Progress from Analytic to Global Perception of Modulations with Increased Familiarity with Music

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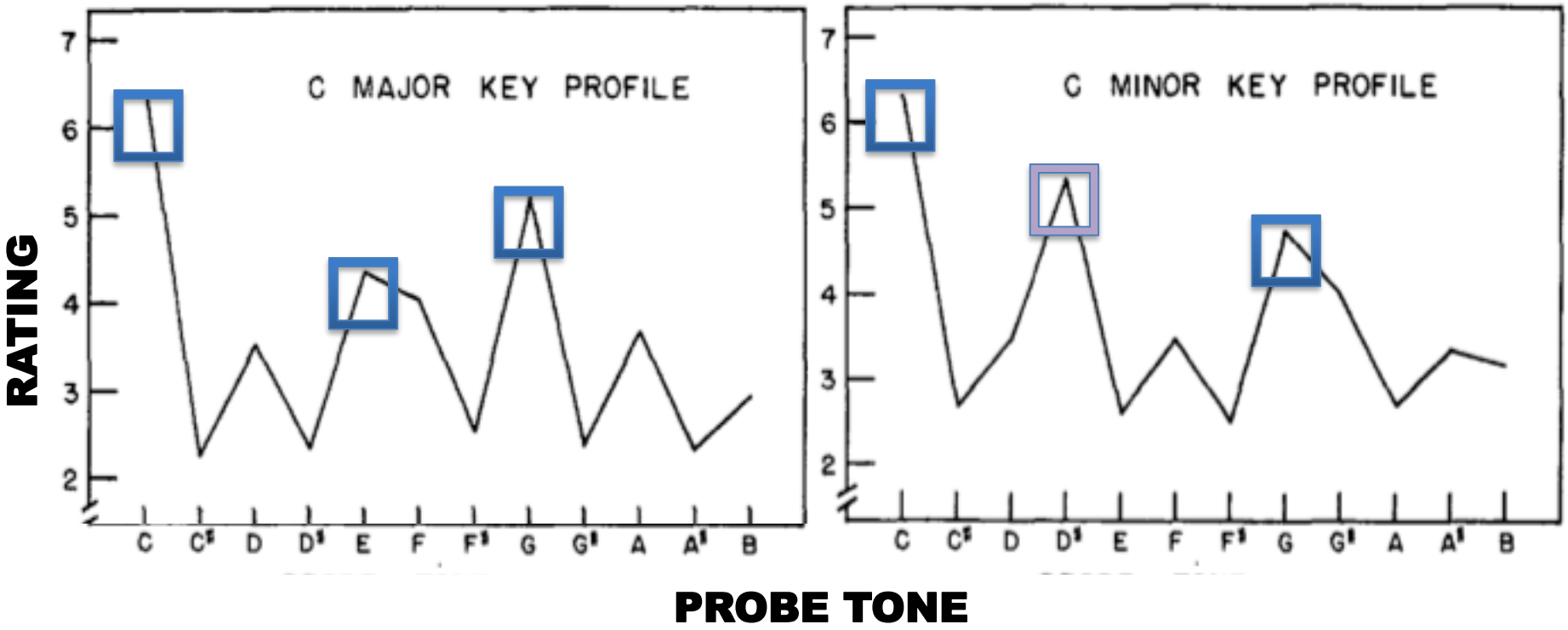
Tonal Hierarchy

- Provides a framework for encoding the pitches of a melody
- Selects 5-7 pitches out of the 12 semitones to form a “scale”
- Establishes a tonal center – “tonic” pitch – and a hierarchical pattern of importance of the other pitches
- This can be seen in tonal profiles that describe the hierarchies in different keys.

Two Western Tonal Hierarchies

- Krumhansl & Kessler (1982)
- Key profiles
- Notice “in-scale” vs. “out-of-scale” pitches



Melody and the Tonal Hierarchy

- The tonal hierarchy defines a set of expectancies
- Expectancies guided by general, “schematic” knowledge of the tonal system, and “veridical” knowledge of particular melodies (Bharucha)
- For example, out-of-key pitches in Schubert’s Ave Maria – note that they sound perfectly natural in a well-known melody
- Increasing familiarity with a piece develops expectancies such that formerly surprising events begin to sound “natural” – and so are no longer sharply differentiated from their context

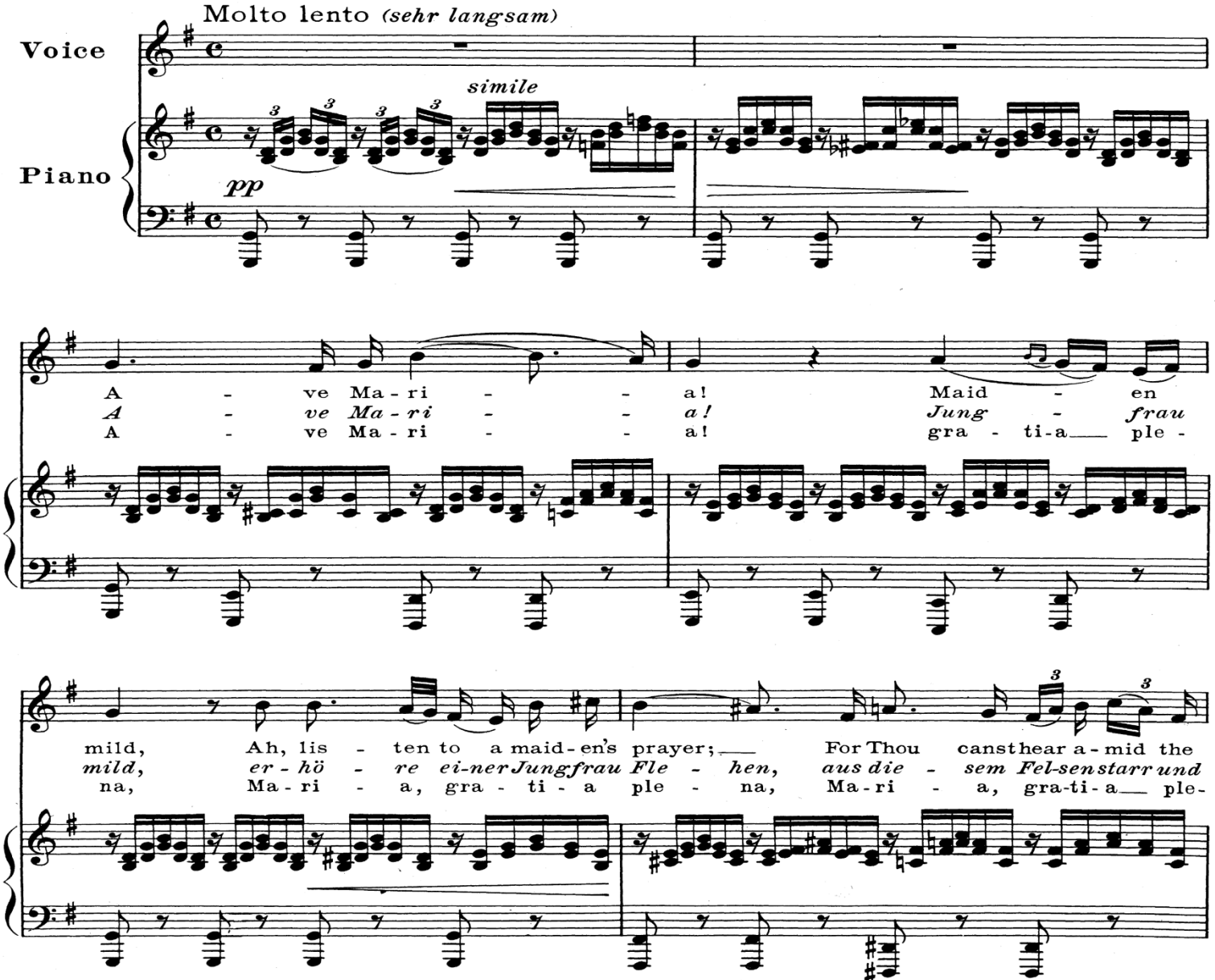
Ave Maria

(Walter Scott)

