Effects of Cochlear Synaptopathy on Single-Unit Cochlear Nucleus Responses in the Budgerigar

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Cochlear Synaptopathy

Cochlear Synaptopathy (CS) is the loss of synapses between hair cells and auditory-nerve fibers (ANFs).

CS is hypothesized to impair perception of sounds in noise, called hidden hearing loss, but underlying neural mechanisms are unknown.

Previous studies of CS
- Conflicting literature about the changes in the spontaneous rate of ANFs[3,6]
- Enhancement of ANF onset response[2,6]
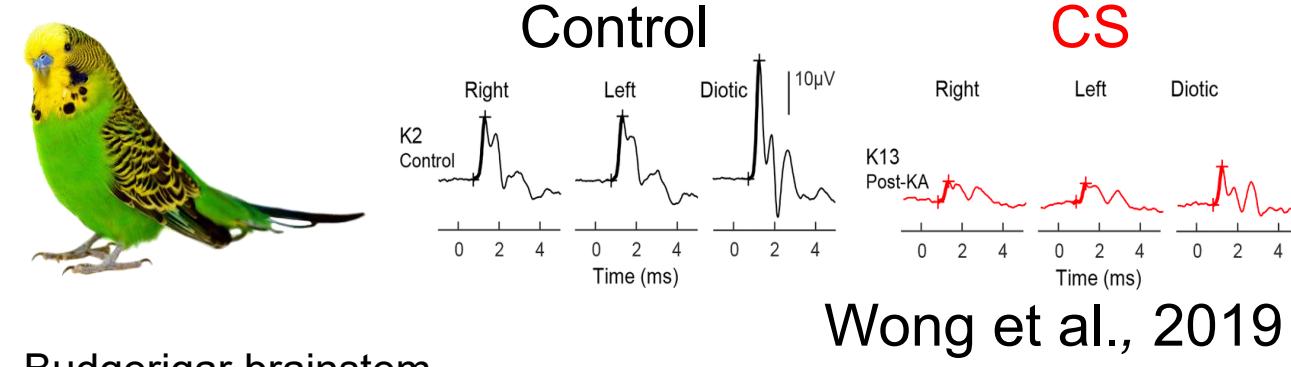
Only a single study has examined the effects of CS on the cochlear nucleus (CN).
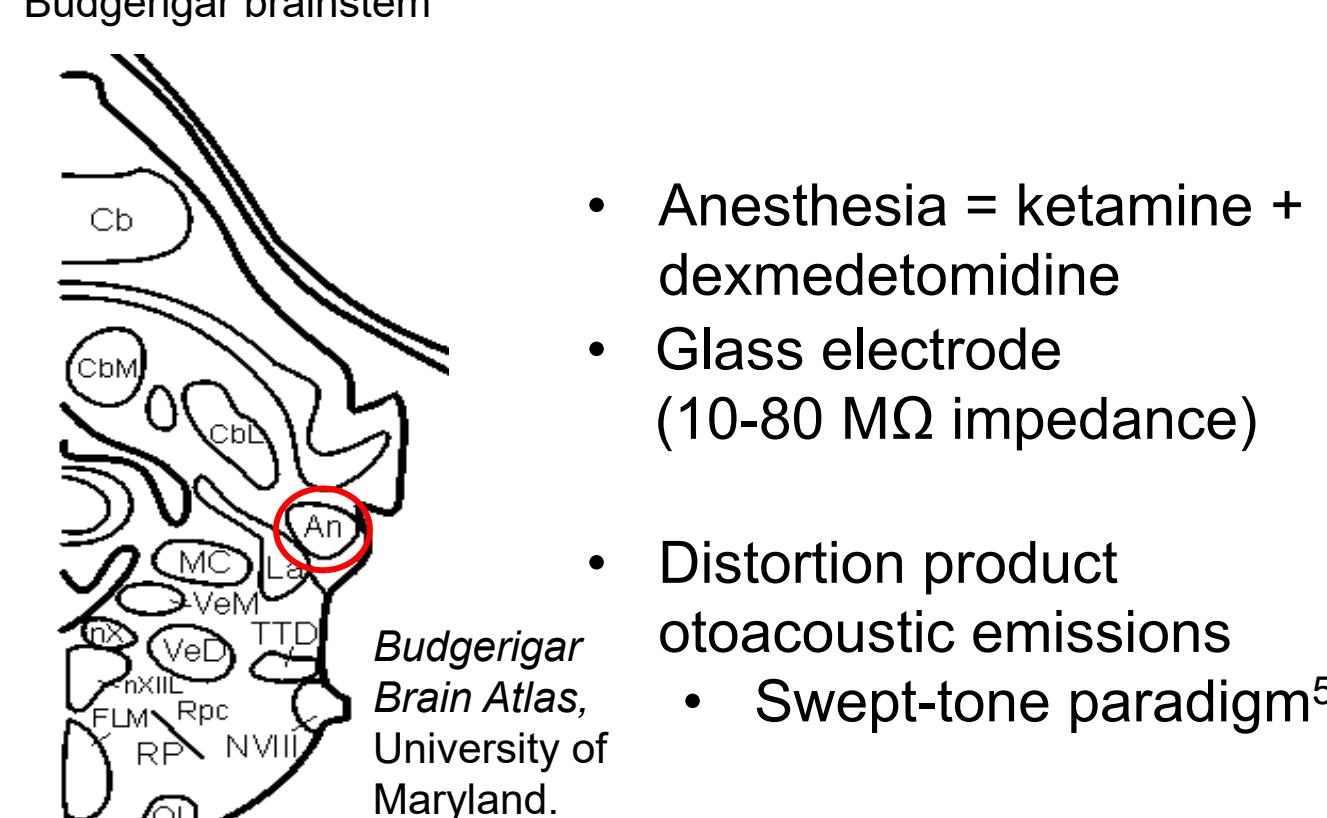
Current Study
Quantified effects of CS on neural encoding in the nucleus angularis (NA) of the CN in the budgerigar.

