

Comparison of performance for cochlear-implant listeners using audio processing strategies based on short-time FFT or feature extraction

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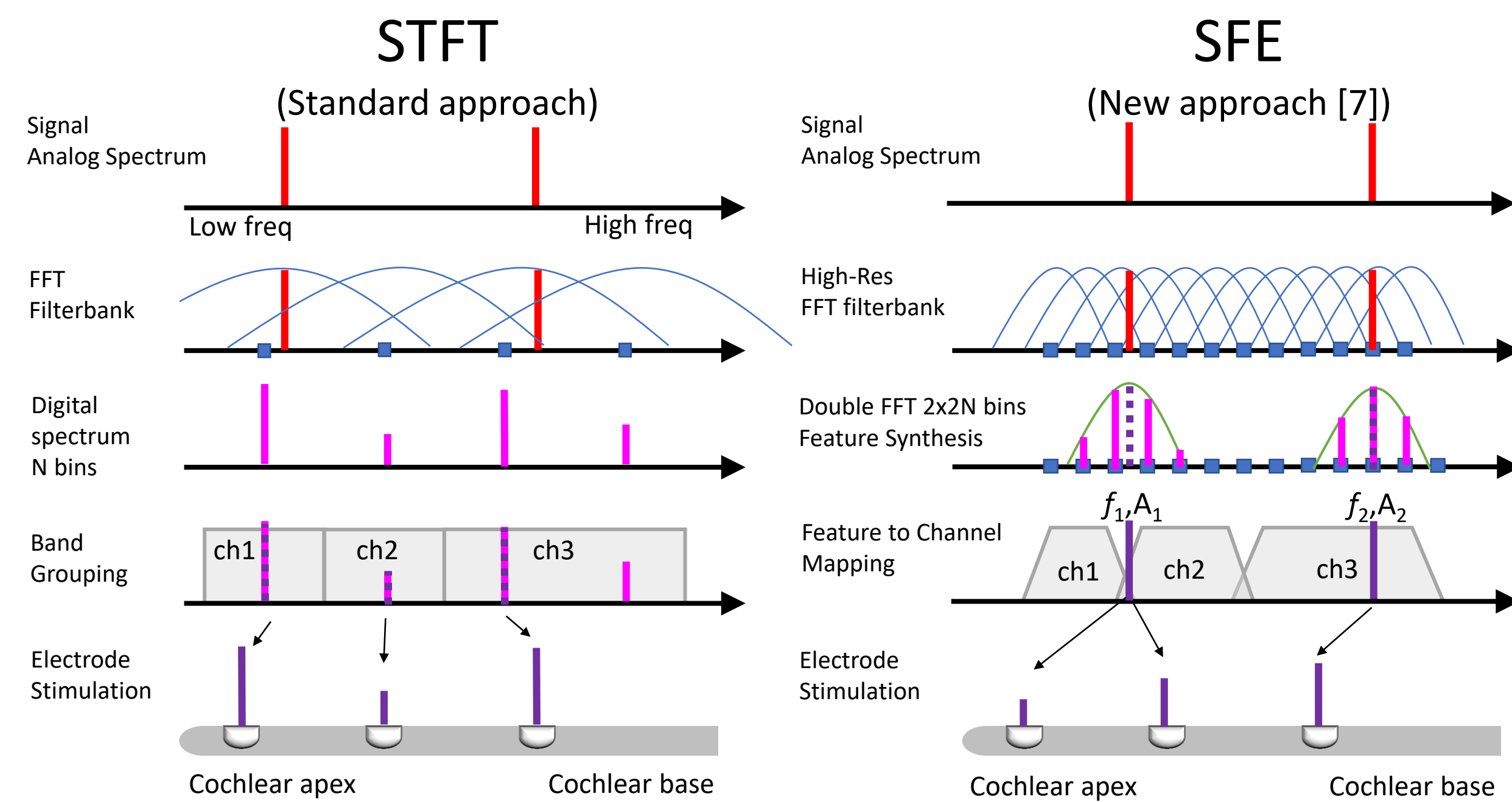
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Introduction and Aims

Current cochlear implants (CIs) are highly successful but still fall short of providing normal hearing. One reason may be the limited frequency resolution (particularly at low frequencies) of audio processing strategies based on short-time FFT (STFT) [1]. Here, we experimentally test an alternative strategy based on spectrum feature extraction (SFE). SFE consists of extracting acoustic events (or spectral peaks) using a synthetic feature extractor and mapping them into the available number of CI stimulation channels (see **poster 1556**). SFE was hypothesized to reduce frequency smearing and improve frequency resolution because spectral peaks are detected and narrower filter spacing can be achieved without the constraints of the FFT bin width. Here, hearing performance and comfort were compared for SFE and STFT strategies on various aspects: word recognition in quiet, sentence reception threshold in noise (SRT), consonant discrimination in quiet, listening effort, melody contour identification (MCI), and subjective sound quality.

