

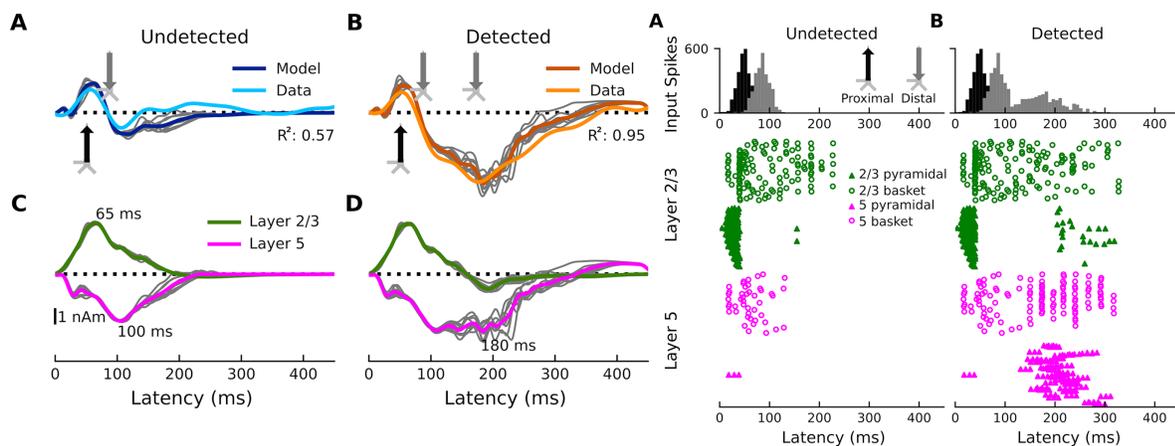
Laminar specificity of the auditory perceptual awareness negativity: A biophysical modeling study

Carolina Fernandez Pujol^{1*}, Elizabeth G. Blundon^{1,2}, Andrew R. Dykstra¹

¹Department of Biomedical Engineering, University of Miami, Coral Gables, FL, United States

²Present address: Department of Medicine, Dalhousie University, Halifax, Nova Scotia, Canada

How perception of sensory stimuli emerges from brain activity is a fundamental question of neuroscience. To date, two disparate lines of research have examined this question. On one hand, human neuroimaging studies have helped us understand the large-scale brain dynamics of perception. On the other hand, work in animal models (mice, typically) has led to fundamental insight into the micro-scale neural circuits underlying perception. However, translating such fundamental insight from animal models to humans has been challenging. Here, using biophysical modeling, we show that the auditory awareness negativity (AAN), an evoked response associated with perception of target sounds in noise, can be accounted for by synaptic input to the supragranular layers of auditory cortex (AC) that is present when target sounds are heard but absent when they are missed. This additional input likely arises from cortico-cortical feedback and/or non-lemniscal thalamic projections and targets the apical dendrites of layer-5 (L5) pyramidal neurons. In turn, this leads to increased local field potential activity, increased spiking activity in L5 pyramidal neurons, and the AAN. The results are consistent with current cellular models of conscious processing [1–3] that highlight the importance of active mechanisms in the apical dendrites of L5 pyramidal neurons [4,5] and help bridge the gap between the macro and micro levels of perception-related brain activity.



References

1. Bachmann T, Suzuki M, Aru J. Dendritic integration theory: A thalamo-cortical theory of state and content of consciousness. 1. 2020;1.
2. Aru J, Suzuki M, Larkum ME. Cellular Mechanisms of Conscious Processing. Trends in Cognitive Sciences. 2020;24: 814–825. pmid:32855048
3. Marvan T, Polák M, Bachmann T, Phillips WA. Apical amplification—a cellular mechanism of conscious perception? Neuroscience of Consciousness. 2021;2021. pmid:34650815
4. Larkum ME, Zhu JJ, Sakmann B. A new cellular mechanism for coupling inputs arriving at different cortical layers. Nature. 1999;398: 338–341. pmid:10192334
5. Larkum ME, Wu J, Duverdin SA, Gidon A. The Guide to Dendritic Spikes of the Mammalian Cortex In Vitro and In Vivo. Neuroscience. 2022;489: 15–33. pmid:35182699