Methods
Animal model: Budgerigar (a parakeet species)

Wong et al., 2019

Budgerigar brainstem


Budgerigar Brain Atlas, University of Maryland.
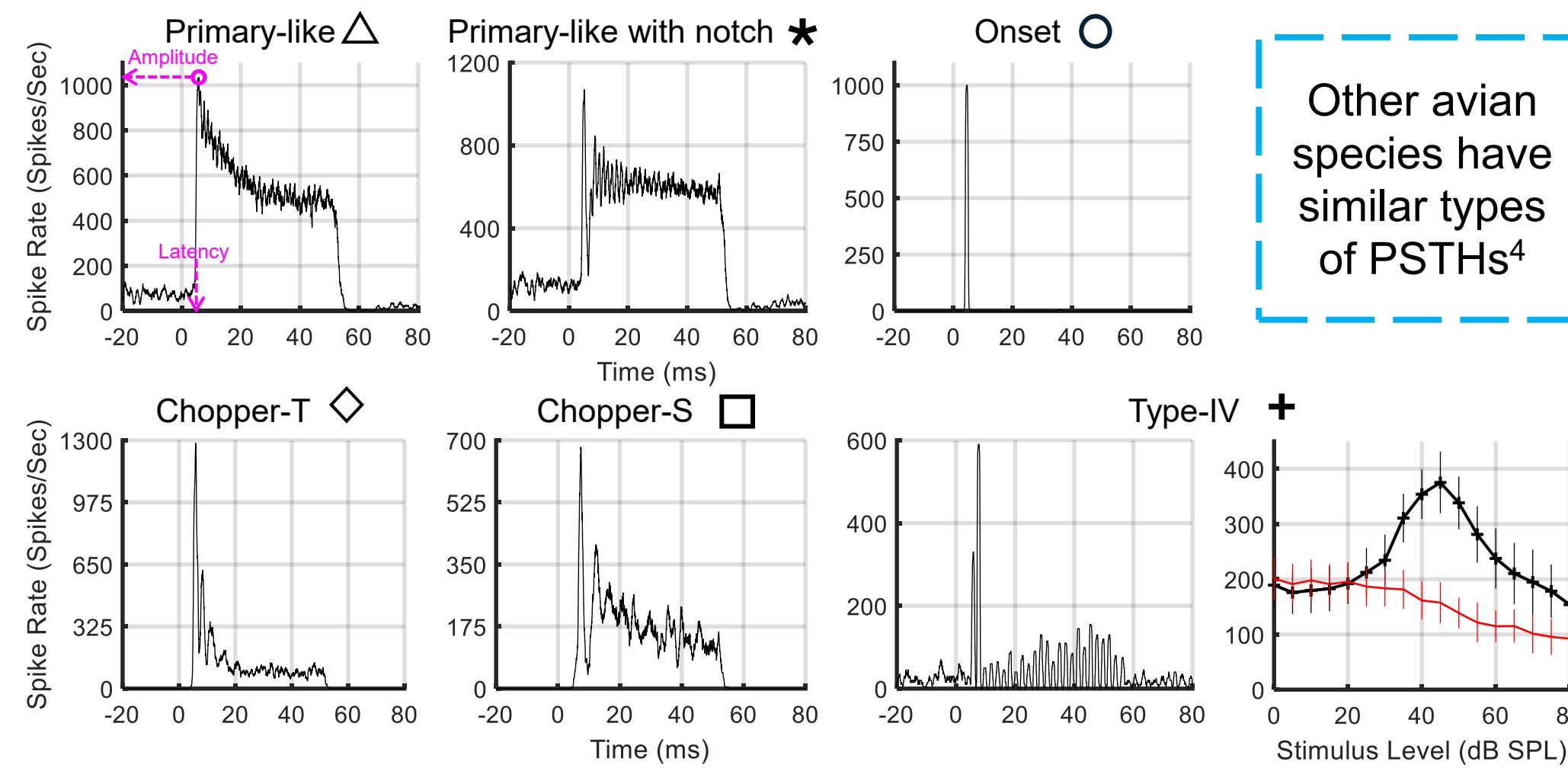
- Anesthesia = ketamine + dexmedetomidine
- Glass electrode (10-80 MΩ impedance)
- Distortion product otoacoustic emissions
