

Interaction of Syntactic and Prosodic Processing in Musicians and Nonmusicians

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Background

- processing tonal elements in music and in language
 - advantage for musicians vs non-musicians
 - Musicians: more bilateral activity pattern
 - Nonmusicians: more right hemispheric dominance
- language processing:
 - interaction of prosodic and syntactic information processing, e.g. prosody influences prediction of upcoming syntactic information
 - STG processes both syntactic and prosodic information
- Eckstein and Friederici (2006) - EEG study
 - early negativity between 300-500ms with respect violating word onsets for the combined prosodic-syntactic violation

- goal 1: analyzing the processing and interaction of syntax and prosody in nonmusicians and musicians with high temporal resolution

Hypotheses

1. interaction of prosody and syntax for both groups (nonmusicians and musicians) within STG
2. stronger responses for musicians due to their 'tonal advantage'
3. different activation pattern for both groups if the advantage leads to differences in processing

Methods

- Stimuli taken from Eckstein and Friederici (2006)
 - sentences of six types (two filler plus four experimental conditions)
 - phrase-structure and intonation contour manipulated in a 2x2 design
- Participants' task: judge the correctness of each sentence in regard to either syntax or prosody
- Eckstein & Friederici (2006) task: Judge the correctness of each sentence.
- data recording with 306 channel MEG, 2 EOG, 1 ECG
- 1000 Hz sampling rate, DC-330 Hz online filtering
- Maxfilter® Elekta Neuromag for noise suppression, movement correction and head position alignment
- Individual volume conductor models + source space (cortical layer) (T1-weighted MRI) as segmented by Freesurfer (Dale et al., 1999), Minimum Norm Solutions by MNE (Hämäläinen, 1993)
- Anatomical definition of regions of interest (ROIs) within the cortical layer, mean activity time courses for further statistical analysis

- Five-way ANOVA for each ROI with factors:
 - Group (musicians/nonmusicians)
 - Syntax (correct/incorrect)
 - Prosody (correct/incorrect)
 - Hemisphere (left/right)
 - Time (0-100/100-150/150-200/200-250/...)

Stimuli

- 48 items/condition
- 4 blocks with 12 test items/condition
- + 24 filler items

Tobias sieht, dass der Dackel zum **Futter** hinausht.
(Tobias sees, that the dachshund towards the chow dashes.)

Tobias sieht, dass der Dackel zum **Futtert** hinausht.
(Tobias sees, that the dachshund towards the chows dashes.)