Materials and Methods

Processing strategies



Participants

- N = 6 unilateral Oticon Medical CI users.
- Ages: 41-65 years (median: 55 years).

Design

- Test order balanced across participants.
- Double blind.
- Acute comparisons.
- Word and sentence tests were conducted on the first and last day of testing to assess potential learning and/or accustomization effects.

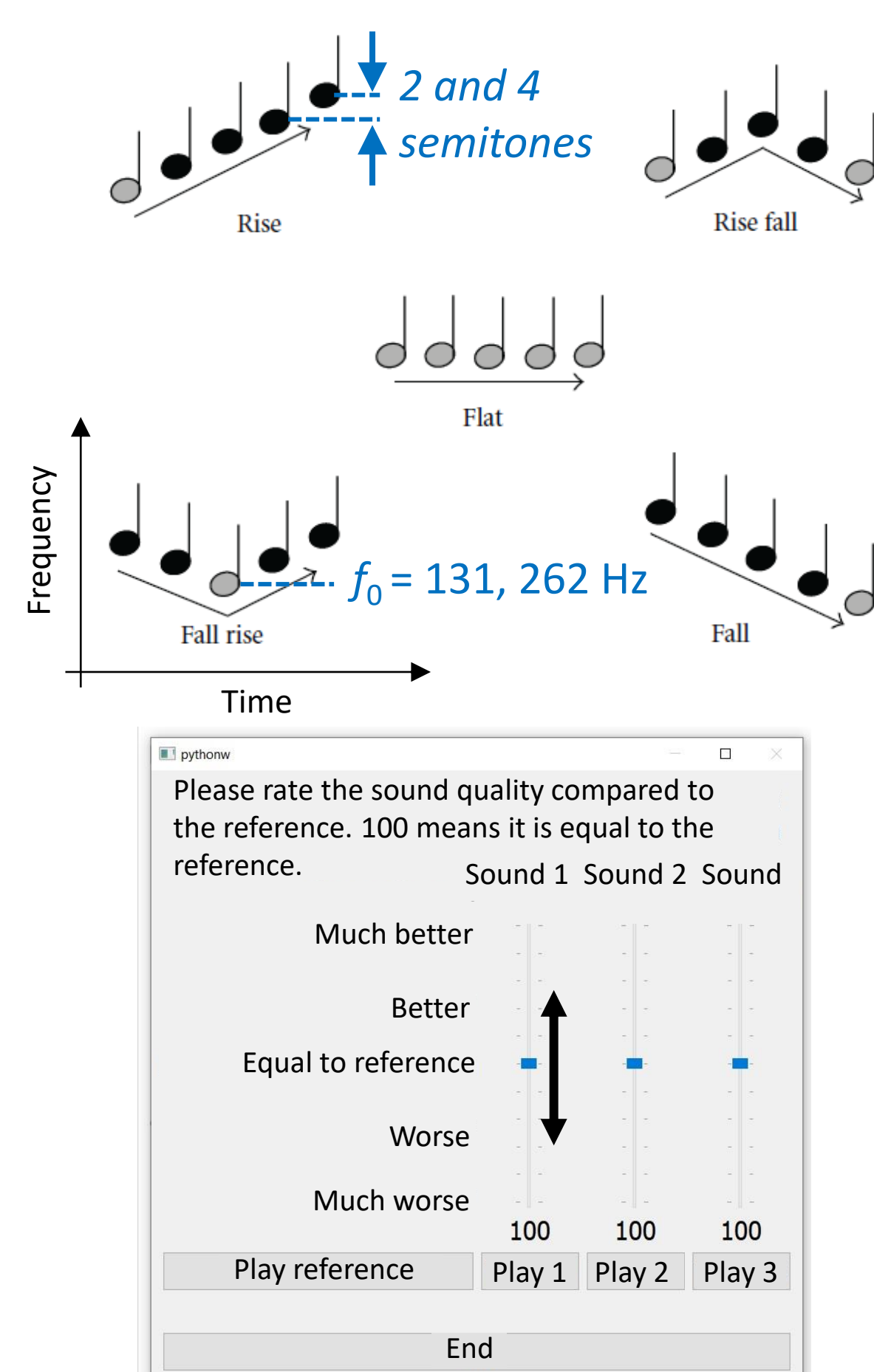
Stimuli

- Direct stimulation (using research platform).
- Level equivalent to 70 dB SPL.

Tests

- Disyllabic words in quiet [2].
- SRTs for HINT sentences [3] in speech-shaped-noise (SSN).
- Consonant discrimination in quiet.