  - Swept-tone paradigm[5]
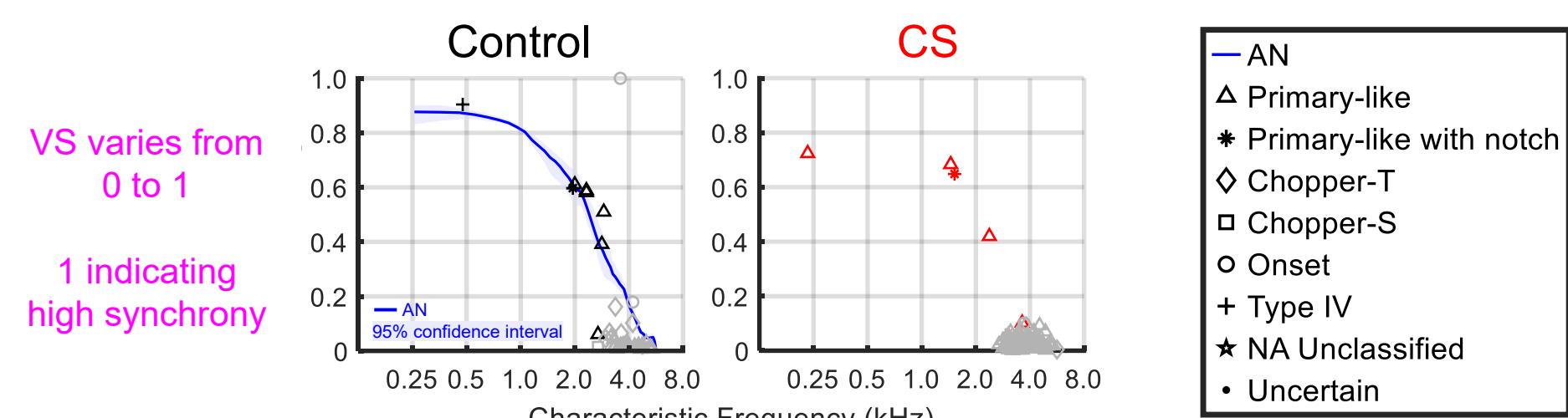
- Stimuli
  - Tuning curve, spontaneous rate, rate-level function and post-stimulus time histogram (PSTH)
- Identifying a CN unit based on action potential shape, vector strength (VS) and PSTH shape[4]
- Recordings are conducted at least 6 weeks after KA-exposure

