



# Contrast enhancement in clearly spoken Mandarin sibilants



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## Contrast in clear speech

- Clear speech typically enhances phonological contrast (see Smiljanic, 2021 for a review)
- In English sibilants: Spectral, durational, and amplitudinal enhancement (e.g. Maniwa et al., 2009)
- **Main question:** What dimensions are enhanced in clearly spoken Mandarin sibilants?
  - Are **extrinsic** primary cues enhanced?

**This study:** Laboratory speech production tasks with explicit clear and casual speech manipulations.

## Mandarin sibilants

- Three-way place contrast: alveolar, retroflex, and alveopalatal /s ʃ ʎ/
- All sibilants contrast before [a u] (e.g. Duanmu, 2007)
- Primary cue distinguishing /ʎ/ is second formant (F2) of following vowel (e.g. Stevens et al., 2004)

## Methods

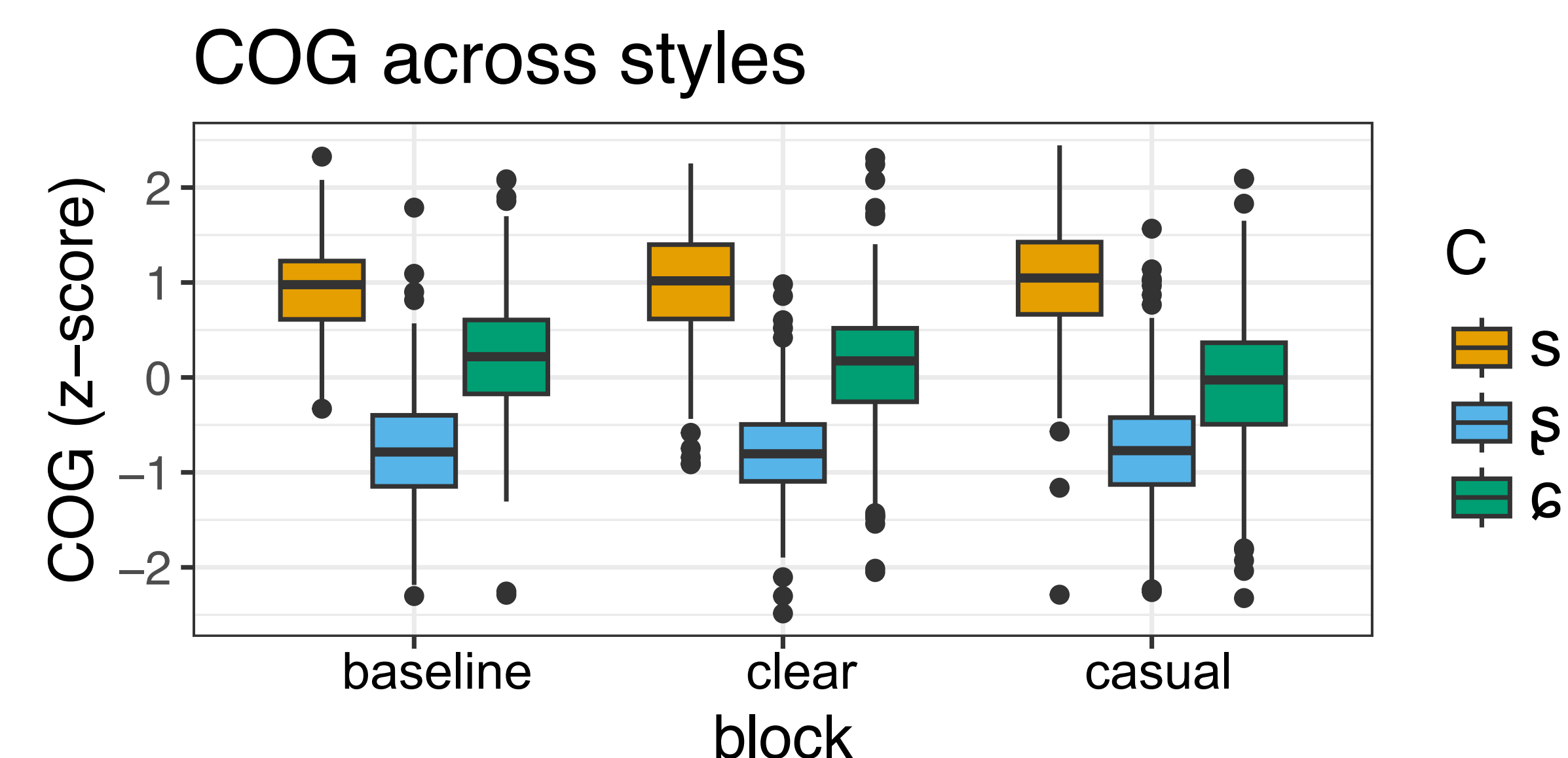
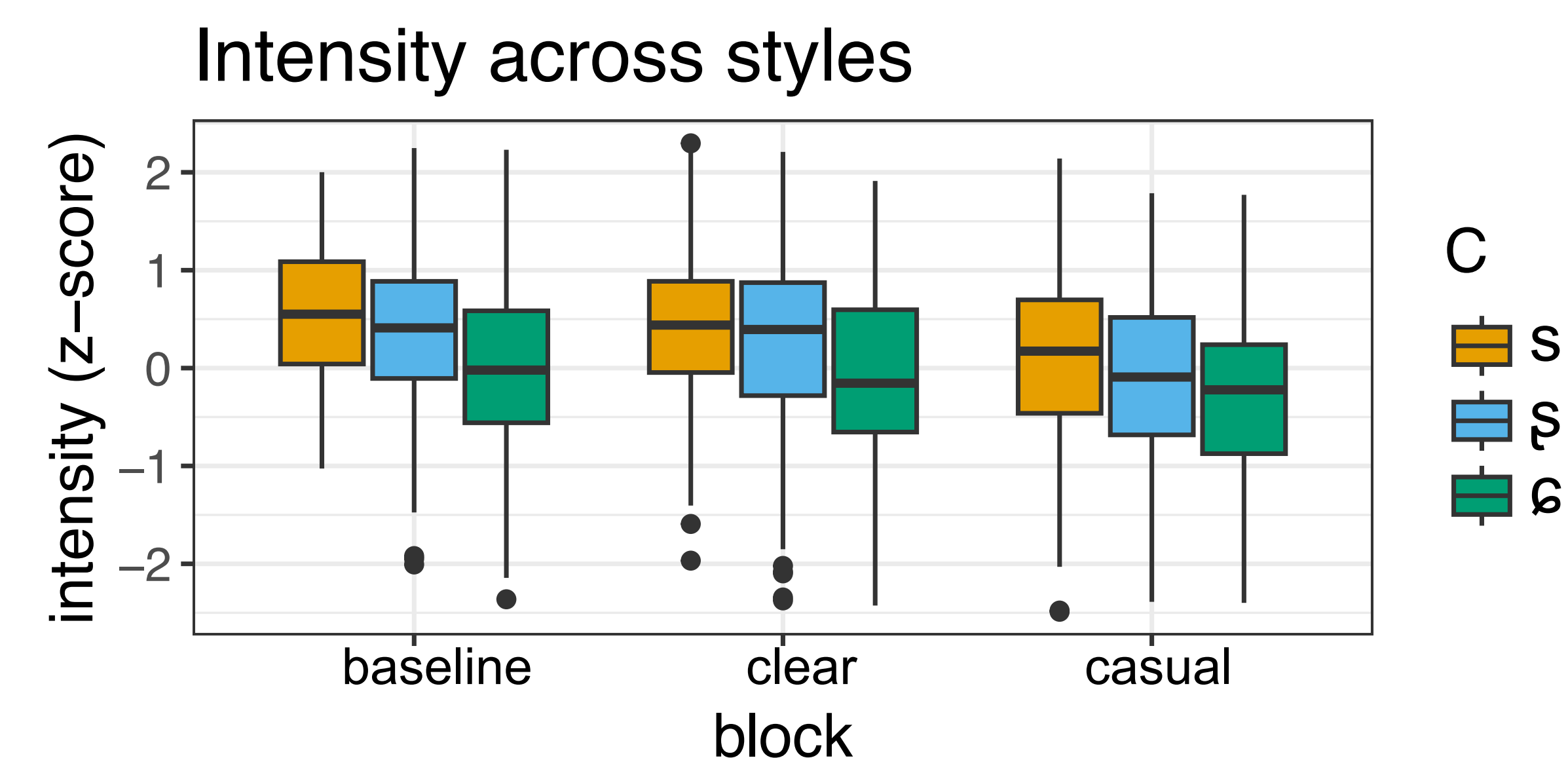
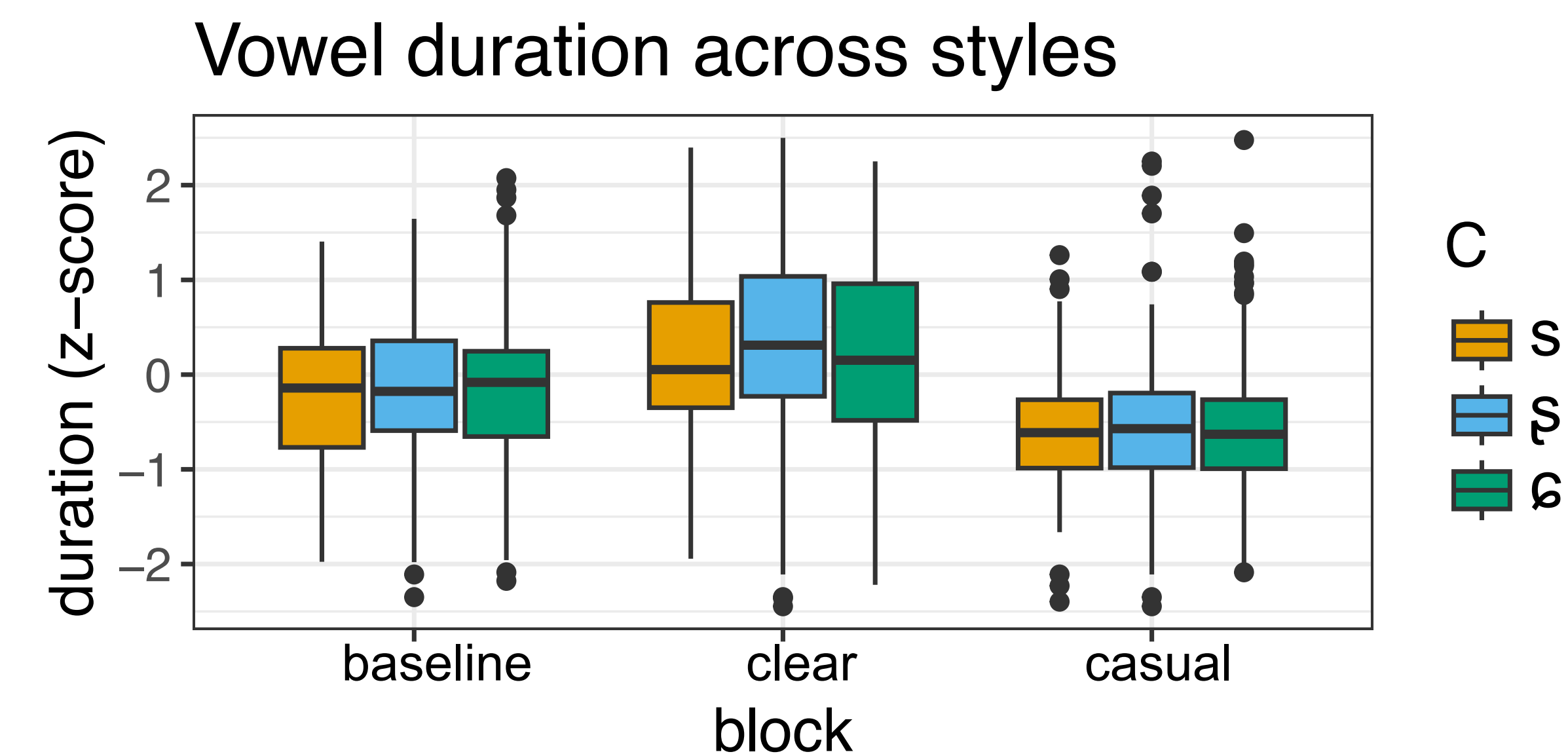
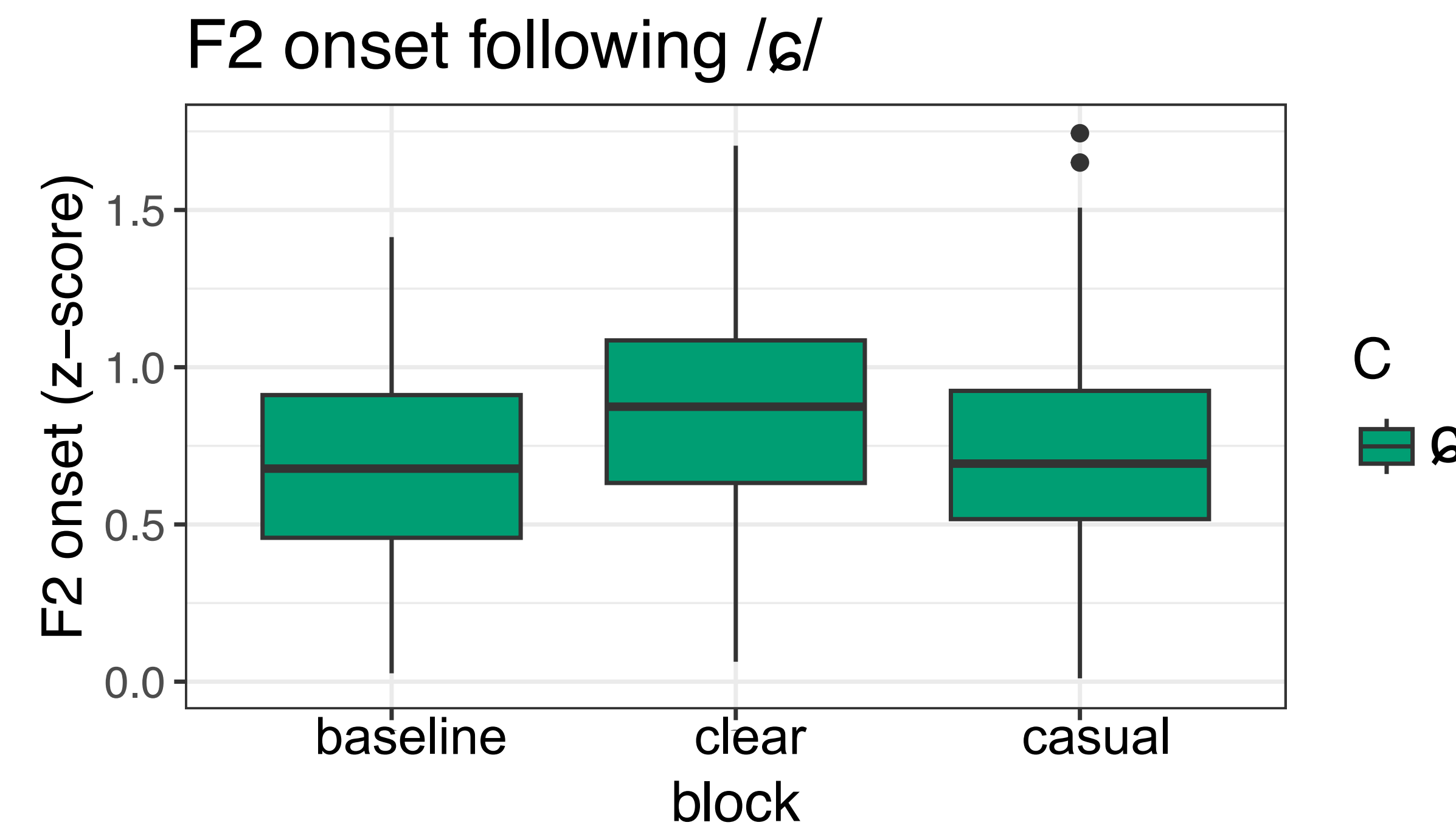
**Stimuli** crossed according to:

