Communication
(Voice, Speech, Song, Language)

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VOCAL LEARNING

(production learning)

5 GROUPS OF MAMMALS

HUMANS

CETACEANS

BATS

ELEPHANTS

SEA LIONS

3 GROUPS OF BIRDS

PARROTS

HUMMINGBIRDS

SONGBIRDS

Different from auditory learning

(comprehension and usage learning)

Auditory Learning:

Dogs can understand the sounds sit (English), sientese (Spanish), osuwari (Japanese).

Vocal Learning:

Dogs can not learn to say these sounds, but vocal learners can.

Vocal learning – a critical behavior for spoken language

Vocal learning birds	Vocal learning human
Song	Speech/Song <-> Spoken Language
Bout	Sentence
Motifs	Words
Notes/Syllables	Phonemes

Reviewed in: Doupe & Kuhl 1999 *Ann Rev Neurosci*; Jarvis 2004 *Ann NY Acad Sci*

African Grey Parrot - training to count (concept of one)

Irene Pepperberg & Alex

Parrots can learn a vocabulary between 100-1700 words

Courtesy, Judy Bolton

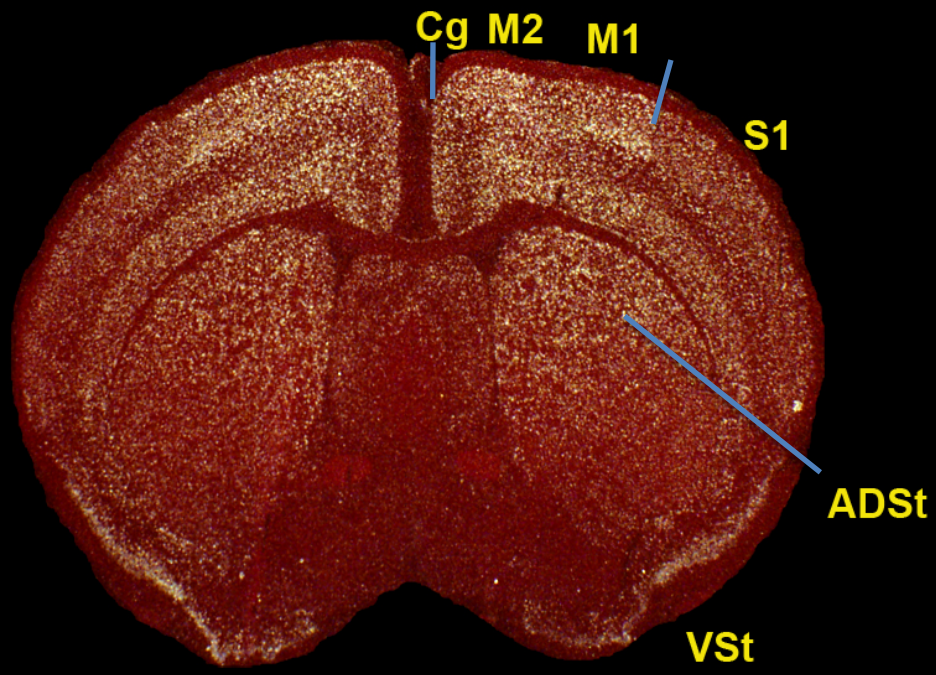
http://www.youtube.com/watch?v=lfbTPc4_7uo

