



Vocal Learning and Development



Intro: 'Innate' and 'Learned'

- Innate = “Existing from birth; known inherently; reflexive; not learned/not taught”
- Learned = “Acquired during development/life; picked up through observation or exploration; not innate”

Why should a behavior be...

INNATE

- Can't be messed up! Protected against poor development, insufficient learning opportunities, or insufficient time to learn.
- For when you really must have that behavior RIGHT NOW!

LEARNED

- Plasticity! – Don't get stuck with a behavior that becomes maladaptive.
- Neurally less expensive! Pre-programmed exact behaviors are complex and associated neurons can't be co-opted for other behaviors.

INNATE
OR
LEARNED?

Imprinting in Ducks and Geese

Innate or Learned?



Lorenz, 1935

Imprinting in Ducks and Geese

Innate!

- Imprint on the first moving thing they see, as soon as they are born
- Respond to mother's assembly calls by assembling, as soon as they can walk (first day of life)



Suckling (in mammals)

Innate or Learned?

- Must be accomplished on first day of life, with no prior experience, without help of the mother



Suckling (in mammals)

Innate!...mostly

Injecting mother's womb with citrol causes pups to seek out smell of citrol, not mom's nipple.



Preference for human faces (in humans)

Innate or Learned?

- Contrary to popular belief, babies actually prefer hands to faces until 8 months of age.
- BUT they do prefer 'face-shaped stimuli' at birth. What gives?



Preference for human faces (in humans)

Learned!...mostly

Figure 19.1 Fantz's face shapes



Only *perceptual*
biases are innate.



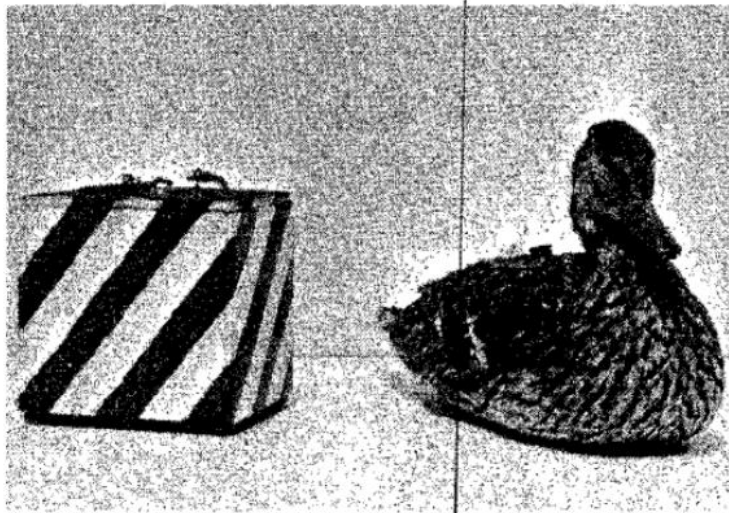
Other examples of 'sort of innate, sort of learned'

- Sense of gravity (up vs. down) (Alberts)
- Fear of hawks in gull chicks (Tinbergen)
- Gulls pecking beaks of parents (Tinbergen)
- Chickens pecking behavior (Kuo)



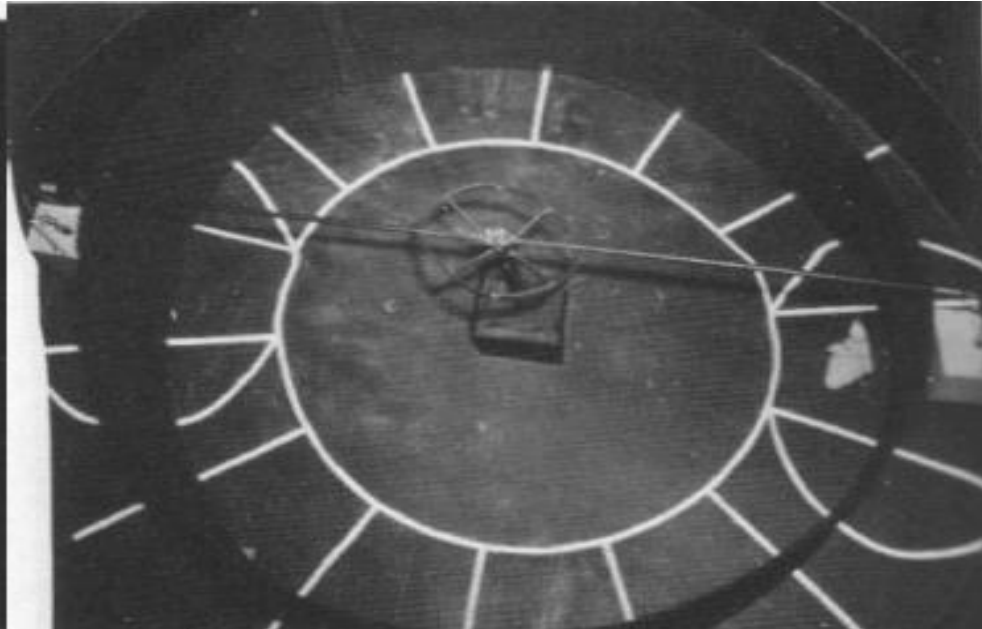
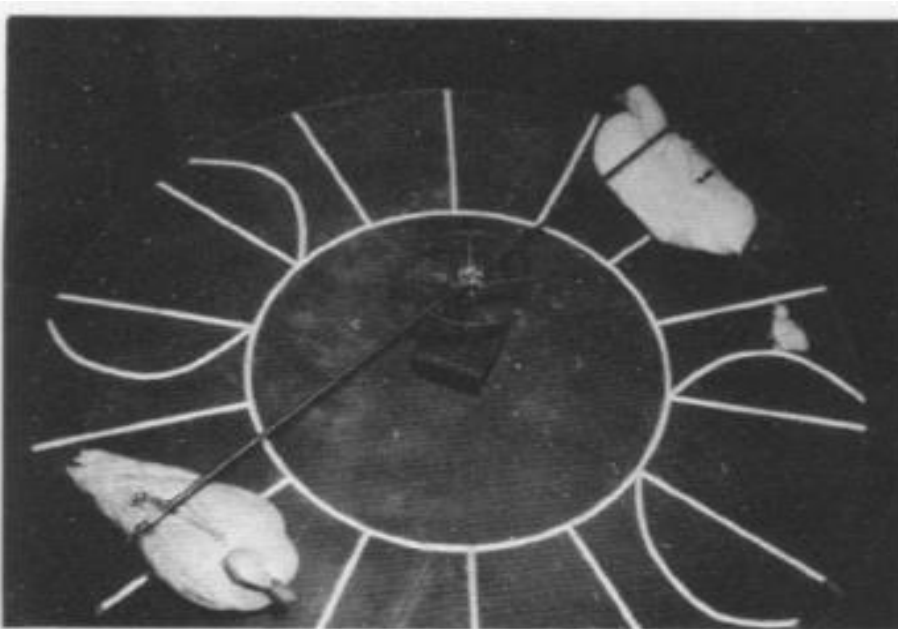
Third behavioral category? EXPERIENCE.





Johnston & Gottlieb, 1981

Figure 2. The two models used in the study. (Subjects were imprinted to the stuffed mallard model and then tested in a variety of choice situations involving these two models and the mallard maternal call.)



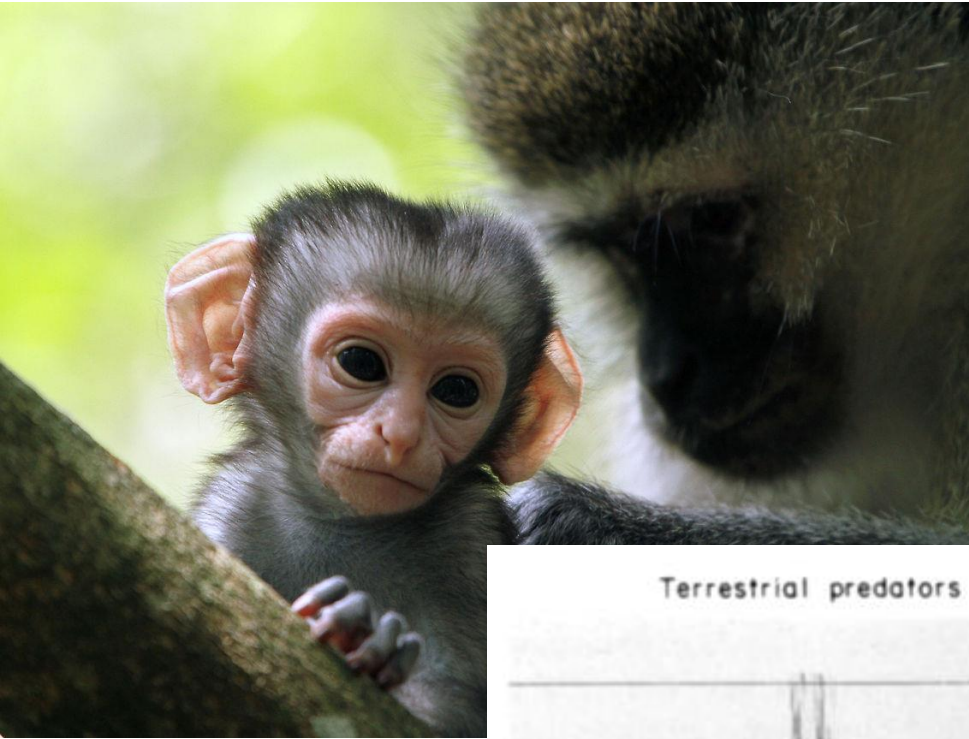
Take-aways

- Normally occurring sensory stimulation is often critical for development of a species-typical behavior (exogenetic inheritance!)
- Behavior that seems instinctive and innate often turns out to be probabilistic, with multiple determinants both maturational and experiential

