The perception and characterization of acoustic fine structure in bird vocalizations

Methods paper (submit to ??? JASA?? Bird journal? Bioacoustics?? Suggestions??)

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***Justification***

Birds appear to have a remarkable ability to discriminate acoustic fine structure. So far, perceptual studies suggest this ability may be widespread amongst parrots and songbirds, but only 7 captive species have been studied. Thus, it remains unclear how widespread and important this ability is for informing bioacoustics and social behavior research across bird species.

A key challenge to expanding this research to wild birds is that there are no standard approaches to characterize AFS. *{Note this is also a big challenge for me in my research with zebra finches. I need a program to assess acoustic fine structure during song learning (socially guided vocal learning of artificial Schroeder harmonics) and also how fine structure may change during social interactions (I have preliminary evidence, which I excluded from the Prior et al., 2018 paper that there is call convergence between pair bonded partners at the level of the AFS).*

***Primary Goals: (1) Describe the limitations of different bioacoustic analysis programs in quantifying AFS on the order birds can hearing; and (2) Determine the effect of natural environmental degradation reliability in AFS.***

***Part 1:*** *Describe the limitations of different bioacoustic analysis programs in quantifying AFS on the order birds can hearing.*

1. Use schroeder waveforms to determine commonly used acoustic analyses programs capture AFS on the order birds perceive it. (Nora and Karan?)
   1. What programs can discriminate between positive and negative Schroeder with a fundamental of at least 600hz (or higher) and 15-25 components (harmonics).
   2. Programs:
      1. Sound analysis Pro (NO?)
      2. RAVEN (NO?)
      3. SIGNAL (YES??)
      4. AVISOFT
      5. Spectral reduction packages used in R …?
2. Propose new biacoustic package that captures real variation in AFS (Marcelo)
   1. Show what parameters allow for discrimination and characterization of positive and negative Schroeder with a fundamental of at least 600hz (or higher) and 15-25 components (harmonics).

***Part 2:*** *Determine the effect of natural environmental degradation reliability in AFS.*

1. Determine how environmental degradation and recording conditions impacts the AFS of Schroeder signals.
   1. Using new program (and any other programs that can discriminate AFS)
   2. Look at natural playbacks at 5m, 10m and 20m (see attached folder)
   3. Look at AFS in natural calls at 5m, 10m, and 20m (haven’t completed recordings)
   4. Anything else?

***Part 3 Conclusion:*** A list of best practices for researchers trying to consider AFS in natural experiments.

***Notes on Schroeder Variation:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Order** | **Fund** | **#Comp** | **Schr** |
| 1 | 200 | 5 | pos |
| 2 | 200 | 5 | neg |
| 3 | 200 | 15 | pos |
| 4 | 200 | 15 | neg |
| 5 | 200 | 25 | pos |
| 6 | 200 | 25 | neg |
| 7 | 400 | 5 | pos |
| 8 | 400 | 5 | neg |
| 9 | 400 | 15 | pos |
| 10 | 400 | 15 | neg |
| 11 | 400 | 25 | pos |
| 12 | 400 | 25 | neg |
| 13 | 600 | 5 | pos |
| 14 | 600 | 5 | neg |
| 15 | 600 | 15 | pos |
| 16 | 600 | 15 | neg |
| 17 | 600 | 25 | pos |
| 18 | 600 | 25 | neg |
| 19 | 800 | 5 | pos |
| 20 | 800 | 5 | neg |
| 21 | 800 | 15 | pos |
| 22 | 800 | 15 | neg |
| 23 | 800 | 25 | pos |
| 24 | 800 | 25 | neg |

To test what acoustic analysis techniques allow us to capture variation in within period acoustic fine structure. Key is for file “SchroederCallsTest4\_3Nov2022.wav”. Each Schroeder “call” is 200ms. The waveforms vary in fine structure (positive vs negative), number of components (complexity of fine structure & bandwidth - 5,15,25), and fundamental frequency (200hz, 400hz,600hz, and 800hz). Use this table key to the left.