A Personality-based Adaptive System for Visualizing Classical Music Performances

Markus Schedl, Mark Melenhorst, Cynthia C.S. Liem, Agustín Martorell, Óscar Mayor, Marko Tkalcic

http://www.cp.jku.at
A Personality-based Adaptive System for Visualizing Classical Music Performances

- Performances as Highly Enriched and Interactive Concert Experiences
- Aims at making classical concerts appealing to new audiences, in particular, the younger generation
- Social media as a means to create user profiles and elaborate personalized music information and recommendation systems (pre-, during-, post-concert experiences)
- Motivate fans of classical music to use social media
To create a **personalized** music information system, in this case a **music visualization system**.

For personalization, we model listeners in terms of **personality traits**, according to the Big Five Inventory (BFI): Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism.
Overview

- Visualizations for classical music in PHENICX
- Investigating personality-based preferences for visualizations
- Personalized music visualization system
- Evaluation and conclusions
Visualizations for classical music

Score Follower
Visualizations for classical music

Score Follower
Visualizations for classical music

Orchestra Layout
Visualizations for classical music

Orchestra Layout
Visualizations for classical music

Structure Visualization

- Beethoven - Symphony n.9
- Movement IV
- Introduction, theme & variations
- Scherzo
- Meditation
- Fugato finale
- Intro
- Recitative & Citations
- Theme & Variations (instrumental)
- Theme
- var.1
- var.2
- var.3
- closing
- Intro
- Theme & Variations (vocal)
- Theme
- var.1
- var.2
- Recitative & Citations
- I
- Recitative
- II
- Recitative
- III
- Recitative
- IV
- Recitative
Visualizations for classical music
Structure Visualization

Exposition

<table>
<thead>
<tr>
<th>Theme 1</th>
<th>Theme 2</th>
<th>Theme 3</th>
<th>Closing</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>C</td>
<td>F</td>
<td>I</td>
</tr>
<tr>
<td>A'</td>
<td>D</td>
<td>G</td>
<td>J</td>
</tr>
<tr>
<td>B</td>
<td>E</td>
<td>H</td>
<td>K</td>
</tr>
<tr>
<td>A''</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Exposition | Exposition | Development | Recapitulation

1:00 | 2:00 | 3:00 | 5:00 | 10:00 | 15:00
Investigating personality-based preferences for visualizations

User study to investigate relationship between personality traits and preference for visualization

Experimental setup:

- Personality traits assessed by 44-items BFI questionnaire
- Preference assessed by pragmatic quality (technical, complicated, impractical, cumbersome, unpredictable, confusing, unruly)
- Study conducted via Amazon Mechanical Turk
- 185 participants, paid 1.50$, task lasted 17 minutes on average
- Between-subject design
- Participants first filled in the BFI-44 questionnaire, then were shown a demo video of the assigned visualization (Beethoven’s 9th symphony), and asked to answer the pragmatic quality questions on a 7-point scale
Investigating personality-based preferences for visualizations

Correlation analysis between personality traits and pragmatic quality ratings revealed several moderate, significant correlations ($p < 0.03$):

<table>
<thead>
<tr>
<th>Visualization</th>
<th>Personality Trait</th>
<th>Rating Question</th>
<th>Correlation</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score Follower</td>
<td>Conscientiousness</td>
<td>cumbersome-direct</td>
<td>0.30</td>
<td>0.02184</td>
</tr>
<tr>
<td>Score Follower</td>
<td>Extraversion</td>
<td>pragmatic quality (overall)</td>
<td>0.36</td>
<td>0.00633</td>
</tr>
<tr>
<td>Score Follower</td>
<td>Agreeableness</td>
<td>lame-exciting</td>
<td>0.31</td>
<td>0.01727</td>
</tr>
<tr>
<td>Score Follower</td>
<td>Agreeableness</td>
<td>pragmatic quality (overall)</td>
<td>0.32</td>
<td>0.01637</td>
</tr>
<tr>
<td>Structure Visualization</td>
<td>Extraversion</td>
<td>technical-human</td>
<td>0.30</td>
<td>0.01540</td>
</tr>
<tr>
<td>Structure Visualization</td>
<td>Agreeableness</td>
<td>technical-human</td>
<td>0.33</td>
<td>0.00729</td>
</tr>
<tr>
<td>Structure Visualization</td>
<td>Agreeableness</td>
<td>impractical-practical</td>
<td>0.45</td>
<td>0.00019</td>
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<tr>
<td>Structure Visualization</td>
<td>Agreeableness</td>
<td>cumbersome-direct</td>
<td>0.38</td>
<td>0.00207</td>
</tr>
<tr>
<td>Structure Visualization</td>
<td>Agreeableness</td>
<td>confusing-clear</td>
<td>0.42</td>
<td>0.00052</td>
</tr>
<tr>
<td>Structure Visualization</td>
<td>Agreeableness</td>
<td>unruly-manageable</td>
<td>0.42</td>
<td>0.00065</td>
</tr>
</tbody>
</table>
A Personality-based Adaptive System for Visualizing Classical Music Performances

