

Introduction:

The Avian Brain as a Model for Human Communication

- The Zebra Finch's song is a model for deconstructing vocalization production and vocal learning functions
- Difficulty in conducting this research is that not much is known about Local Field Potential (LFP) in birds
- An area of interest in understanding LFP in the avian pre-motor region HVC can help elucidate similarities with the human motor and pre-motor cortex
- The ultimate goal of the main project is to be able to develop a neuro-speech prosthesis for humans



Methods (cont.):

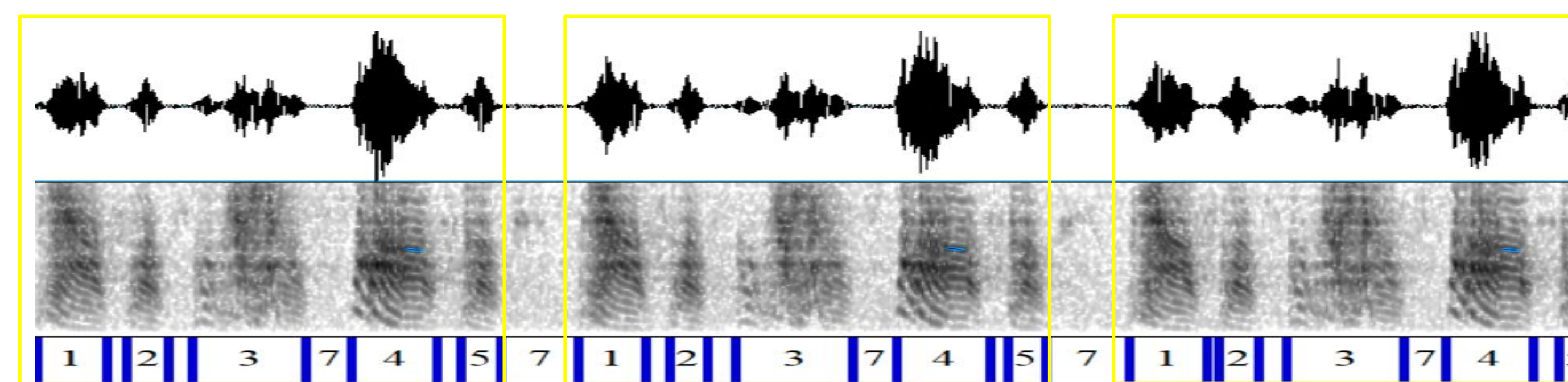


Fig 1. Praat hand labels: Spectrogram and pressure waveform showing stereotyped vocalization