Vocal learning: Alarm Calls

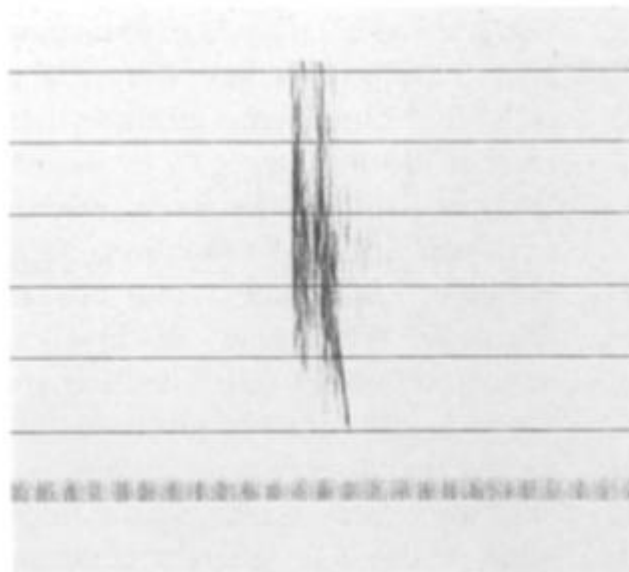


Alarm Calls

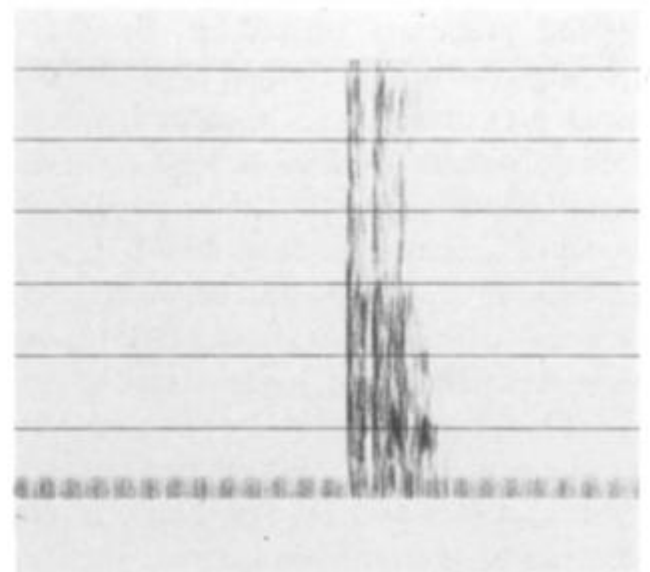


Seyfarth & Cheney, 1990

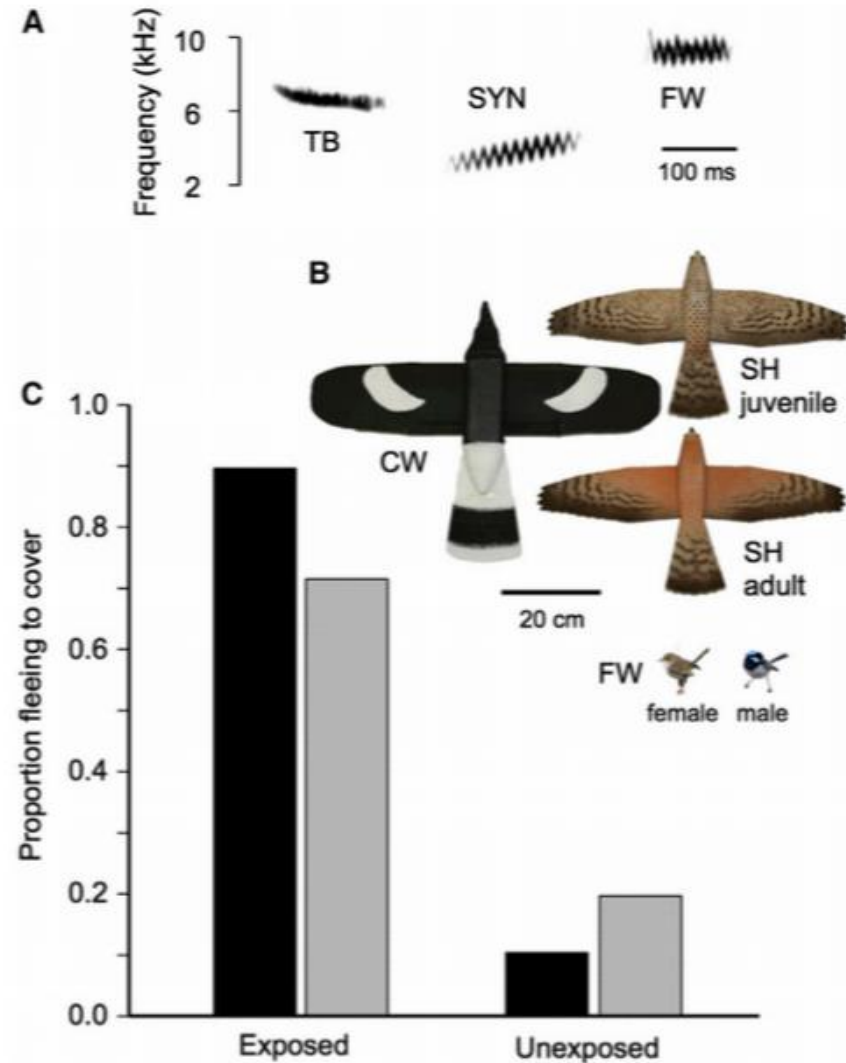
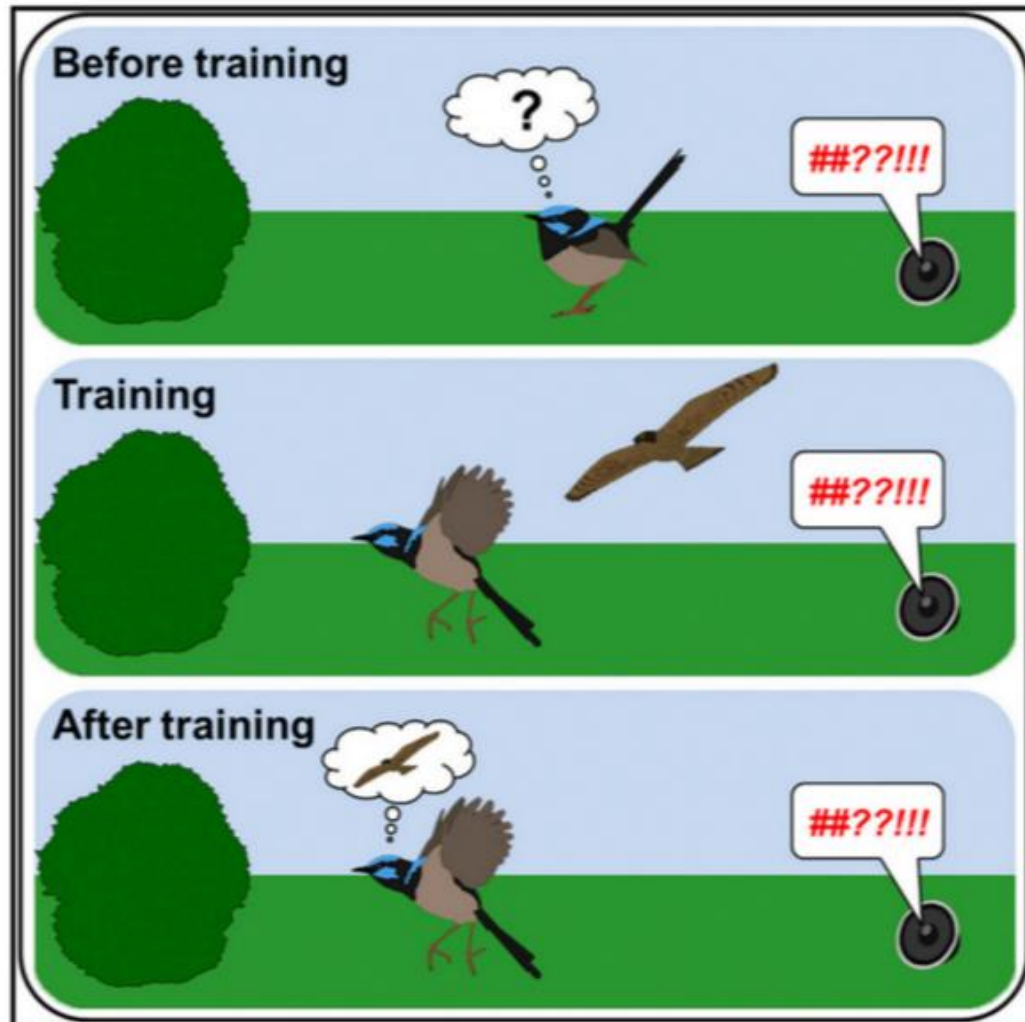
Terrestrial predators