PSTH shapes in the NA

Other avian species have similar types of PSTHs[4]
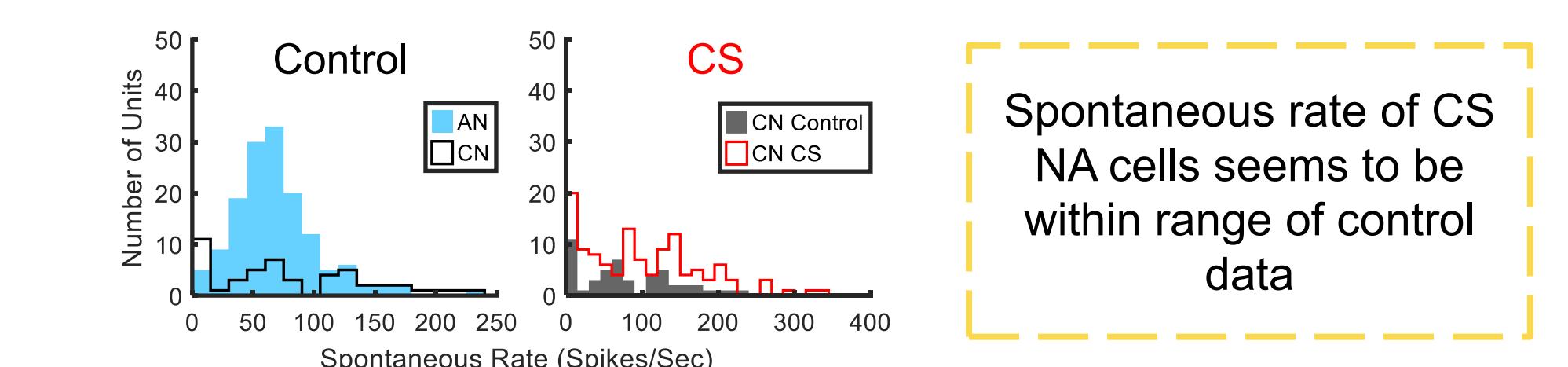
Vector Strength in CN units (PSTH)