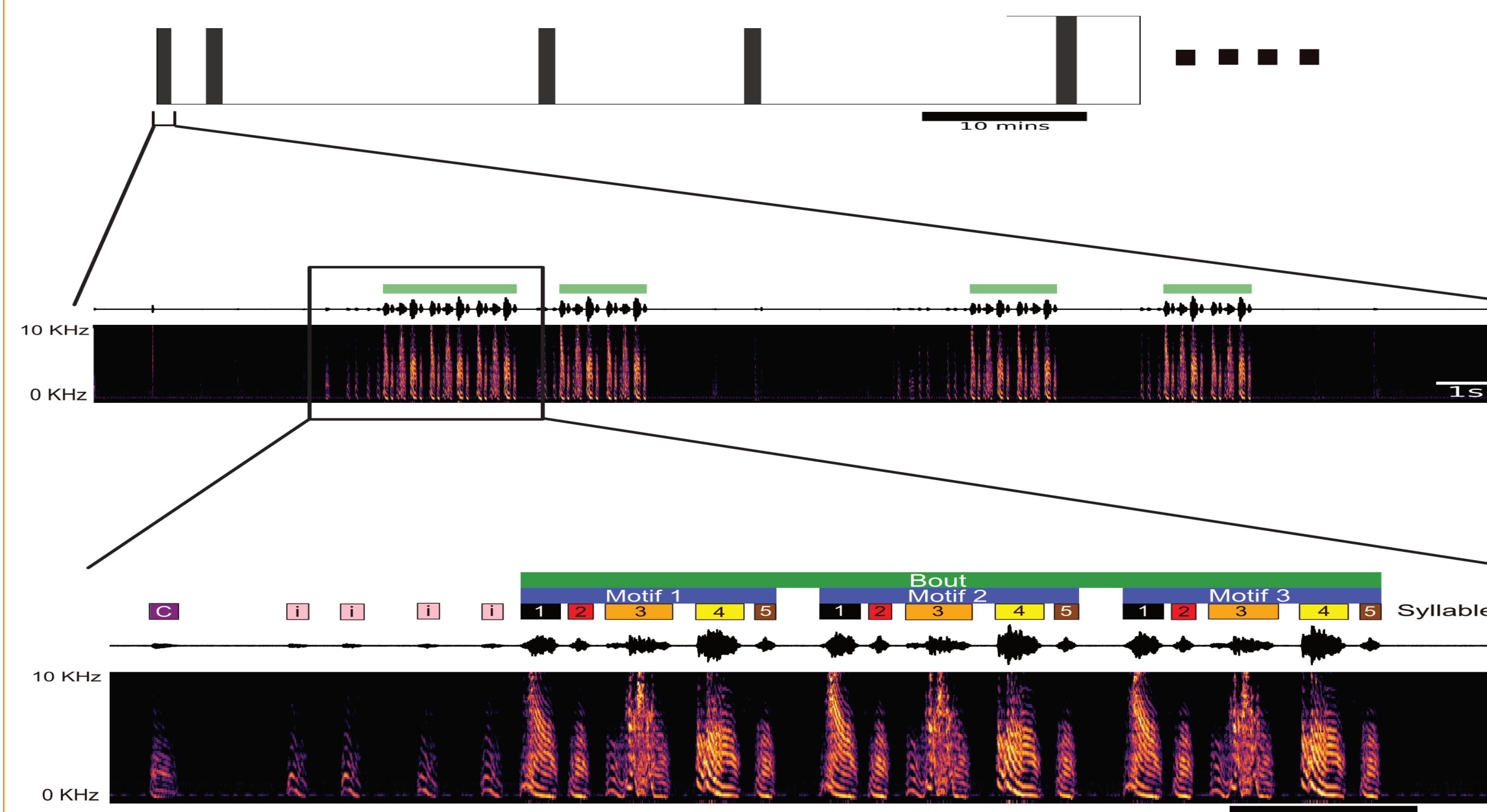


Fig 2. One day's continuous recording : One days recording further showing the