

Quantitative experiment



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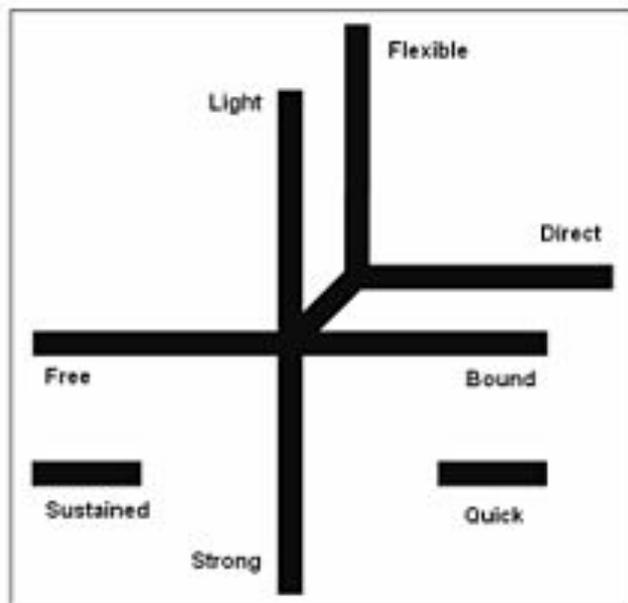
Quantitative experiment: Effort

- Effort = Exertion of physical / mental power, Endeavor, Energy, Force, Stress, Stretch, Striving
- Effort vs. Arousal (agitated-serene) and mood valence (happy-sad)
- Focus on perception, not experience
- Effort can be seen and heard

Laban Movement Analysis

Rudolph Laban (1879 – 1958)

Effort: Space, Weight, Time, Flow



Experiment: Questions

- How similar are audio and video ratings?
- Which one dominates?
- Contributing factors?

Design

- Continuous response rating
- Logarithmic mapping to finger pressing force
- Stimuli: 5+1 segments, duration 20-40 sec.
- Between subjects conditions: A / V / AV
- Randomized order

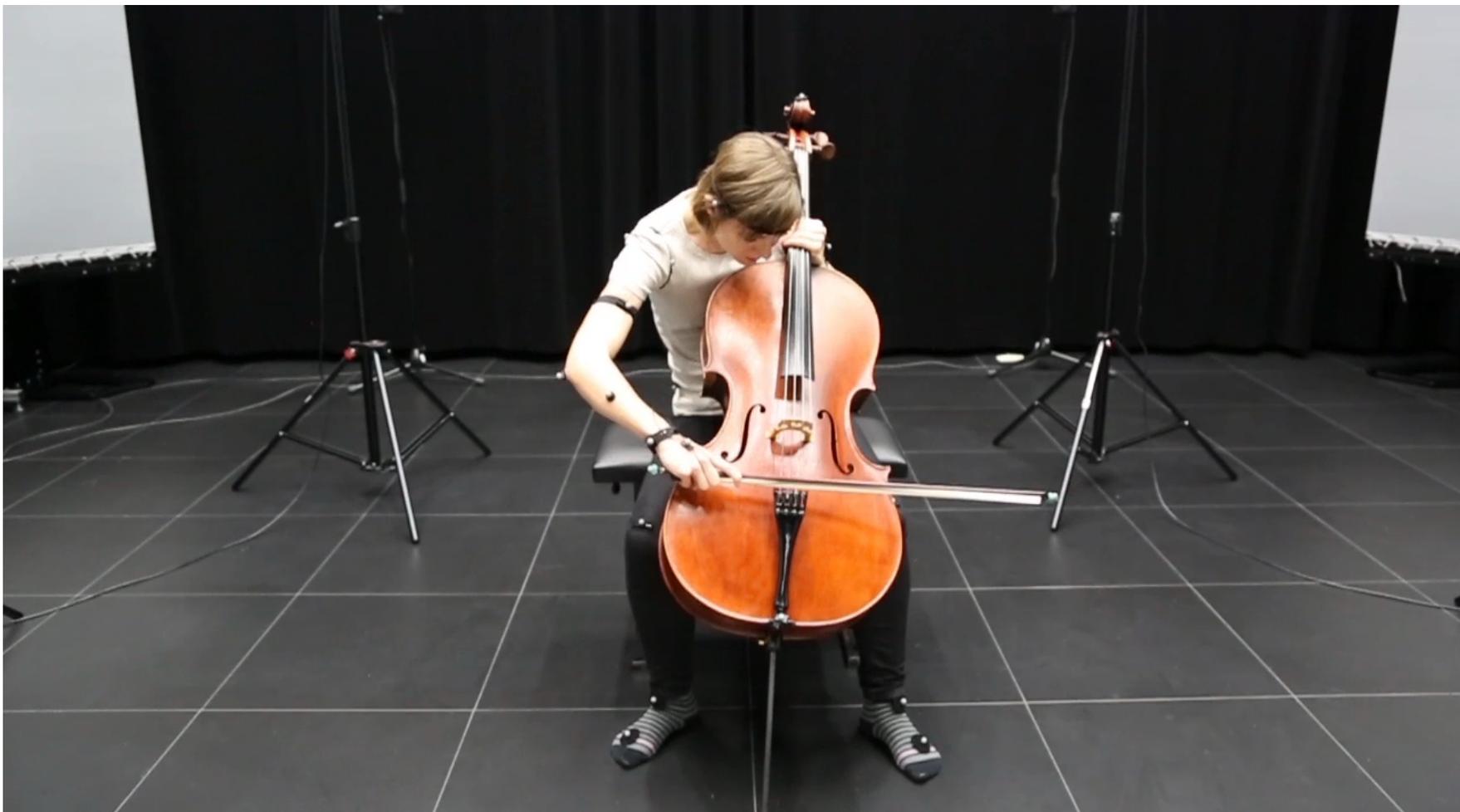
Subjects

- $N = 3 * 14 = 42$
- Musicians 50%, non-musicians 50%
- Students at ZHdK, age 20-30

Task

- Rate perceived effort in music performance using the Touch box
- Training: Effort categories by pressing on Touch box; One rating segment
- Duration: 15-20 min.

Helmut Lachenmann: Pressure for solo cello







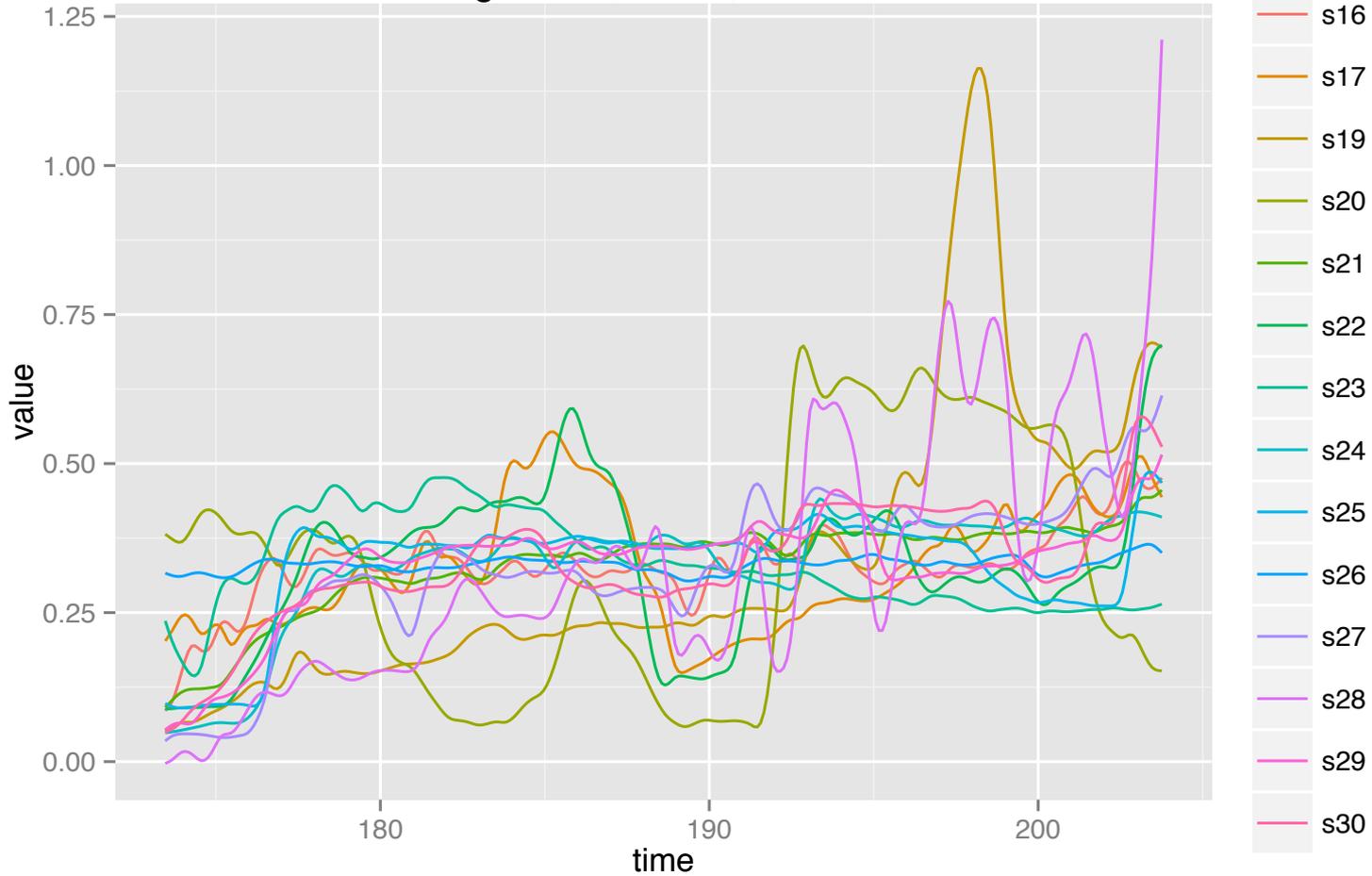
Data preprocessing

- Non-stationary, dependent time series
- $F_s = 100$ Hz
- Downsample to 10 Hz
- Smoothing: 0.50-sec splines for each individual rating (Vines et al., 2006)
- Mean centering

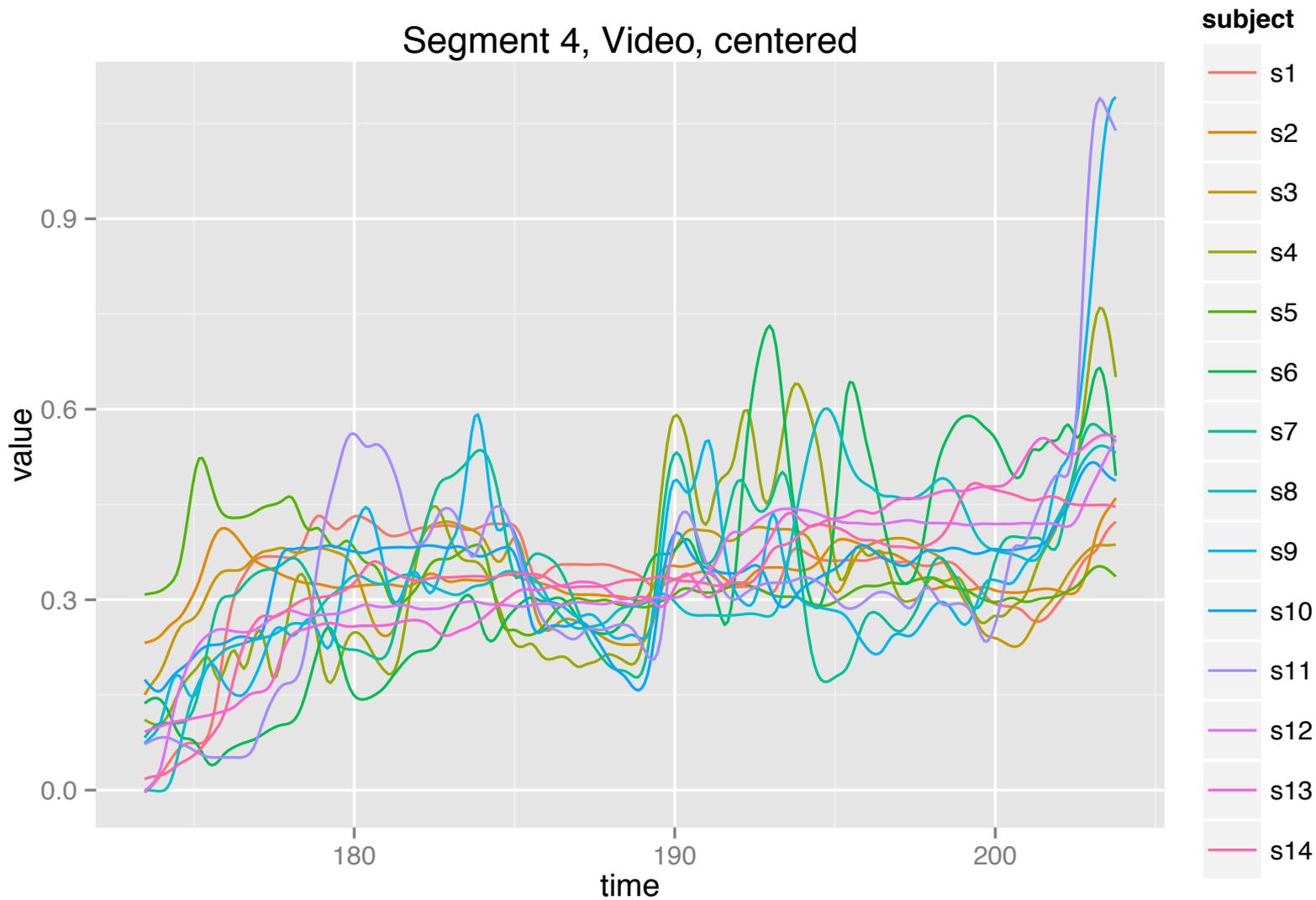
Vines, Krumhansl, Wanderley, Levitin: Cross-modal interactions in the perception of musical performance. *Cognition* (1), p. 80, 2006.

