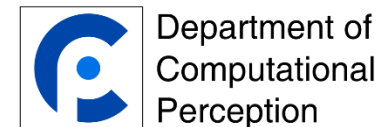


# A Personality-based Adaptive System for Visualizing Classical Music Performances



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

<http://www.cp.jku.at>



Symphony No. 3

Allegro con brio. (♩ = 60)

Flauti 1, 2  
Oboi 1, 2  
Clarinetti 1, 2 in B $\flat$   
Fagotti 1, 2  
Corni 1, 2 in E $\flat$

**PHENICX**  
Performances as Highly Enriched  
aNd Interactive Concerts eXperiences

- FISCHER
- SCORE
- BAR TO BAR



00:15

- 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

## Aim

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

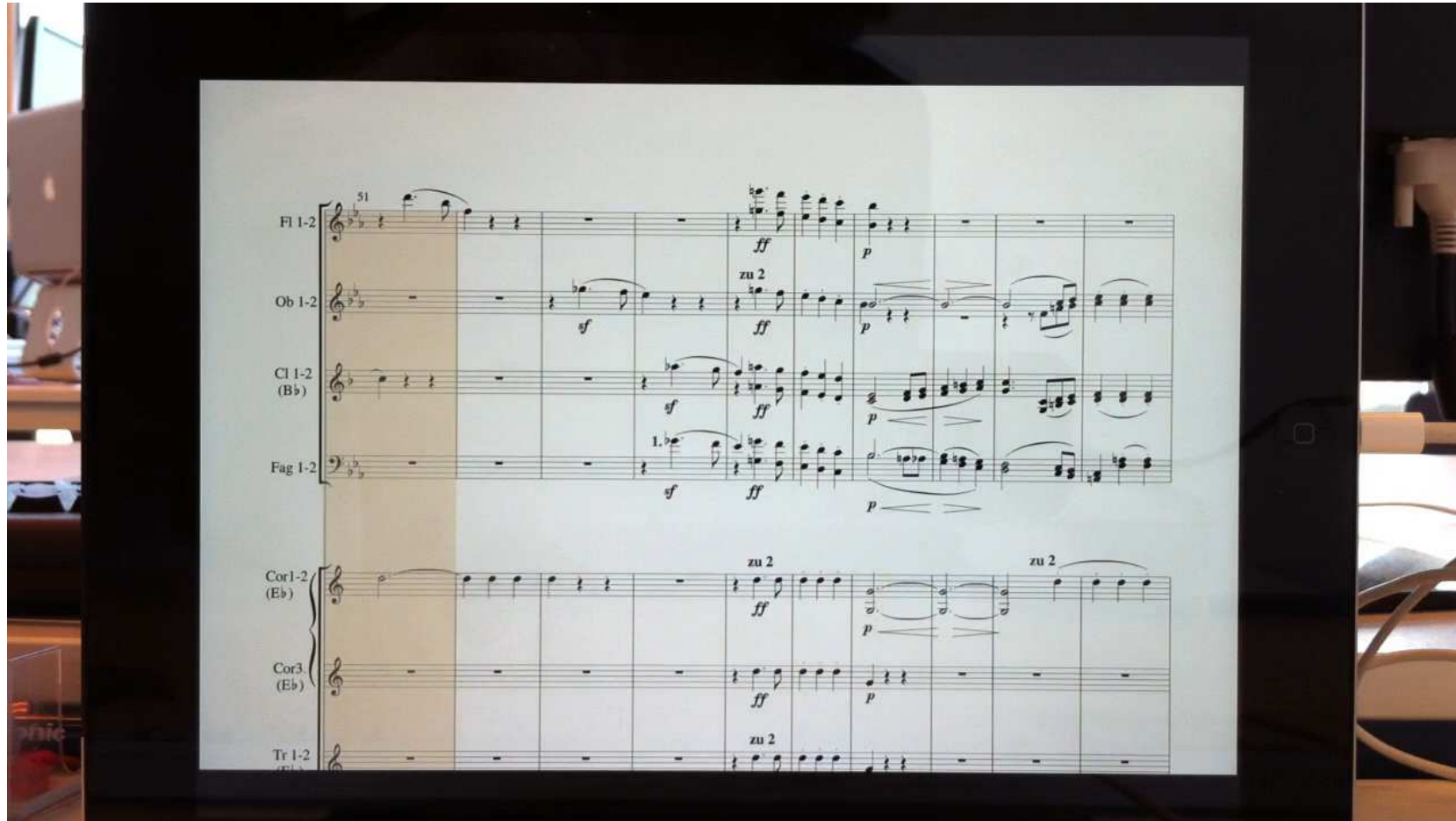
- Visualizations for classical music in PHENICX
- Investigating personality-based preferences for visualizations
- Personalized music visualization system
- Evaluation and conclusions