structured song spectrogram in a larger context

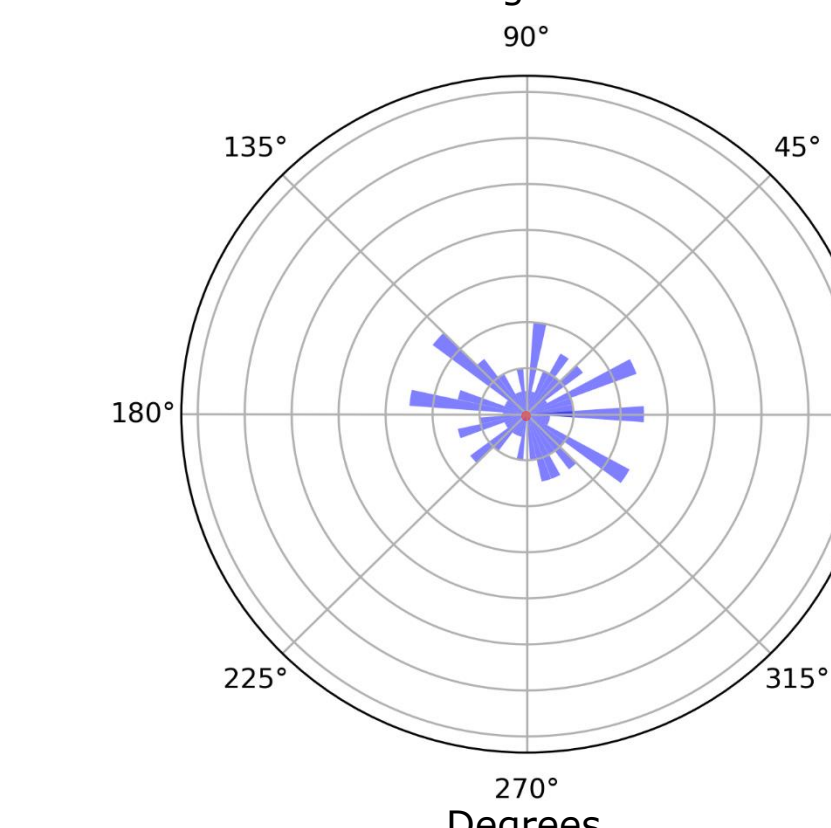
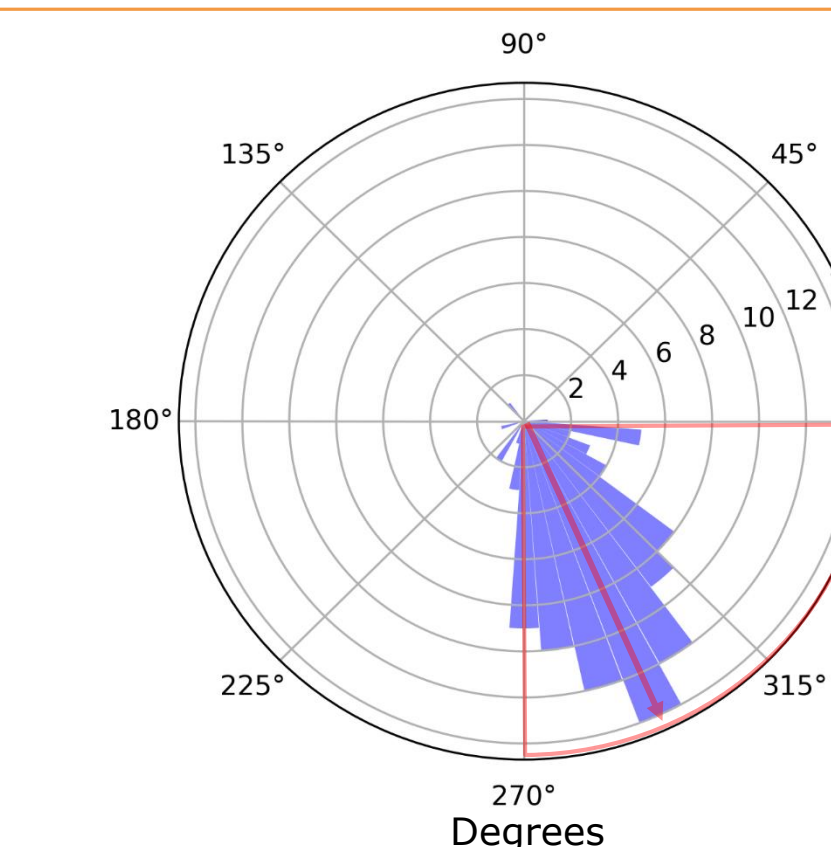