German translation by
Adam Stork

English adaptation by
Dr. Theo. Baker

Franz Schubert. Op. 52, No. 6



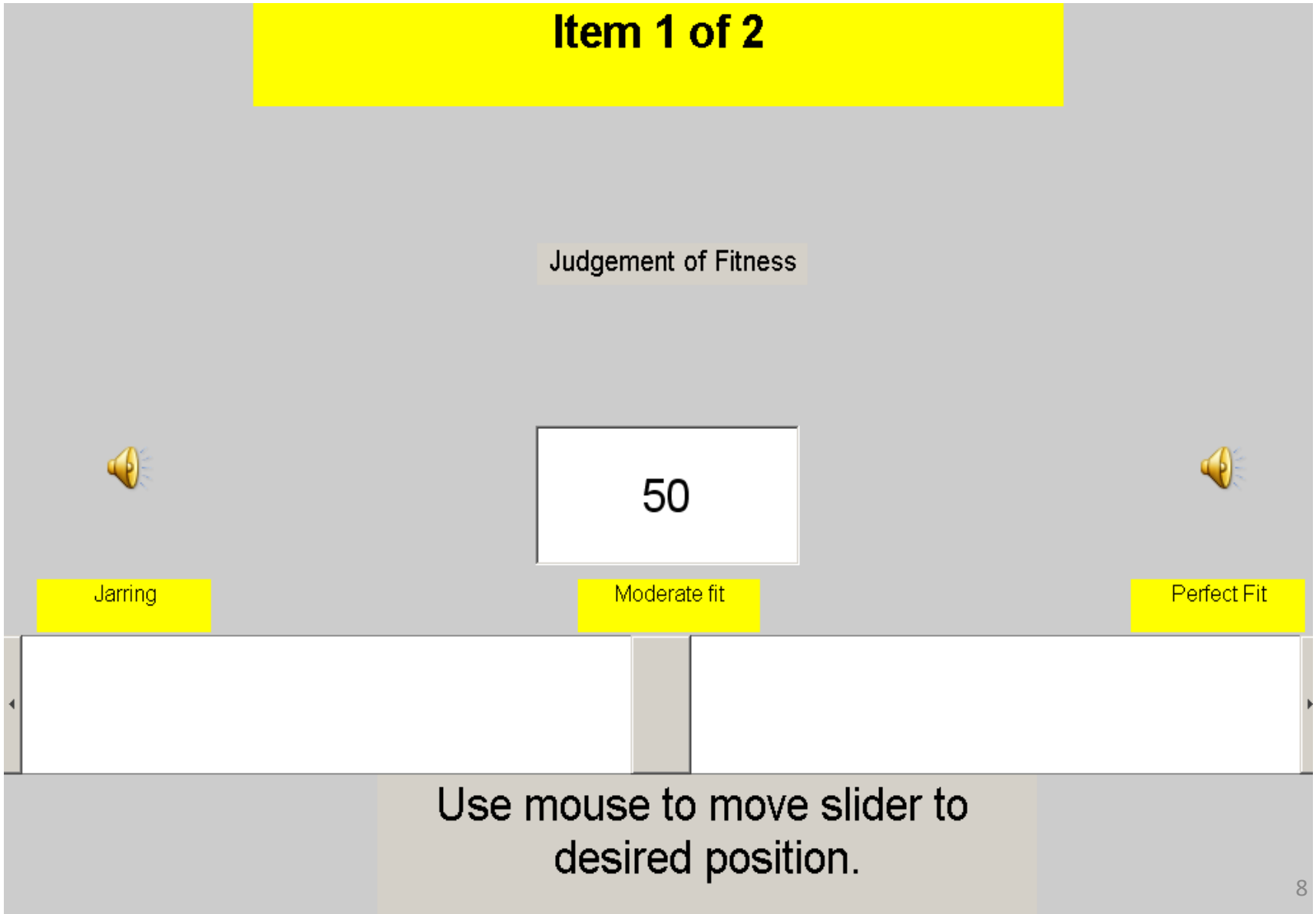
Modulation

- Modulation from one “key” to another involves replacing the tonal profile with a new one. This can involve:
  - Changing the set of pitches (e.g., C major to C minor)
  - Changing the tonal center (e.g., C major to A minor)
  - or both (e.g., C major to A major)
- Modulation can take us to a closely related key that shares many pitches with the starting key (e.g., C major to G major), or to a distant key that doesn’t (e.g., C major to B major)
- Close modulations often heard simply as variants of the original key (tonic-dominant)

Experiments

- Listeners hear a musical excerpt in one ear, along with a probe tone in the other ear (one of the 12 possible semitones)
- They rate the probe tone continually for how well it goes with the music (Toiviainen & Krumhansl, 2003)
- They go through the excerpt 12 times, each time with a different probe
- Different listeners hear the 12 probes in different orders, randomly determined

TASK


Item 1 of 2
Judgement of Fitness
50
Jarring
Moderate fit
Perfect Fit
Use mouse to move slider to desired position.

Experiments

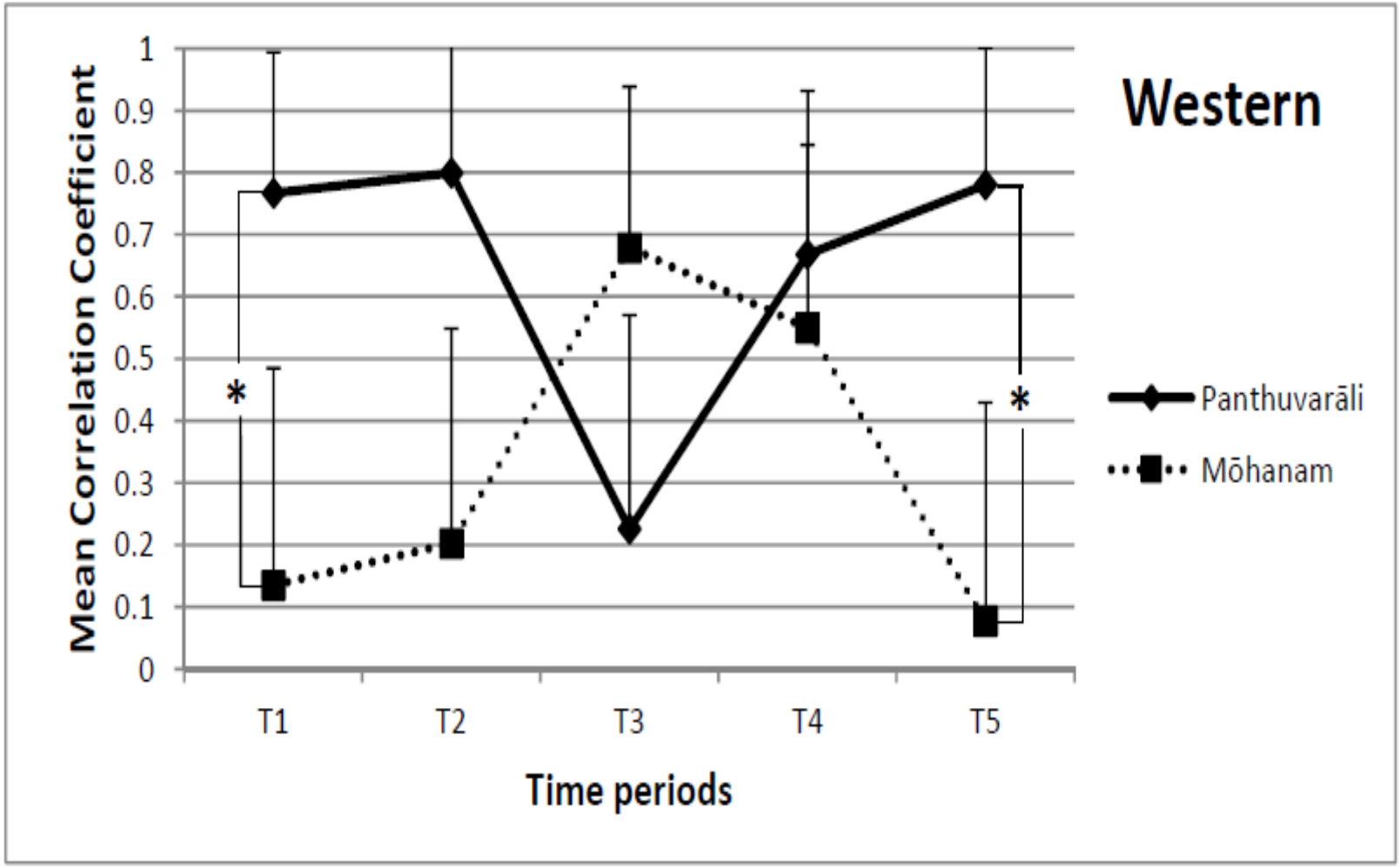
- We use the ratings to put together tonal profiles that may change as the listener progresses through the piece
- We correlate those profiles with the standard profiles for the possible keys that the listener will encounter
- If the listener is following the modulations in their ratings, the correlations will show the shifts from key to key

