

# Correlations between Musical Descriptors and Emotions Recognized in Beethoven's *Eroica*

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Listeners often recognize emotion in response to music<sup>1</sup>. The categorical approach sees understands emotion as one of several distinct categories, such as those specified in the Geneva Emotional Music Scale<sup>2</sup>. PHENICX is an interdisciplinary research initiative that analyzes how humans describe music, to develop technology that enhances the listener experience of orchestral music. Our focus is on the *Eroica*, especially the evolution of emotional and musical content over time. The present study utilizes the MIR Toolbox<sup>3</sup> (a set of MATLAB functions that extract musical features from audio) and listener-provided data to quantify the correlation between listeners' perceived emotions from music and 1) musical descriptors, and 2) listeners' backgrounds.

## ► Method

**Participants:** Students, researchers, musicians, and social networking site users of different musical backgrounds and countries (Spain, USA, Japan) (n=26).

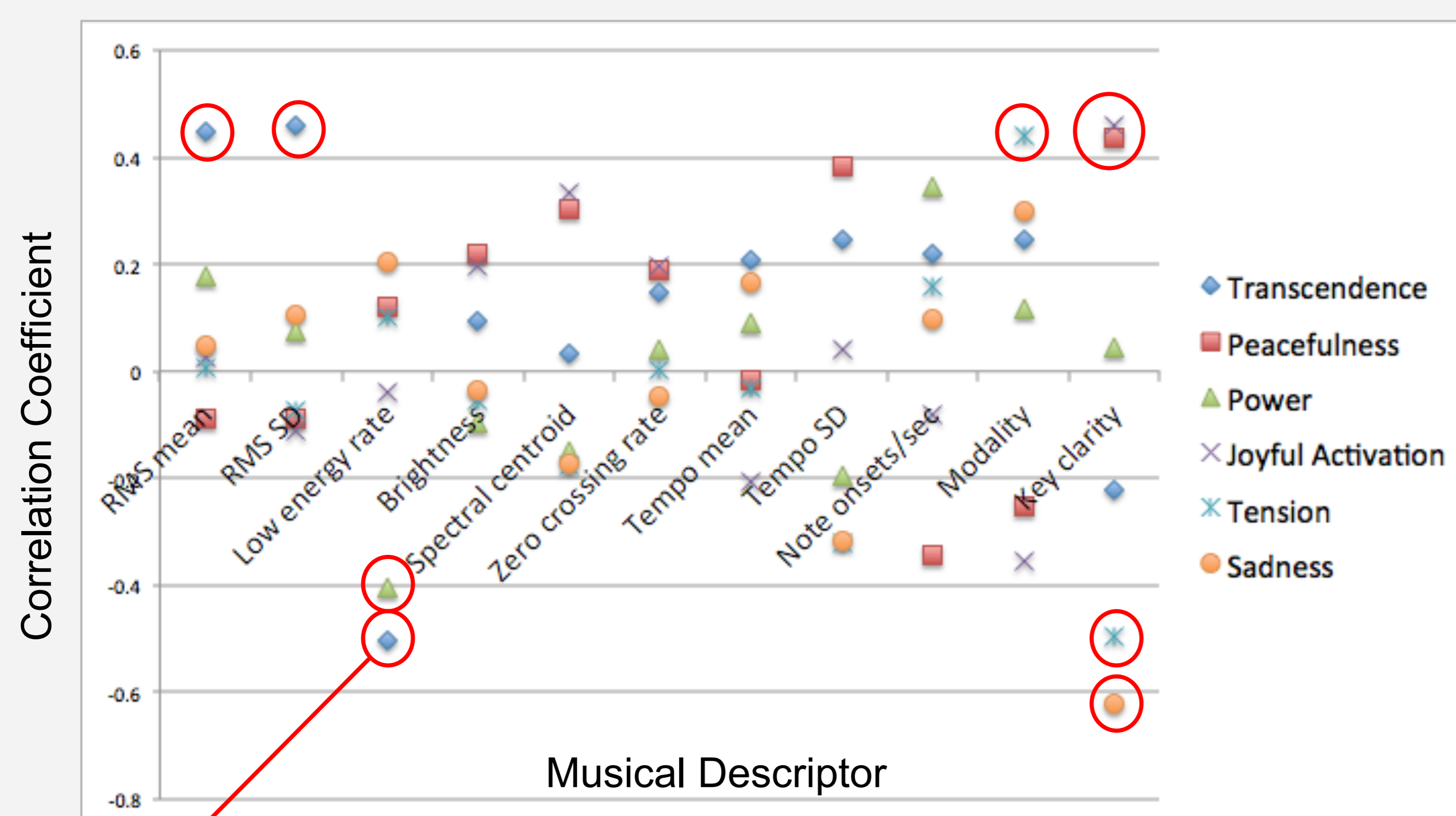
**Stimuli:** Fifteen 11-29 sec excerpts from the *Eroica*.

**Procedure:** Volunteers rate emotional response to excerpts through online survey (offered in English and Spanish), options of six GEMS emotions.

Please listen to Excerpt 1 at <http://www.museofmusic.net/survey/O11.mp3>. Overall, how strongly do you feel... \*

	Not at all	A little	Somewhat	Strongly
Transcendence	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Peacefulness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Power	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Joyful Activation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tension	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sadness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## ► Results: Emotional Ratings and Descriptors



Significant using Pearson statistic, n =26, df = 24, two-sided sig. level 0.05.