Avian predators

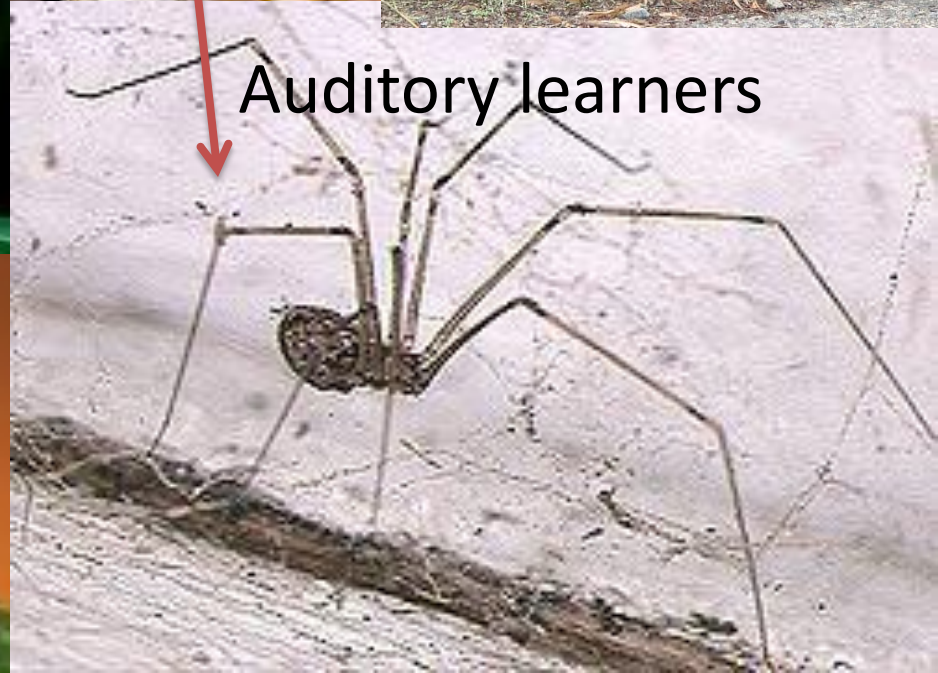


Learning Sound Associations



Who we aren't talking about today





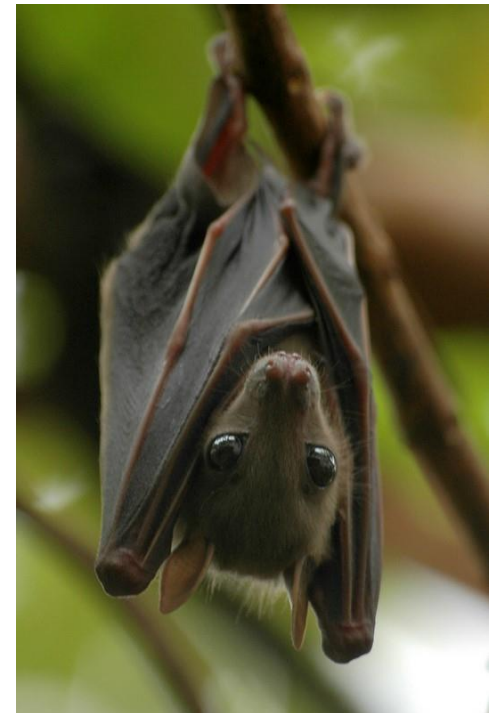
Auditory learners

Vocal modification





Vocal learning is
not common!





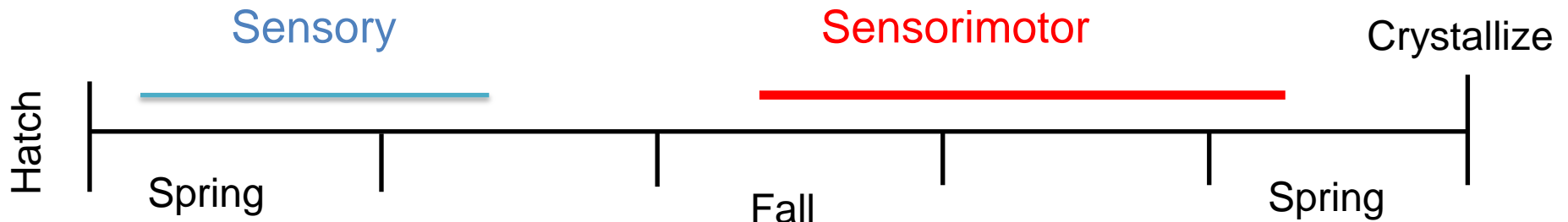
So why learn vocalizations?

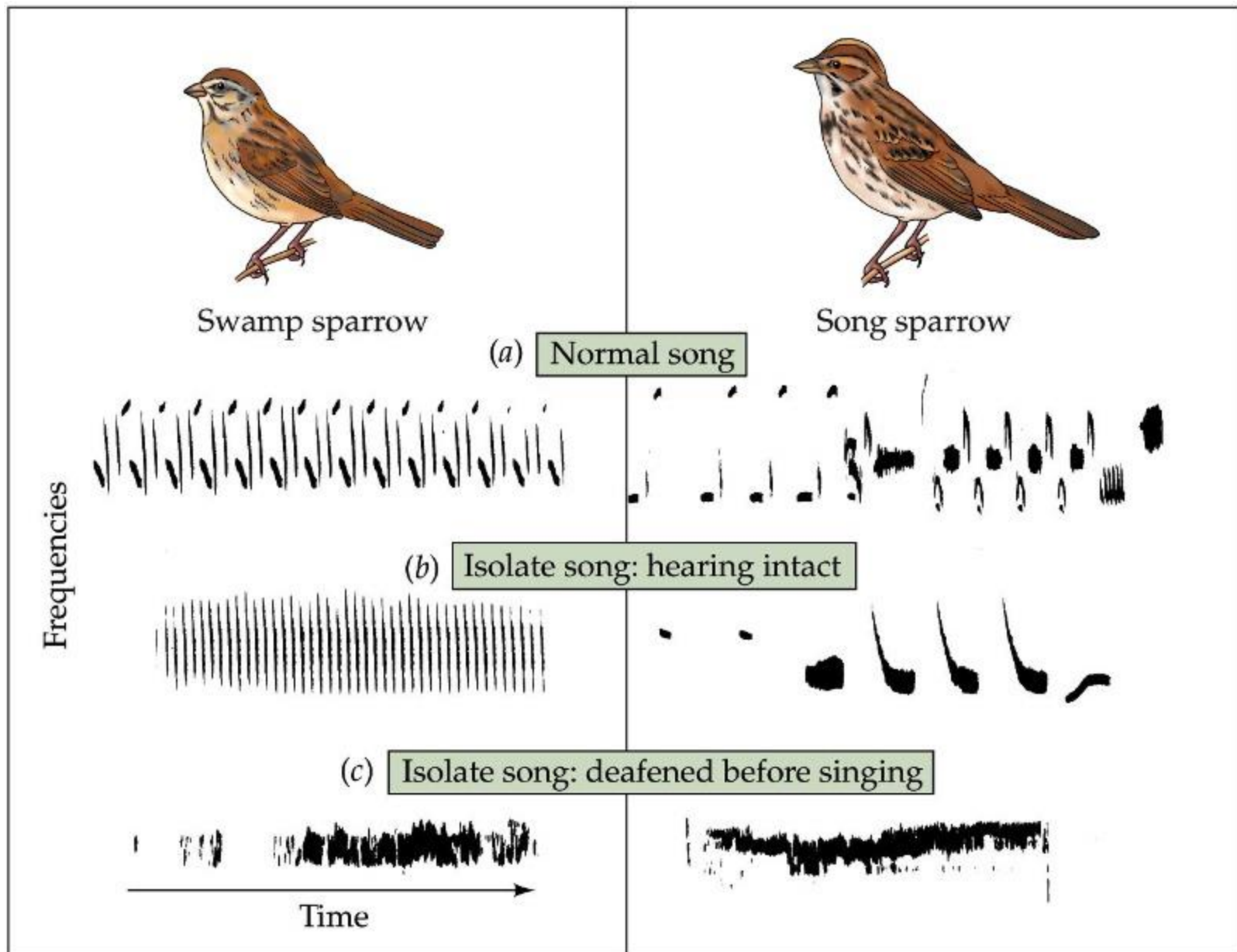
- Individual identification? (esp. humans, dolphins, parrots)
- Semantic communication?
- Mate attraction/territory defense (sexual selection)
- Rapid adaptation to sound propagation in different environments

The song learning model

- Song learning is a two-stage process:
 - **Sensory phase**: memorize the tutor's song
 - **Sensorimotor phase**: practice song and match it to memory of the tutor's song