Behaviorally regulated egr1 expression in parrot brain

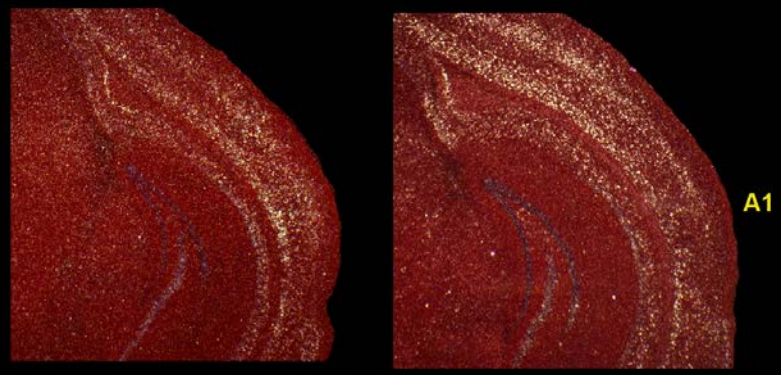
Feenders et al 2008 PLoS ONE

Mouse singing-driven gene expression

HEARING ONLY

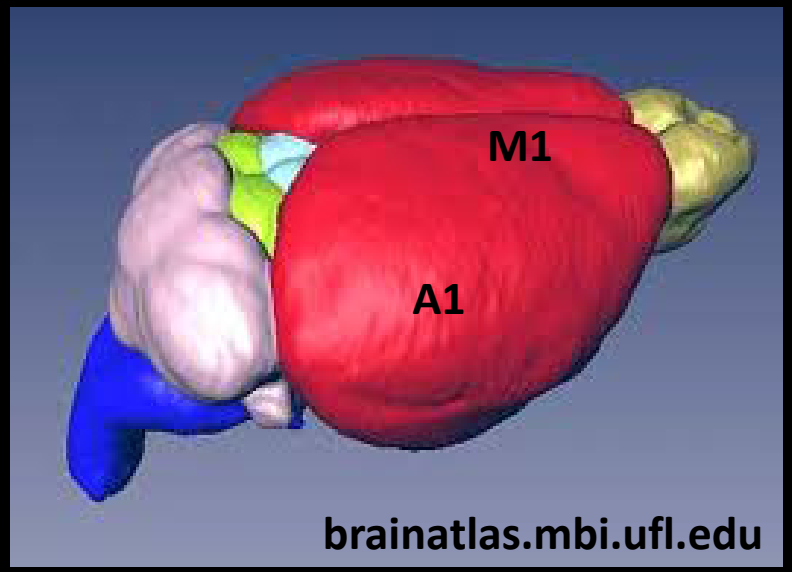