# Visualizations for classical music

## Score Follower

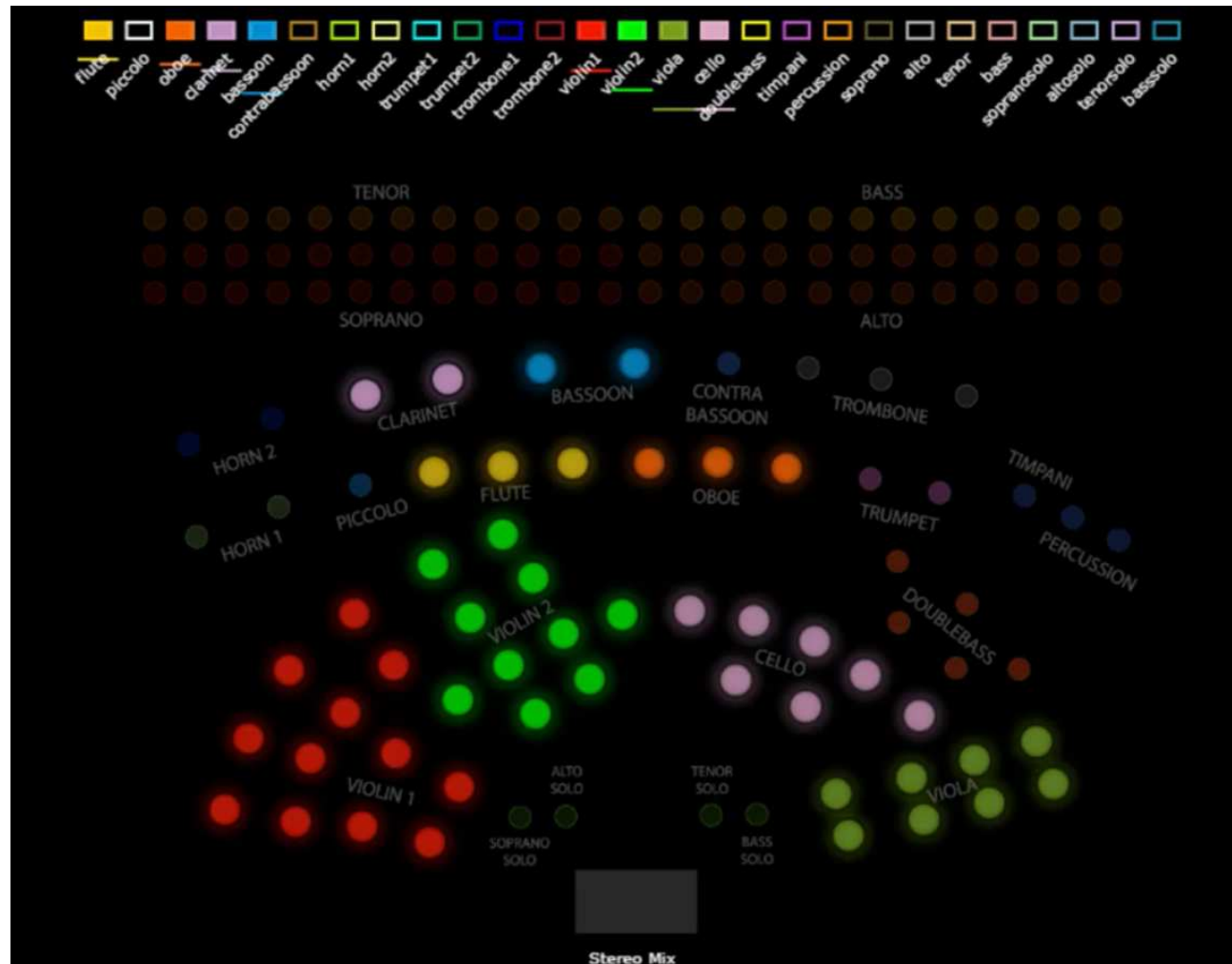
The image shows a page of a classical music score, likely from a symphony. The score is written for a full orchestra and includes the following instruments: Flauti (Flutes), Oboi (Oboes), Clarinetti (Clarinets), Fagotti (Bassoons), Contrafagot (Contrabassoon), Corni (Horns), Trombe (Trumpets), Timpani (Timpani), Violini I (Violins I), Violini II (Violins II), Viole (Violas), Cello (Cello), and Contrabbassi (Double Basses). The score is in 3/4 time and is marked "Allegro ma non troppo" and "Tempo I". A blue box highlights a section of the score, specifically the measures from approximately 24 to 30. The score is written in a standard musical notation with a key signature of one flat (B-flat) and a common time signature of 3/4. The highlighted section shows a complex rhythmic pattern in the lower strings and woodwinds, with the cellos and double basses playing a prominent role.