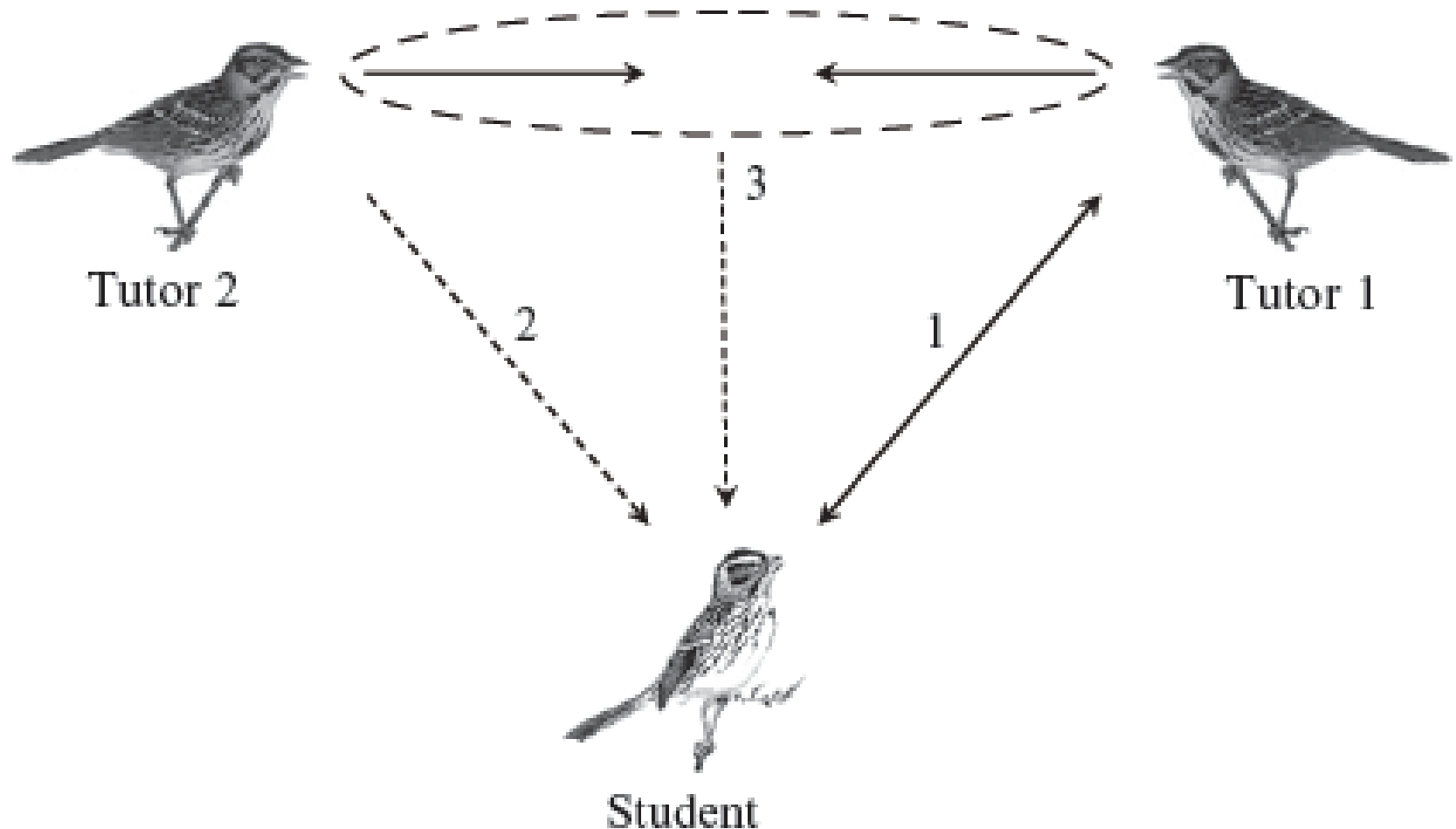
Marler, 1970





After Marler & Sherman, 1983

Eavesdropping in Sparrows



Imitation! – but not all birds learn this way

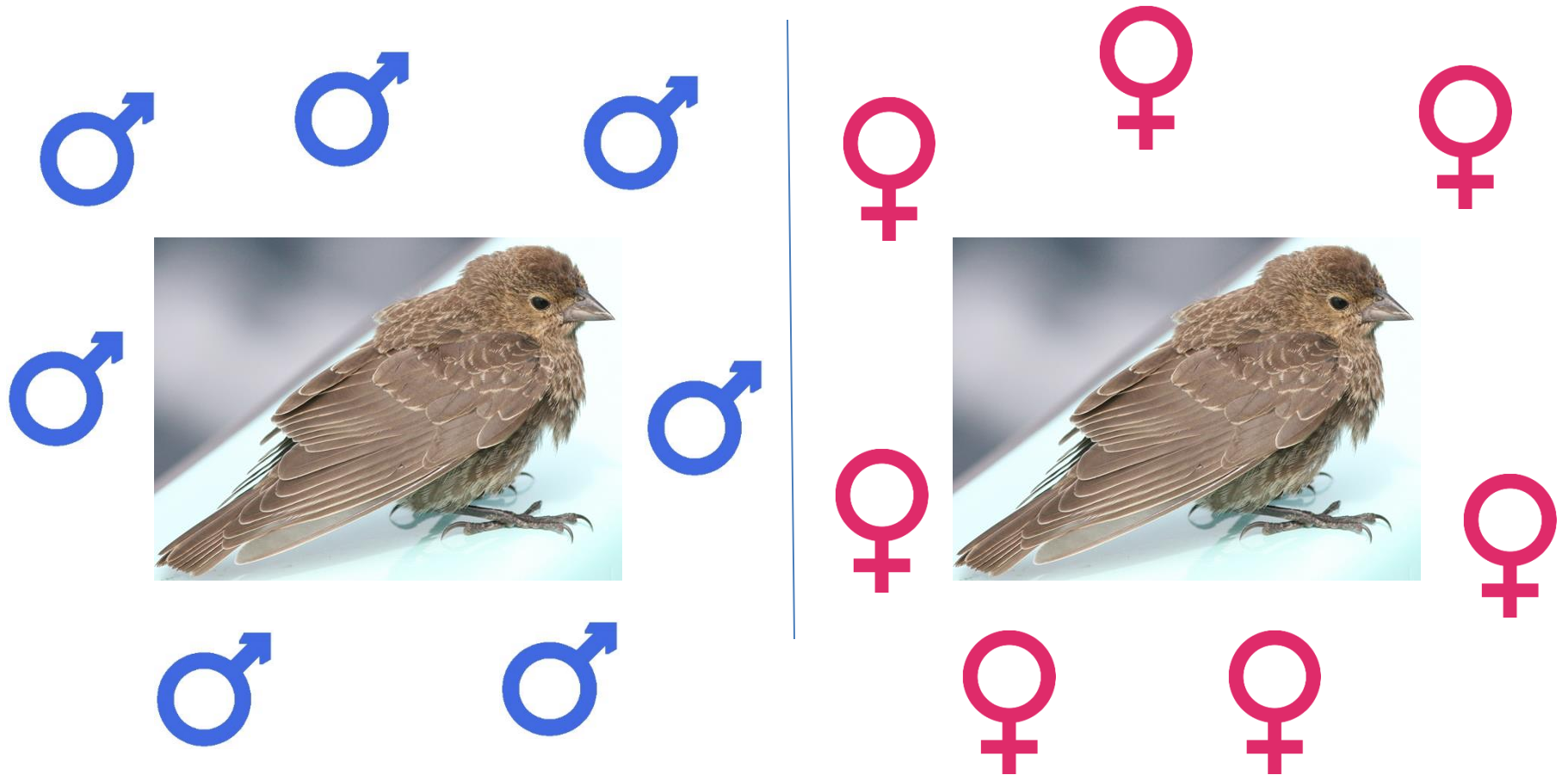
Social Isolation Paradigm



What happens without a song model?