VS varies from 0 to 1

1 indicating high synchrony
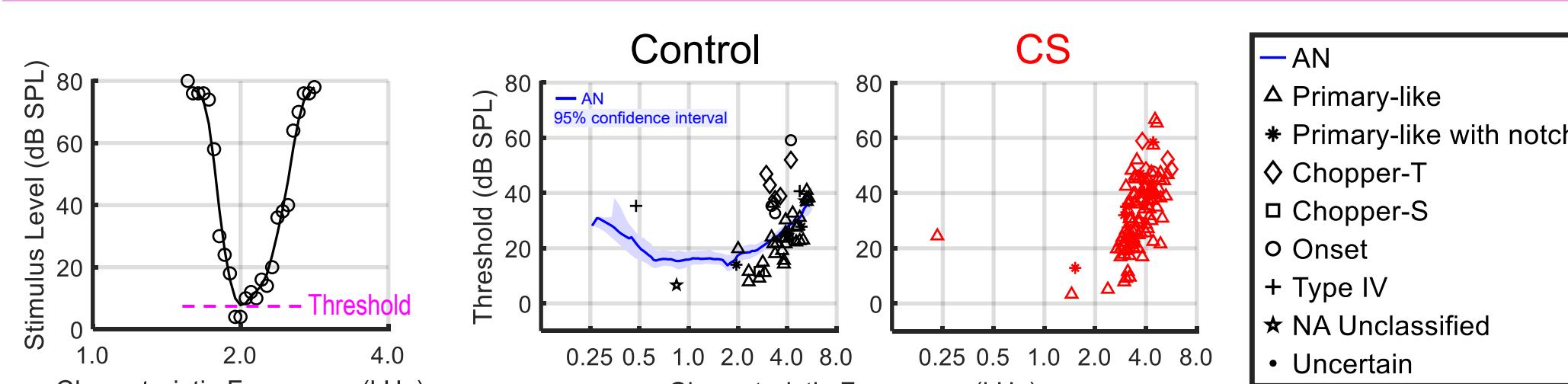
Vector strength of CS NA cells seems to be within range of control data
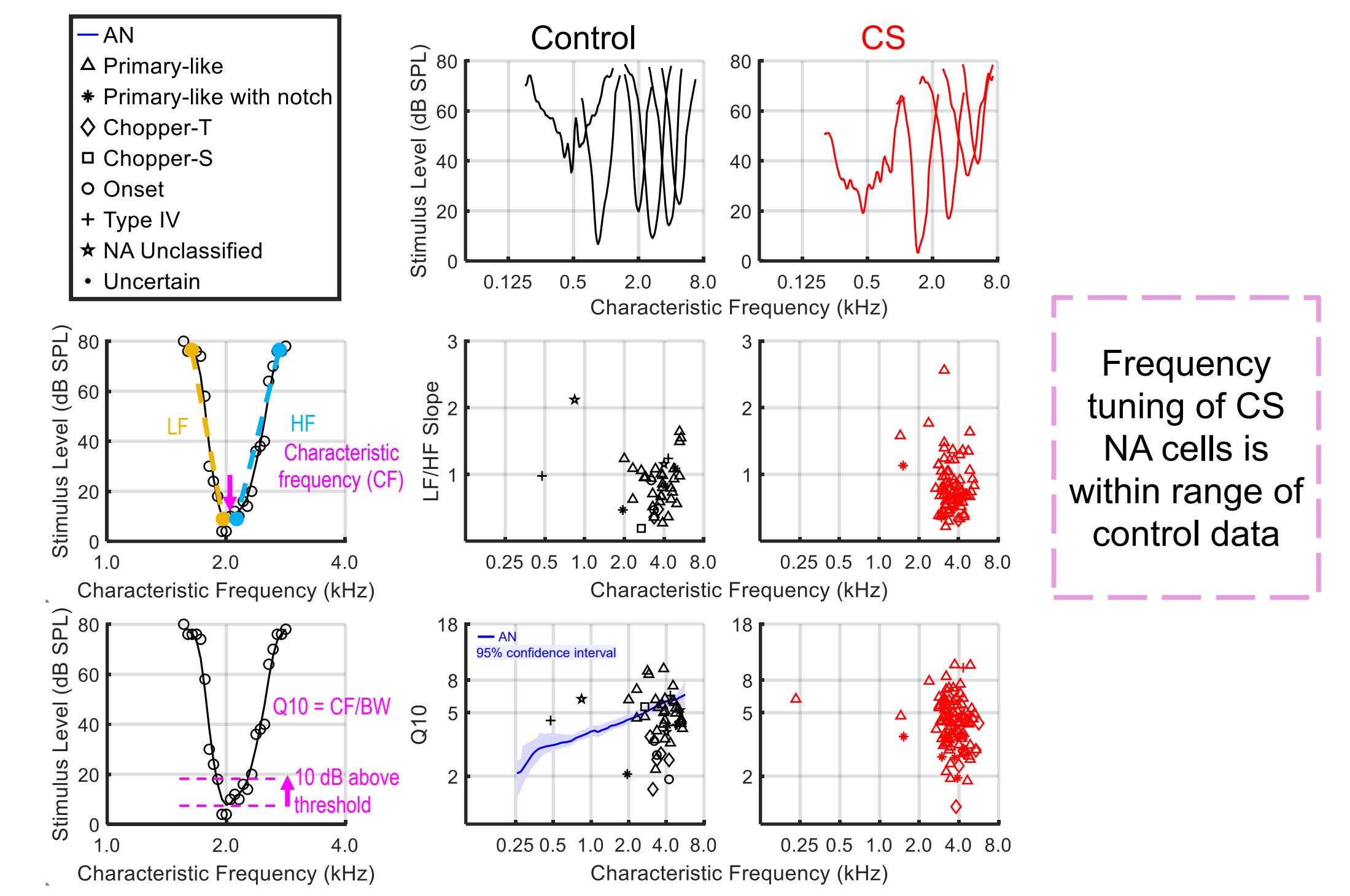
Is spontaneous activity of CN units altered by CS?