# Visualizations for classical music Score Follower



# Visualizations for classical music

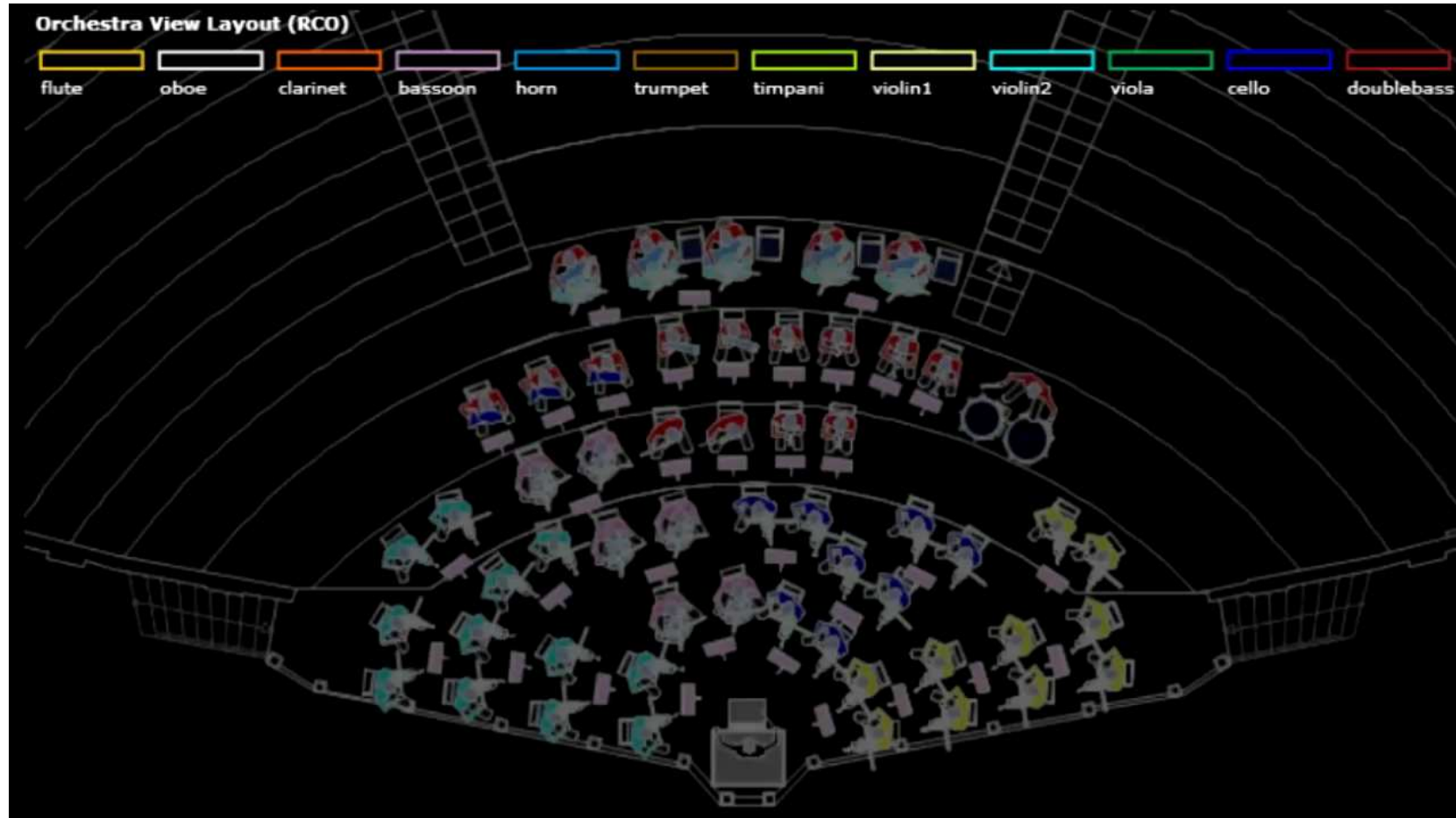