HEARING & SINGING

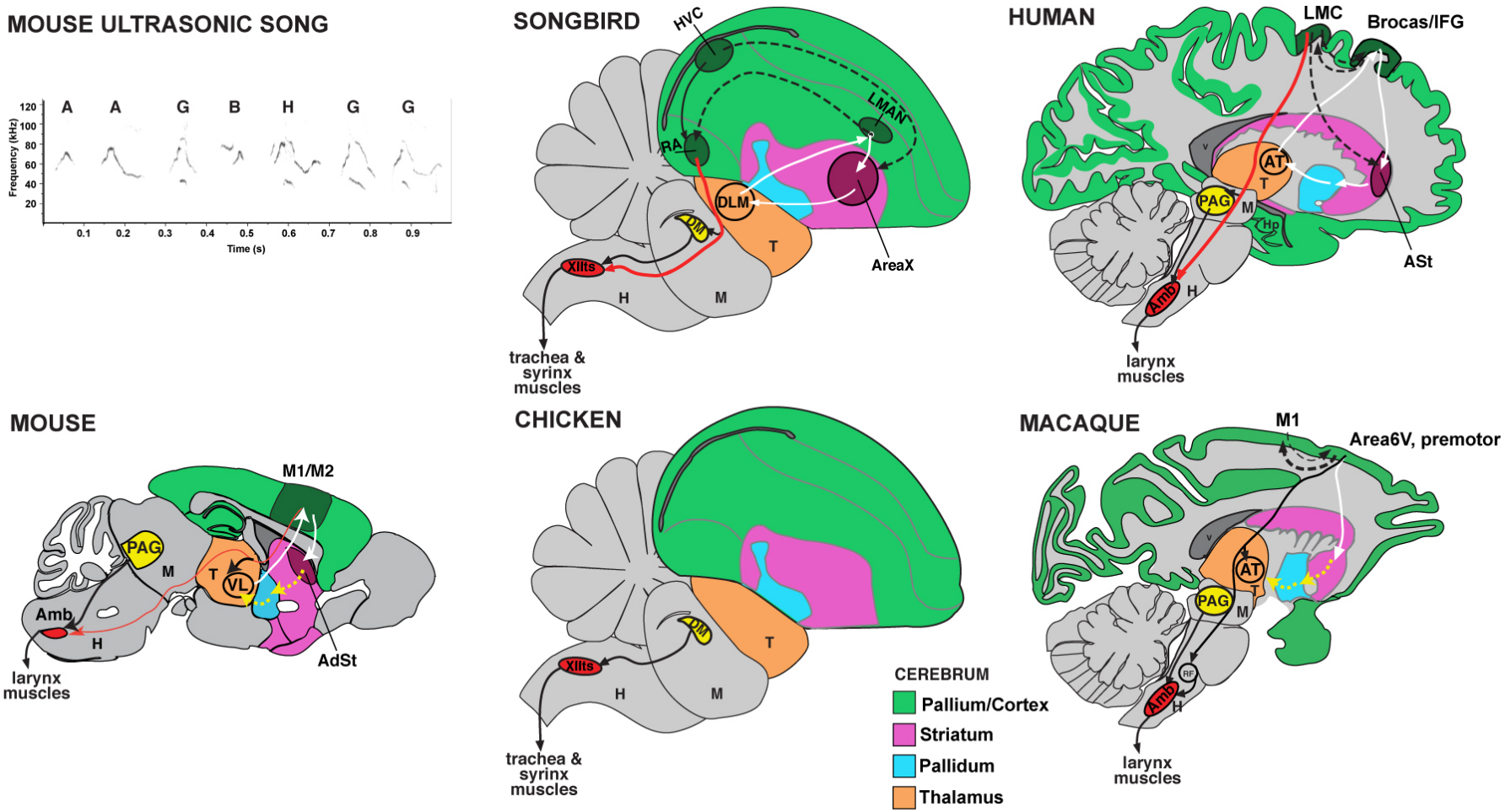


HEARING ONLY DEAF-SINGING

Arriaga et al PLoS ONE (in press)



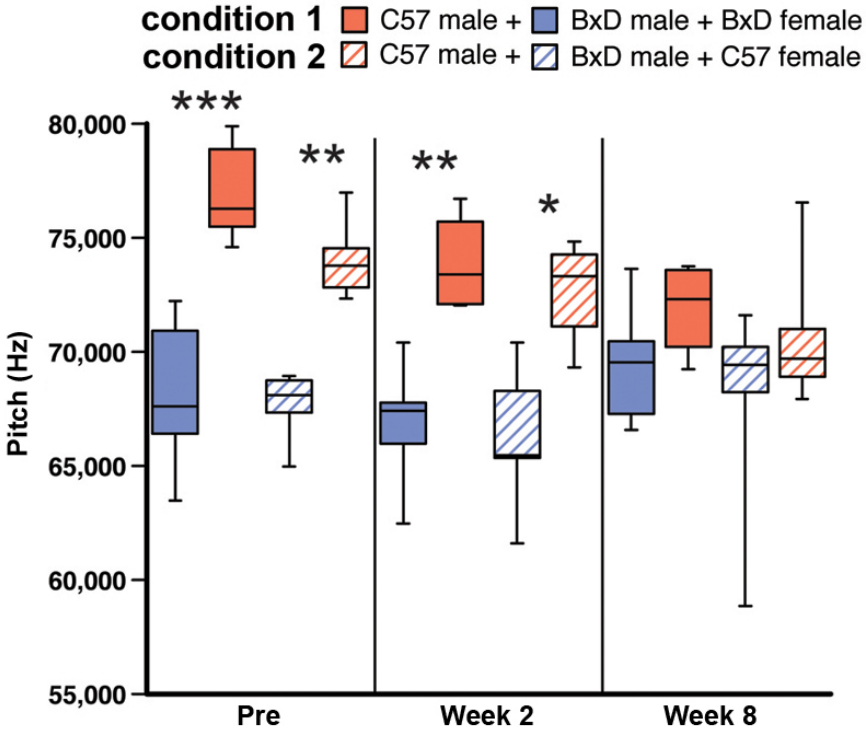
Mouse song system connectivity more similar to songbird and human