Experiment 1

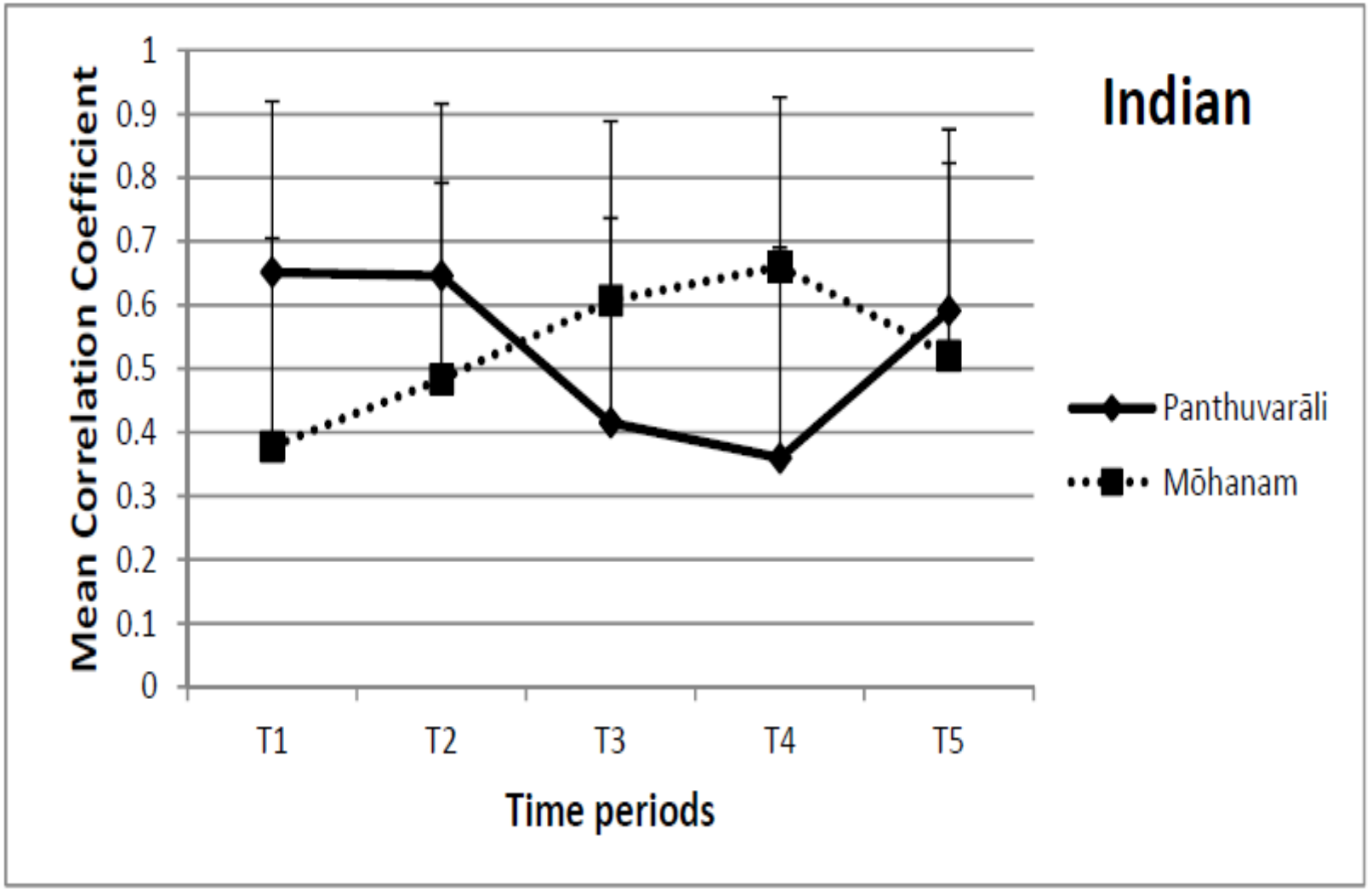
- There are two kinds of modulation in Carnātic (South Indian classical) music: grahabēdham (like C major to A minor), and rāgamālikā (like C major to C minor)
- We used one excerpt of each type, about 1 min long
- 10 Indian & 10 Western music teachers participated
- The Indian teachers were familiar with the excerpts, especially the rāgamālikā excerpt, whereas Western teachers were unfamiliar with both excerpts