Results

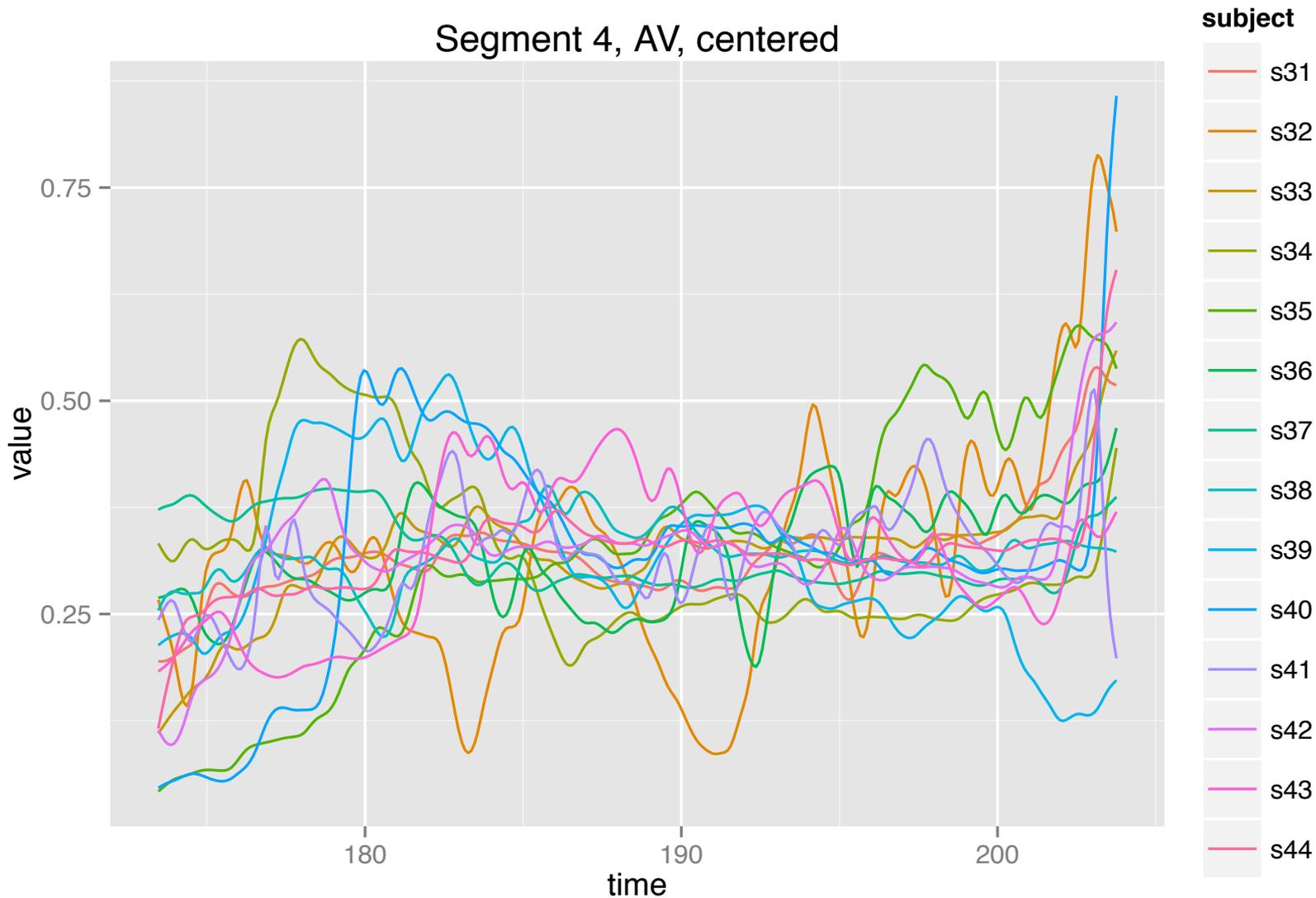
Segment 4, Audio, centered



Segment 4, Video, centered

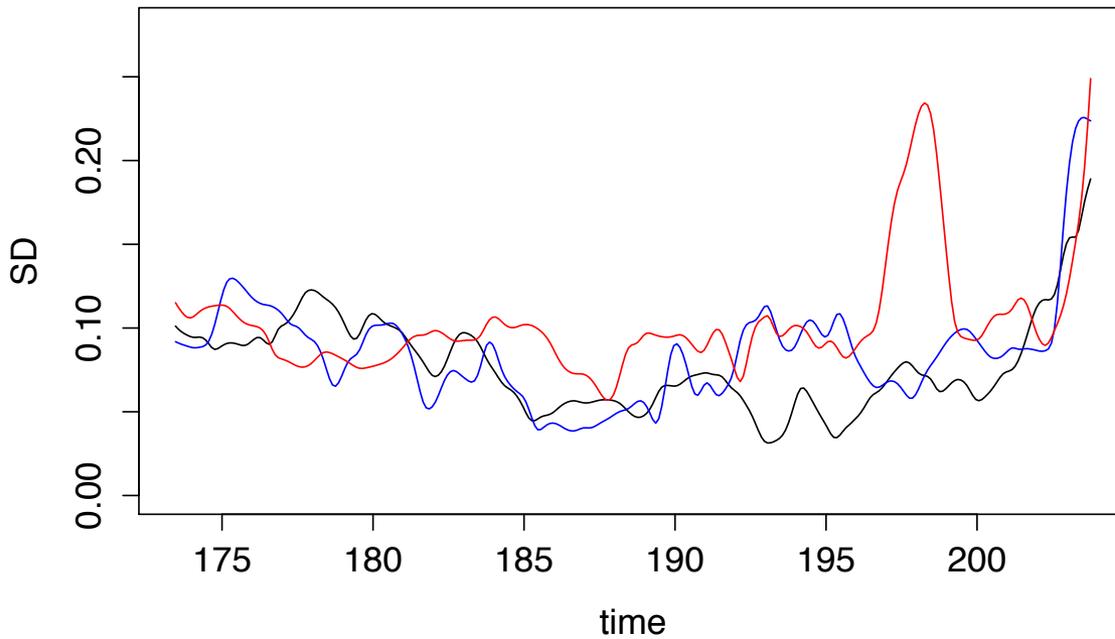


Segment 4, AV, centered



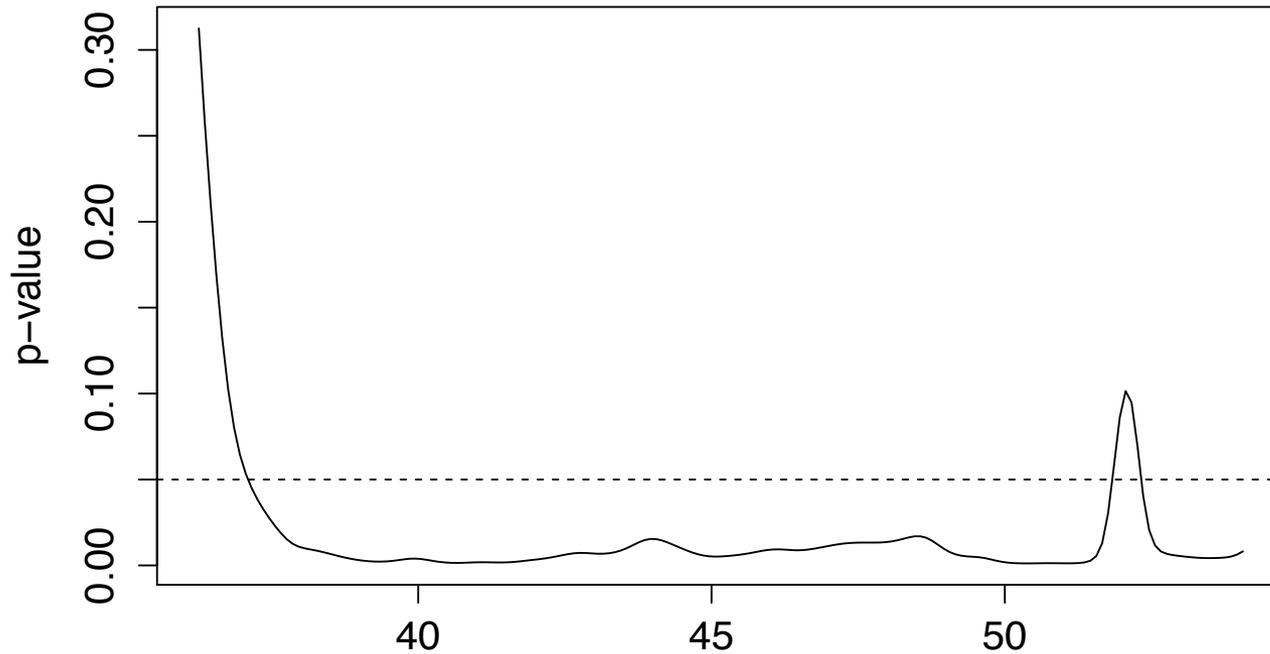
Inter-individual agreement

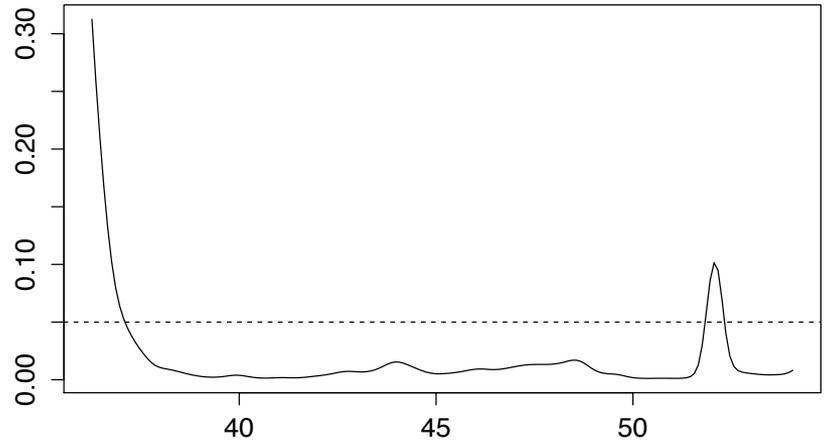
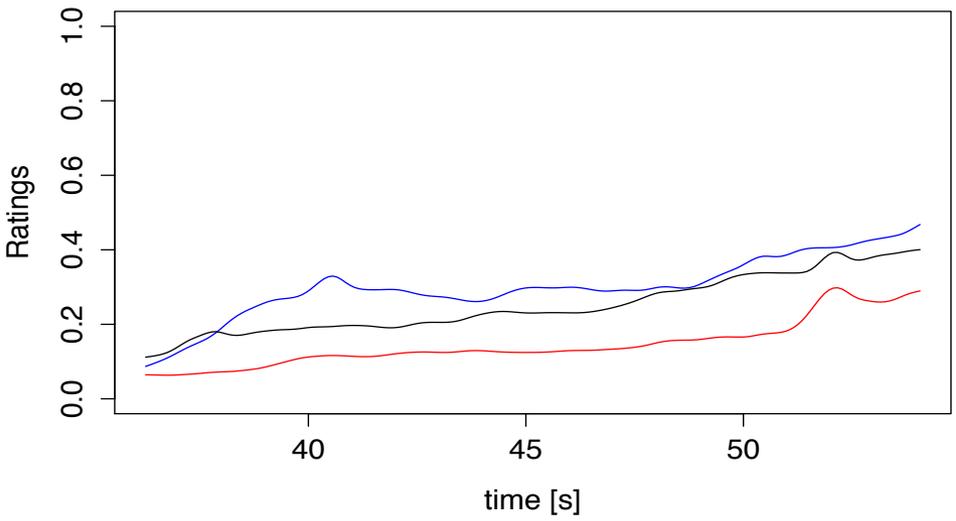
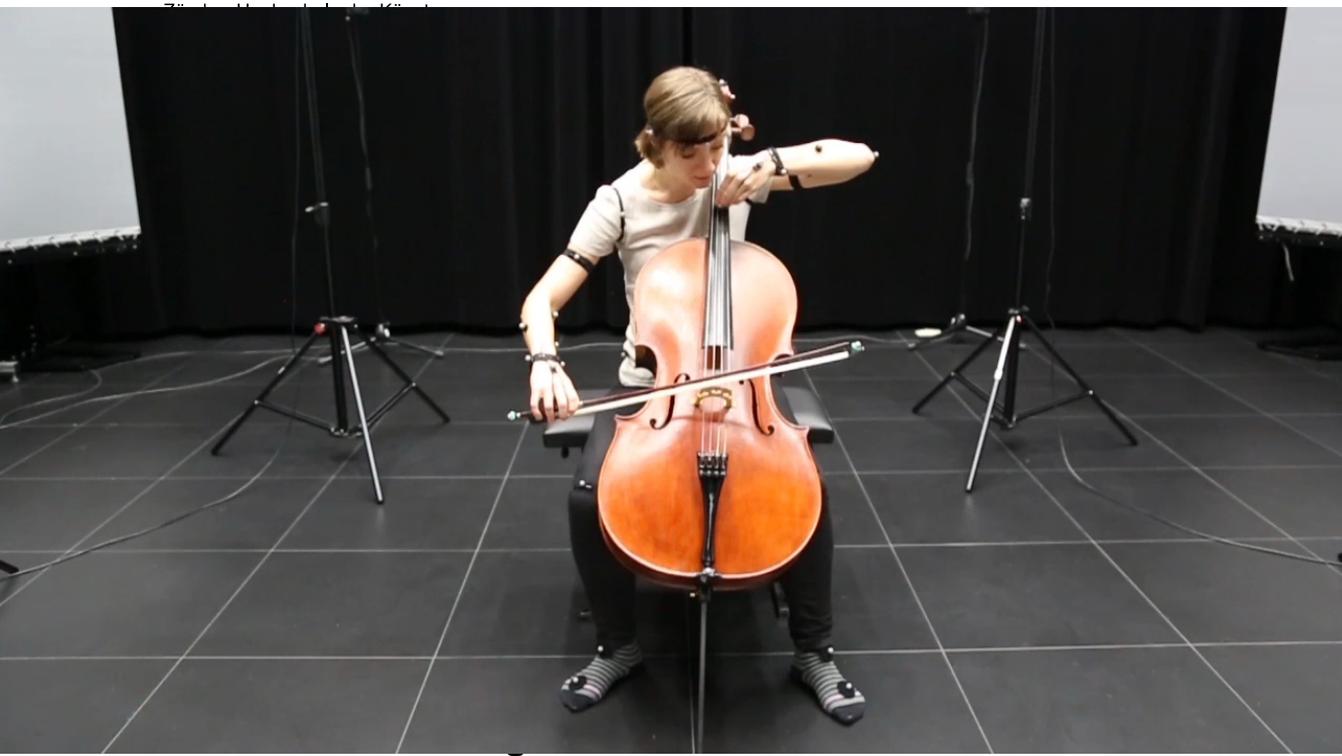
