

Introduction and hypotheses

- ❖ **Aim:** to examine the acoustics of L1 Polish, L2 English and L3 Norwegian sibilants produced by L3 learners during semi-spontaneous and read speech in an L3 acquisition context
- ❖ Polish: /s/, /ʃ/, /ɕ/ (Jassem, 2003; Czaplicki et al. 2016;)
- ❖ Norwegian: /s/, /ʃ/, /ɕ/ (Kristoffersen, 2000; van Dommelen, 2019),
- ❖ English: /s/ and /ʃ/
- ❖ The interplay between sibilant systems of multilingual learners with speaking mode remains largely understudied prior to this investigation
- ❖ **RQ1:** Do sibilants produced by multilingual language learners differ across speech modalities, i.e., spontaneous vs. read speech?
- ❖ **RQ2:** Does L2/L3 language proficiency interact with speaking mode to influence the spectral characteristics of sibilants?
 - ❖ **H1:** In the spontaneous mode, spectral neutralization is expected among comparably articulated sibilants across language systems, as spontaneous speech is produced with reduced spectral space when compared to read speech in the L1 (Nakamura, et al., 2008) or in the L2 (Cucchiari et al., 2002).
 - ❖ **H2:** L1 CLI should be more prominent on L2/L3 sibilants at lower L2/L3 proficiency based on L1 dominance effect

Methods

- ❖ **Participants:** 39 (f=35) L1 Polish, L2 English, L3 Norwegian learners
- ❖ Production of 7 sibilants from Polish, English, and Norwegian:
 - semi-spontaneous story recollection task** (n = 780 tokens per sibilant)
 - naturalistic sentence reading task** (50 < n < 150 tokens per sibilant)
- ❖ Sibilants presented orthographically to participants in carrier sentences within an intervocalic context /VSV/ (or /V#SV/). Vowel context was not controlled for the semi-spontaneous mode
- ❖ Carrier sentences in read task were randomised per participant
- ❖ Spectral **Center of Gravity (CoG)** was used to quantify spectral differences between sibilants based on prior literature (Jongman et al., 2000; Lee, 2011; Żygis et al., 2012; Nirgianaki, 2014; Żygis et al., 2015; Czaplicki et al., 2016; Petrović, 2020; Nguyen et al., 2022; Wikse Barrow et al., 2022; Żygis et al., 2023)
- ❖ **Linear mixed effects modeling** was used to examine the effects of phoneme, speech mode, Norwegian proficiency and English proficiency on CoG of sibilants across phonemic inventories of multilinguals.

Results & Analysis

- ❖ **H1:** Sibilant place neutralization was observed for /s/ across languages, primarily in the spontaneous mode (i.e., s_p, s_E, and s_N). The presence of weak bimodality in read speech for /ɕ/ and /ʃ/ also suggests larger variation in the realizations of sibilants in the read speech as compared to spontaneous mode