Grahabēdham

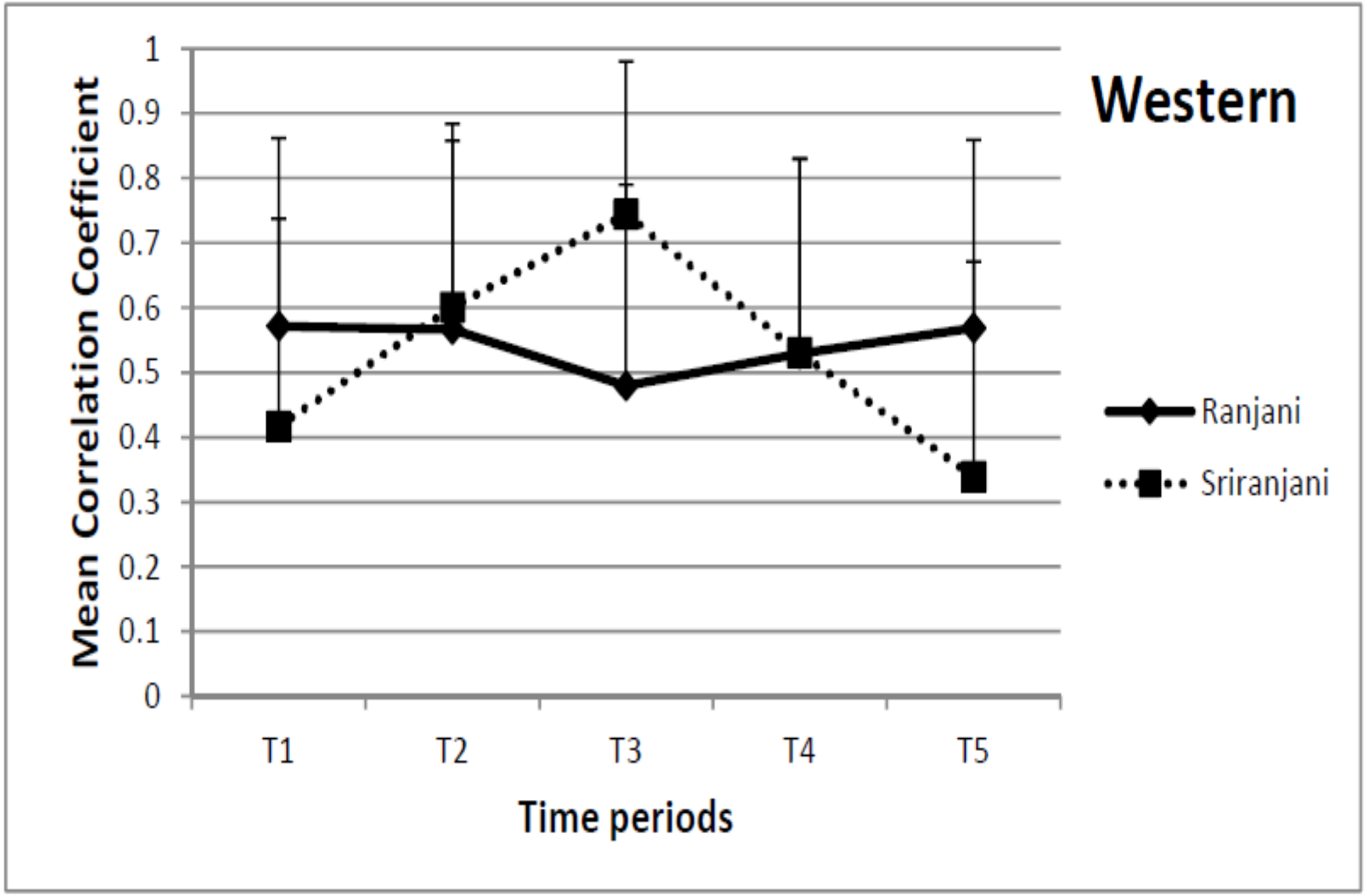
(Raman & Dowling, 2016)



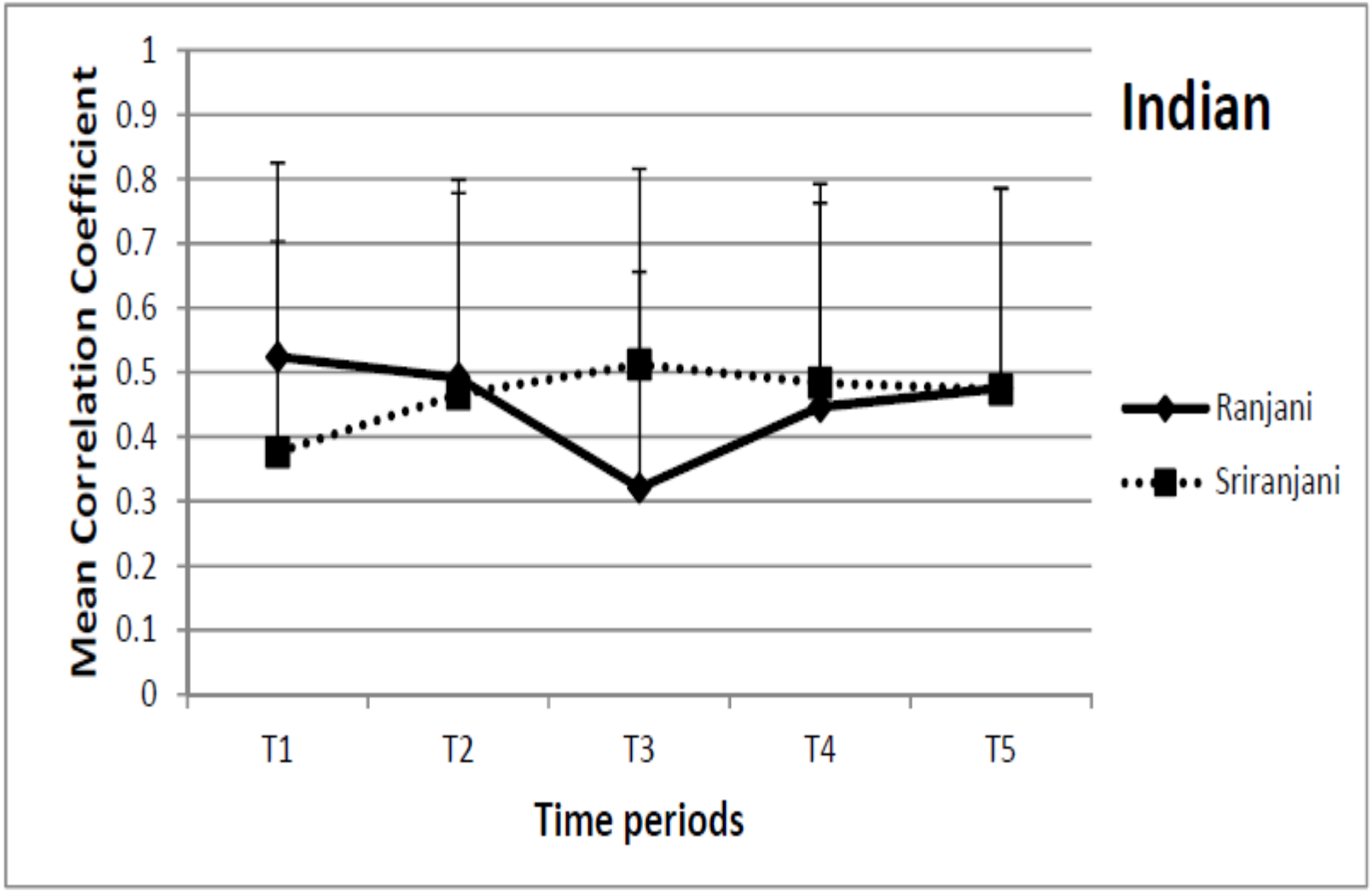
Grahabēdham



Rāgamālikā


Western
Mean Correlation Coefficient
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
T1
T2
T3
T4
T5
Time periods
Ranjani
Sriranjani

Rāgamālikā


Indian
Mean Correlation Coefficient
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
T1
T2
T3
T4
T5
Time periods
Ranjani
Sriranjani

Results

- MANOVA: 2 Nationalities X 5 Time Periods
- There were main effects of time period for both modulation types: rāgamālikā, $F(8,11) = 5.25$, $p<.01$; grahabēdham, $F(8,11) = 8.57$, $p<.001$.
- The Time Period X Nationality interaction approached significance overall for rāgamālikā, and was significant for the Sriranjani rāgam in particular, $F(4,15) = 4.60$, $p<.01$.