**Personalized music visualization system**

- Real system that was implemented into the “RCO Editions” mobile application for enhanced experience of concerts
- Users won’t answer 44 BFI questions before using the system
- Cross-correlations between BFI-44 and PQ scores to select two questions with highest absolute correlation:

  BFI-7:  “I see myself as someone who is helpful and unselfish with others.”

  BFI-18: “I see myself as someone who tends to be disorganized.”

![Correlation Matrix Image]
Personalized music visualization system

**Recommending visualization:**
- Cluster users with respect to their answers to BFI-7 and -18
- Split at median value into lo-lo, lo-hi, hi-lo, and hi-hi groups
Personalized music visualization system

Recommending visualization:
• Cluster users with respect to their answers to BFI-7 and -18
• Split at median value into lo-lo, lo-hi, hi-lo, and hi-hi groups
• Each cluster has its own preferred visualization

<table>
<thead>
<tr>
<th>Personality Cluster</th>
<th>1(^{st}) Rank</th>
<th>2(^{nd}) Rank</th>
<th>3(^{rd}) Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>lo-lo</td>
<td>Orchestra Layout</td>
<td>Structure Visualization</td>
<td>Score Follower</td>
</tr>
<tr>
<td>lo-hi</td>
<td>Orchestra Layout</td>
<td>Structure Visualization</td>
<td>Score Follower</td>
</tr>
<tr>
<td>hi-lo</td>
<td>Structure Visualization</td>
<td>Orchestra Layout</td>
<td>Score Follower</td>
</tr>
<tr>
<td>hi-hi</td>
<td>Score Follower</td>
<td>Orchestra Layout</td>
<td>Structure Visualization</td>
</tr>
</tbody>
</table>
Personalized music visualization system

Recommendation visualization:

- Cluster users with respect to their answers to BFI-7 and -18
- Split at median value into lo-lo, lo-hi, hi-lo, and hi-hi groups
- Each cluster has its own preferred visualization
- New users are assigned to a cluster based on their answers and recommended the visualization preferred by similar users

- Prototype: http://bird.cp.jku.at/phenicx_visrecsys/index.php
Evaluation

Experimental setup:
- User study conducted via Amazon Mechanical Turk
- 79 participants, paid 0.35$, task lasted 3 minutes on average
- Participants first asked two questions (BFI-7 and -18), then shown the three visualizations (in randomized order) and asked to rank them after having watched video of each for at least 20 seconds

Performance measure: normalized discounted cumulative gain (nDCG)

Results:
- nDCG = 0.87 for our personalized approach
- nDCG = 0.82 for random ranking
- nDCG = 0.69 for worst possible ranking
- Differences statistically significant (t-test at p = 0.03)
Conclusions

• Investigated three visualizations for classical orchestra performances: Score Follower, Orchestra Layout, and Structure Visualization

• User study on relationship between personality traits (BFI) and visualization preferences (PQ) showed substantial correlations

• Two most significant BFI questions used to cluster users and build a personality-based adaptive system to order the different visualizations

• User study showed that personalized approach is preferred over non-personalized (nDCG, t-test)