Importance of social learning in cowbirds

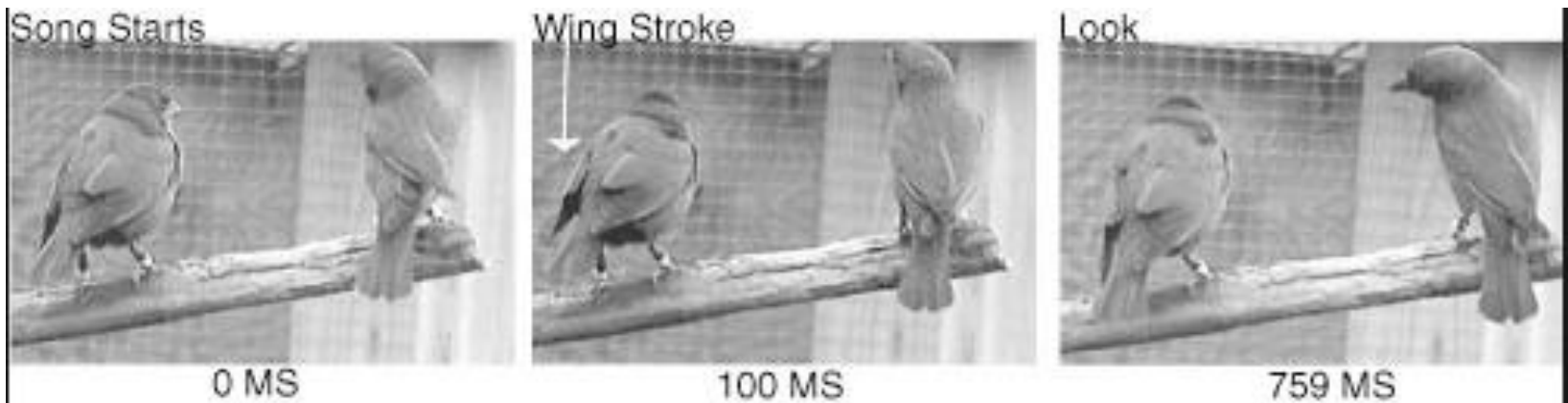


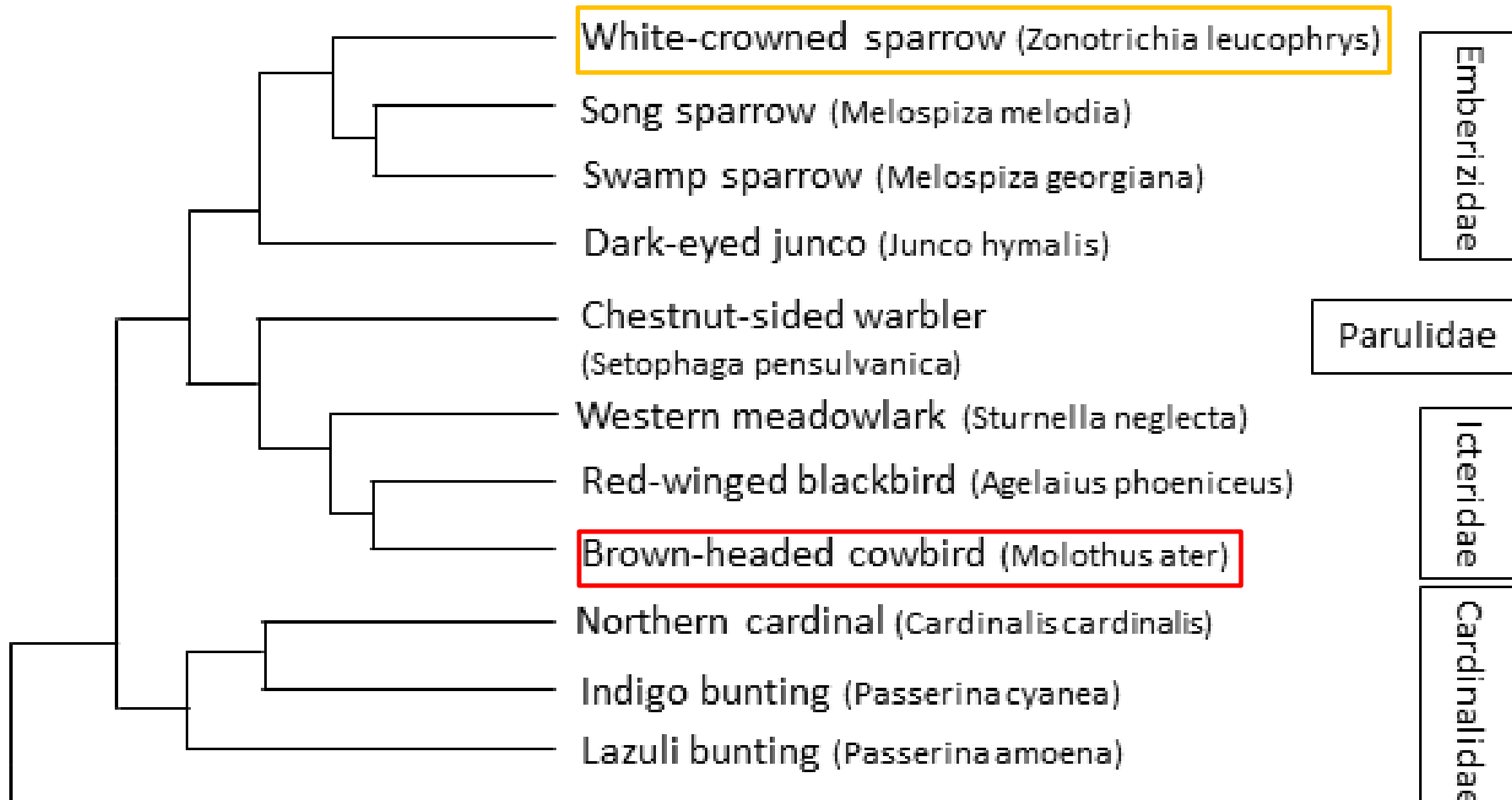
1980 - “Enriching Cowbird Song by Social Deprivation” (???)

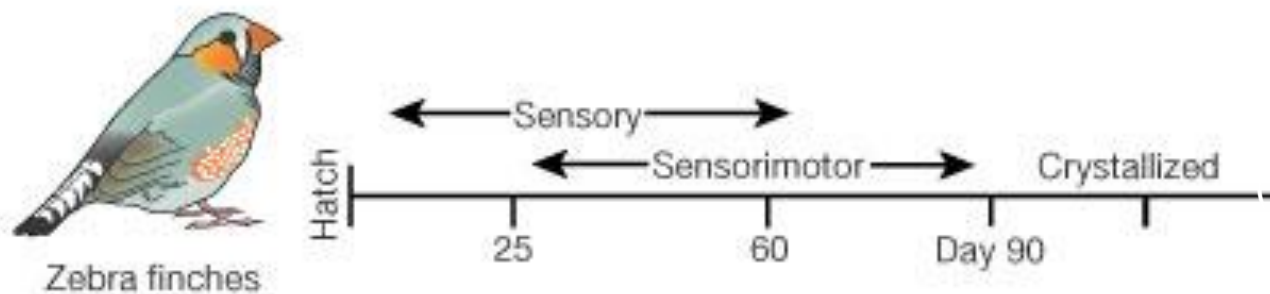
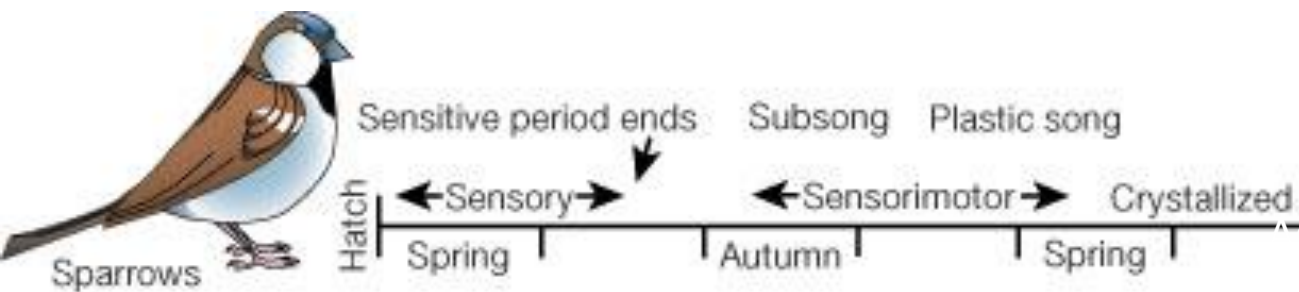
Non-vocal social guidance of vocal learning