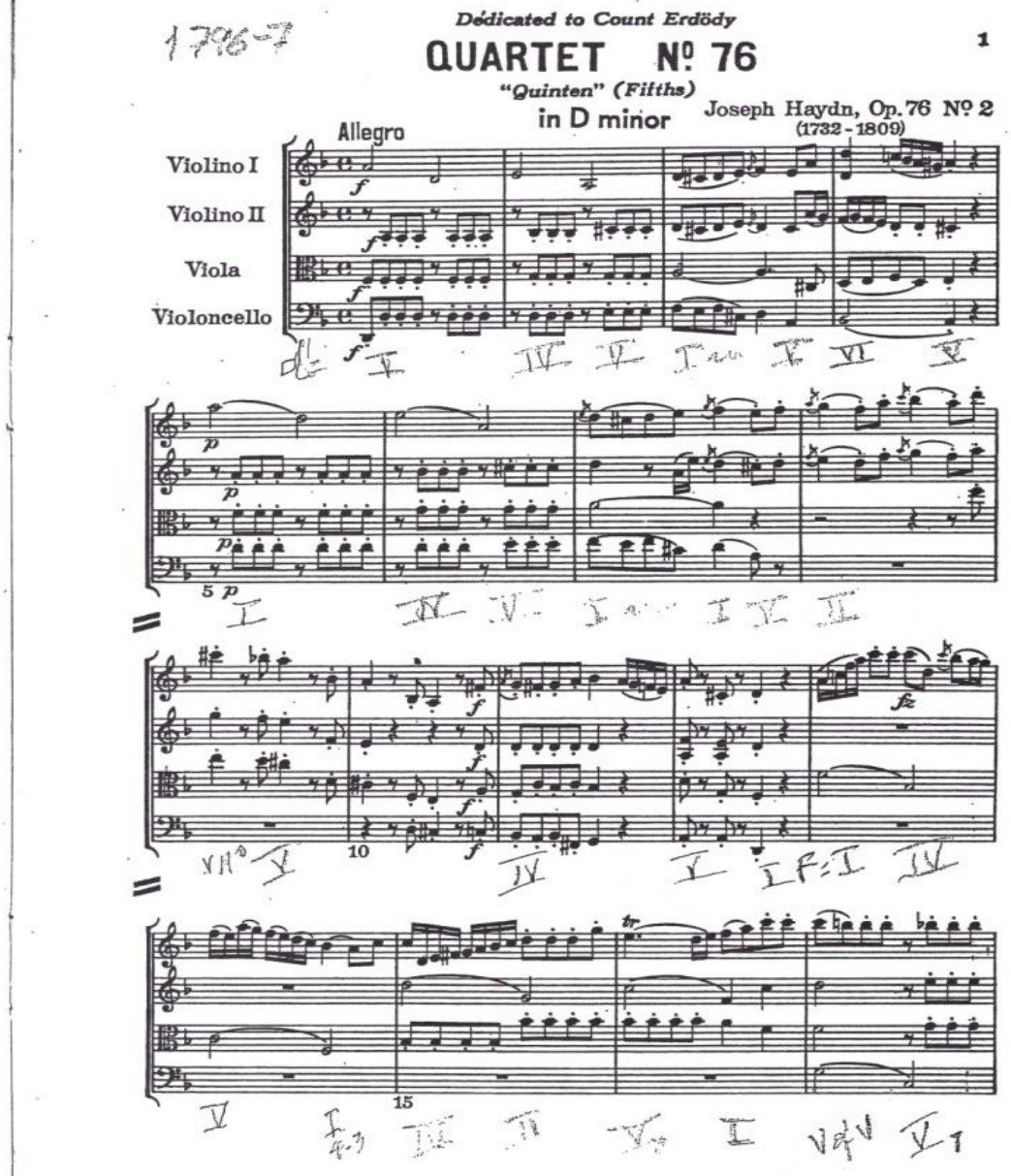
Results

- For grahabēdham, the Time Period X Nationality interaction was not significant overall ($p<.18$), but was significant for the individual ragams: Panthuvarāli, $F(4,15) = 5.22$, $p<.01$; Mōhanam, $F(4,15) = 6.47$, $p<.01$.
- Clearly, the Indian teachers were responding in a more global fashion to the modulations than the Western teachers, who were more analytic.
- Could this global responding be due to their greater familiarity with the pieces?

Experiment 2

- In Experiment 2, we were able to look at possible effects of increasing familiarity
- Since listeners heard the excerpts 12 times in the continuous probe-tone method, we could look at their responses during the first 3 hearings compared with the last 3 hearings
- The excerpts were the first 2 min of Haydn's Quartets op. 76, no. 2 ("Quinten") and op. 76, no. 3 ("Emperor"), starting at the beginning and stopping at the end of the exposition section
- The excerpts contained 3 or 4 modulations:
  - d minor, F major, f minor, F major
  - C major, G major, g minor, E^{b} major, G major

https://www.youtube.com/watch?v=wp2x0YKI7QE

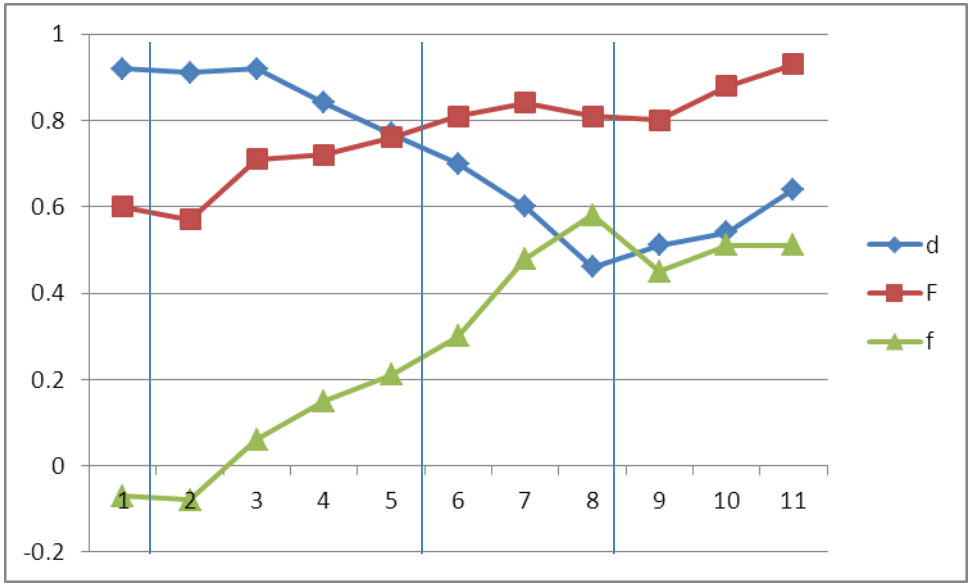


Experiment 2

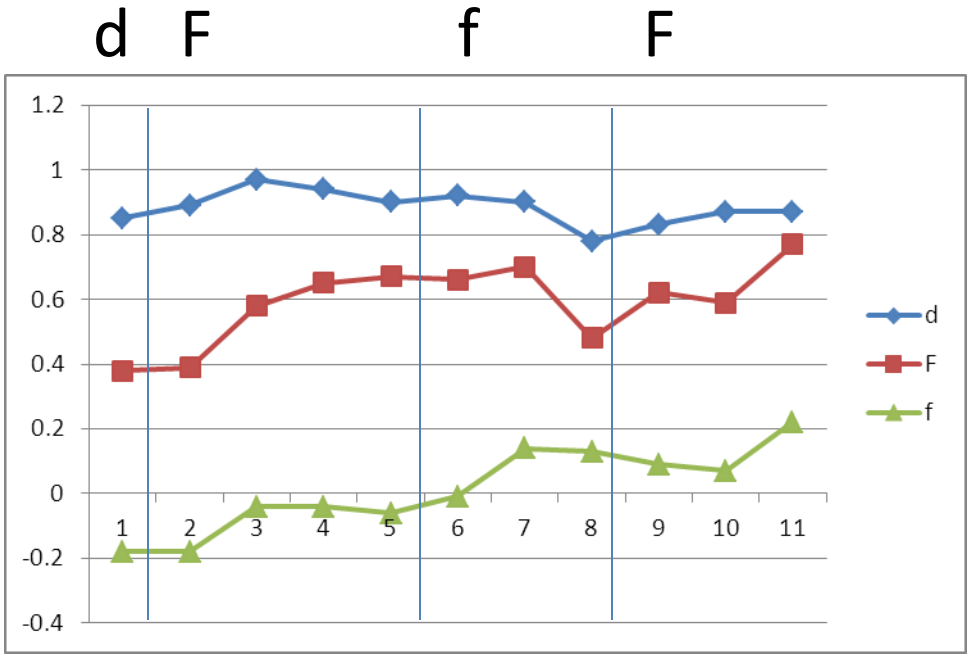
- Blocks of 12 listeners with the same level of musical training complete a Latin square, so that for each trial each of the 12 probes is represented
- We will look at the responses of the 60 listeners with more than 5 years of musical training, and the 60 with no musical training
- We use the ratings to put together tonal profiles that (we hope) will change as the listener progresses through the piece
- We correlate those profiles with the standard profiles for the possible keys that the listener will encounter