Segment 4, SD

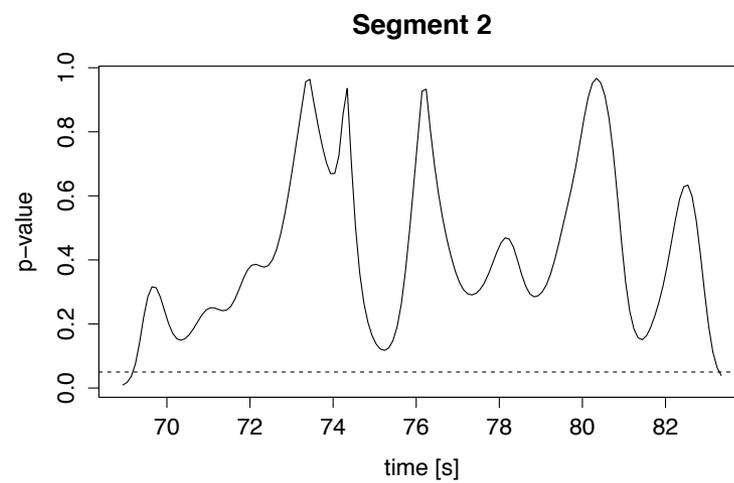
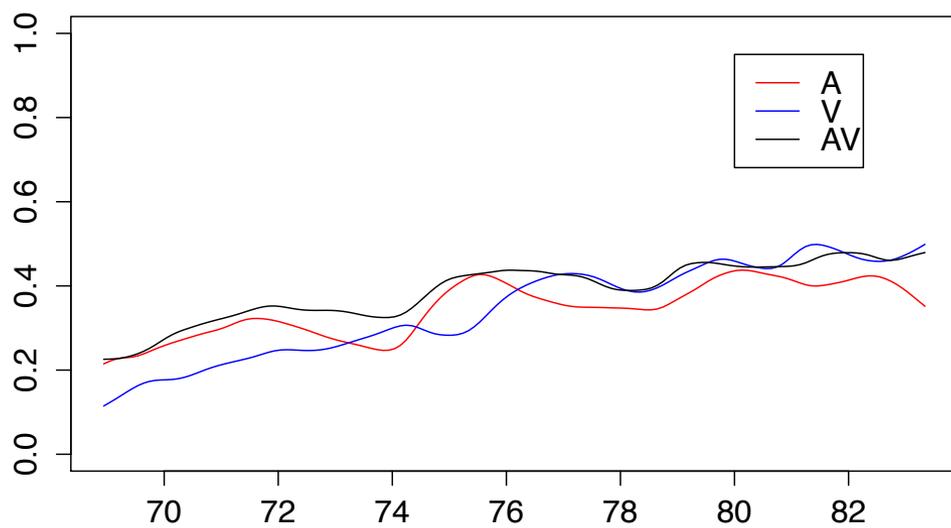


Mean (SD)
0.08 (0.03)

Agreement between conditions: Functional F-tests

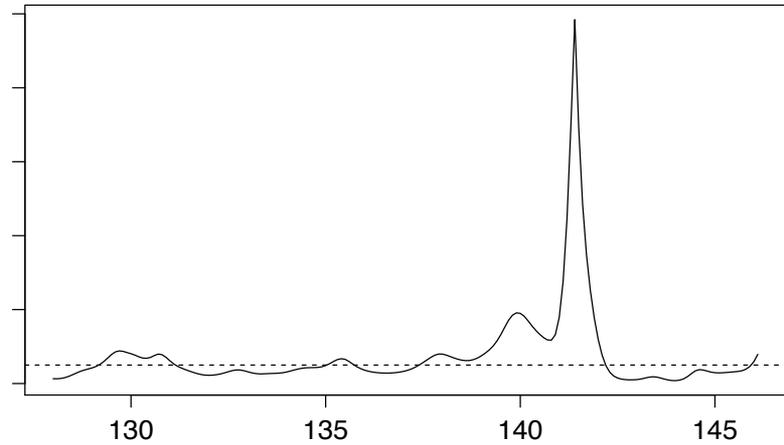
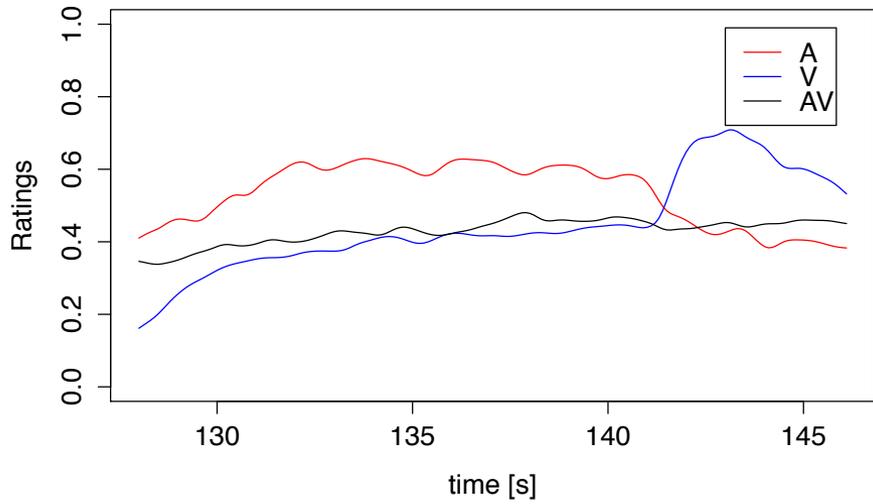








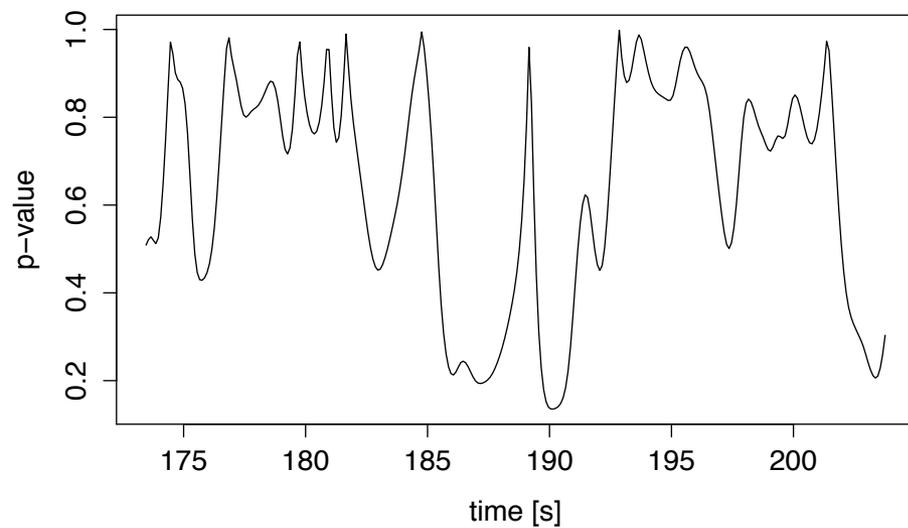
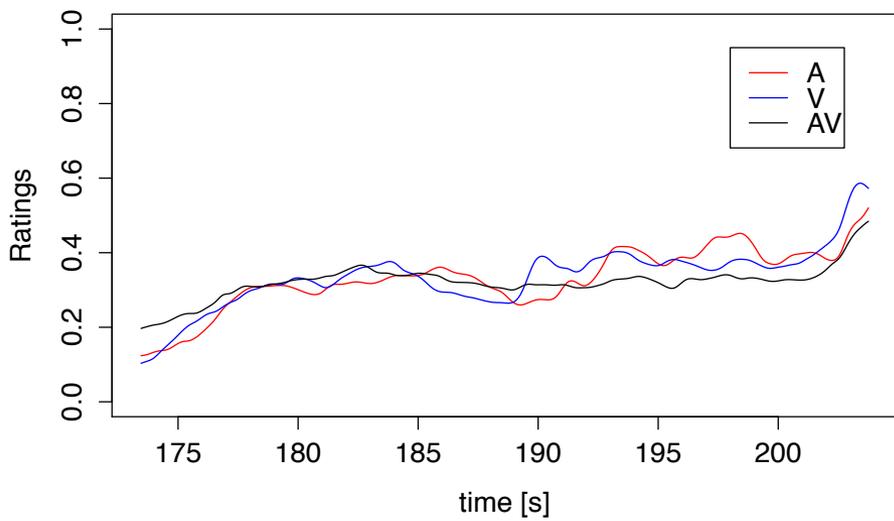
Segment 3