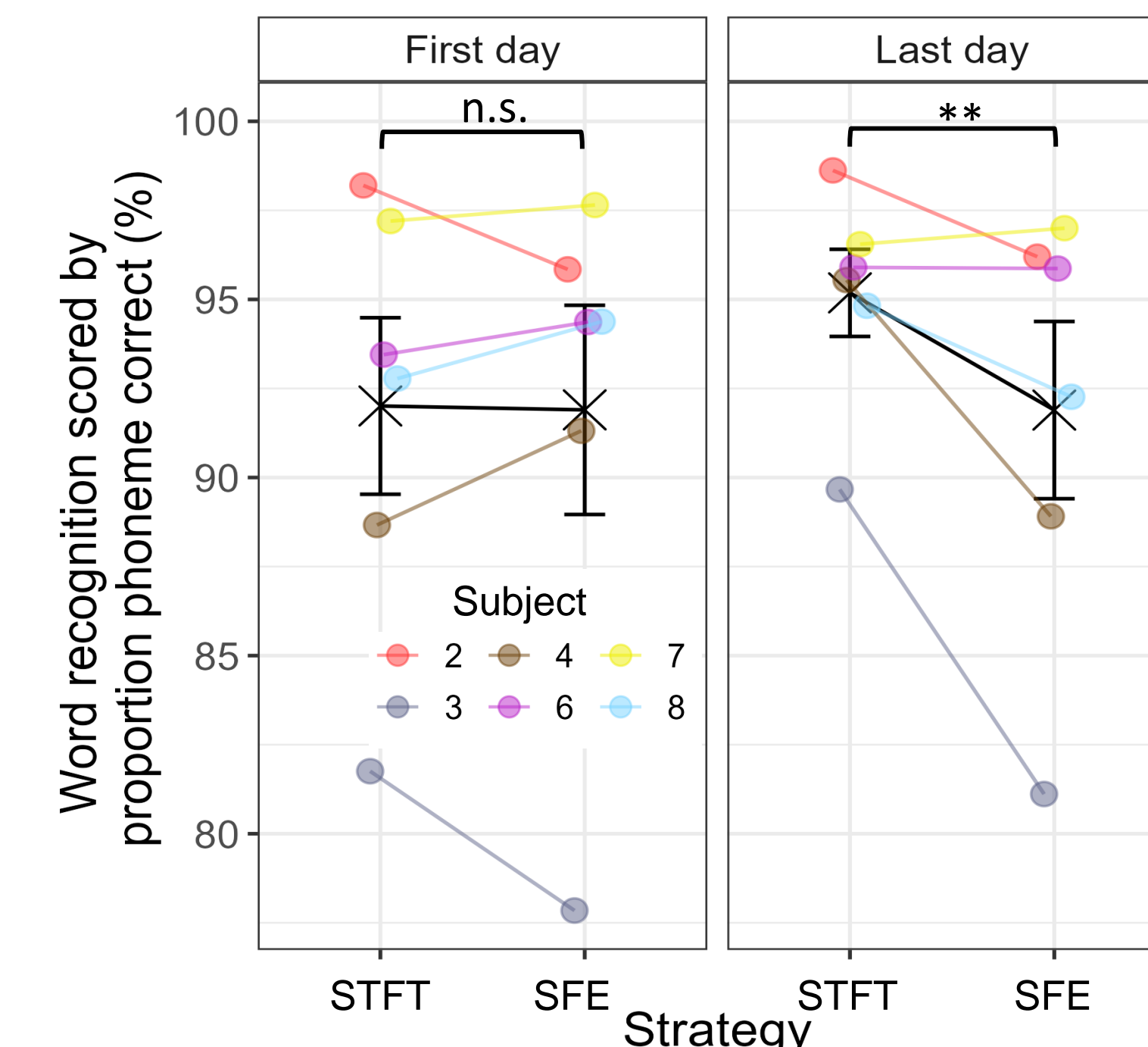
- Listening effort: assessed by measuring pupil dilation [4] while recognizing HINT sentences in quiet and in SSN at individual SRT+15 dB.
- Melody Contour Identification (MCI): identify a five-tone pattern among five possible patterns [5].



- Subjective sound quality: multiple stimulus with hidden reference and anchor (MUSHRA) [6]. Three groups of sounds: sentences, music, and ambient sounds.

