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(I) Synchrony in the auditory periphery

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Bilateral symmetry in animals commonly leads to a duality in peripheral sensory apparatus. For example, two eyes, as commonly found in most vertebrates, provide a mechanism to encode information such that subsequent neural processing can create stereoscopic perception. Further, two ears lateralized to the sides of the head are important for sound source localization, a key ecological consideration. Recent evidence expands upon this duality and points to a novel biophysical principle, that of synchrony, doubly at play in the auditory periphery. By synchrony, we mean dynamics associated with weakly-coupled self-sustained (i.e., active) oscillators. This talk will discuss two facets by which this arises in the Anolis lizard. First, within a given inner ear, evidence suggest that the sensory cells acting as mechano-electro transducers metabolically use energy to behave as limit cycle oscillators. Further, these "hair cells" can couple together to form groups (or "clusters") that synchronize, effectively allowing them to greatly increase their sensitivity to low-level sounds. Second, by virtue of direct coupling between the tympana (i.e., "eardrums") via an interaural canal, the two ears can synchrnonize, possibly thereby allowing improvements in localization to low-level sounds. Thus in essence, each eardrum is effectively and meaningfully driven from both sides, not just via sound fields external to the head. Taken together, these considerations illustrate a remarkable example by which collective active behavior can mesoscopically emerge to improve the ability of peripheral sensory systems to encode incident information.

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