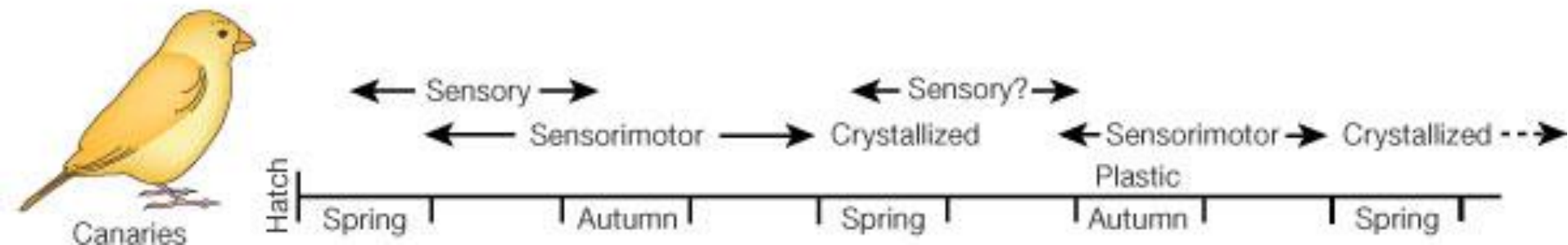
West & King,
1988



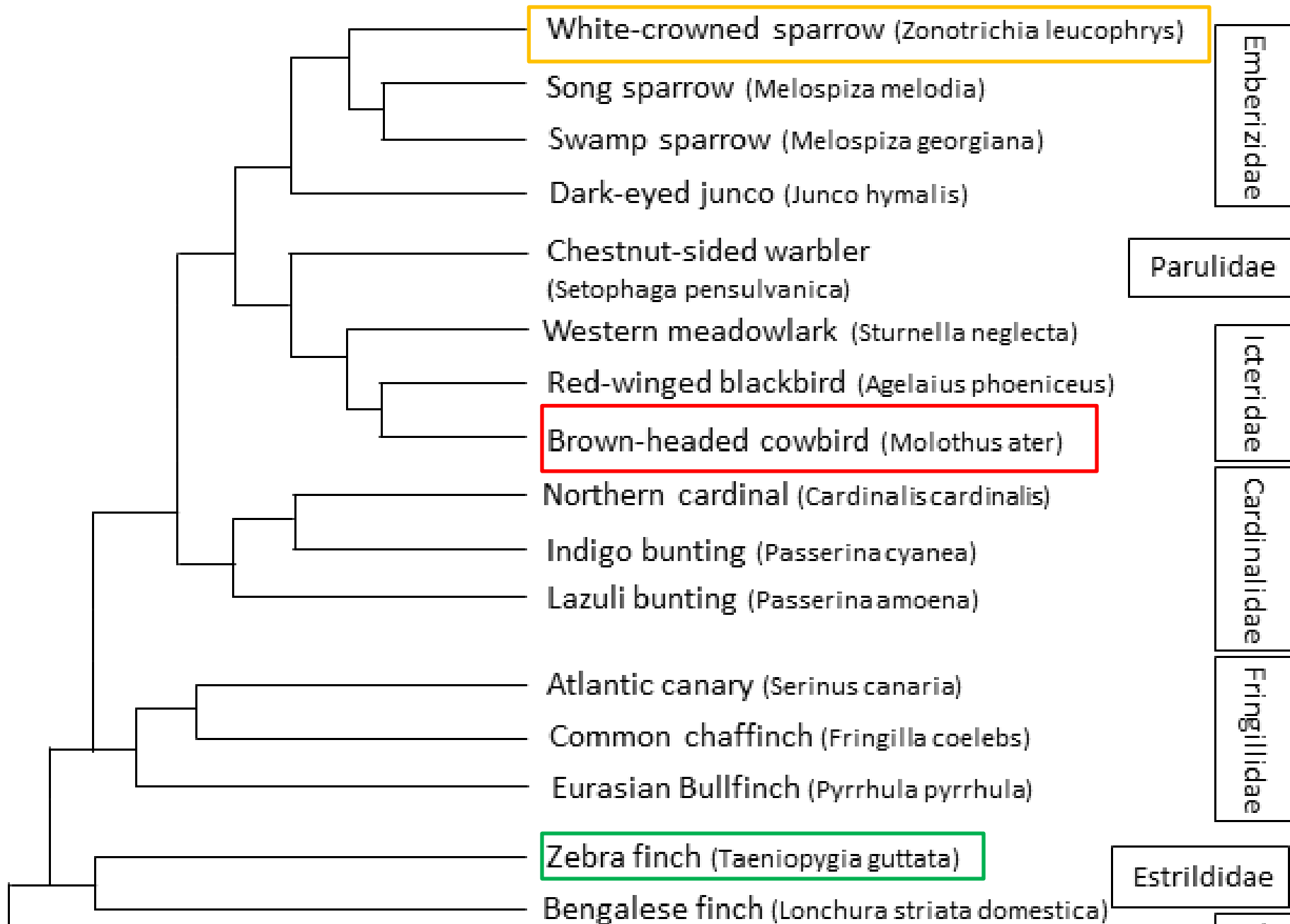




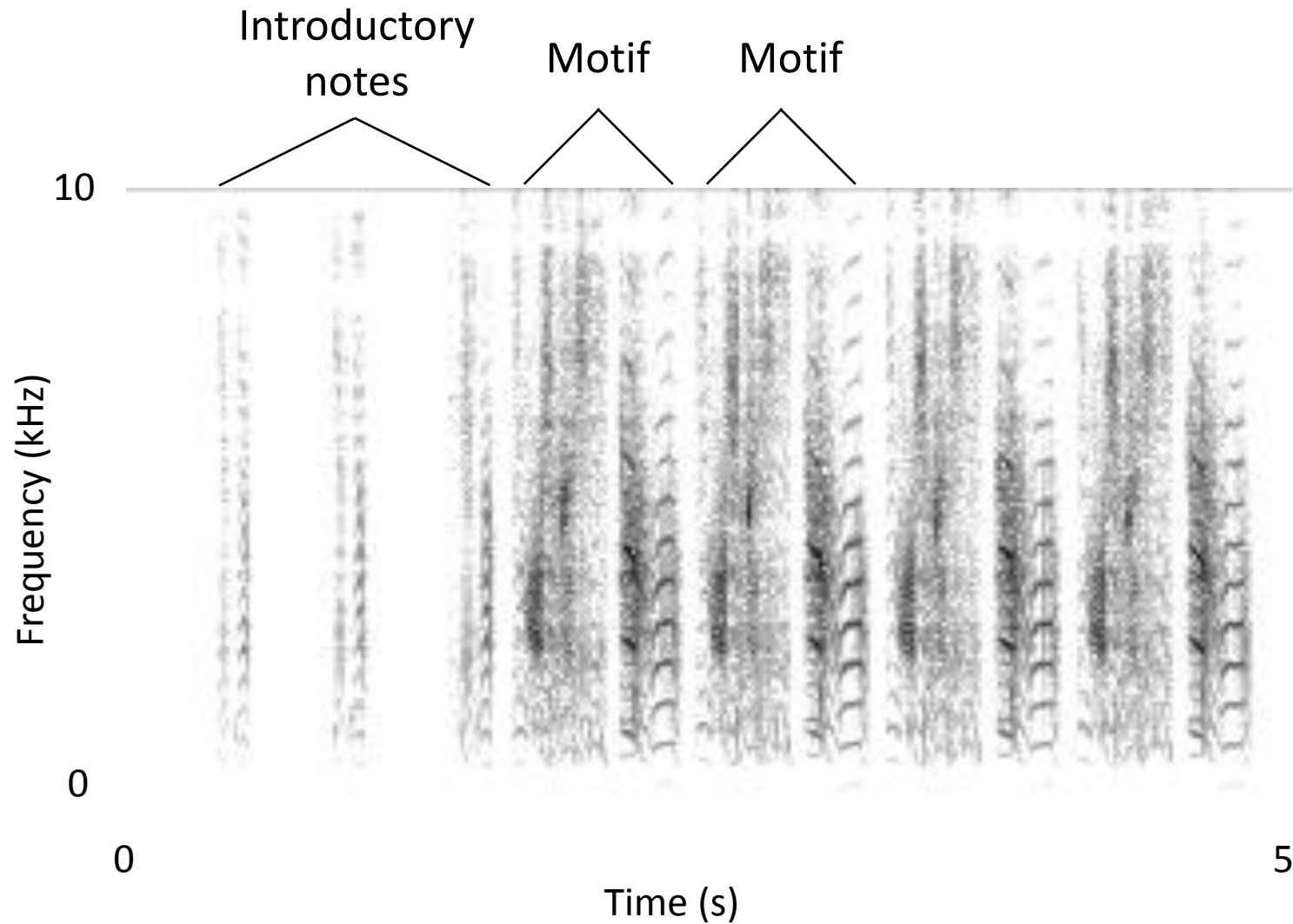
← Also cowbirds



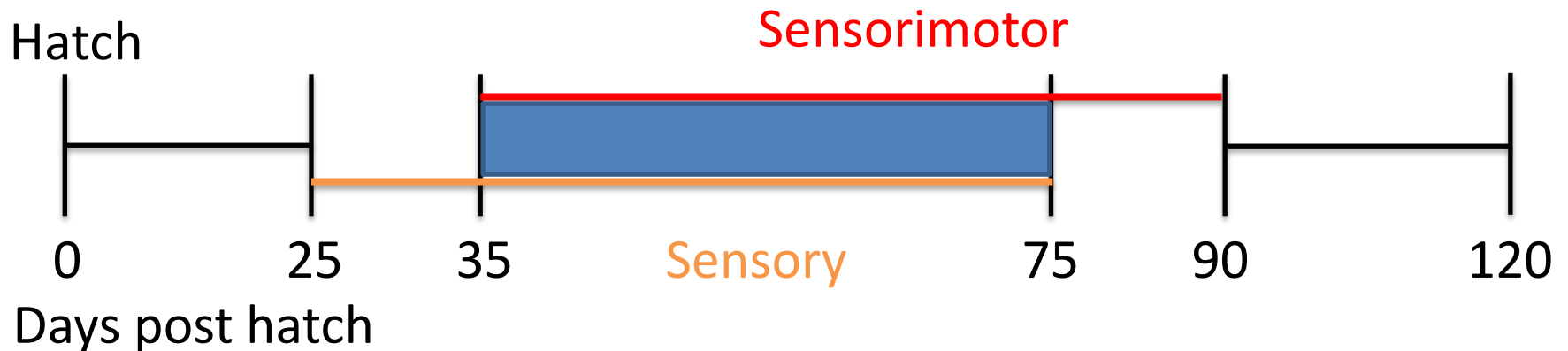




Song structure and development



Sensory/sensorimotor overlap



In humans





Eastern Towhee



House Sparrow



Brown Creeper



Northern Mockingbird



Song Sparrow



Cedar Waxwing



White-breasted Nuthatch



Blue Jay