		Syntax	
		correct	incorrect
Prosody	correct	CC	CS
	incorrect	PC	PS

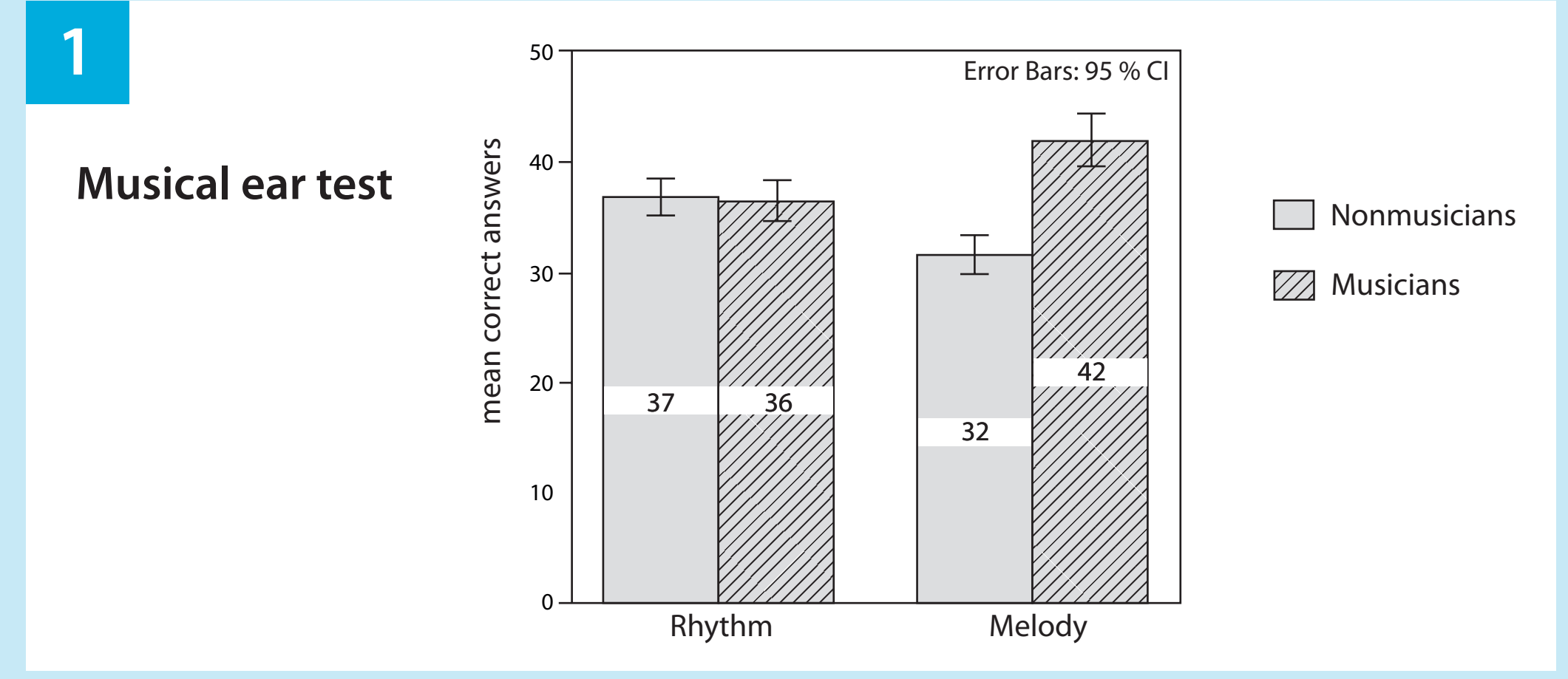
Trial design