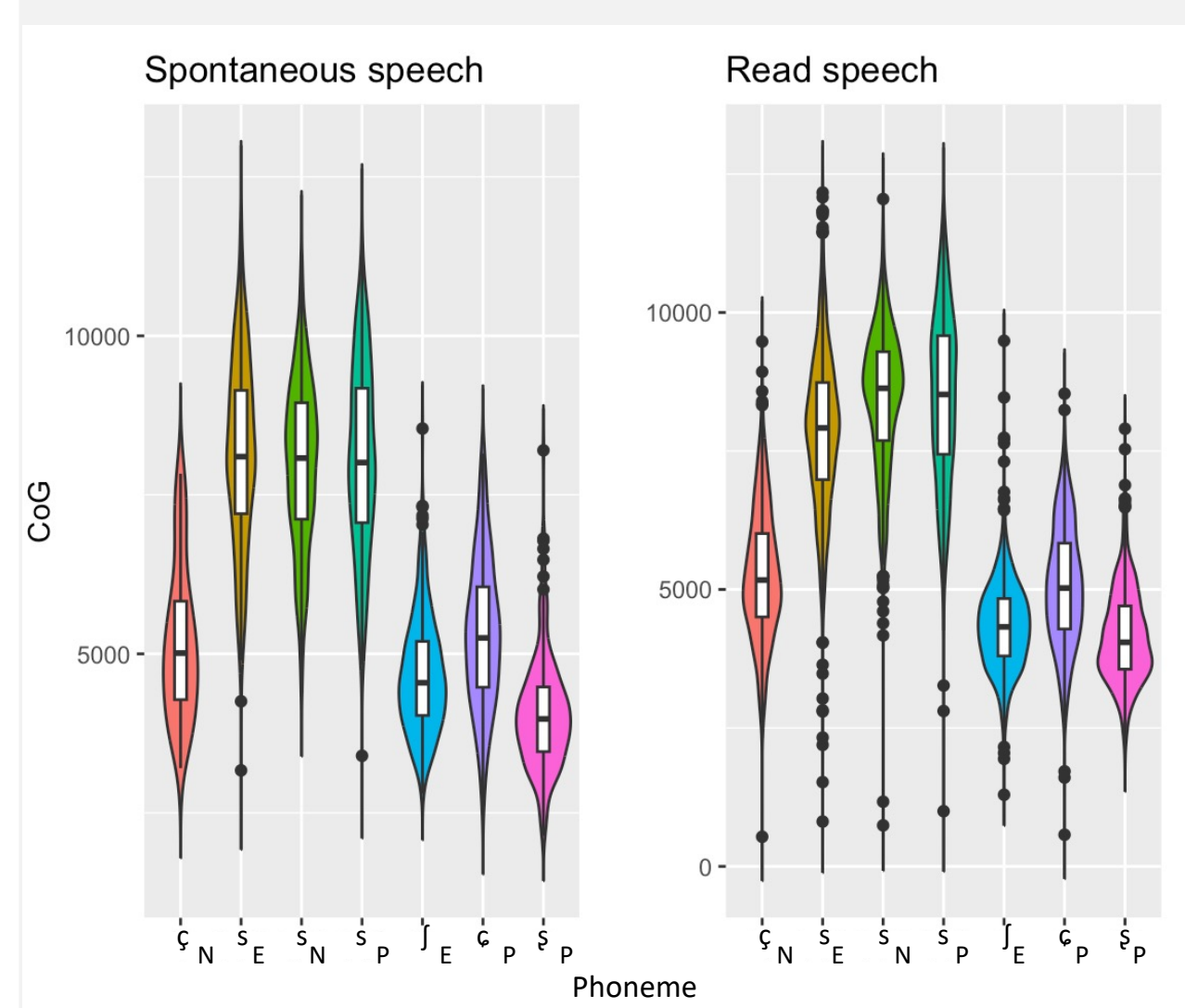


Figure 1. Distributions of CoG by phoneme and speech mode. Spontaneously produced sibilants exhibit qualitatively Gaussian distributions. Several read sibilants exhibit weak bimodality (i.e., Polish /s/ and /ɕ/ and /ʃ/)

