

Origins and Evolution of Language
Week 5 tutorial
Tutor notes

Comments for tutors are in italics.

As usual week, two aims for today:

- 1. Read and talk about a couple of very interesting papers with results I find slightly challenging for my world view, as discussed below!*
- 2. More generally, practice reading, summarising, and evaluating research papers, with a bit of encouragement from questions are intended to help think critically about the paper's methods and conclusions.*

This week's reading was about vocal learning, and in the lecture I focussed on grammar learning. The tutorial exercise this week picks up on both topics, and since it's so interesting we'll return to a related topic next week.

For this week's tutorial, read Fehér et al. (2009) and Fehér et al. (2017) - they are both very short!

Olga Fehér is a friend and former postdoc of mine and very kindly provided the songs for this exercise. She tells me zebra finch song is beautiful, I don't hear it, which is a constant source of disappointment to her.

Don't worry about the technicalities of the acoustic analysis (unless you are in to it), but try to get the gist of what they are describing; you can also skip the mathematical model in the 2009 paper.

It might be worth pointing out that knowing what details you can gloss over and which ones are important for your purposes is one of the skills you have to pick up when reading papers! If you are in hyper-critical mode and focussed on low-level details you might care about exactly how they conducted these analyses, but in the questions I set here the focus is more on the general findings and the relationship to human language, in which case I can take the acoustics and the analysis on trust. It is definitely not the case that you need to understand every detail of every paper you read.

To get a feel for zebra finch song, have a listen to the songs below - 6 wild-type song examples, then 6 mystery songs. The mystery songs are in two groups: songs 1-3 and songs A-C. One of these two groups are songs of isolate birds, and the other group is songs from birds from later generations in the Fehér et al (2009) experiments (a generation 2 bird, a generation 3 bird, and a 5th generation bird from their colony). Can you guess based on the description in the paper which group of songs is the isolate and which group is the more wild-type-like song? This may be challenging! How distinctive do the two song types seem to you? Are you surprised by similarities or differences across or within these song groups?

This might not be possible for the naïve listener, I am curious how they approach it! But songs A-C are isolate song, songs 1-3 are the later generations (song 1 is 3rd generation, song

2 is 2nd generation and sounds quite bad, song 3 is 5th generation from the colony and maybe has the most wild-type like rhythm). The superficial difference is that the isolate songs are a bit longer, they have more repetition of individual notes and less repetition of note sequences, and are generally a bit more screechy. But to be honest for me the difference is pretty subtle and I am not sure I could solve this challenge myself – all these songs sound quite similar to me! I think that speaks to the strength of the blueprint for song structure that zebra finches have.

Questions:

- What are the papers about? What did they do? What did they find?

They explore the consequences of song transmission in zebra finches. Isolated zebra finches, who receive no song input during development, sing songs that are structurally different from wild-type (i.e. naturally reared) birds. They show in the 2009 paper that if you expose a 2nd generation of birds to songs produced by isolate tutors they will shift it towards wild type song (on several different kinds of acoustic analysis); if you apply this recursively in an iterated learning design (so the 2nd bird tutors a 3rd and so on), or let the birds run free in a colony, you see further progression towards wild-type song in later birds born into the colony. Surprisingly, you see some of the effects if you “trick” the birds into self-tutoring by playing their own recent songs back to them. This suggests that are constraints on the form of zebra finch song that gradually exert themselves over iterated learning, driving the emergence of wild-type song structure – like universal grammar for zebra finches!

- What are the crucial differences between the "recursive tutoring" and "isolated colony" experiments in the 2009 paper, and the self-tutoring experiment in the 2017 paper?

The recursive tutoring experiment described in the 2009 paper is close to the transmission chain methods we have talked about a few times on the course already – one bird tutors the next bird in the chain of transmission, who tutors the next bird, and so on. The colony is much less controlled – while the starting point is the same, each bird at later generations potentially learns from multiple tutors (their siblings) in a much more natural and complex social environment, and there are also female zebra finches around (and their calls, as distinct from songs, sometimes get copied and incorporated). The self-tutoring set-up is the most stripped back – a single zebra finch which hears its own earlier songs played back to it on request, so it’s not hearing any input it didn’t generate itself.

- If you can imagine running similar experiments with humans, what do you think would happen? How different would the methods have to be to show interesting results? This question is intended to be about the factors you think are crucial in understanding human language transmission, rather than the ethical issues!

Obviously this kind of thing couldn’t be done with humans for multiple ethical and practical reasons (although it perhaps has been done in the past, see https://en.wikipedia.org/wiki/Language_deprivation_experiments), so try not to get too sidetracked on that! But strictly as a thought experiment, I think the results of something equivalent with humans would be radically different in some respects. For starters, I think there’s nothing equivalent to isolate song for human language – an isolated human would be

mute – so self-tutoring would be a non-starter. And for me, language is inherently communicative, so I don't think anything would happen in the recursive tutoring version unless there was full communicative interaction between tutor and pupil. However, once you set up conditions where people are actually communicating and learning from each other, as in the iterated learning experiments we have already talked about briefly on the course and will return to in week 7, I think stuff would happen and linguistic structure (arbitrary symbols, duality of patterning, compositionality) would rapidly emerge, so in that sense I'd expect the same end result. You could also point them ahead to week 8, where we will talk about emerging sign languages, which is a "natural experiment" roughly along these lines (mentioned briefly in Fehér et al, 2009).

However, I think the mechanisms with humans would be different – here it seems like the learning bias in the birds (their innate song template) is very strong and determine what happens, for humans our experimental results lead me to believe the learning bias is much weaker and many of the constraints on what the linguistic system looks like come from communicative constraints. But this is where I find the results of the Fehér et al papers challenging – their work on zebra finches is the best model we currently have, and it shows that innate learning biases play a crucial role, so I am sort of committed to a view that while Olga's results are very interesting and shows the importance of transmission, I feel like the important mechanisms shaping linguistic universals in humans are rather different!

- What aspect of their findings strikes you as most interesting or surprising from the perspective of someone interested in human language? Or if you think these results aren't relevant to understanding human language, why not?

See above – for me the most striking and challenging aspect of their findings is that there is very convincing evidence for an innate template that shapes how song culture develops in zebra finches, and the obvious implication is that human language works in the same way. The work on iterated learning we talked about in week 1 and return to in week 7 instead emphasises the interaction between learning and communication in shaping human language, and in general I think of learning constraints as being relatively weak and quite general (e.g. a preference for simpler grammars over more complex ones, rather than a highly detailed template for what grammars should look like), which seems not to be how it works for zebra finches. Of course zebra finches might be radically different from humans, but since this is the species that has been studied most closely we have to take note of it.