500 ms + Sentence ≈ 3300 ms 1500ms ≤ 4500 ms 2500 ms

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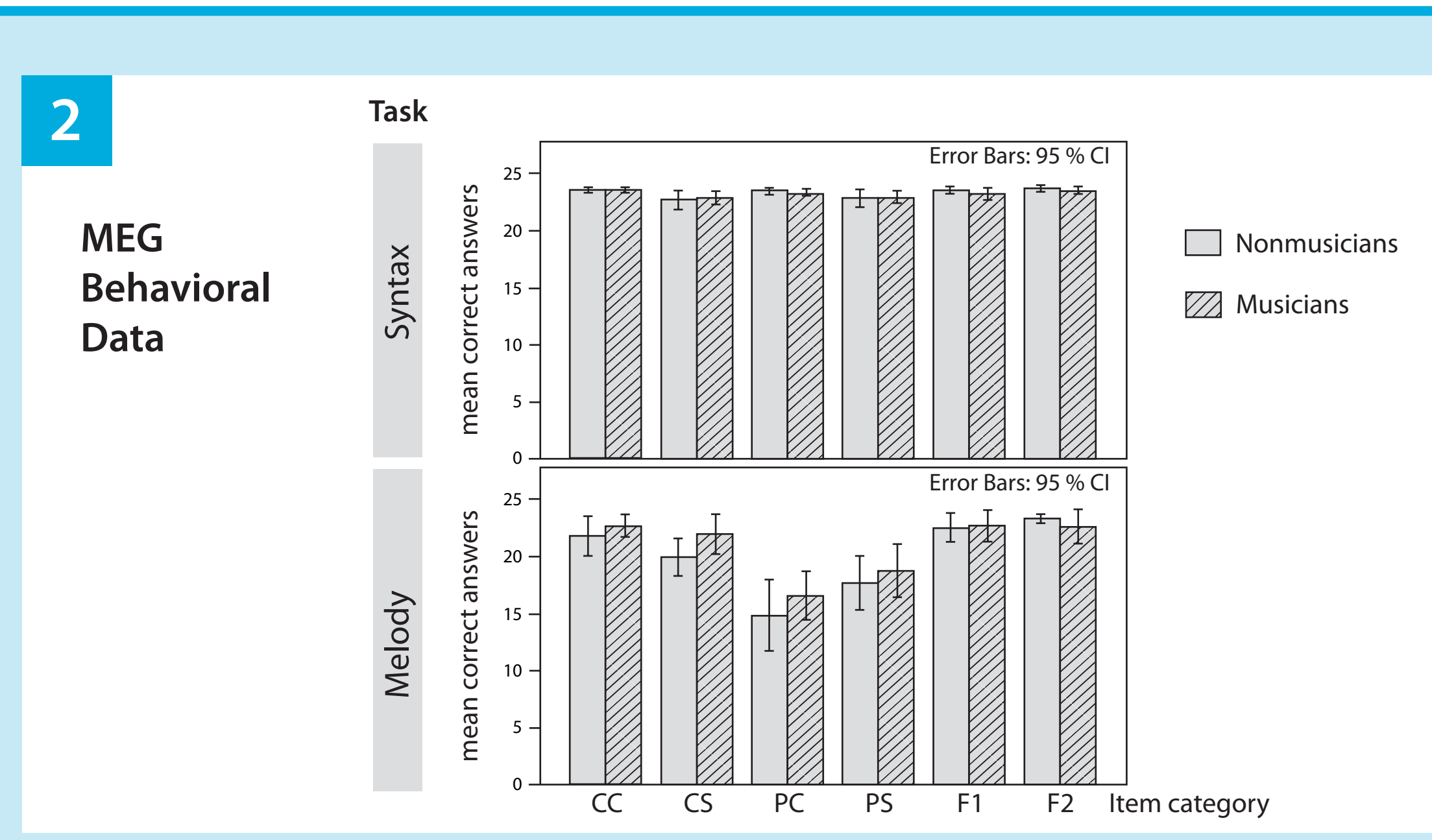
Behavioral Data