76/2 Exp trials 1-3

d F f F

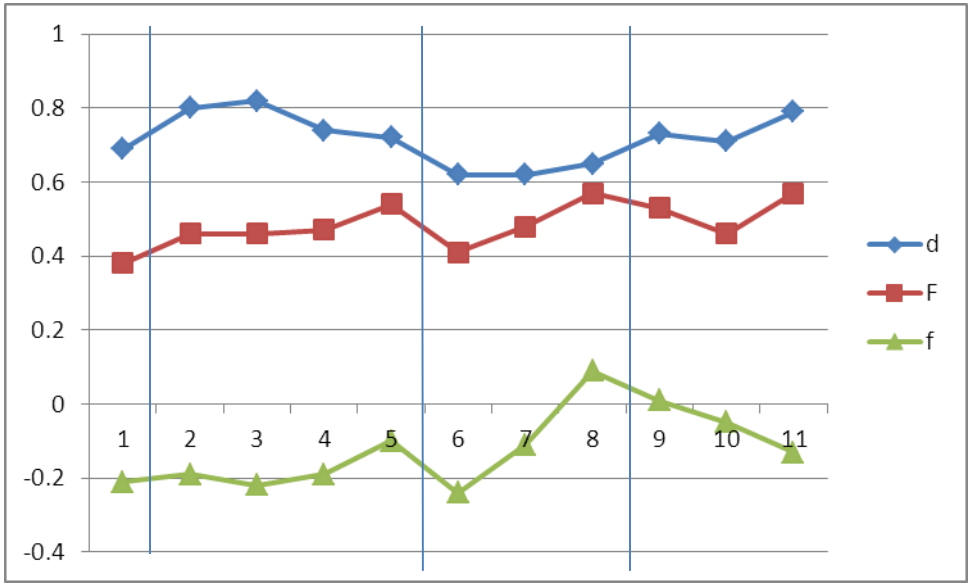


76/2 Exp trials 10-12

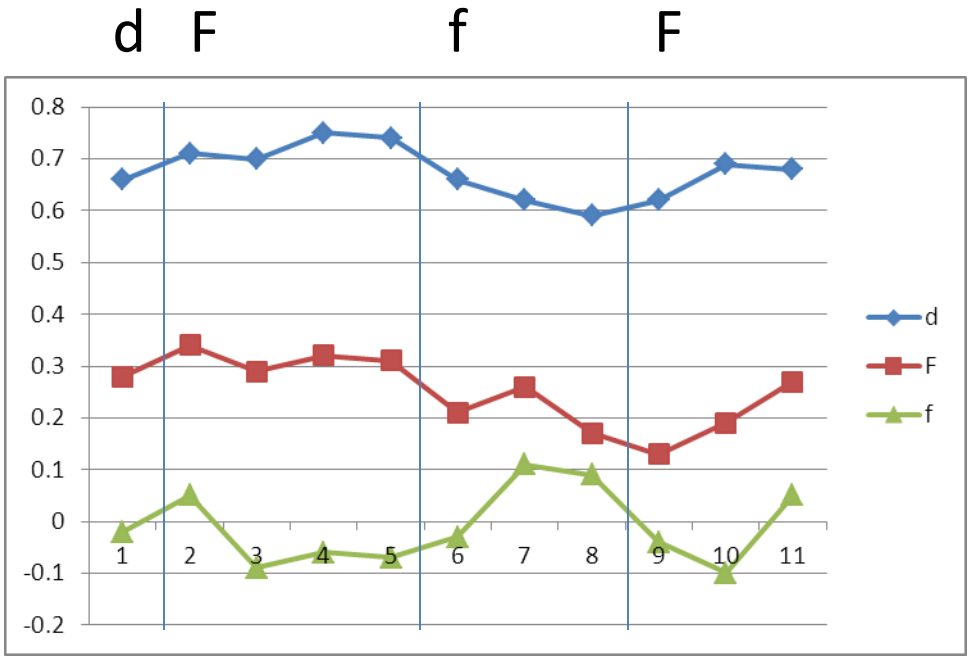


76/2 Inexp trials 1-3

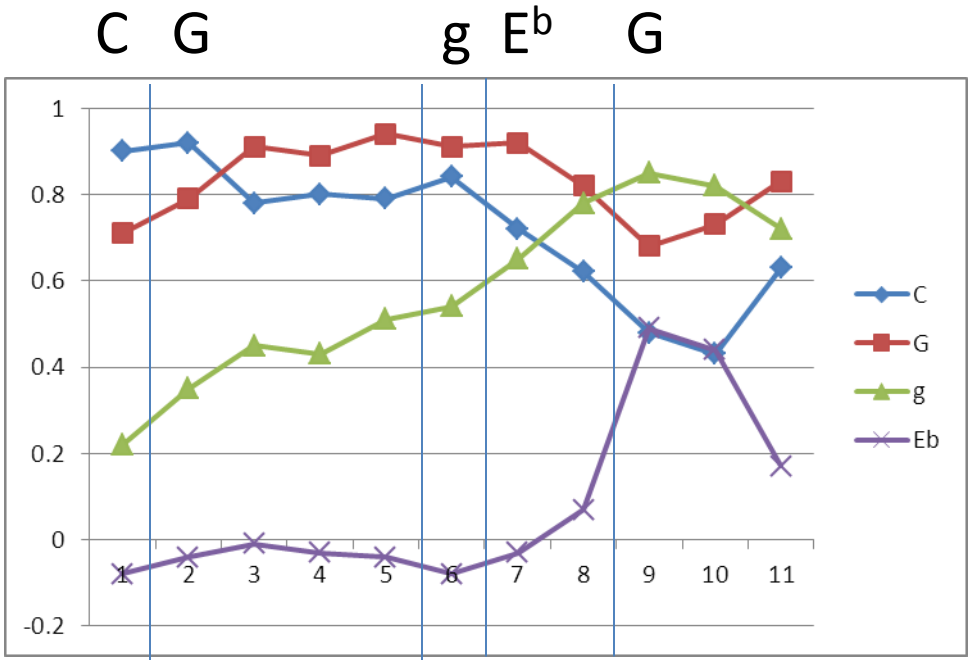
d F f F



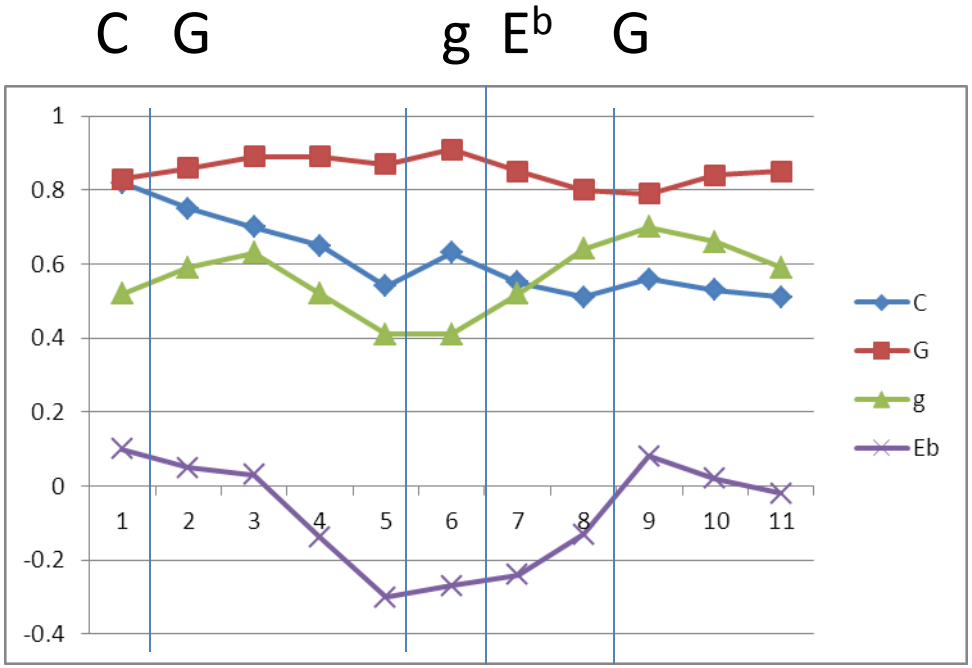
76/2 Inexp trials 10-12



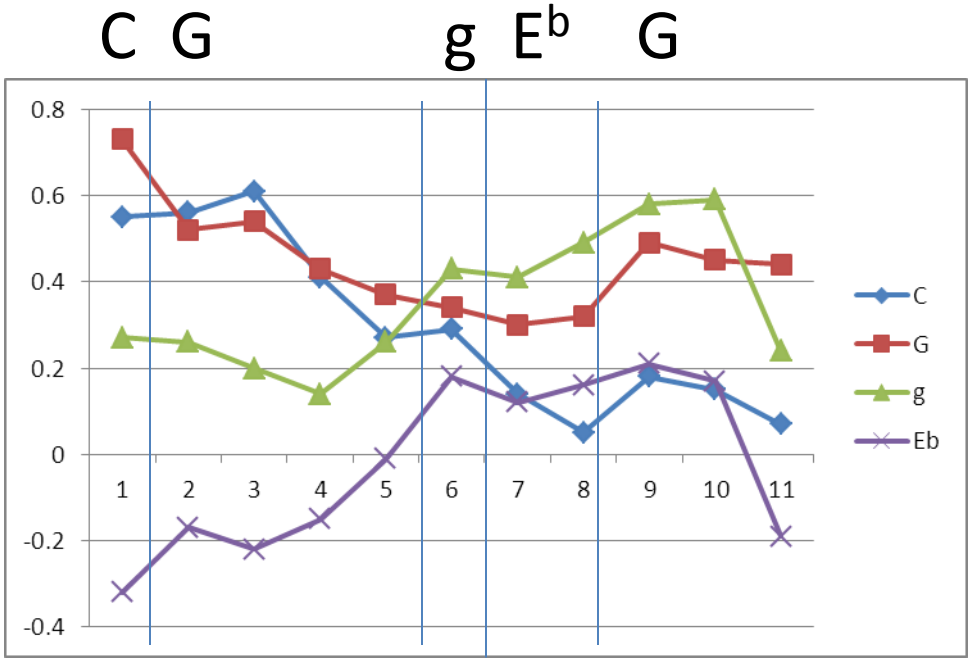
76/3 Exp trials 1-3



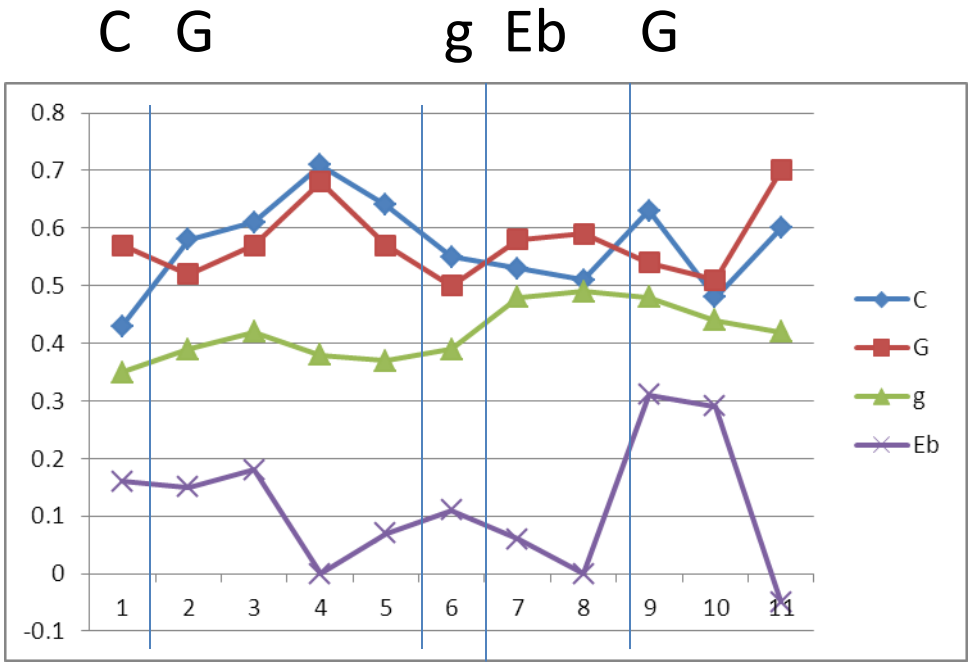
