

Auditory Pitch Cells Can Emerge from Natural Sound Statistics: An Analogy with Visual Complex Cells

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The complex cells were found in the visual cortex more than fifty years ago. The concept of nonlinear responses with phase invariance has been firmly established and successfully modelled as an adaptation to natural image statistics [1]. However, analogous discussions have been lacking in other modalities, despite of the anatomical uniformity across sensory cortices. A kind of universality in sensory areas has been suggested by successful applications of models for visual cortex to auditory cortex [2, 3], although they studied only linear receptive fields. In the present study, we applied a nonlinear model of visual complex cells [1] to natural sounds; receptive fields of the auditory “complex cells” typically had multiple peaks at harmonic frequencies [4]. Moreover, some of them resembled the pitch cells that were recently found in auditory cortex and nonlinearly respond to harmonic complex tones in a way similar to a psychoacoustic phenomenon called “missing fundamental” [5]. The result suggests that the pitch cells might be analogous to the complex cells [6]: the visual complex cells are phase-invariant, whereas the pitch cells are invariant under a spectral transformation with a constant pitch.

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