- from Musical Ear Test (Wallentin et al., 2010):
 - no difference between groups in comparing rhythm patterns
 - musicians showed clear advantage in comparing melodies
- from MEG experiment:
 - syntax task: no difference between groups
 - prosody task: a tendency of better performance for musicians vs. nonmusicians



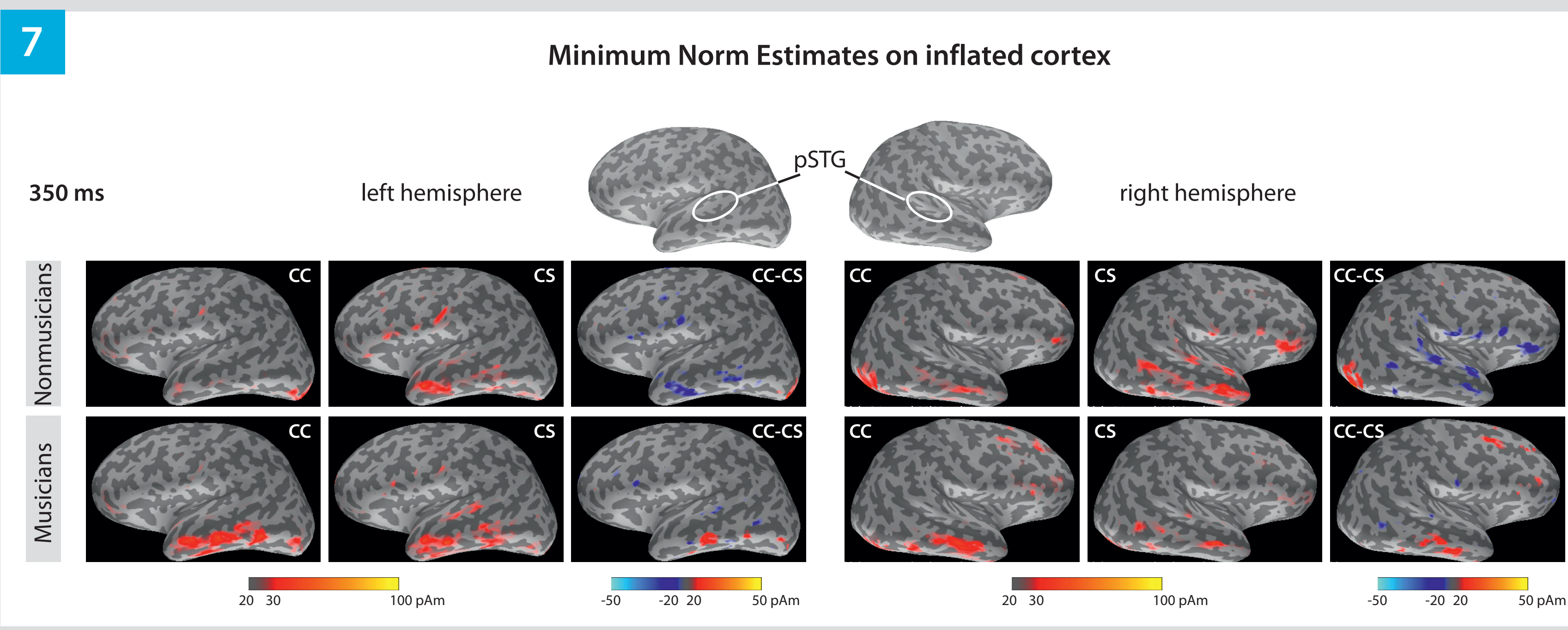
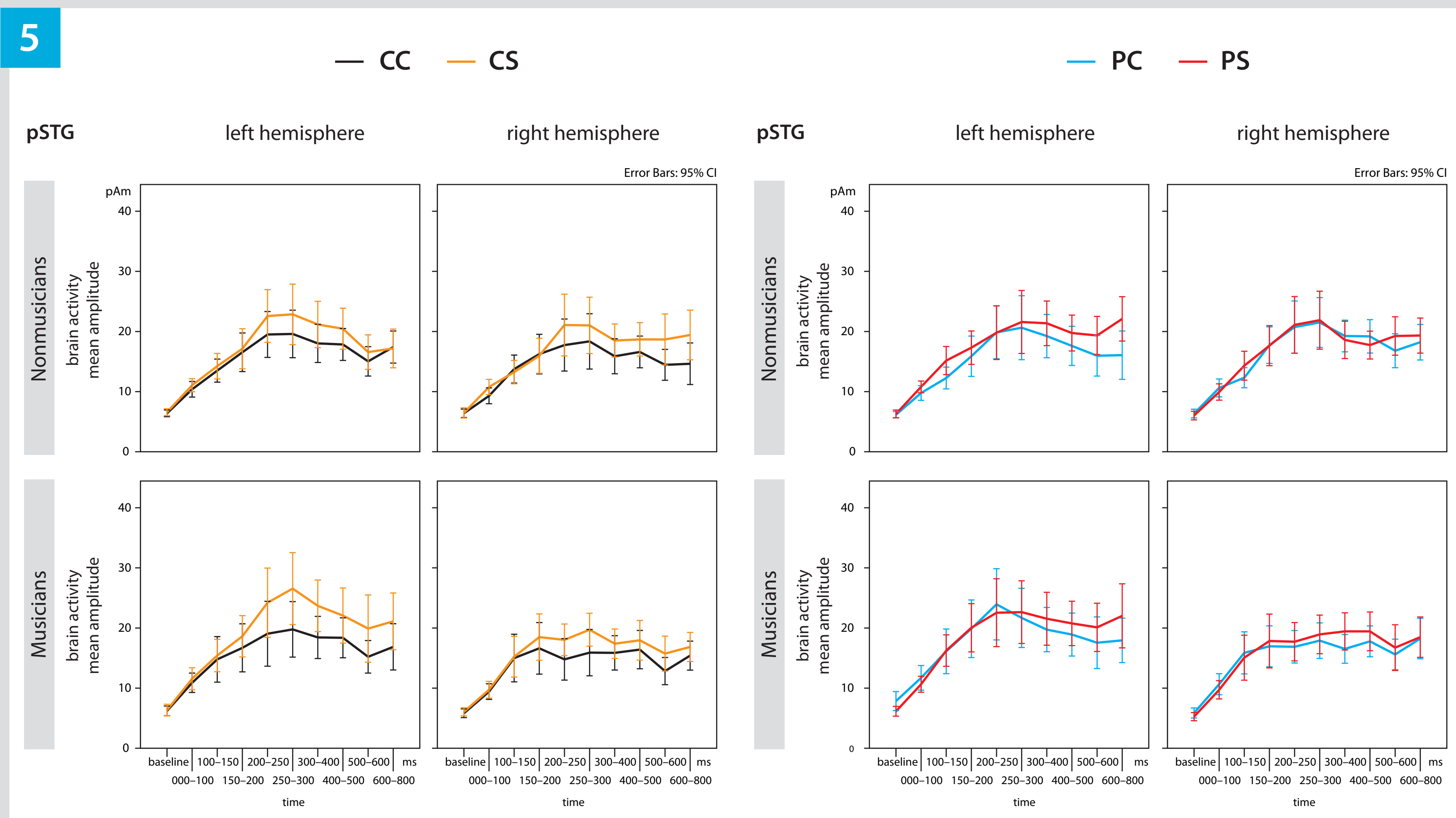
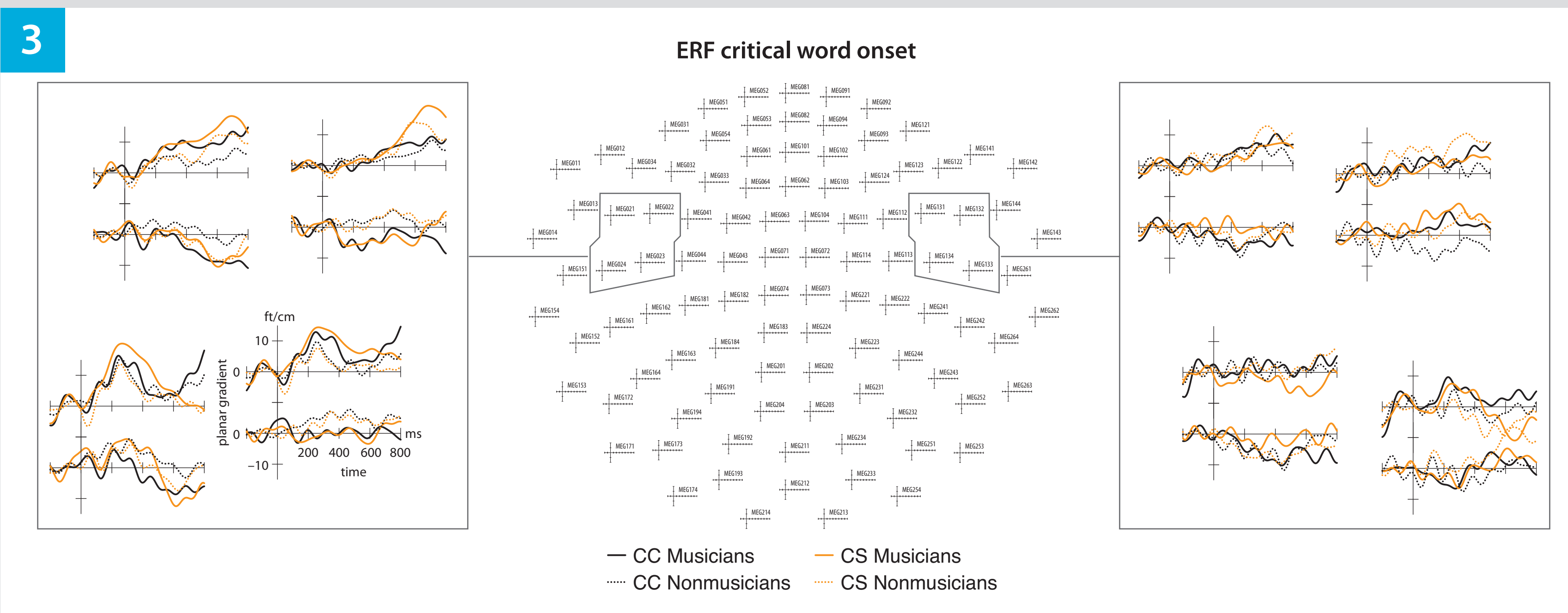
Participants

- 22 nonmusicians and 20 musicians
- age range 18-35 years
- right handed



MEG Data

- analysis of 10 musicians and 10 nonmusicians with more than 70% of useable trials
- ERF amplitudes over temporal areas significantly larger for musicians vs. nonmusicians in both tasks with prosodic violations
- four-way-interaction of Syntax*Prosody*Hemi*Group in pSTG
- follow-up analysis
 - pSTG & 300-400ms, right hemi, non-musicians: significant Syntax*Prosody
 - pSTG & 300-400ms, left hemi, musicians: significant Syntax*Prosody
 - pSTG & 400-800ms & right hemi, nonmusicians: significant Syntax*Prosody



Discussion

- Hypothesis 1: interaction present in some ROIs
- Hypothesis 2: stronger responses in sensor data for violation conditions in musicians compared to non-musicians
- Hypothesis 3: different interactions in time window 300-400ms and left/right pSTG