Segment 4

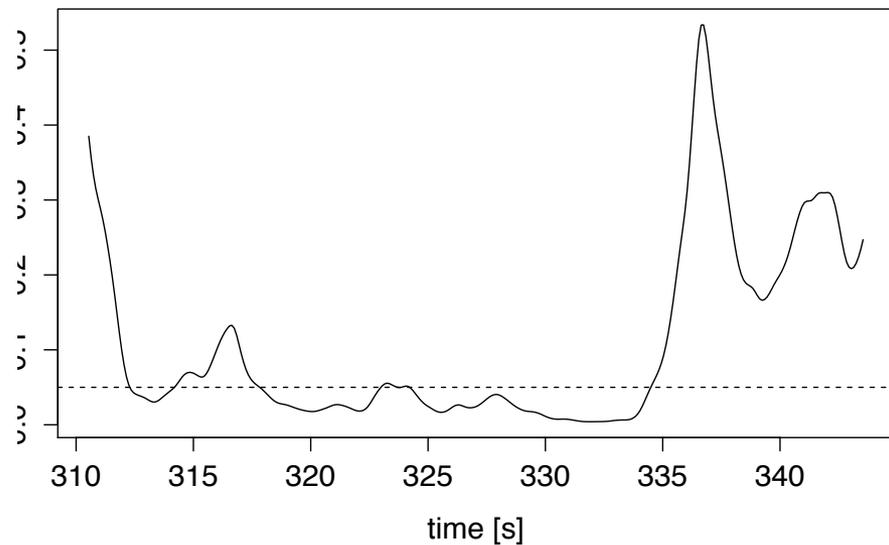
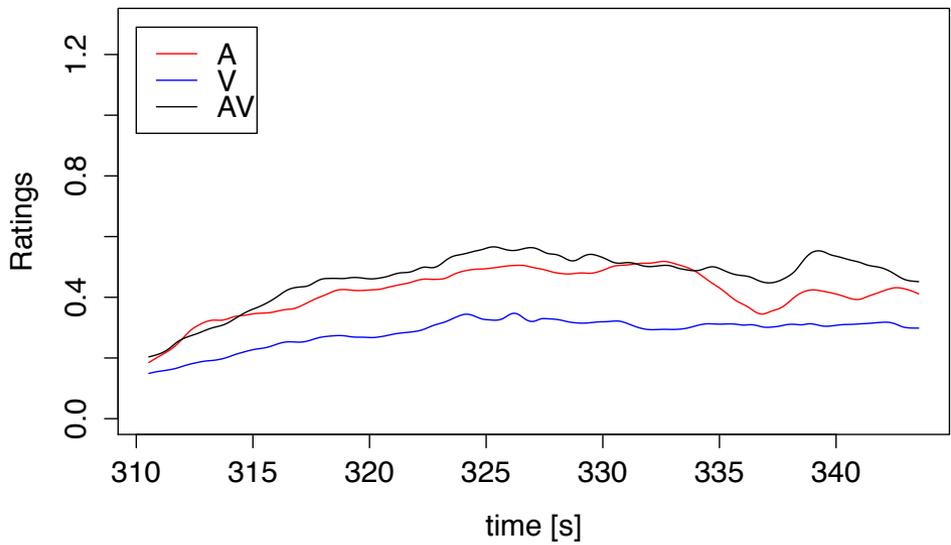
Segment 4





Segment 5

Segment 5

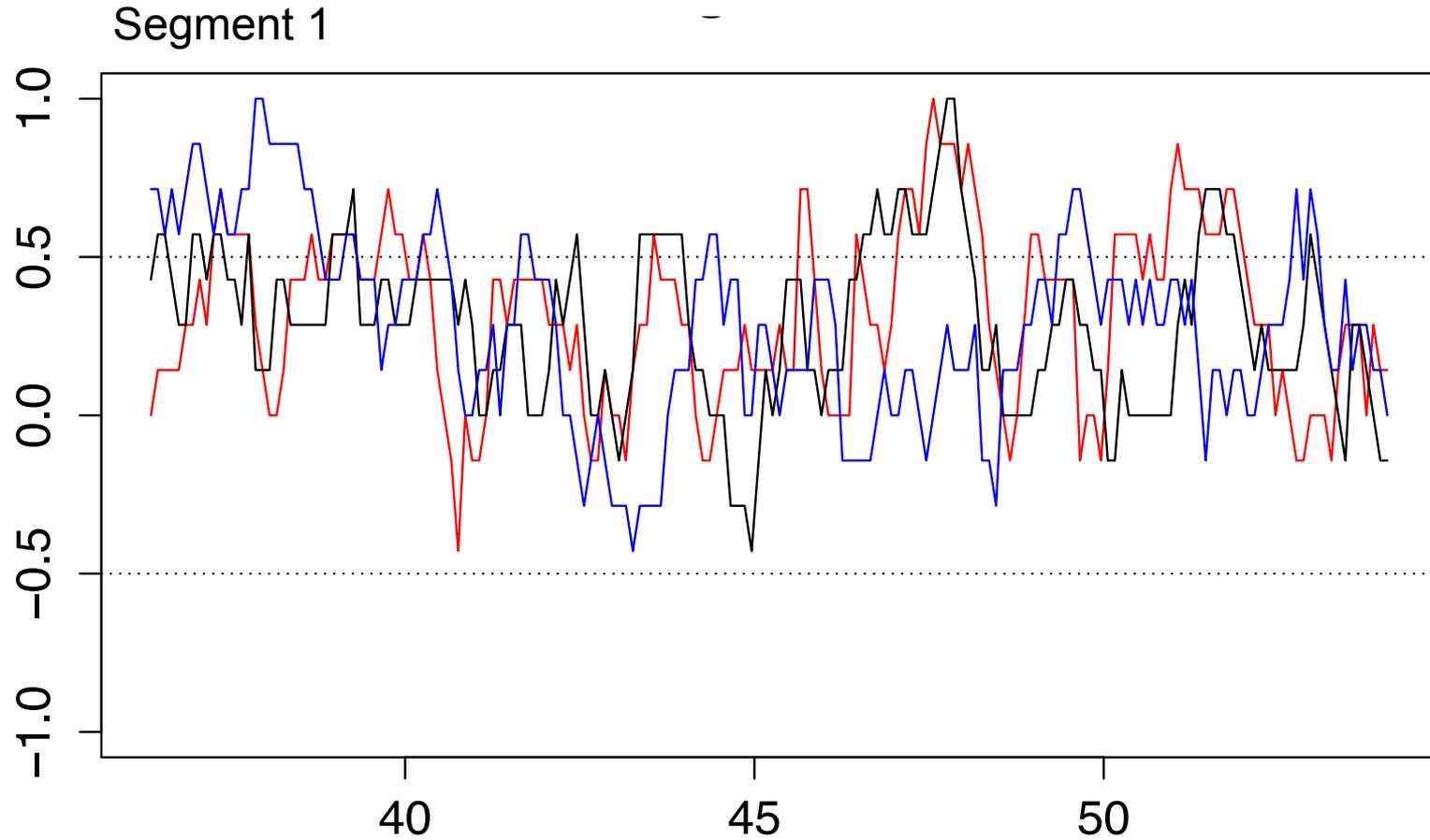


Areas of consonance

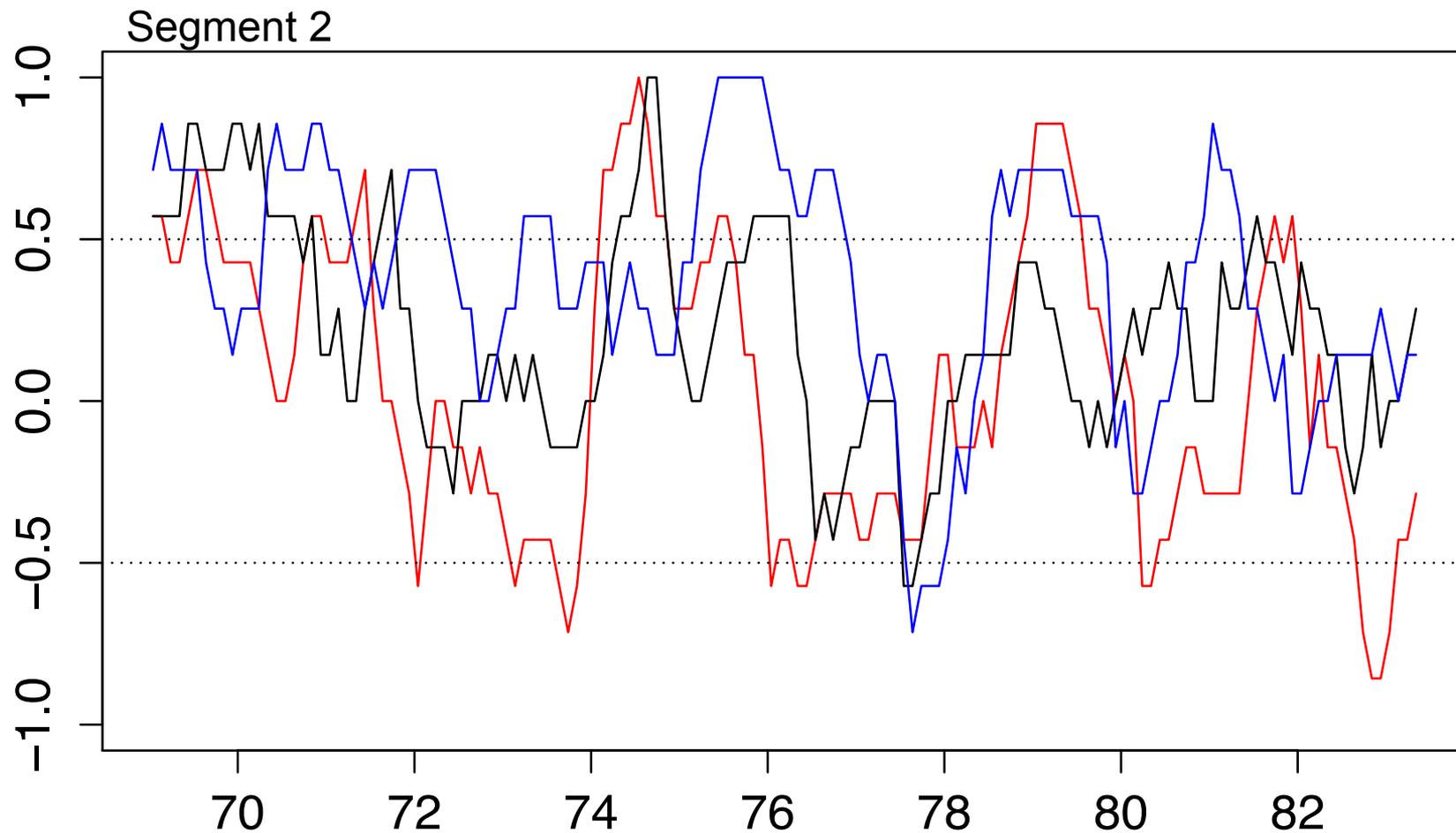
Between individuals and groups

- Agreement: Number of subjects going up vs. going down
- Time-varying consonance profiles