Northern Cardinal



Eastern Bluebird



European Starling



American Goldfinch



Eastern Phoebe



House Finch



Carolina Chickadee



Carolina Wren



Field Sparrow

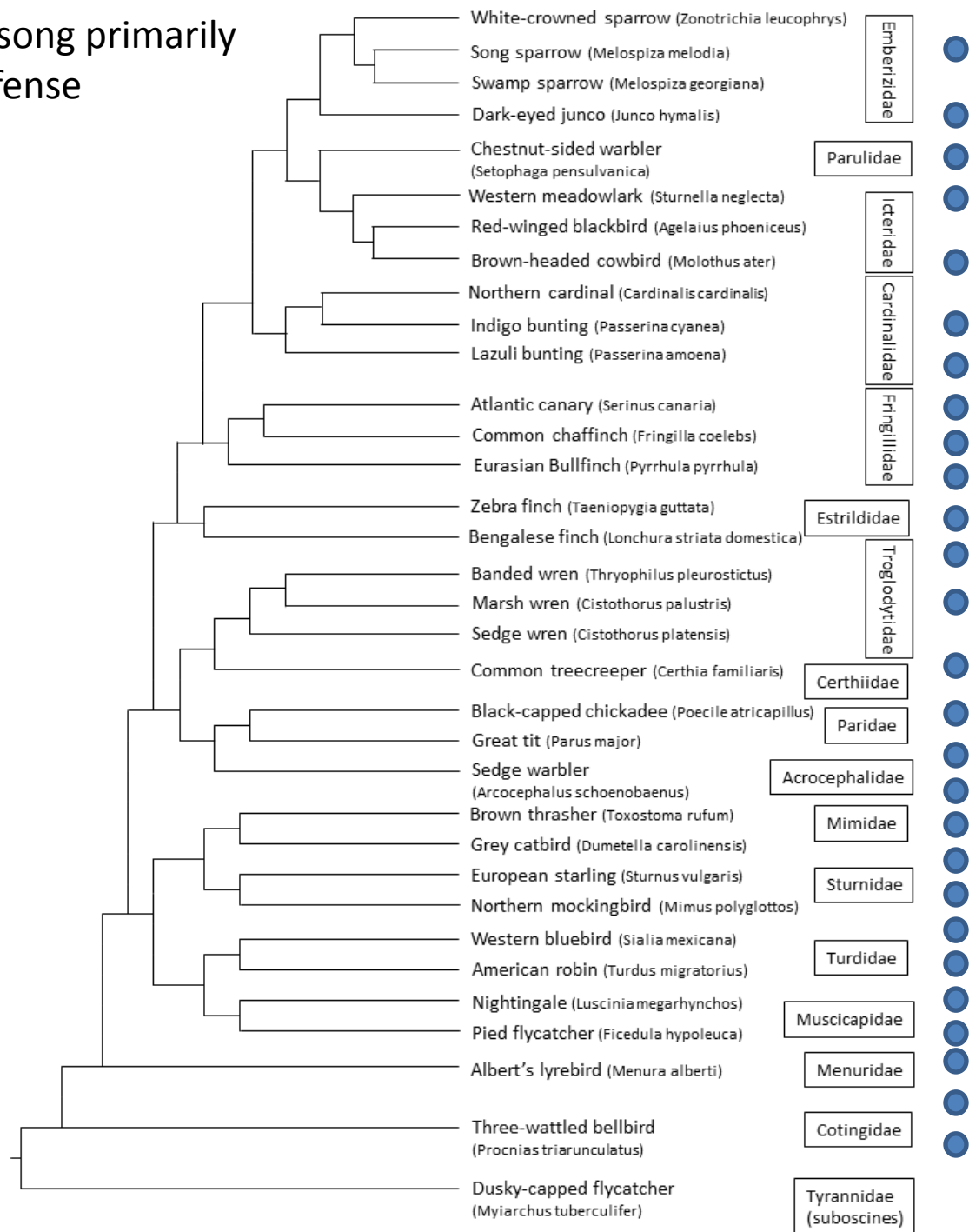


American Robin



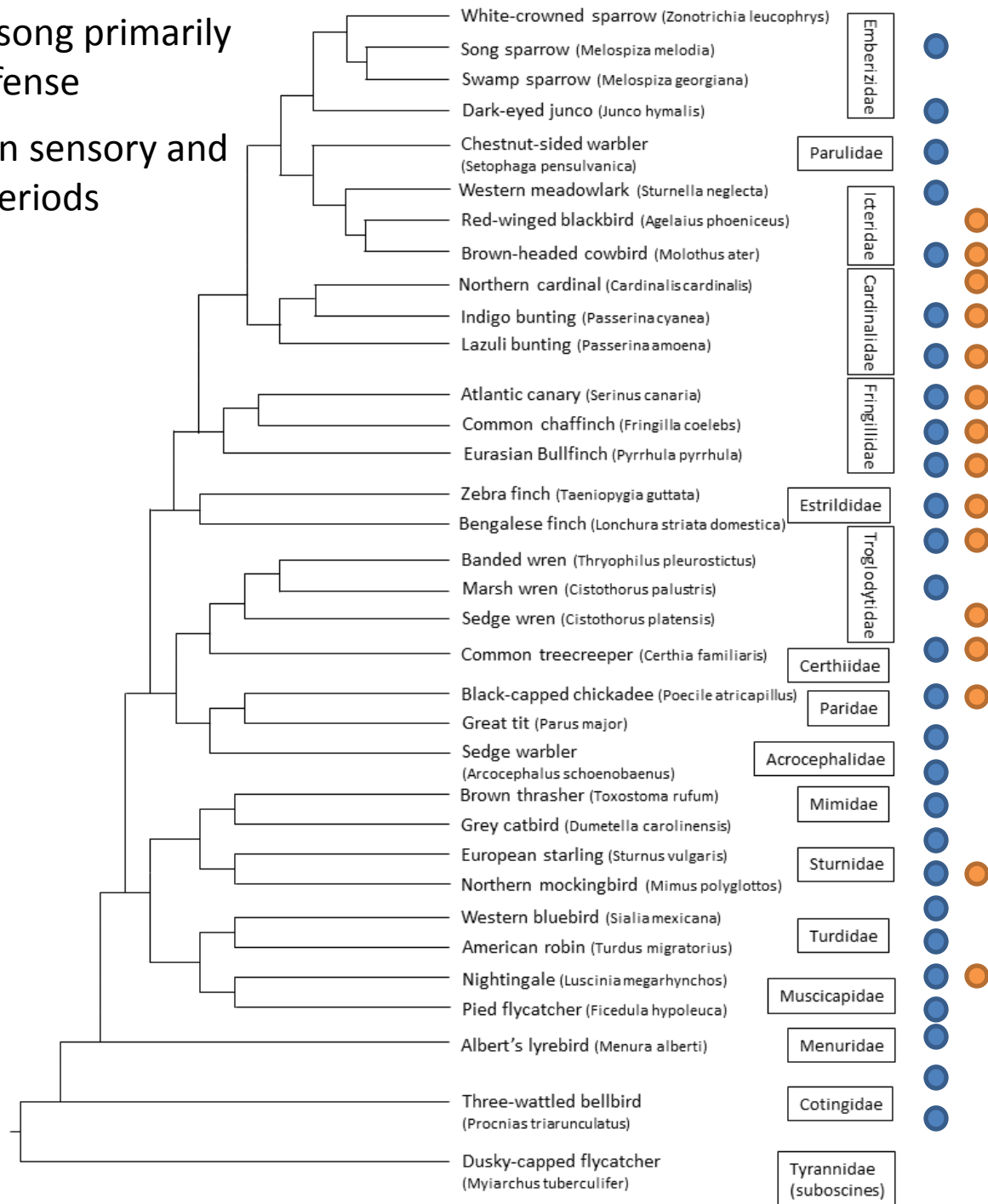
Tufted Titmouse

● = does not use song primarily for territory defense



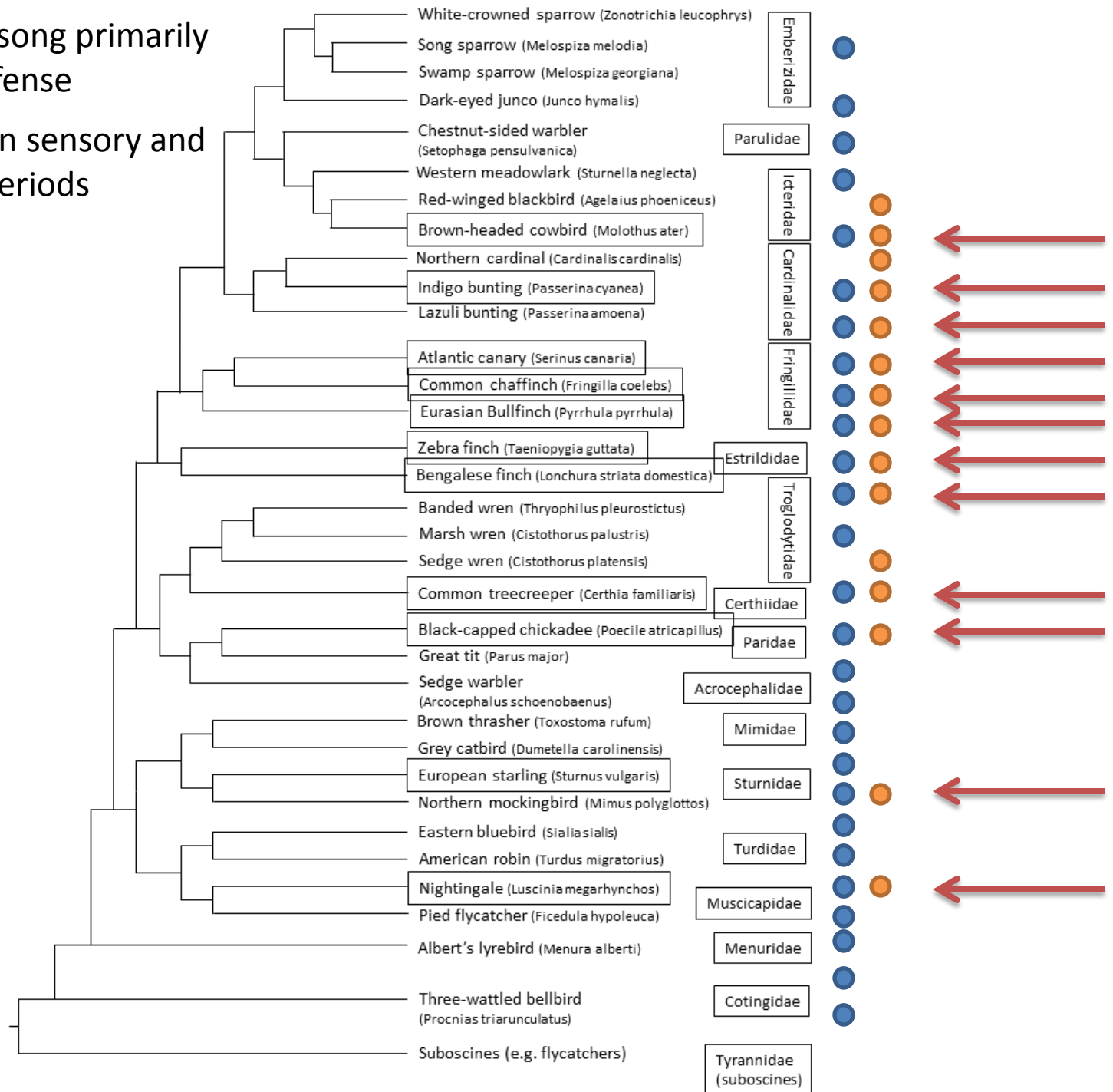
● = does not use song primarily for territory defense

