Abstract

The rare sound objects present in the environment carry important information about the physical phenomenon happening in the environment. Being capable of identifying, processing and inferring from those rare sound objects is fundamental for the survival of an organism. The present understanding of neural development states that an important developmental epoch known as the critical period is crucial for the cortical maturation and refinement of the neural circuitry within the auditory pathway. However, a recent study demonstrated that if certain stimuli features are salient enough to stand out in the stimuli space, like a rare event, the auditory circuitry is mature enough to pick it up and extract information from it much before the critical period. We present a simple framework using computational modelling and mathematical optimization to explain how and why an early developing neural circuit before the critical period can process salient information from the stimuli. Although this framework can explain selectivity towards pure tones, it fails to explain how selectivity for complex Spectro-temporal features are formed within the neural circuit. We analyzed neural data obtained from in-vivo electrophysiology and 2-photon Ca2+ imaging to show that functional subnetworks which form within the recurrent circuitry can differentially encode for spectral and temporal features present in the stimuli. The inhibitory neurons especially the Parvalbumin (PV) and Somatostatin (SOM) play a major role in the formation of these subnetworks.