Fig 3. Polar histogram: Binned counts of phase values for the narrow band frequency that had the highest and lowest phase preference in syllable 1 at point of alignment (t=0)

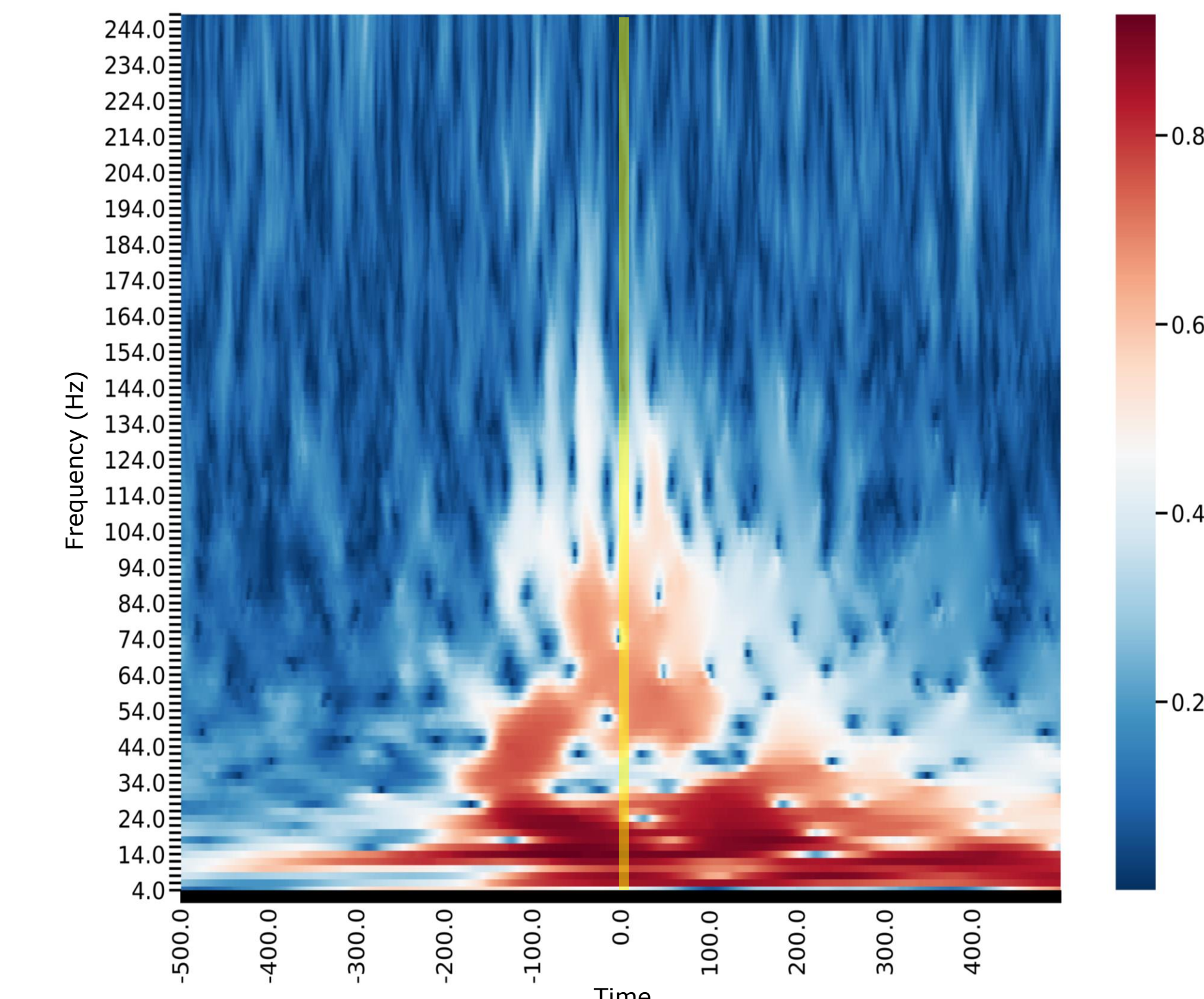


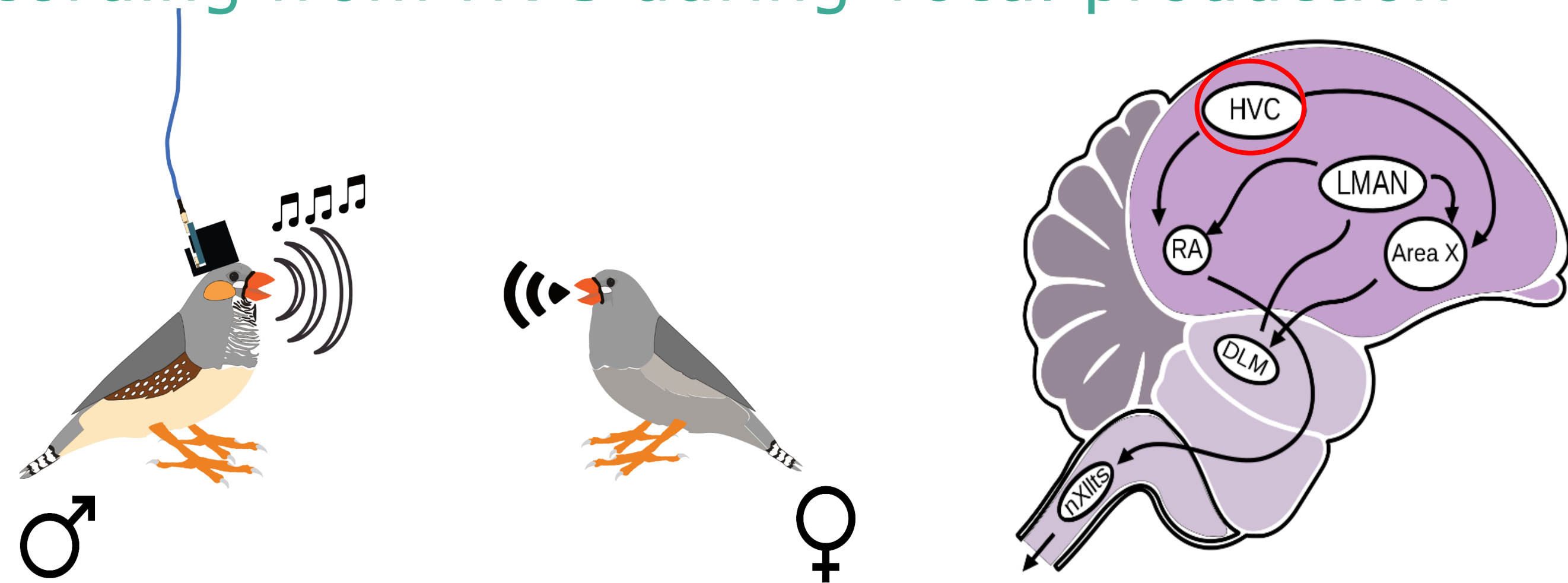
Fig 4. Inter-trial coherence: Showing phase preference centered on syllable 1 (N=98) where the color bar represents vector length