Spontaneous rate of CS NA cells seems to be within range of control data
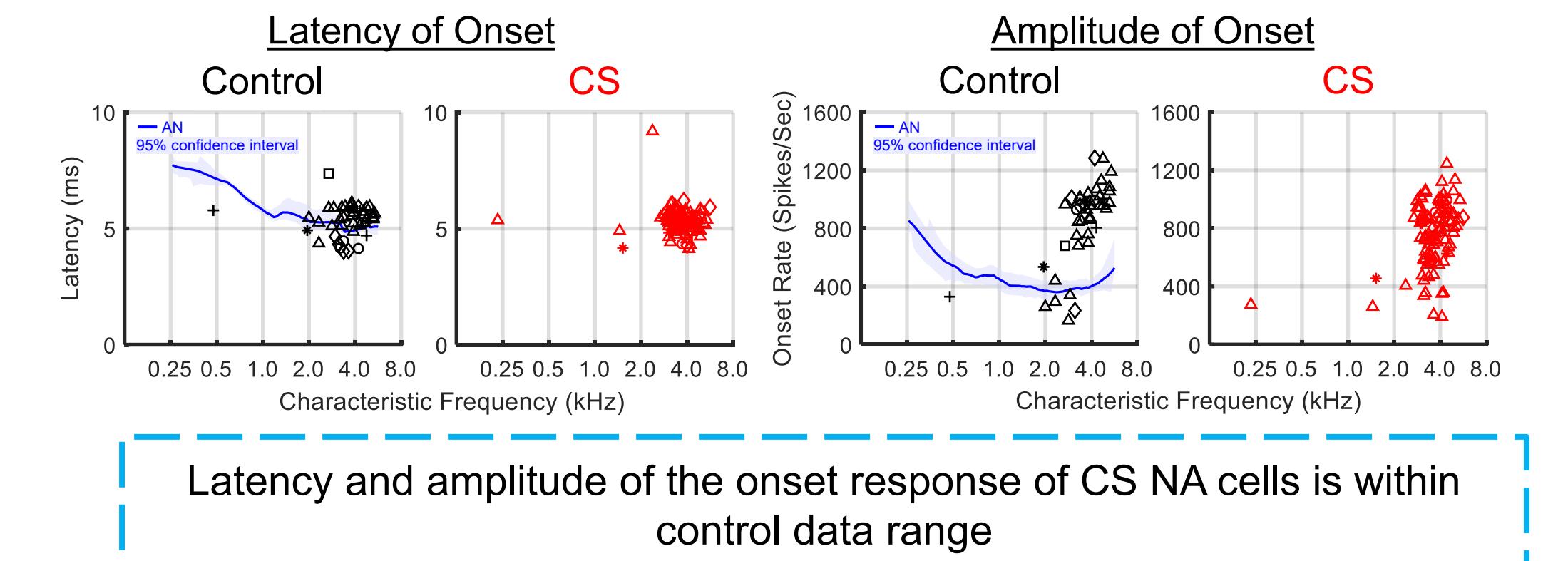
Does CS affect sensitivity of CN units? (Tuning curve)

Threshold sensitivity of CS NA cells is within range of control data

Does CS affect frequency tuning of CN units? (Tuning curve)

Frequency tuning of CS NA cells is within range of control data

Are onset responses of CN units altered by CS? (PSTH)

Latency and amplitude of the onset response of CS NA cells is within control data range

Summary
Neural encoding in the NA of the CN in the budgerigar does not seem to be affected by CS.

Future directions
Study neural encoding of complex sounds in the NA of the CN in the budgerigar. Conduct histology to investigate if molecular changes occur in NA cells of CS-induced animals.

References
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