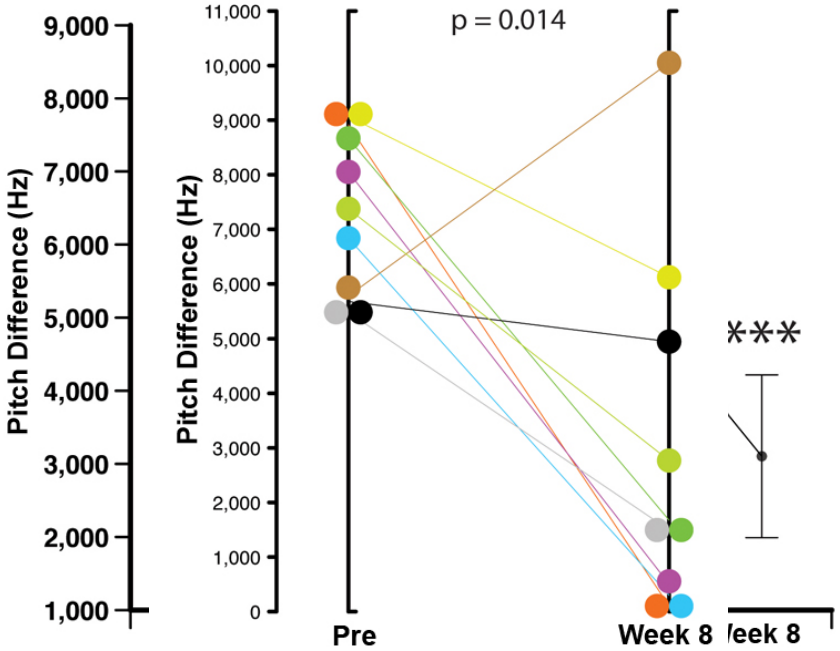


Arriaga et al PLoS ONE (in press)

Song pitch convergence caused by competitive social experience

Co-house adult C57 males + BxD males that sing at different pitches in the presence of either a C57 female or BxD female

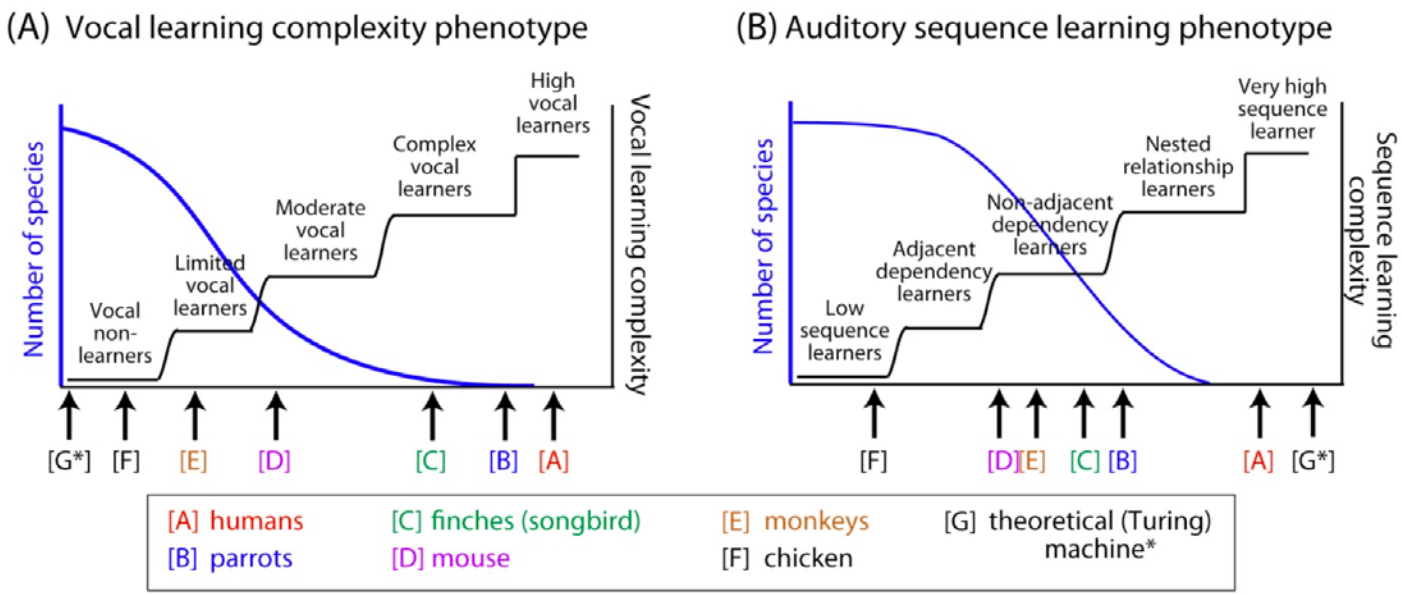




Arriaga et al PLoS ONE (in press)