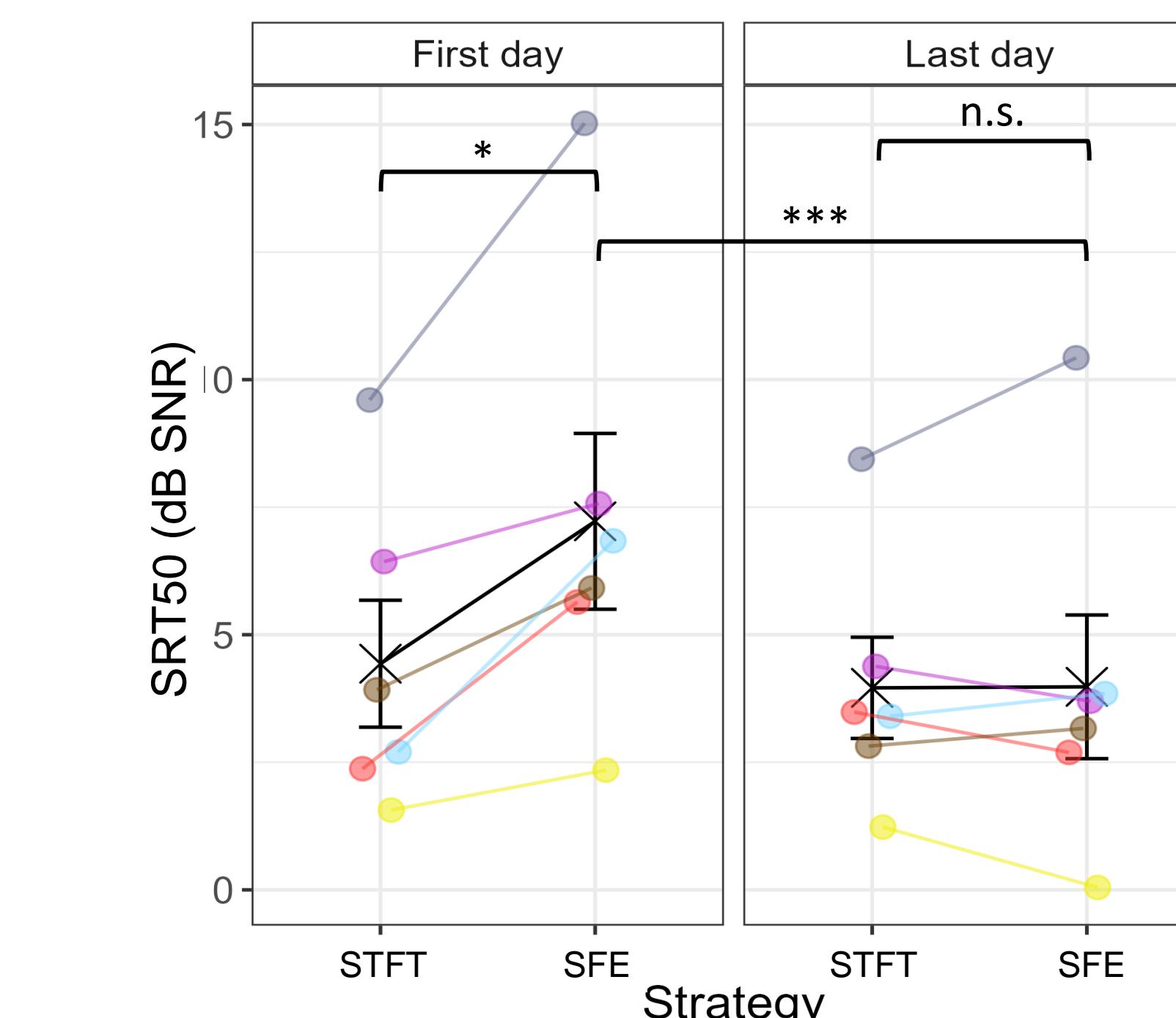
Results #1

Words in quiet



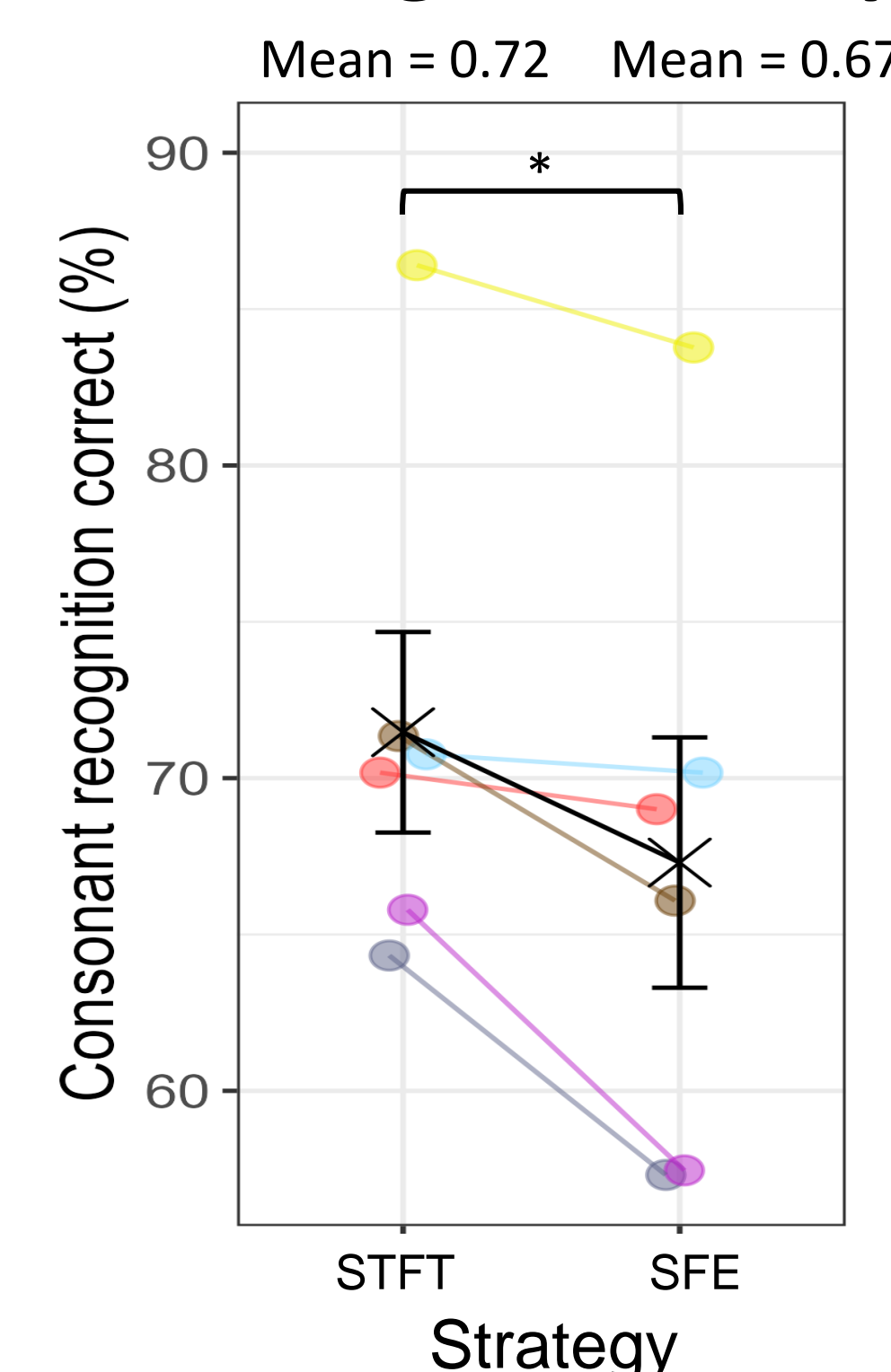
- First day: Mean SRT was not different for the STFT and SFE strategies.
- Last day: SRTs were better for the STFT than the SFE strategy.
- Scores for the STFT or SFE strategy did not improve from first to last day → No learning effect.