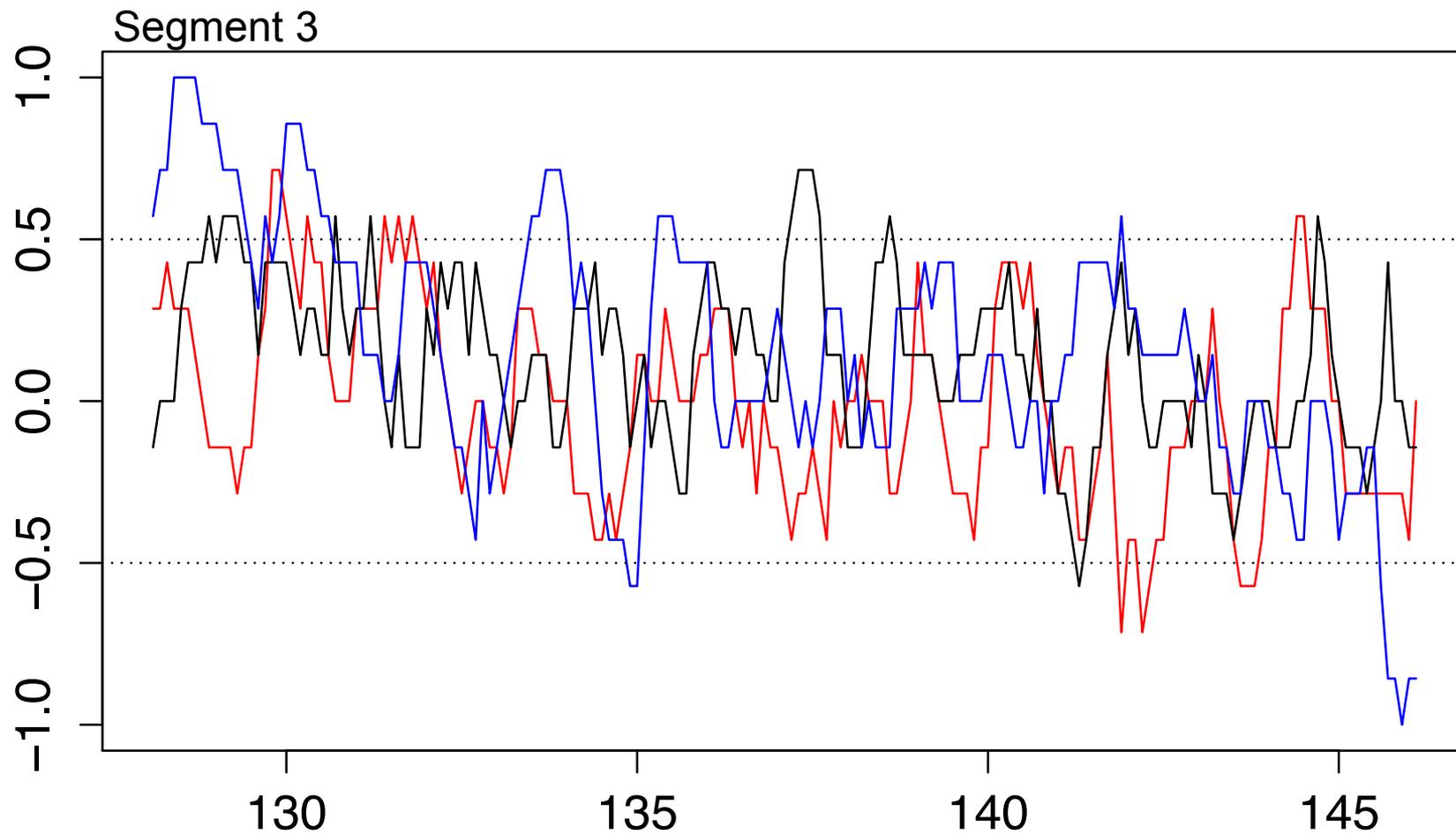
Agreement profiles

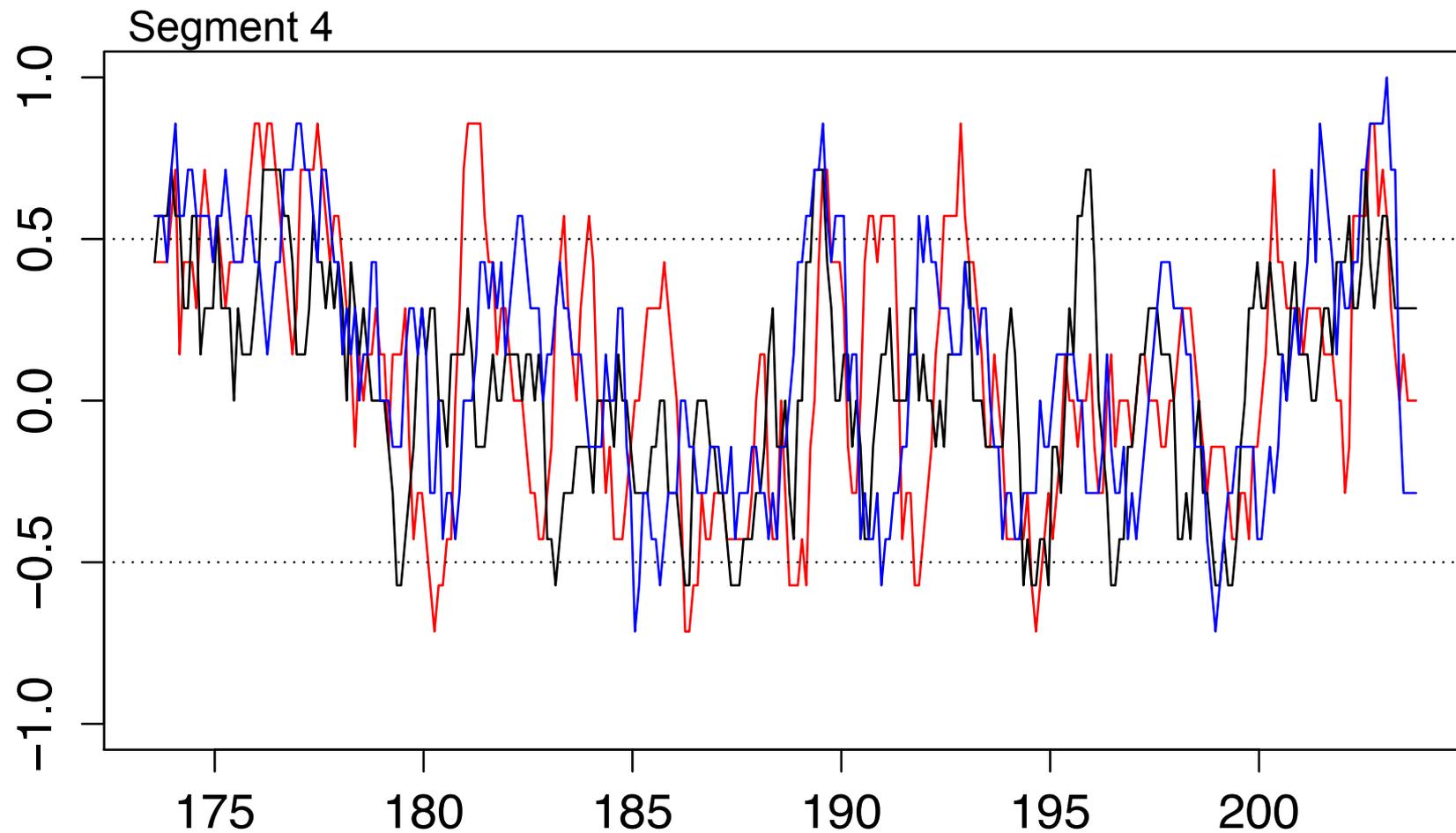


Highest mean: V2 (0.37)

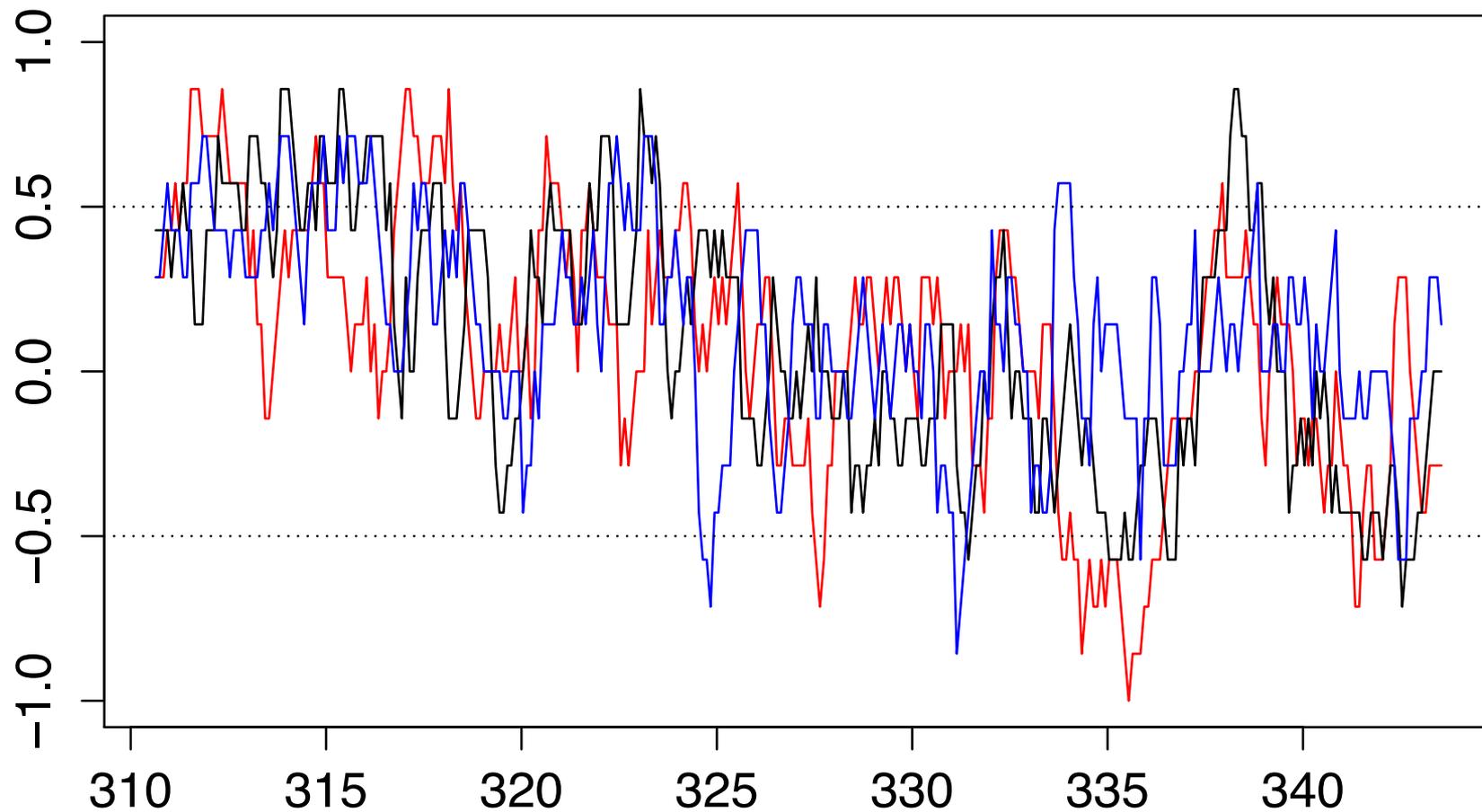


Lowest mean: A3 (0.0)