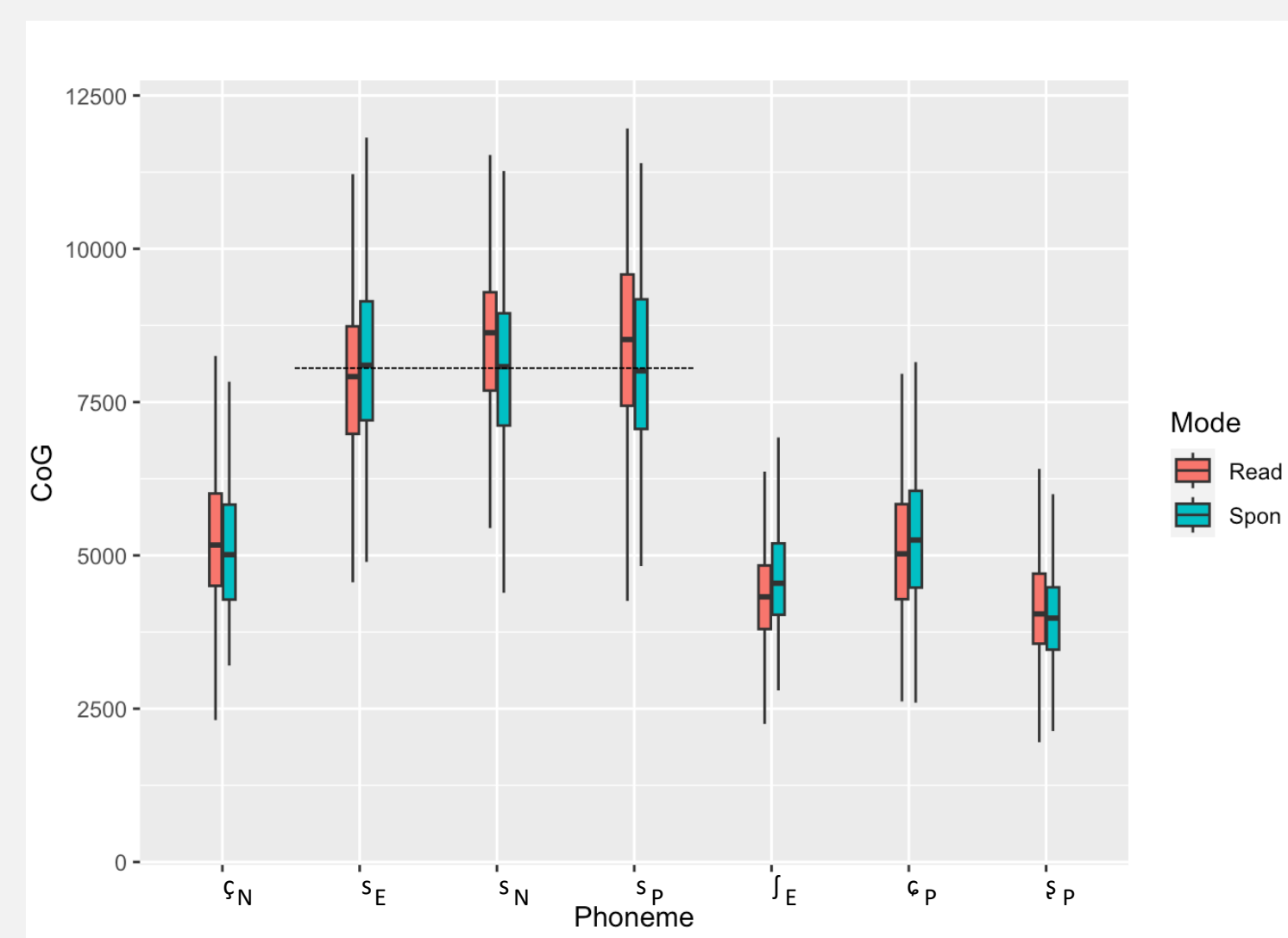