Sentences in noise



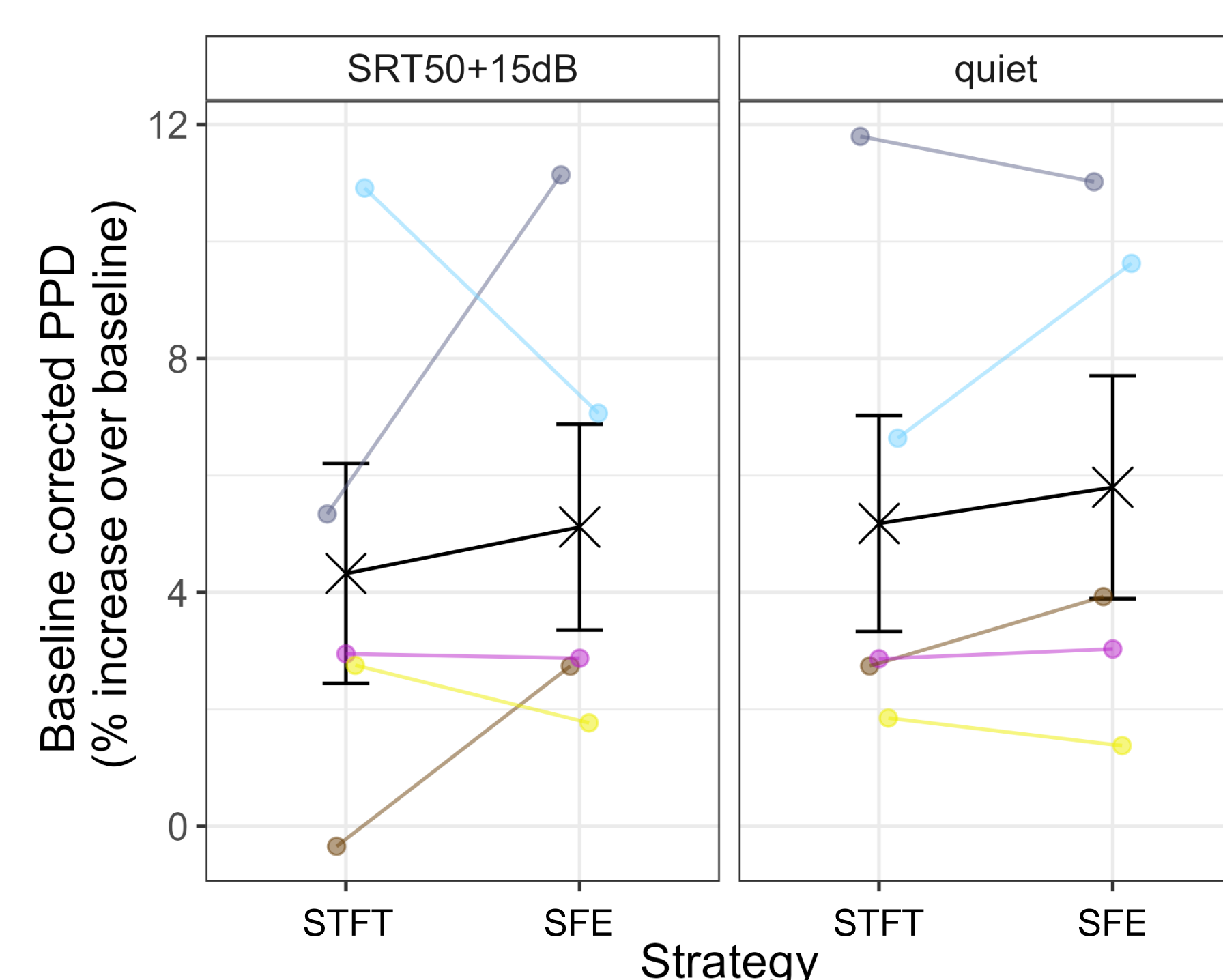
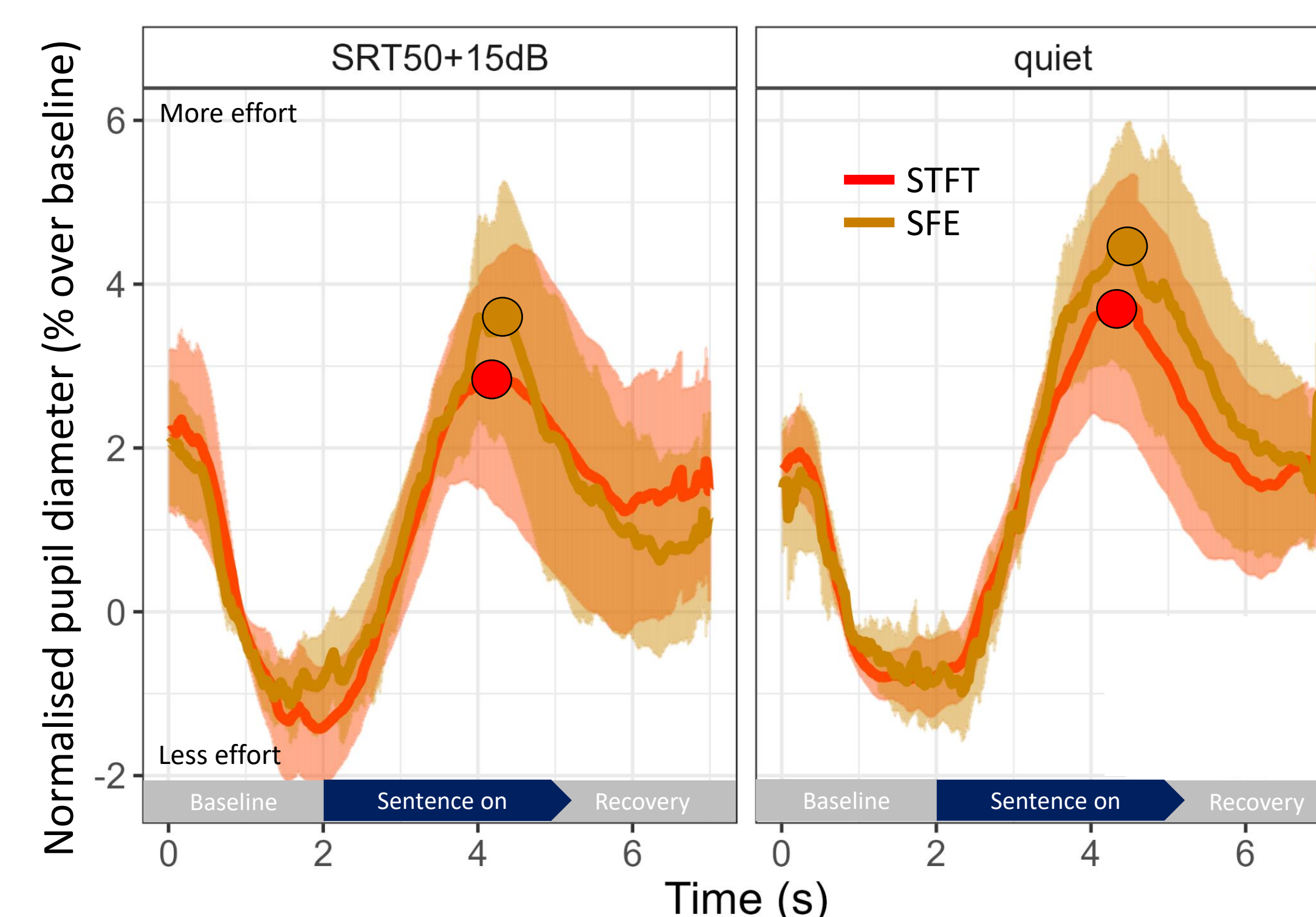
- First day: Mean SRT was better with the SFE than the STFT strategy.
- Last day: no difference between the SFE and STFT strategies
- Scores for the SFE strategy improved from first to last day → Learning effect?