● = high overlap in sensory and sensorimotor periods



● = does not use song primarily for territory defense

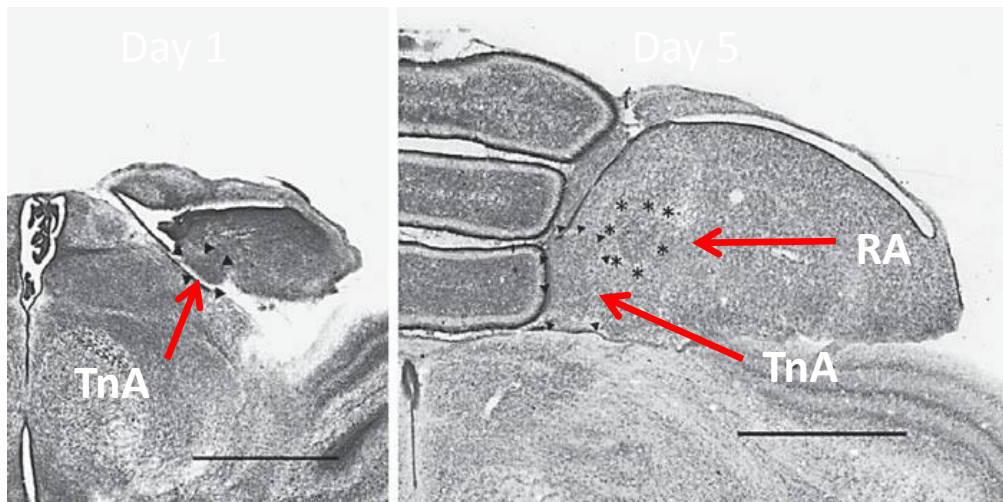
● = high overlap in sensory and sensorimotor periods

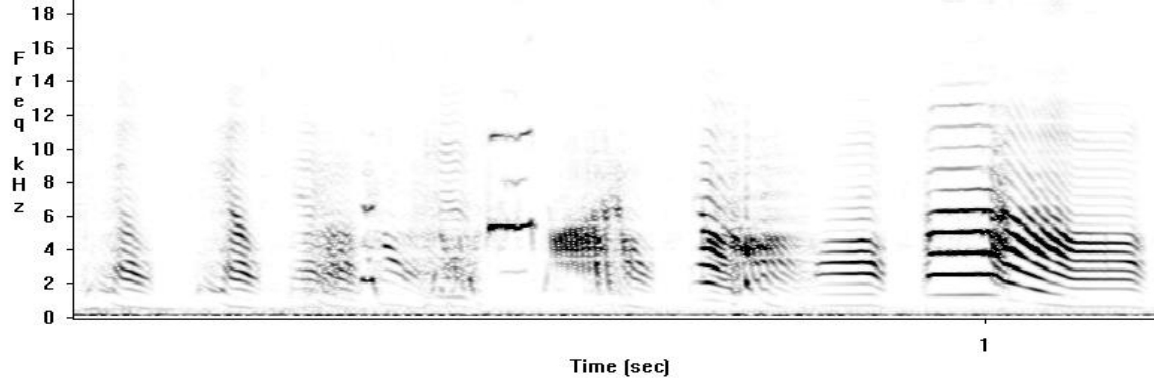


What happens without social guidance? A manipulation

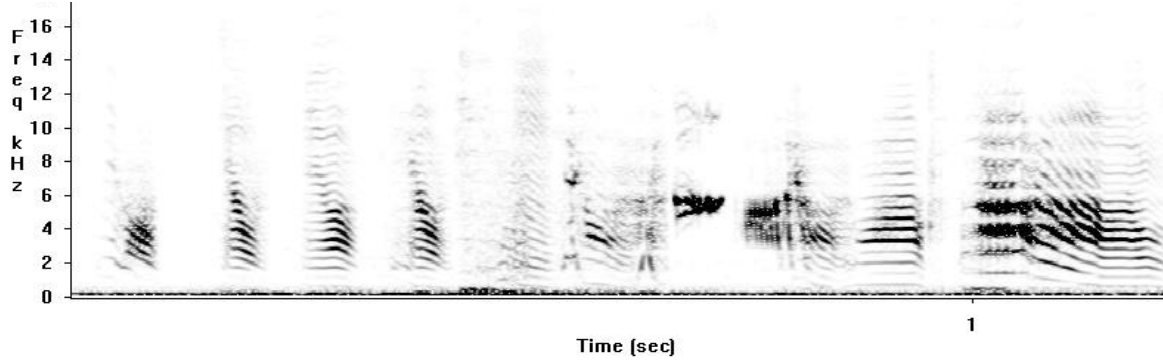
Intracranial injections (2 μ l) post-hatch days 2-8:

- AVT: Arginine vasotocin (50ng)
- MC: Manning Compound, V1aR/OTR antagonist (250ng)
- Control: 0.9% isotonic sterile NaCl

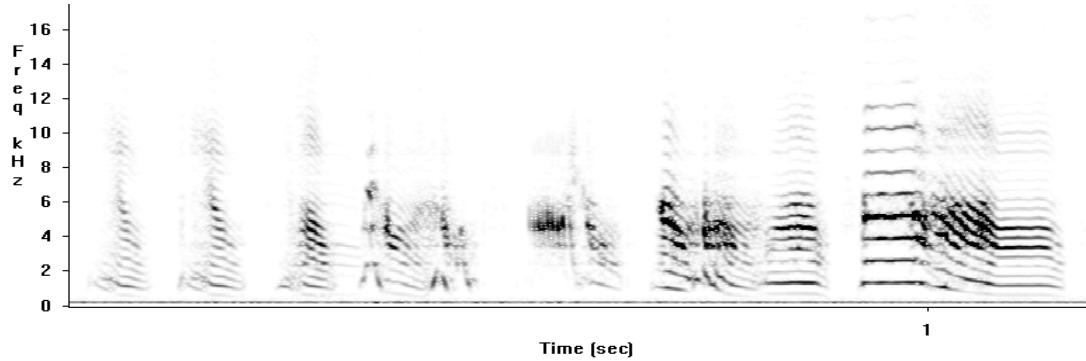




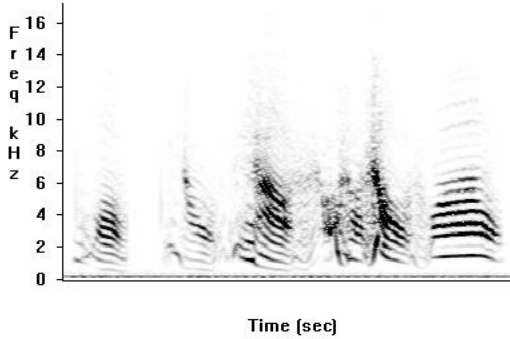
Tutor #1



Control



AVT



MC
(V1aR Antagonist)



Why the second level of analysis (development) is so scary

- ‘Innate versus Learned’ is a false dichotomy. Many behaviors that seem purely innate have learned aspects, and vice versa. Don’t forget about experience!
- Vocal learning doesn’t have to be about imitation. How a species learns is determined by its life history.

Sources of stimulation: Life before birth

Infants can hear speech *in utero*

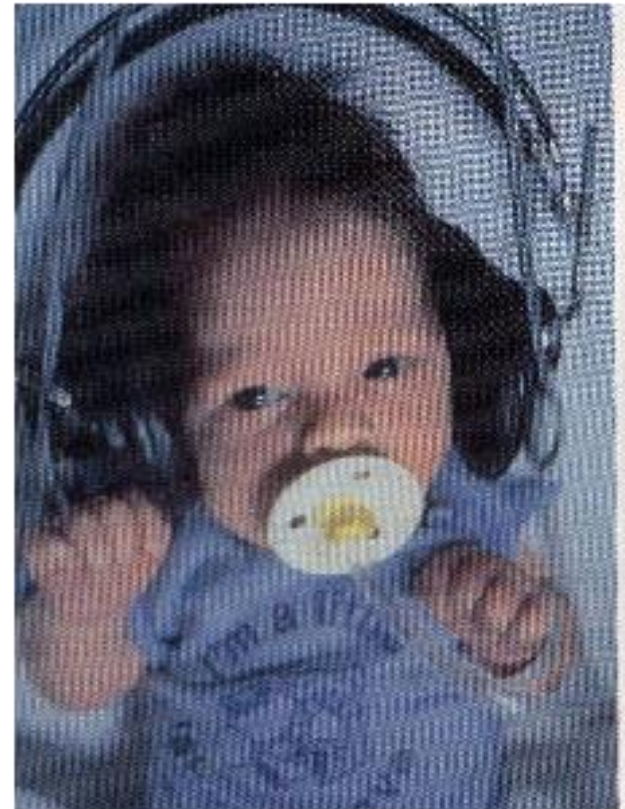
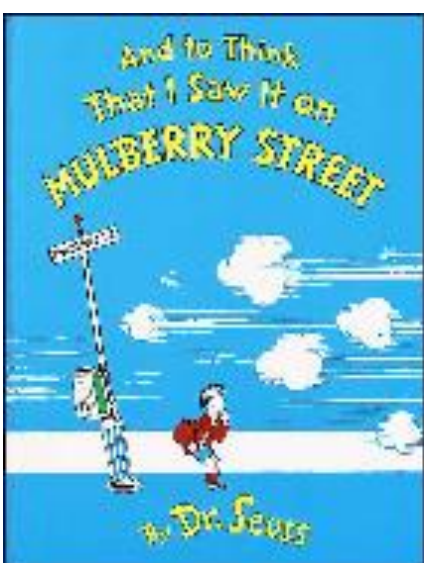


normal



in utero

- DeCasper & Fifer (1980). Of human bonding: Newborns prefer their mothers' voices. *Science*, 208, 1174 - 1176.
- Reinforcement paradigm using IBI



- Self-stimulation: As a result of its movements, the chick embryo is tossed about “like a boat in a storm” (Kuo, 1967)