76/3 Exp trials 10-12



76/3 Inexp trials 1-3



76/3 Inexp trials 10-12



Conclusions

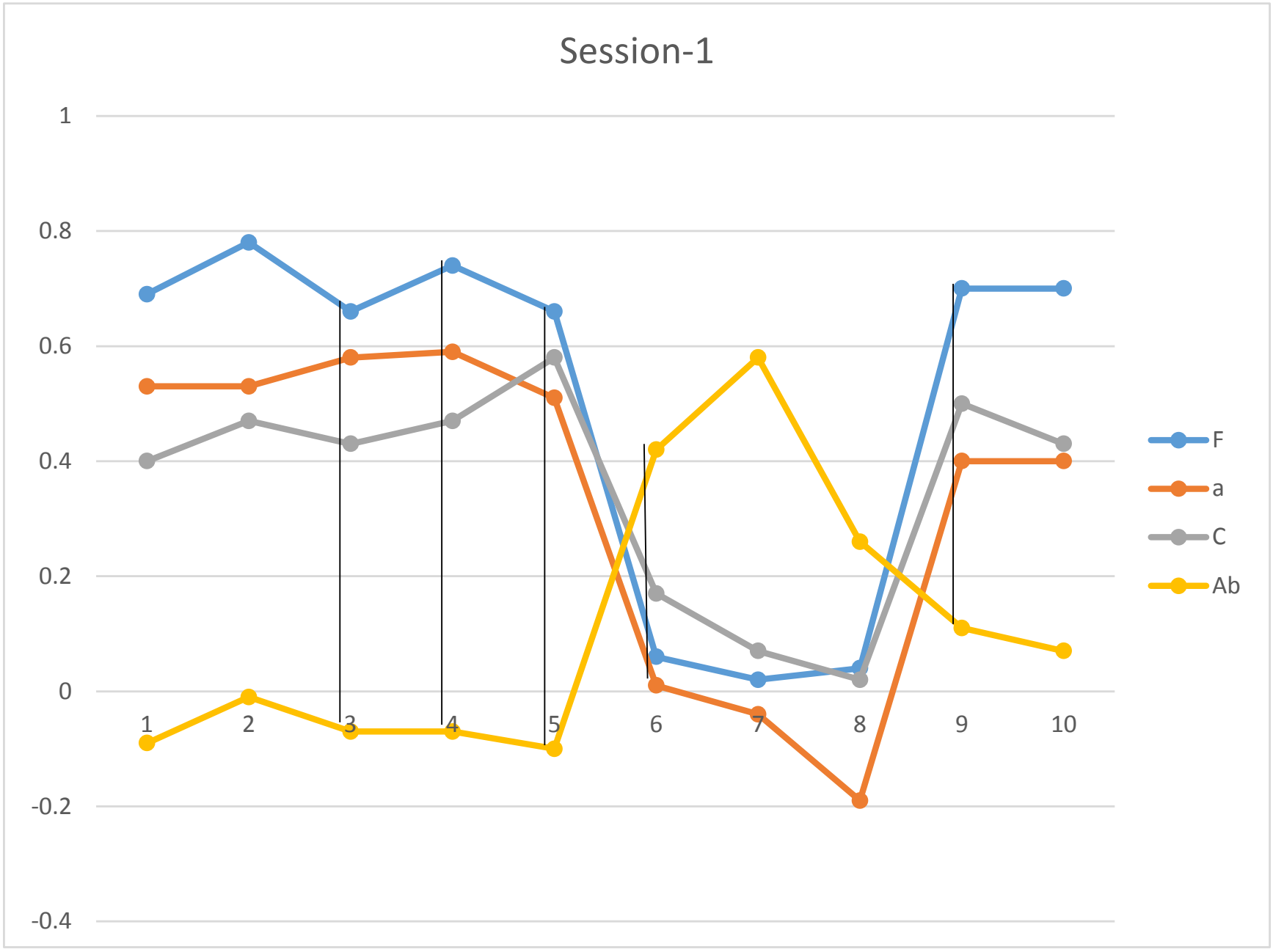
- The more experienced listeners differentiated the changes of key more clearly
- With repeated exposure to the pieces, the sharp differentiation of keys tended to get smoothed out, suggesting that familiarity leads to a more global approach to hearing the piece