Data handling pipeline:

1. Context labeling of epoch
2. Hand labeling in Praat centered on the first motif in the bout
3. Cleaning of hand labels
4. Data is Hilbert transformed and band-pass filtered

Methods:

Recording from HVC during vocal production



- The male bird is anesthetized and is then implanted with a 16-32 channel silicon laminar electrode in the avian brain region HVC
- The bird's free vocal behavior was recorded using an omni-directional microphone while the electrode picked up the neural activity using the same digital clock at 30Khz

Result:

Inter-trial coherence to syllable onset is not random

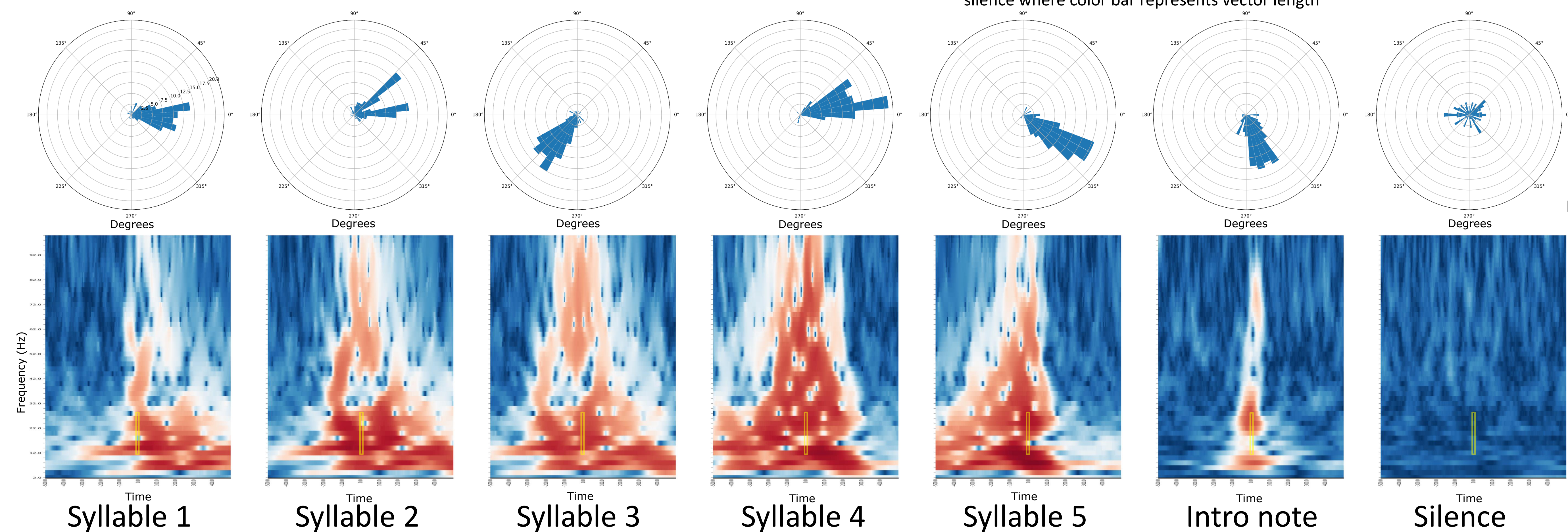


Fig 5. Polar histogram across different syllables: Binned counts of phase values showing phase preference in different syllables in the beta range and no phase preference for silence
 Fig 6. Inter-trial coherence across different syllables: Showing phase preference centered to onset of different syllables where (N=98) showing synchronization and desynchronization in silence where color bar represents vector length

Discussion:

The phase preference shown in the inter-trial coherence displays that each syllable has a particular angle during the LFP phase in which it occurs. The results were generated for the beta frequency band (13-30Hz). Similar results for phase preference in the beta range has been seen in a Venkatesh N. Murthy and Eberhard E. Fetz's study of looking at LFP oscillations in rhesus monkeys

1. Coherent 25- to 35-Hz oscillations in the sensorimotor cortex of awake behaving monkeys

Future steps:

The phase preference for syllable onset in the beta range helps strengthen our understanding of the beta range being closely associated with the sensorimotor region. Looking into if there is a phase preference in other frequency ranges as well as replicated the results across other days and birds will help solidify our findings.

Acknowledgments:

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