Consonant recognition in quiet



Recognition was better with STFT than with SFE strategy, but the mean difference was small.

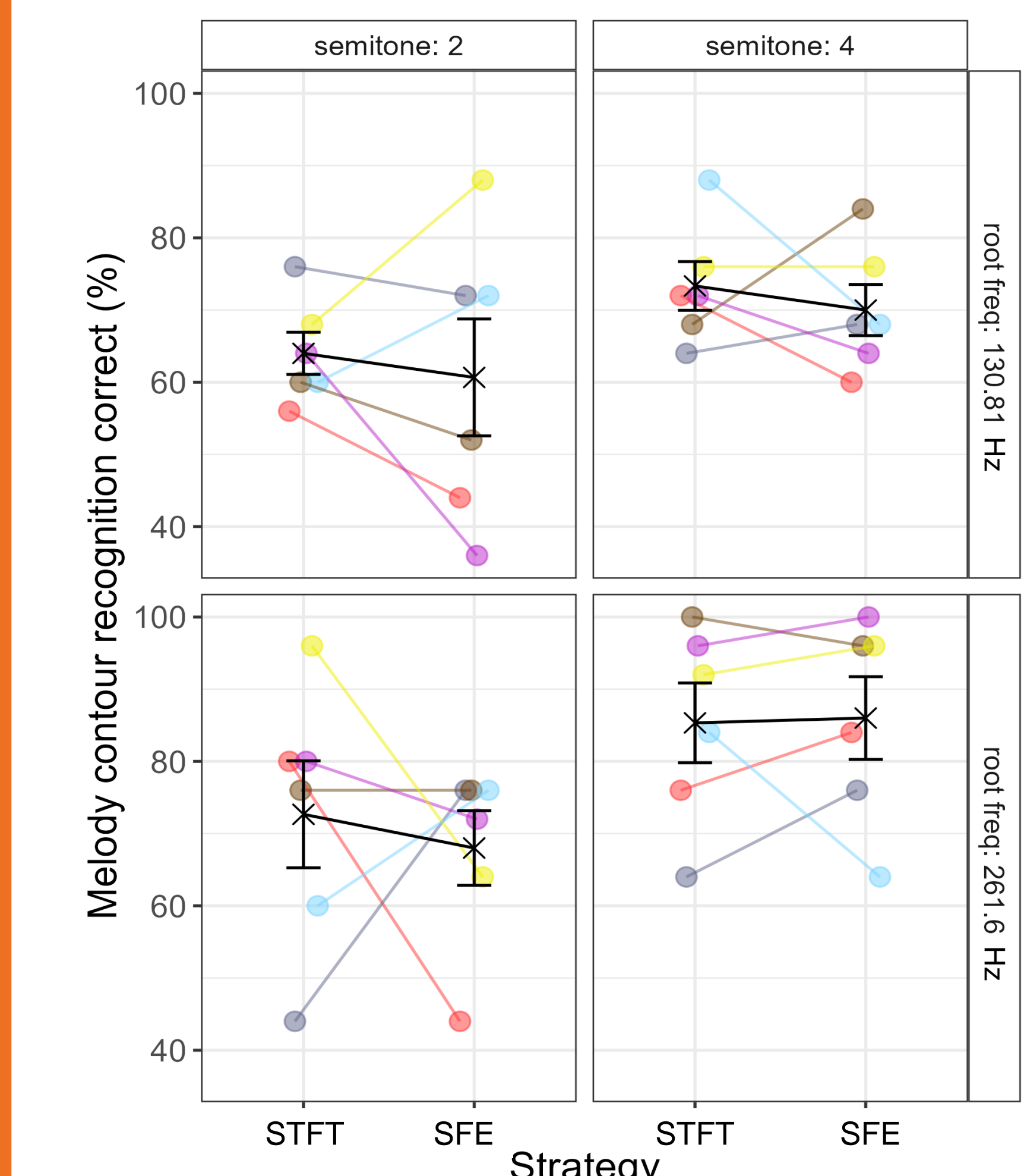
Listening effort



No significant difference in pupil dilation between STFT and SFE strategies.