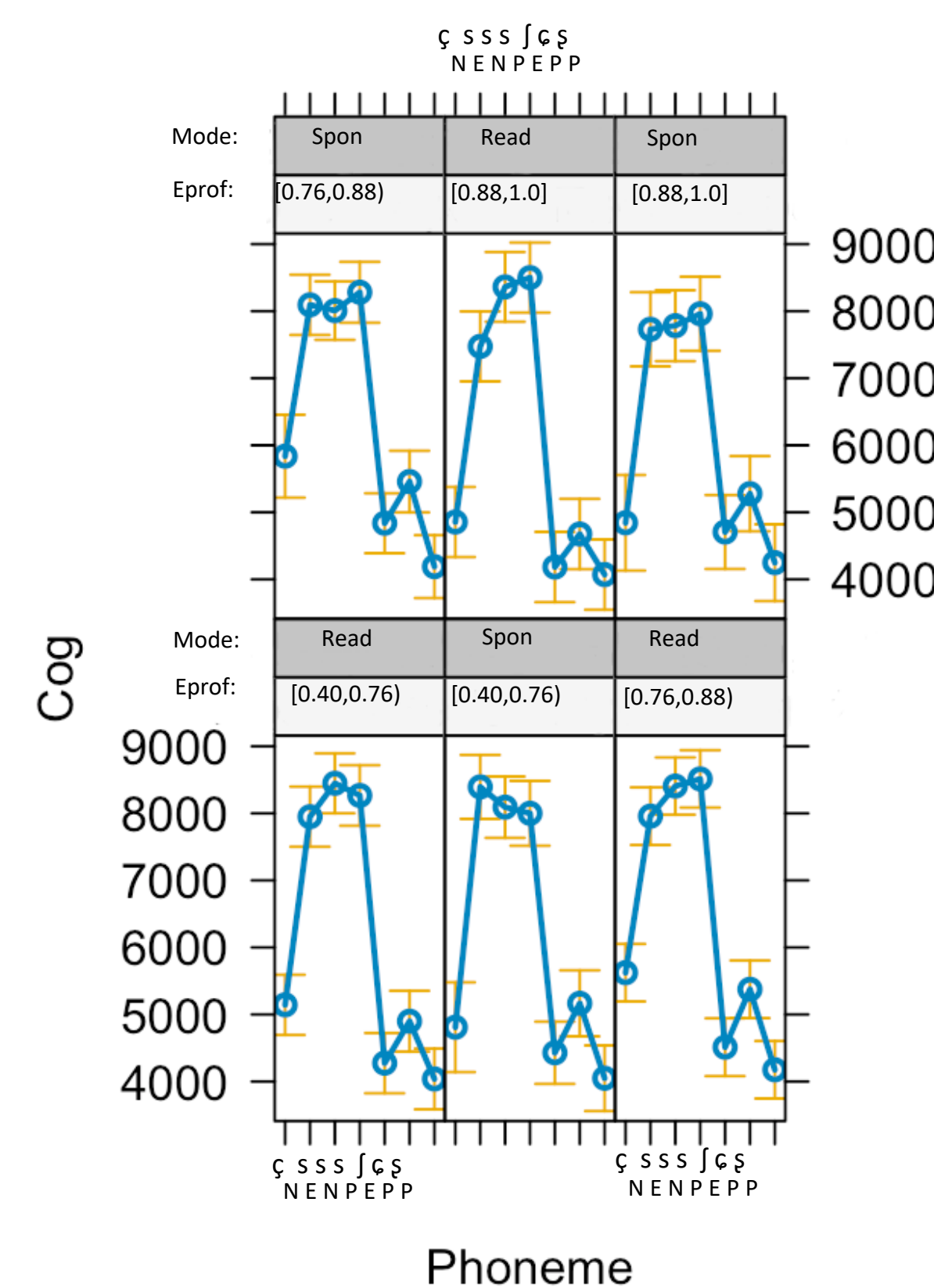