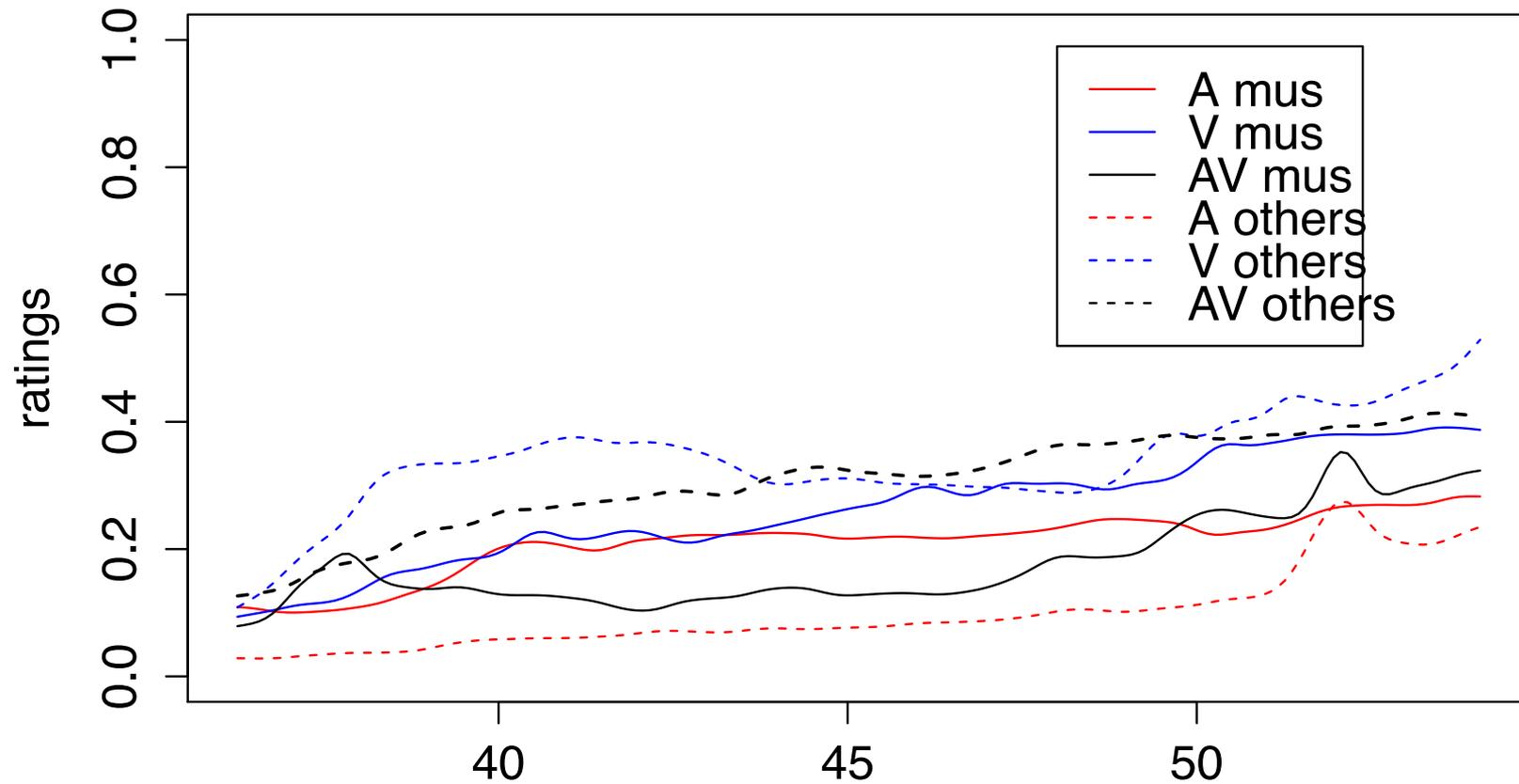


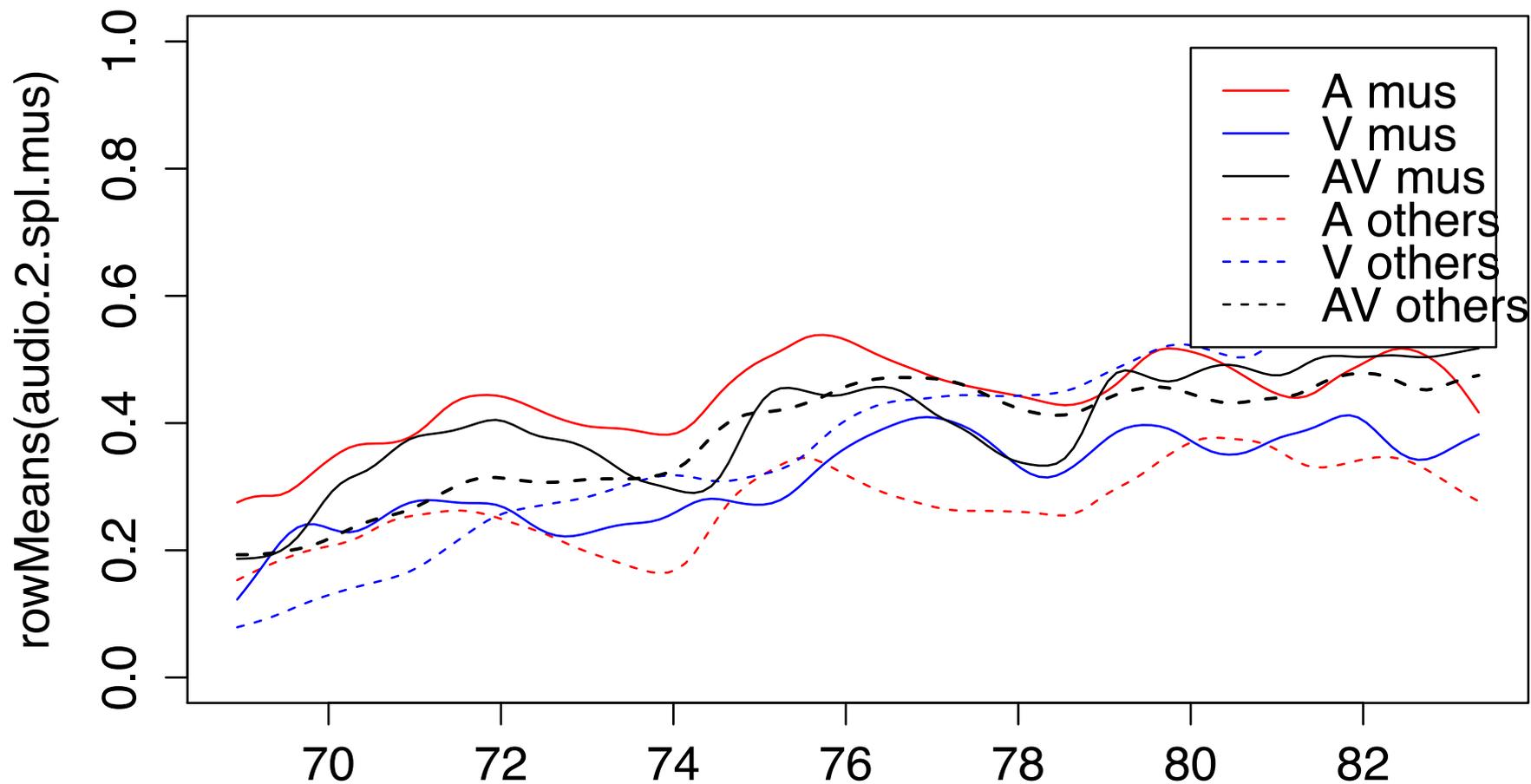


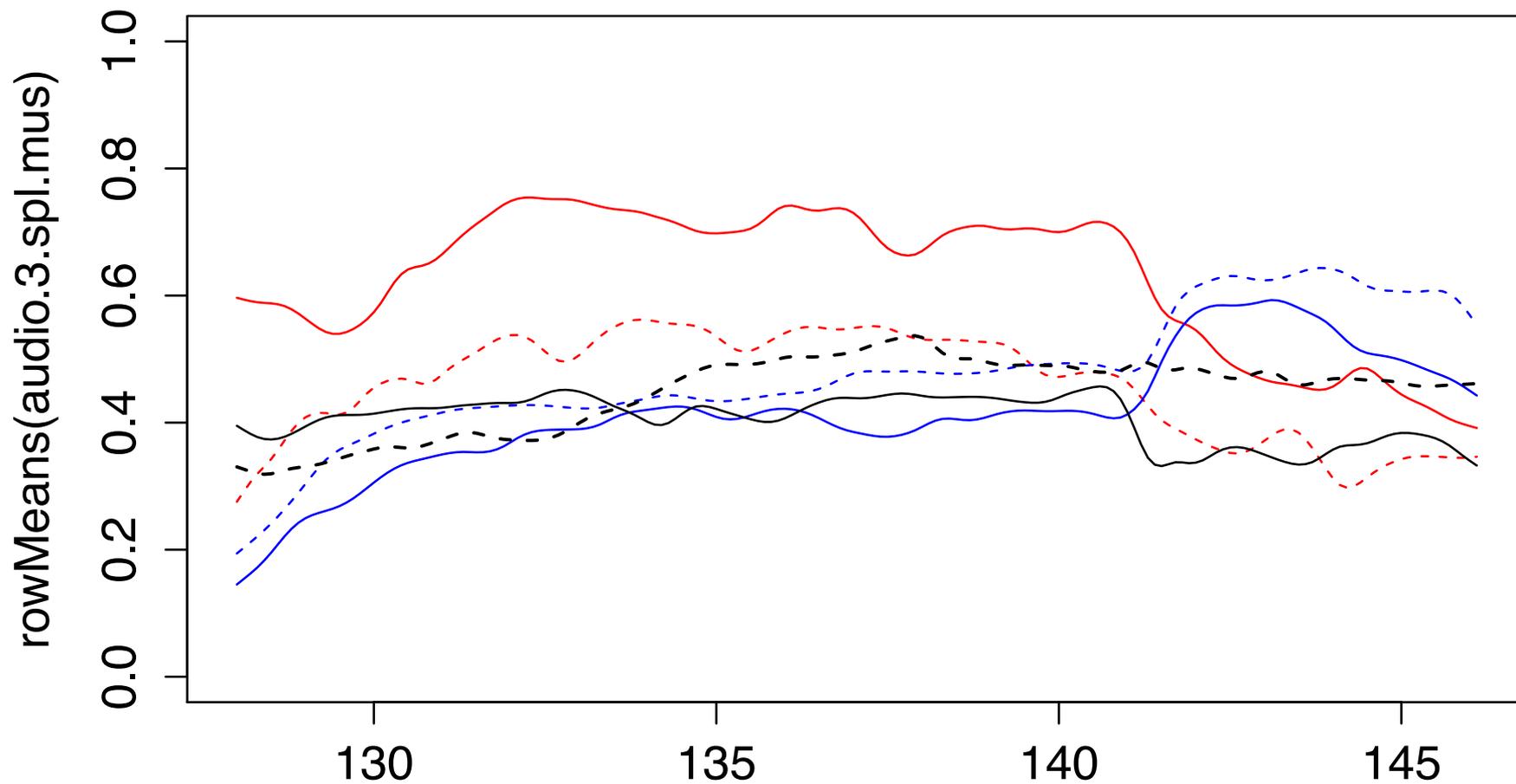
Segment 5

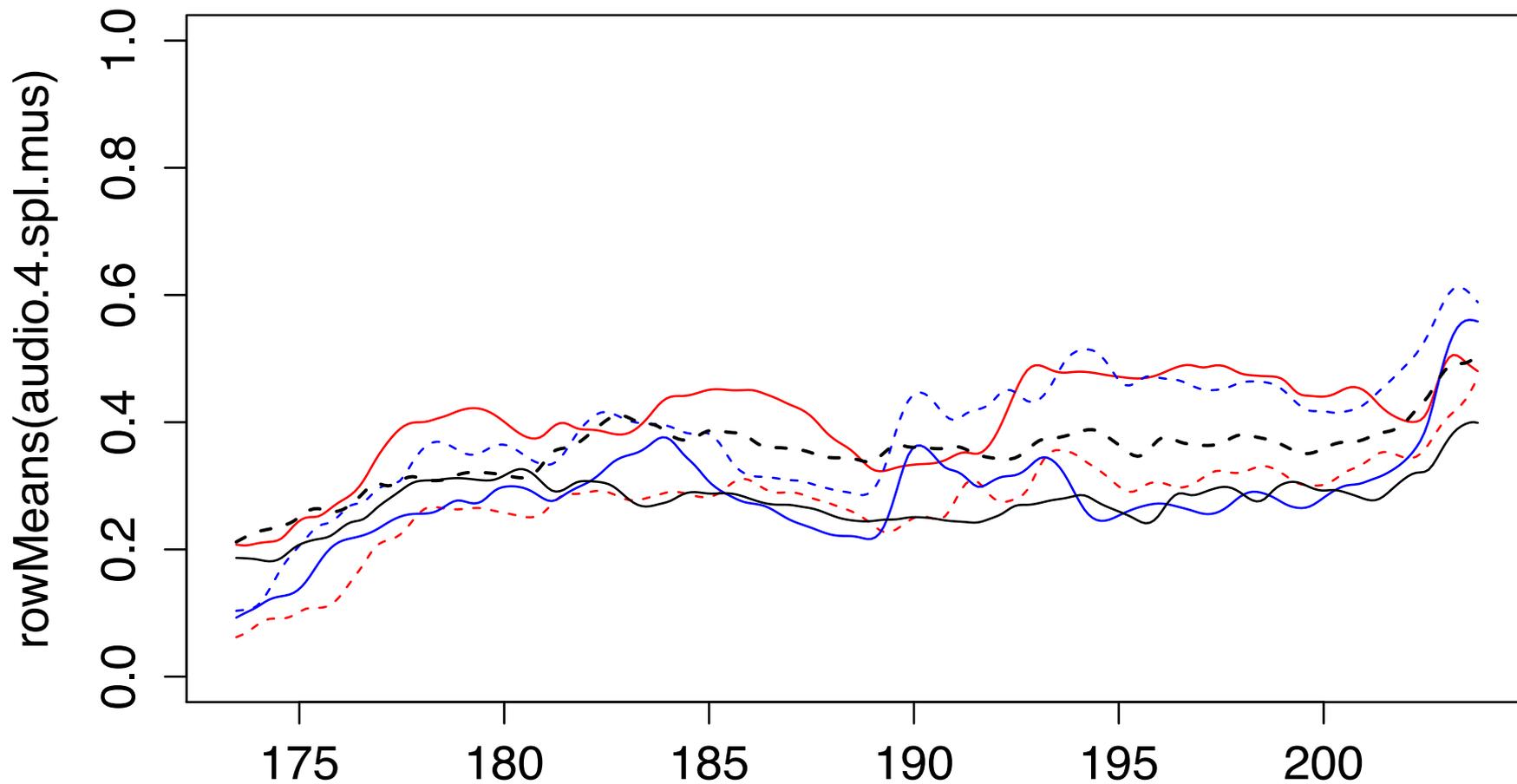


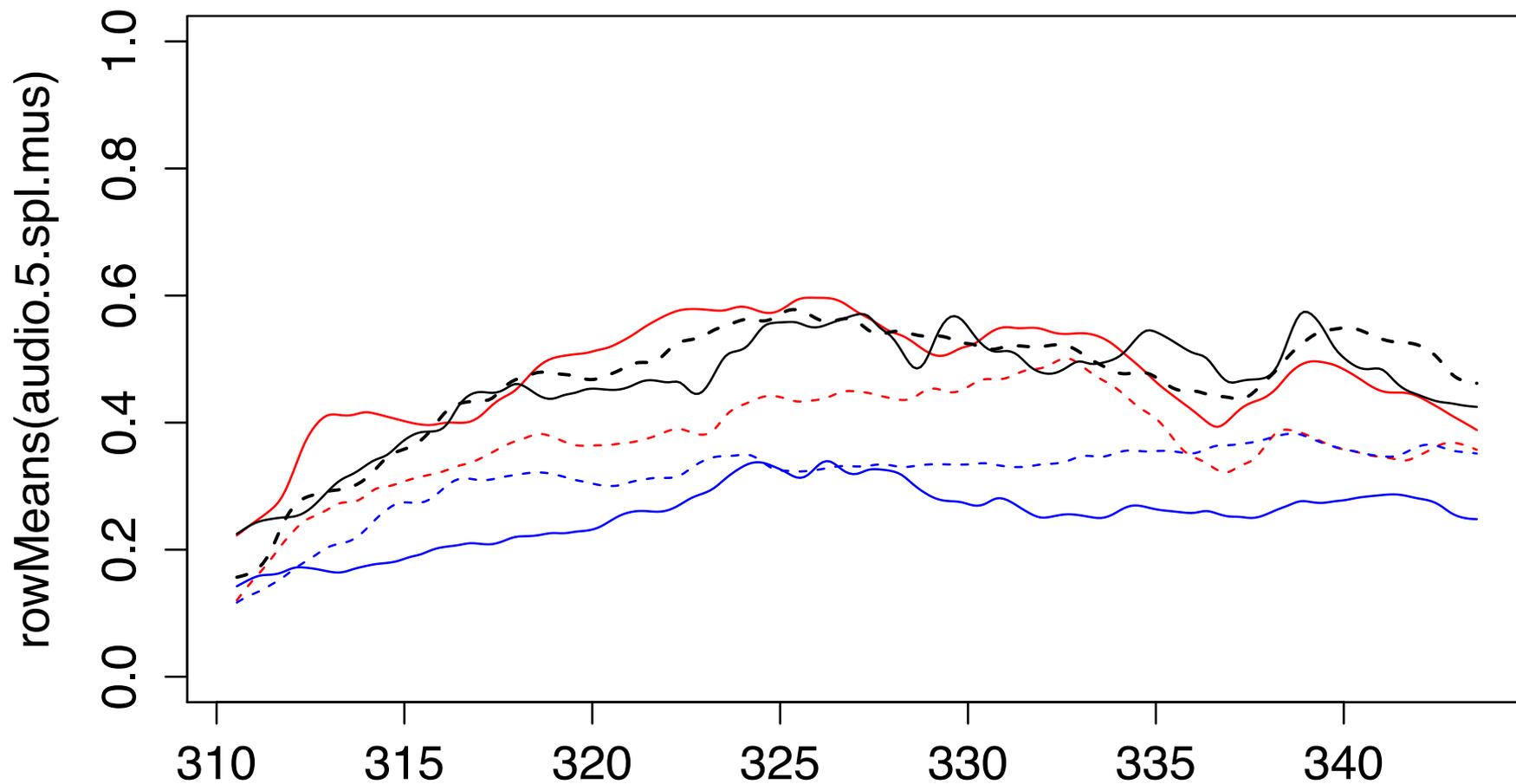
Musicians vs. non-musicians



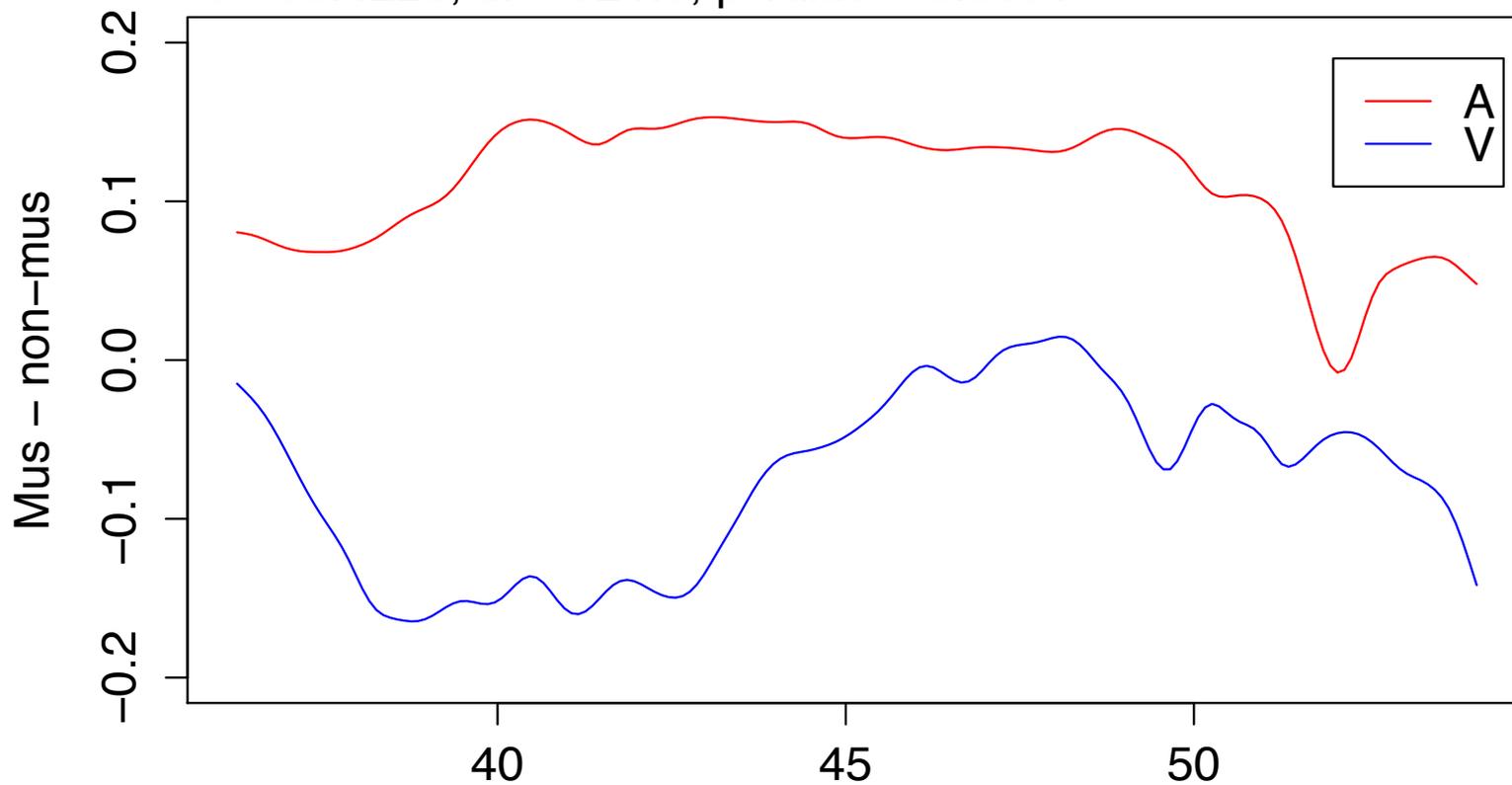






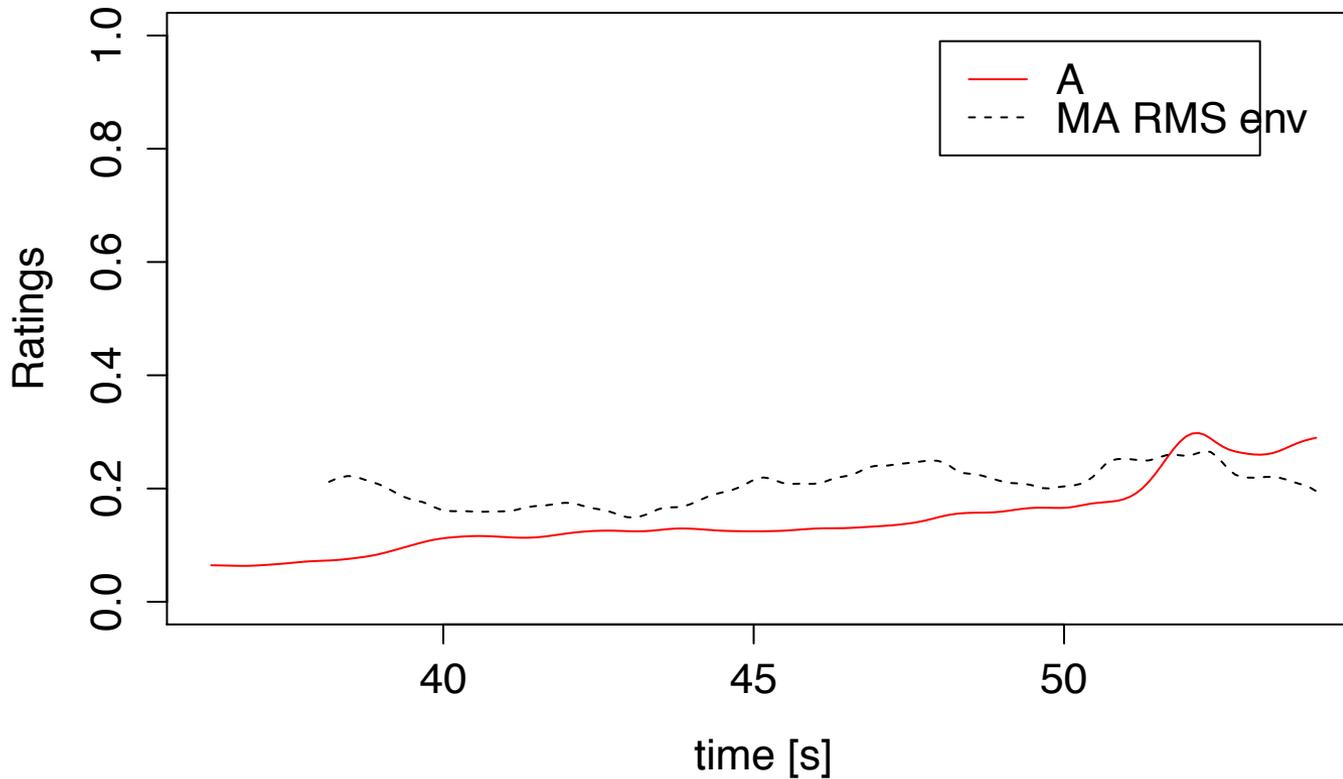