Results #2

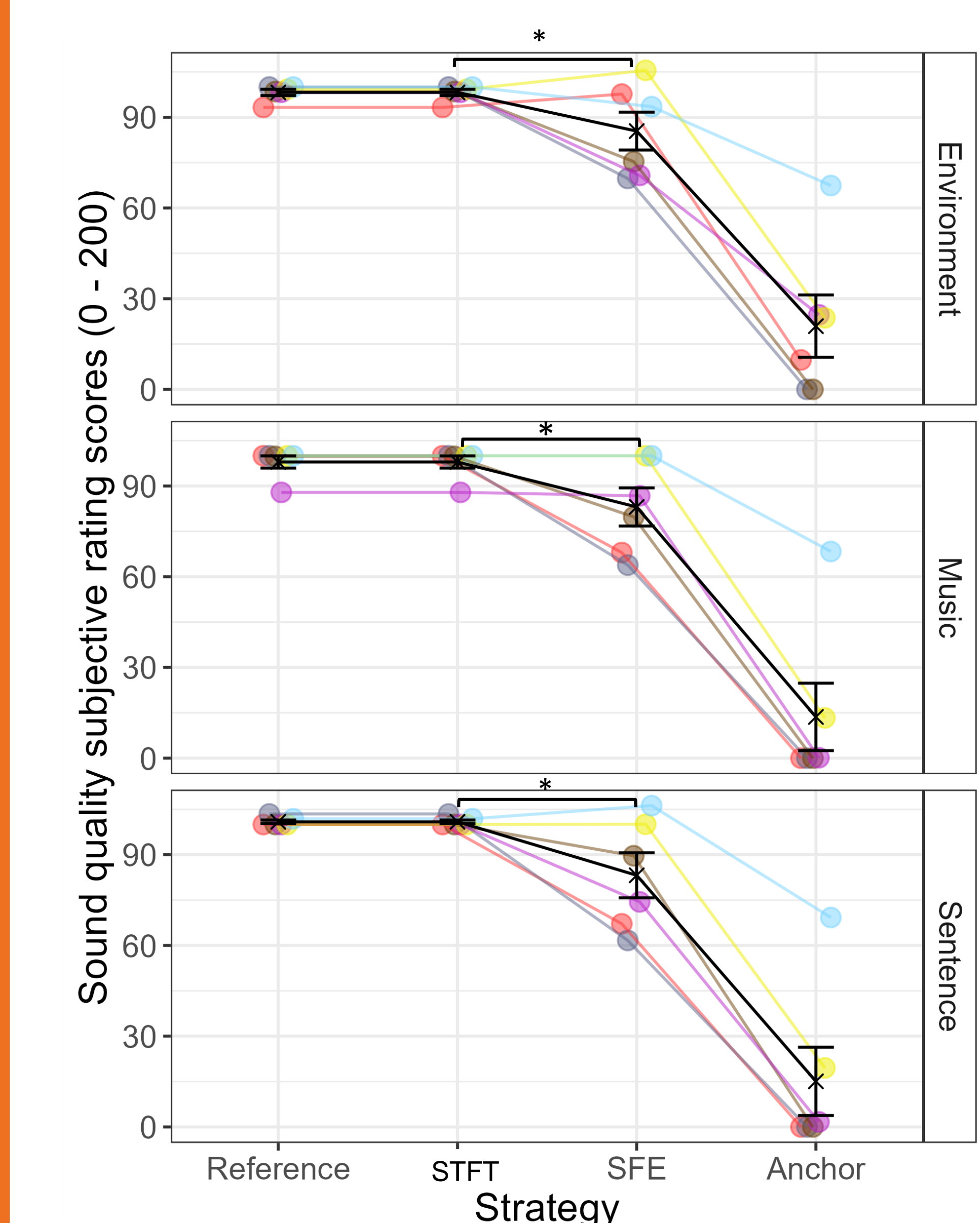
Melody contour identification



RMANOVA:

- No effect of strategy.
- Better score for 4 than 2 semitones.
- Better score the for higher f_0 .

Subjective sound quality rating



Participants preferred the STFT strategy.

Ratings were similar for all sound categories.

Conclusions

SFE strategy was only slightly worse than STFT for:

- Word recognition in quiet on the last day of testing.
- Sentence-in-noise recognition on the first day of testing.
- Consonant recognition in quiet.
- Subjective quality rating.

SFE and STFT were not significantly different for:

- Word recognition in quiet on the first day of testing.
- Sentence-in-noise recognition on the last day of testing.
- Listening effort (pupil dilation).
- Melody contour identification.

Overall, differences in performance with SFE and STFT were small and possibly due to acute testing.

Acknowledgements

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References

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