Summary: Continuum hypothesis

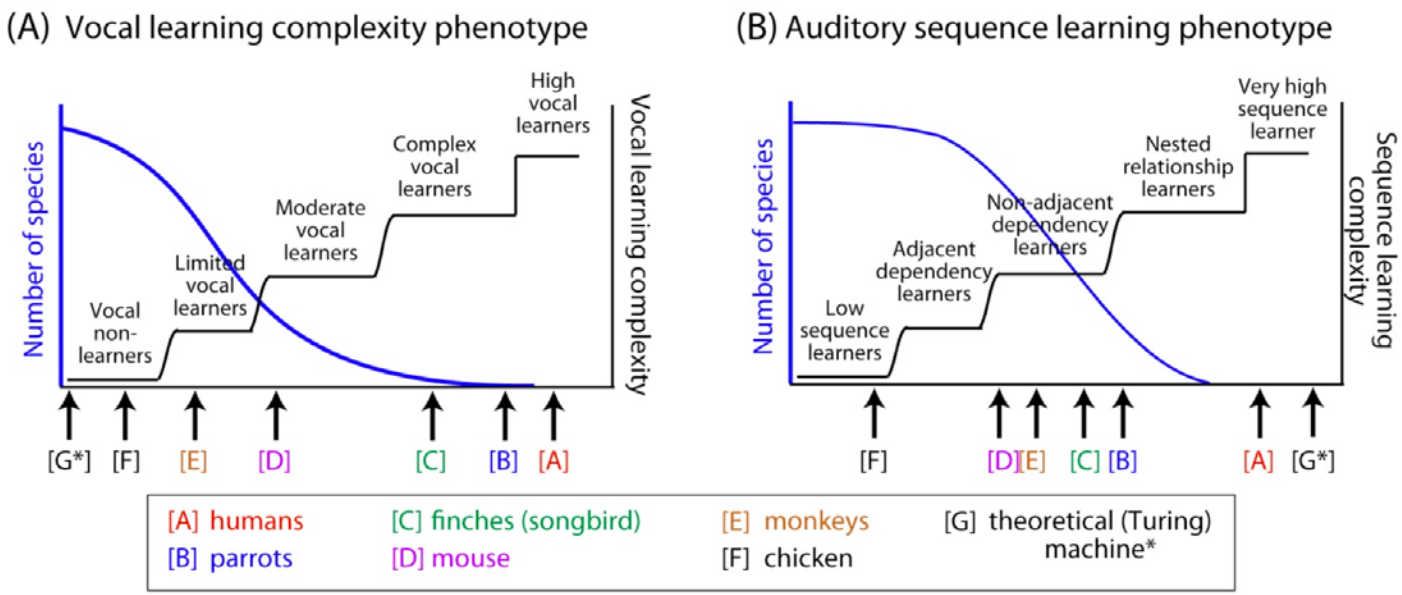
1. We propose that vocal learning is not dichotomous, but a continuous trait. Mice are limited vocal learners, in the middle.
2. Mice might serve as genetic models for some properties thought unique to humans for speech-language disorders.
3. Given the convergent behavior, neural networks, and genes for vocal learning, it is theoretically possible to enhance the circuit.



Arriaga & Jarvis, Brain & Language (in press); Petkov & Jarvis, Frontiers in Neuroscience (in press)

Summary: Continuum hypothesis

1. Learned vocal communication we argue can be modeled in animals on a continuum of traits depending on species.
2. Auditory processing, including for complex communication, can be more easily modeled in non-human animals
3. Not all features of human spoken-language can be modeled in animals, but then again not all features of other animals can be modeled in humans.



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