- Sibilant (alveolar, retroflex, alveopalatal)
- Vowel context (a u)
- Word frequency
- Number of syllables

**Four blocks:**

- Warm-up: familiarization with stimuli words
- Baseline: no instructions on style
- Clear: 'as if talking to someone hard of hearing'
- Casual: 'as if talking to a friend'

## Differences across styles



## Results: Key takeaways

**Significant enhancement in clear block:**

- Duration of sibilant ( $\beta = 0.01, t = 8.44^{***}$ )
- Duration of following vowel ( $\beta = 0.03, t = 5.60^{***}$ )
- F2 of vowel onset following [ʎ] ( $\beta = 75.90, t = 1.91^*$ )

**No significant change across styles/blocks:**

- Sibilant spectral moments, including COG
- Following vowel F2 midpoints

**Reduced** over course of experiment:

- Sibilant and vowel intensity
- [s ʃ] COG contrast

## Conclusion

**Main finding:** alveopalatal contrast enhanced through extrinsic cues in following vowel

- No enhancement of intrinsic sibilant place cues
- Consistent with contrast enhancement in clear speech
- Explicit style instruction task generally less sensitive
- Durational enhancement most consistent

**Implications:** Speakers actively control F2 as a cue to sibilant contrast

- Suggests phonological analysis of assimilation
- Vowel fronting after [ʎ] not only mechanical coarticulation
- Not simply result of general vowel enhancement — F2 midpoint not enhanced