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Vocal Learning in Pinnipeds: A Model System for Human Speech Evolution

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Vocal learning is limited to a small subset of vertebrates: including birds (songbirds, parrots, hummingbirds), and mammals (humans, cetaceans, pinnipeds, and probably elephants and bats). Intriguingly, in most of these species, vocal production involves functionally or mechanistically novel systems: the avian syrinx, the nasal bursae in odontocetes, and ultrasonic echolocation in bats. The novel neural circuitry that evolved to control these systems may provide a "preadaptation" for vocal learning. Only two known vocal learners - humans and seals - definitely use the standard vertebrate vocal production system (larynx and vocal tract). Our studies of vocal production in harbour seals verify a surprisingly human-like vocal production system, and the critical question remaining is what neural mechanisms underlie the control of the *Phoca* vocal system, and whether such "human" specializations as direct cortico-ambiguous connections are also found in seals. Pinniped investigations also open the door to molecular exploration of the genetic bases for neural innovations. In addition to these mechanistic questions, we discuss evolutionary questions. What functional forces might select for vocal learning in aquatic mammals? One hypothesis is that selection for control of breathing may provide a preadaptation for enhanced cortical vocal control, explaining its prevalence in marine mammals.