Ratings of...	Correlated significantly with...
Transcendence	RMS* mean (+), RMS standard deviation (+), low energy rate (-)
Peacefulness	Key clarity** (+)
Power	Low energy rate (-)
Joyful activation	Key clarity (+)
Tension	Modality (+), Key clarity (-)
Sadness	Key clarity (-)

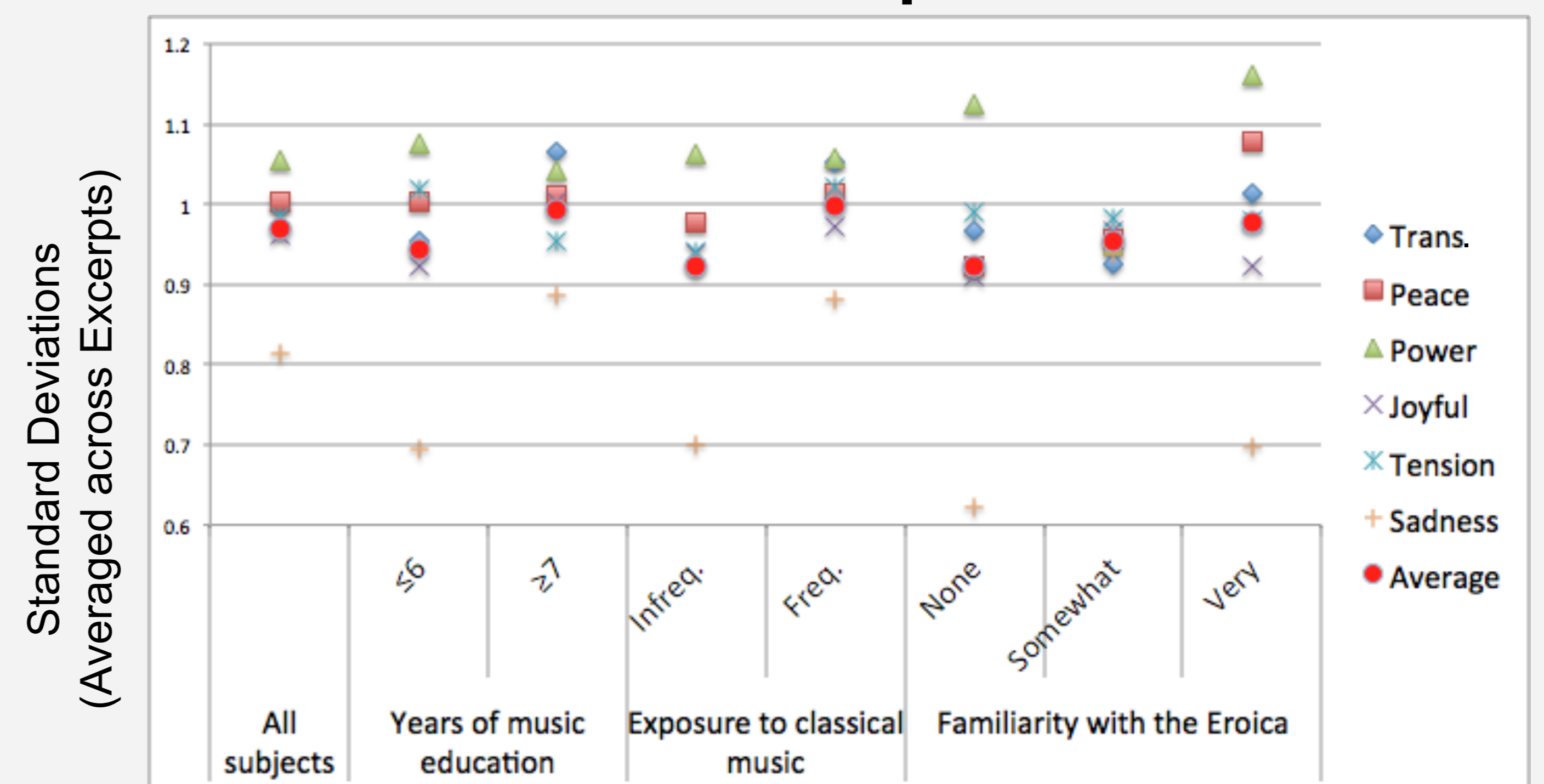
\* RMS: root mean squared (energy).

\*\* Key clarity: key strength of the best musical key candidate.

## ► Conclusions

- Key clarity correlates significantly with listener ratings of peacefulness, joyful activation, tension, and sadness.
- Other significant correlations between emotion ratings and musical descriptors that agree with the literature.
- Listeners of varying backgrounds agree most on their ratings of sadness.
- Significant agreement between listeners who listen to classical music infrequently; and among young listeners (<36 years).

## ► Results: Effect of Musical Experience



- Smaller standard deviation (SD) = more agreement between subjects.
- Sadness ratings have smallest SD between all subjects.
- Subjects who rarely\* listen to classical music show *significantly smaller SD* than subjects who frequently do\*\* (using 2-sample t-test).
- No significant difference in SD between subjects with <6 vs. >7 years of musical education (using 2-sample t-test).
- No significant difference in SD between listeners not/somewhat/very familiar with *Eroica* (using one-way ANOVA).

\* a few times/year or fewer; \*\* a few times/month or more

## ► Results: Effect of Demographic Background



- Subjects younger than 36 show *significantly smaller SD* than older subjects.
- No significant differences in SD between subjects of different countries of origin (one-way ANOVA) & gender (2-sample t-test).

## ► Implications & Future Work

- Listeners of similarly *unmusical* backgrounds, and listeners of young ages, recognize similar emotions to same music.
- Listeners with more musical experience recognize different emotions to the same music. Caused by personal biases?
- Test larger, more diverse group of subjects; test different musical genres.
- Applications:
  - automatically generated playlists that portray certain emotions.
  - share comments on music with users of similar profile/demographic.
  - music therapy.



Full paper available at  
<http://mtg.upf.edu/node/3251>