$t = 36.4228$, $df = 321.9$, $p\text{-value} < 0.0001$

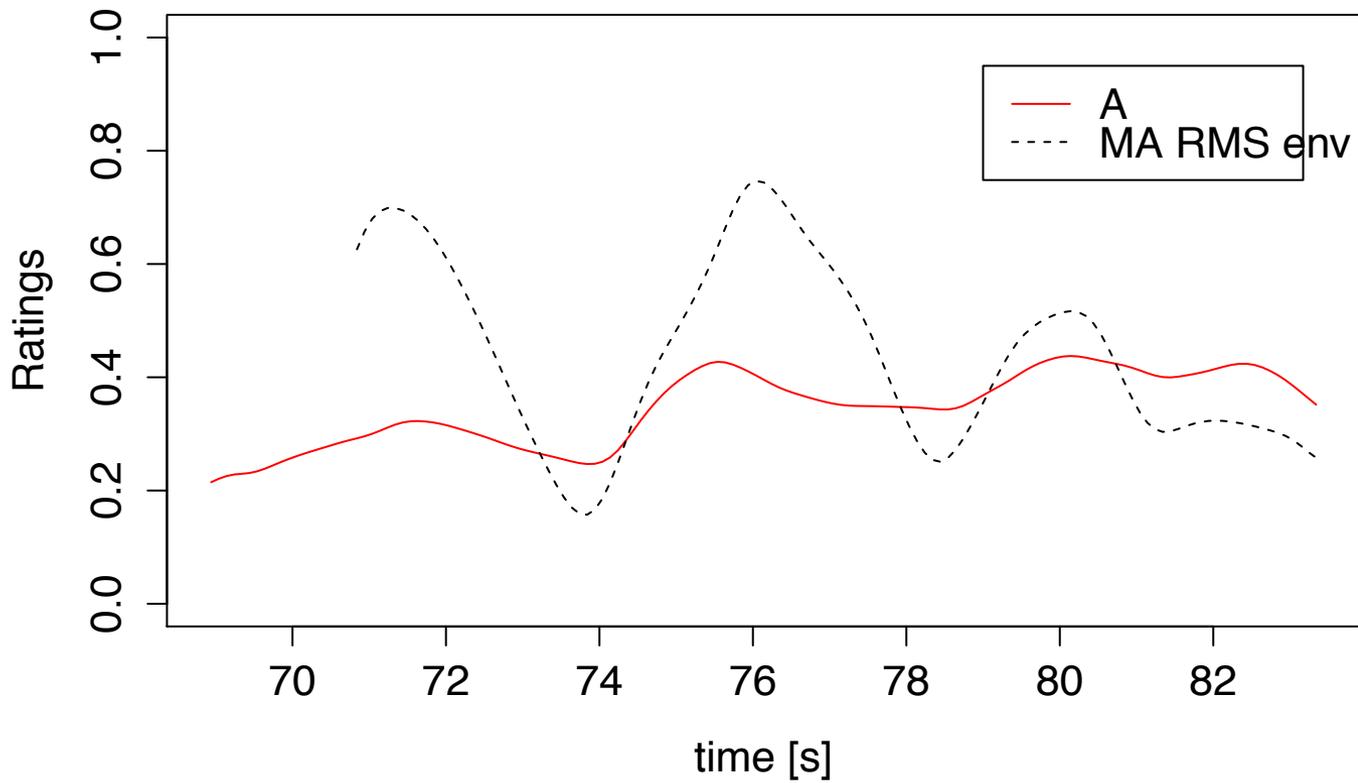


Moving Average of RMS envelope

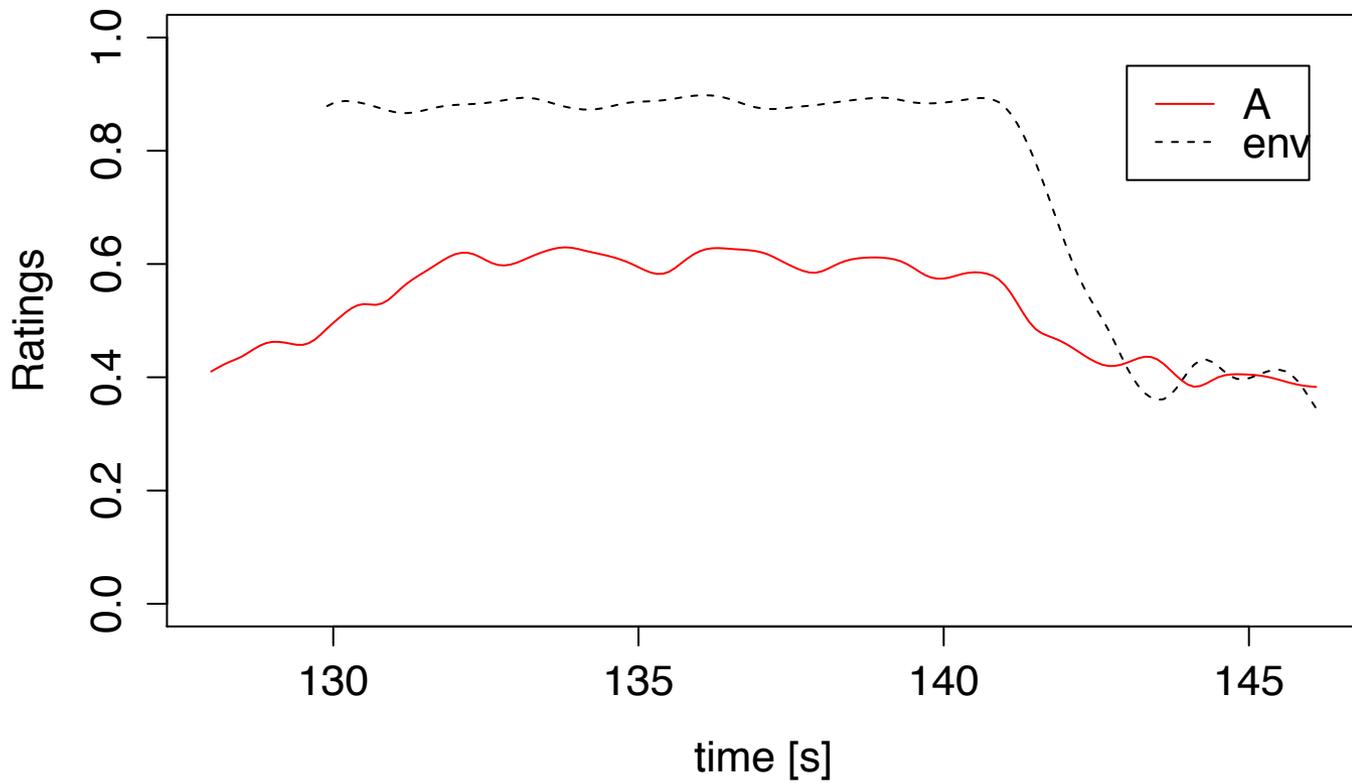
Segment 1



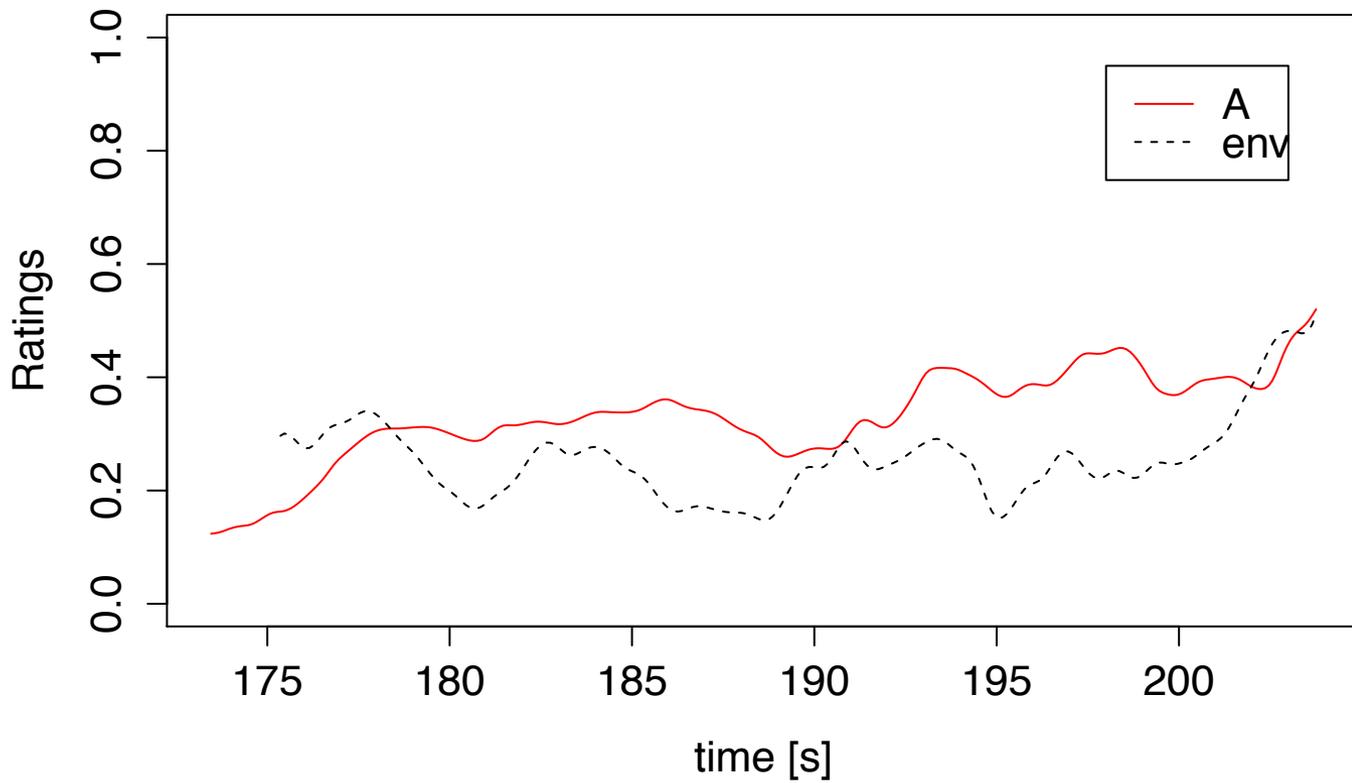
Segment 2



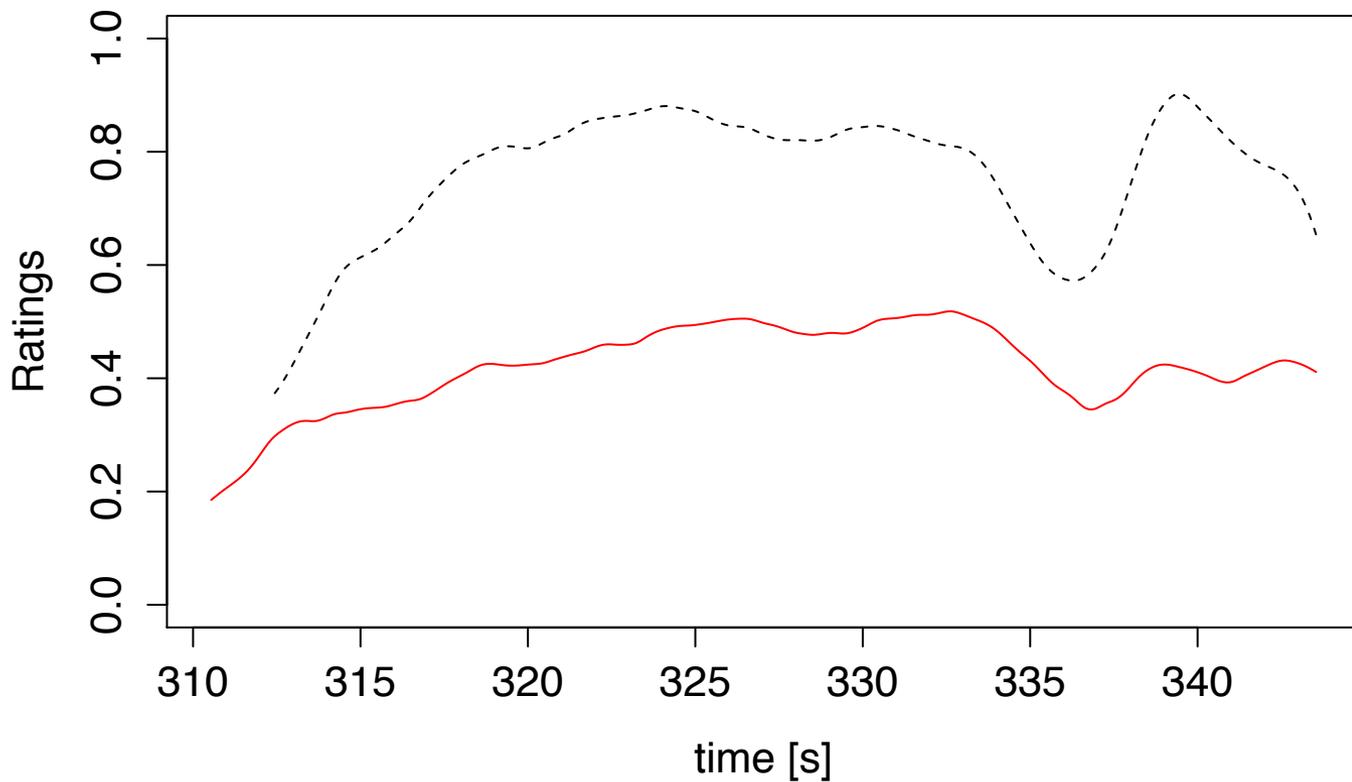
Segment 3



Segment 4



Segment 5



Results:

- Effort is a meaningful measure
- Baseline perception from A, V, AV
- Correlation to audio RMS (MA)
- Effect of isolated auditory / visual gestures
- Effort vs arousal?
- Musicians emphasize auditory aspect

Next:

- Agreement profiles: Isolate gestures
- Models and machine learning
- Baseline effort + effect of significant gestures
- New experiment: Contradicting A-V