly from early visual cortex in two neurosurgical patients undergoing epilepsy monitoring with intracranial electrocorticogram (ECoG) electrodes that covered early visual cortices, including the dorsal and ventral banks of the calcarine sulcus. We used Continuous Flash Suppression (CFS) to investigate the time course of when 'invisible' stimuli broke interocular suppression. Participants were asked to watch faces presented under CFS, to push a button when they started to see any part of the face, and then to indicate its spatial location. This occured over several seconds. During the task performance we recorded intracranial ECoG at high spatiotemporal resolution from all contacts in parallel. We used multivariate decoding techniques and found that the location of the invisible face stimulus became decodable from neuronal activity _1.8 sec before the subject's button press. Counter-intuitively, the same cortical sites from which we were able to decode this predictive signal showed a decrease in activity immediately prior to the transition from invisibility to visibility. Furthermore, we observed an increase in coherence among widely separated electrodes during the invisible epoch, which collapsed to a focal ensemble when the stimulus became visible. These results suggest that diffuse coherent representation is insufficient for visual awareness and that locally specialized patterns of activation may be key to consciousness. Our findings are consistent with one recently proposed framework for understanding consciousness utilizing information integration theory (Tononi, 2008).