Figure 2. Boxplots of CoG by phoneme and speech mode. Median values of /s/ converge in the spontaneous mode but vary in read speech. Other sibilants differ within and across modes

Mode*Phoneme*eprof2 effect plot



Mode*Phoneme*nprof2 effect plot

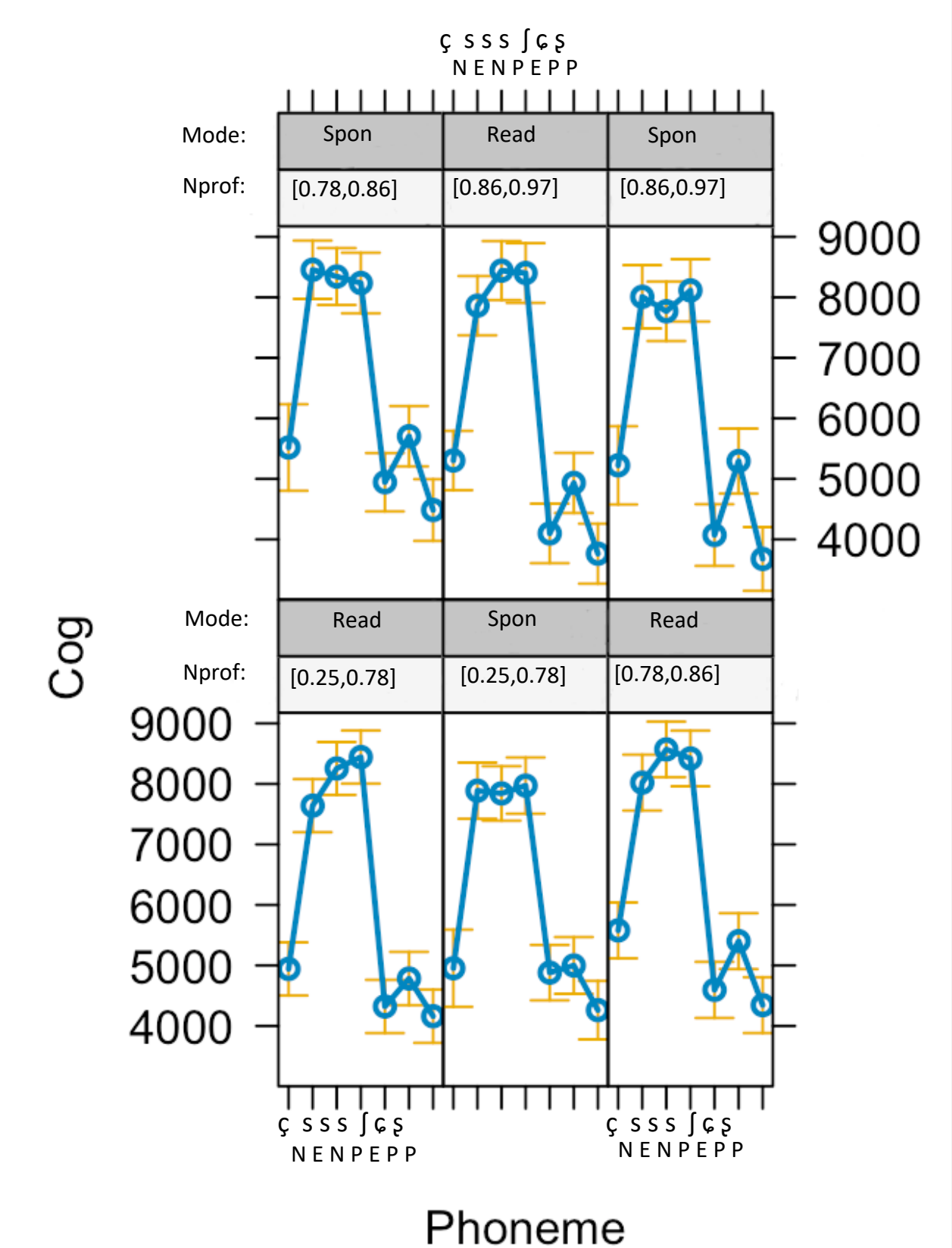


Figure 4. Effect plots of CoG, by phoneme, mode and language proficiencies. These plots demonstrate the effects from the previous LMER analysis.

Discussion

- ❖ **H2:** CoG of sibilants produced by multilinguals varies with English and Norwegian Proficiency (see spline plots in Fig. 3)

- ❖ Linear mixed effects modeling was conducted in R (lme4 package)

- ❖ **LMER:** $\text{CoG} \sim \text{Mode} * \text{Phoneme} * \text{eprof2} + \text{Mode} * \text{Phoneme} * \text{nprof2} + (1 | \text{Speaker})$

- ❖ **EFFECTS:**

- ❖ Mode (p = 0.5257)
- ❖ **Significant effect of Phoneme** (p < .0001)
- ❖ English Proficiency: eprof2 (p = 0.5612)
- ❖ Norwegian Proficiency: nprof2 (p = 0.3731)
- ❖ **Significant interaction of Mode:Phoneme** (p < .0001)
- ❖ Mode:eprof2 (p = 0.7082)
- ❖ Mode:nprof2 (p = 0.0564)
- ❖ **Significant interaction of Phoneme:eprof2** (p < .0001)
- ❖ **Significant interaction of Phoneme:nprof2** (p < .0001)
- ❖ **Significant interaction of Mode:Phoneme:eprof2** (p = 0.0150)
- ❖ **Significant interaction of Mode:Phoneme:nprof2** (p = 0.1340)