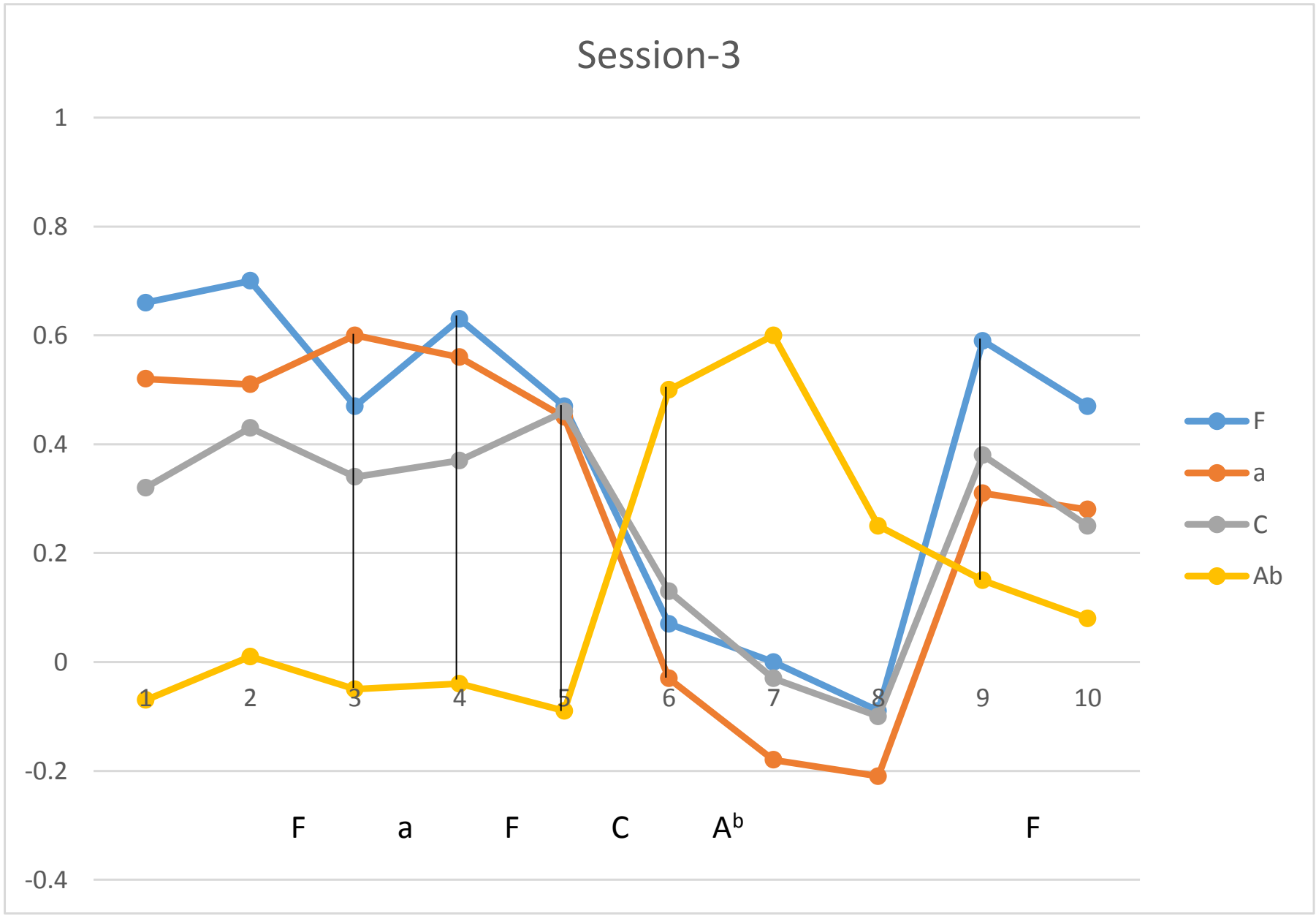
Experiment 3

- This led us to manipulate familiarity even more strongly
- 12 student orchestra members performed the task with a piece they were going to learn, but had not seen yet (the finale of Dvorak's "American" String Quartet)
- Then they did the task in the middle of the semester after practicing the piece for 6 weeks
- Finally the did the task after playing the piece in their concert

Experiment 3

- There were 5 modulations in the first 2 min of the piece, involving 4 keys:
  - F major
  - A minor
  - C major
  - Ab major
- We looked at sessions 1 and 3, where the difference in familiarity was strongest


Session-1
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
1
2
3
4
5
6
7
8
9
10
F
a
C
Ab


Session-3
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
1
2
3
4
5
6
7
8
9
10
F
a
F
C
A^b
F
F
a
C
Ab

Results

- ANOVA: 2 Sessions X 10 Time Periods X 4 Keys
- Strong Period X Key interaction, $F(27,297) = 27.30$, $p<.0001$
- The only interaction involving session was Session X Key, $F(3,33) = 2.39$, $p<.09$, in which the key means were more spread out in Session 1
- This could be taken as a very indirect indication of a global shift, but clearly these listeners started out and finished with quite sharp differentiation among keys

Conclusions

- In some cases there are indications of a tendency toward more global perception with increasing familiarity (Indian vs. Western differentiation of Indian modulations; loss of sharp differentiation throughout session by more experienced musicians)
- Less knowledgeable listeners tend to a more global pattern of response, correctly tracking the principal keys of an excerpt, but not always tracking shifts of key

Conclusions

- However, our attempt at manipulating familiarity with the orchestra members failed to show convincing evidence of a shift from analytic to global perception
- It may be that the demands of playing the piece helped maintain those listeners in their more analytic mode
- This might contrast with familiarity derived from listening, where expected deviations come to blend into their context, with a resulting more global perception of the piece

THANK YOU

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