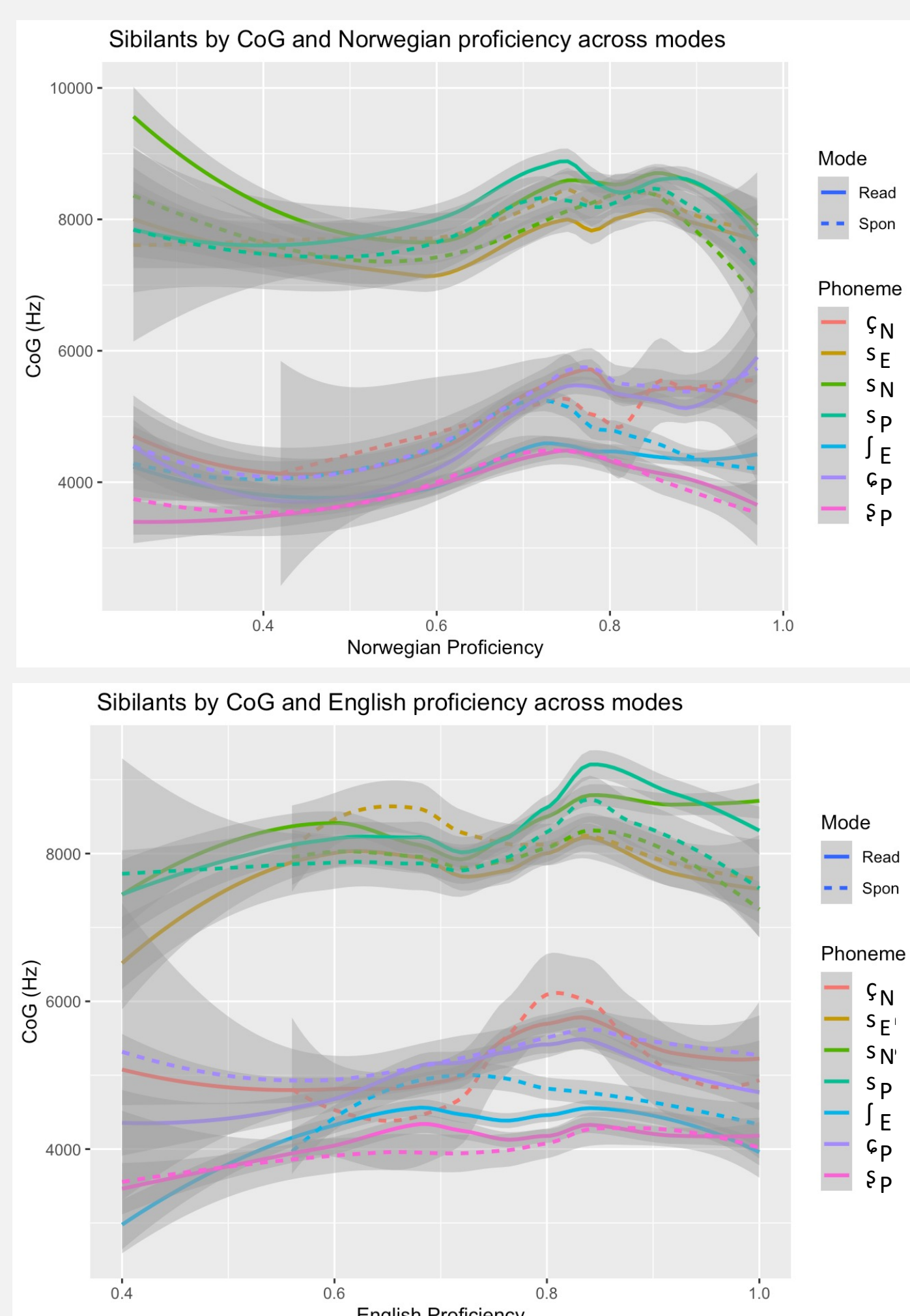


Figure 3. Spline plots of CoG by phoneme across speech mode for Norwegian and English proficiency.

- ❖ Neutralization found for language-specific /s/ phonemes in spontaneous speech but not for other sibilants, e.g., English /ʃ/ and Polish /ʃ/, or Norwegian /ɕ/ and Polish /ɕ/ may hint at underlying differences in how similar phonemes are stored in the multilingual mind

- ❖ The dental-alveolar distinction for sibilants may not be as perceptually robust as the palatal – alveopalatal distinction (Norwegian /ɕ/ and Polish /ɕ/) or the postalveolar domed-laminal distinction between postalveolar English /ʃ/ and Polish /ʃ/, since (alveolar /s/ assimilated to dental <s>_{N,P})

- ❖ **Caveat:** <si> was higher in spontaneous speech, similar to findings in Czaplicki et al. (2016), where alveopalatal sibilants of Polish females shift towards palatal sibilants

- ❖ **H1: Partially supported.** LMERS determined significant main effects for phoneme, and interactions of mode:Phoneme, Phoneme:eprof2, Phoneme:nprof2, Mode:Phoneme:eprof2. Speech does not differ by Mode alone, but rather, phonemes differ in a nuanced fashion based on both mode and L2/L3 proficiency

- ❖ **H2: Not conclusive.** Post-hoc analyses were unable to determine the extent to which L1 transfer influences CoG at various stages of L2 and L3 proficiency. It is possible that additional comparisons with subtractive L1/L2 groups would be necessary to determine the extent of CLI on the sibilant systems of L1 Polish, L2 English, L3 Norwegian learners

References

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