## Orchestra Layout





# Visualizations for classical music

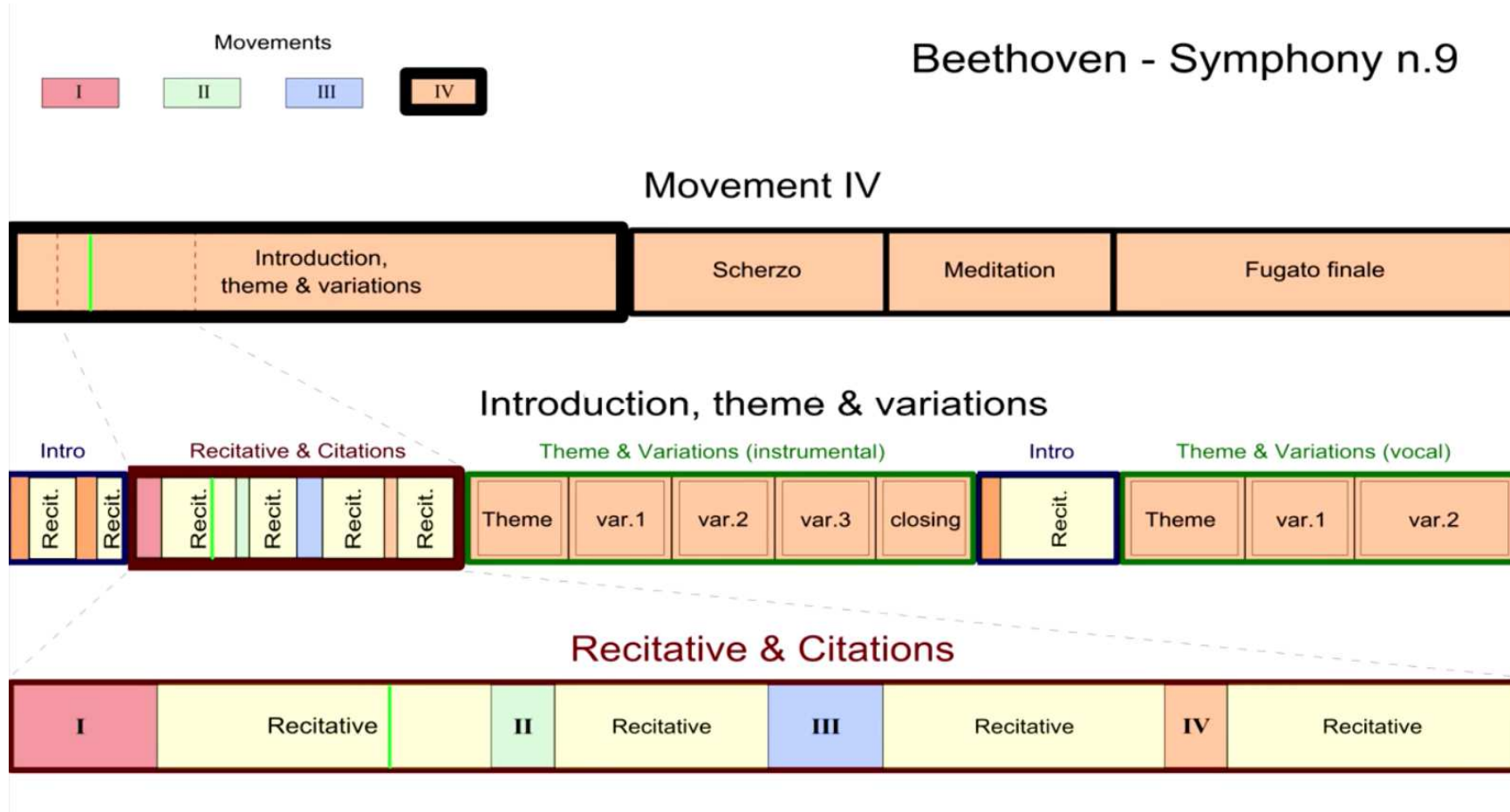
## Orchestra Layout





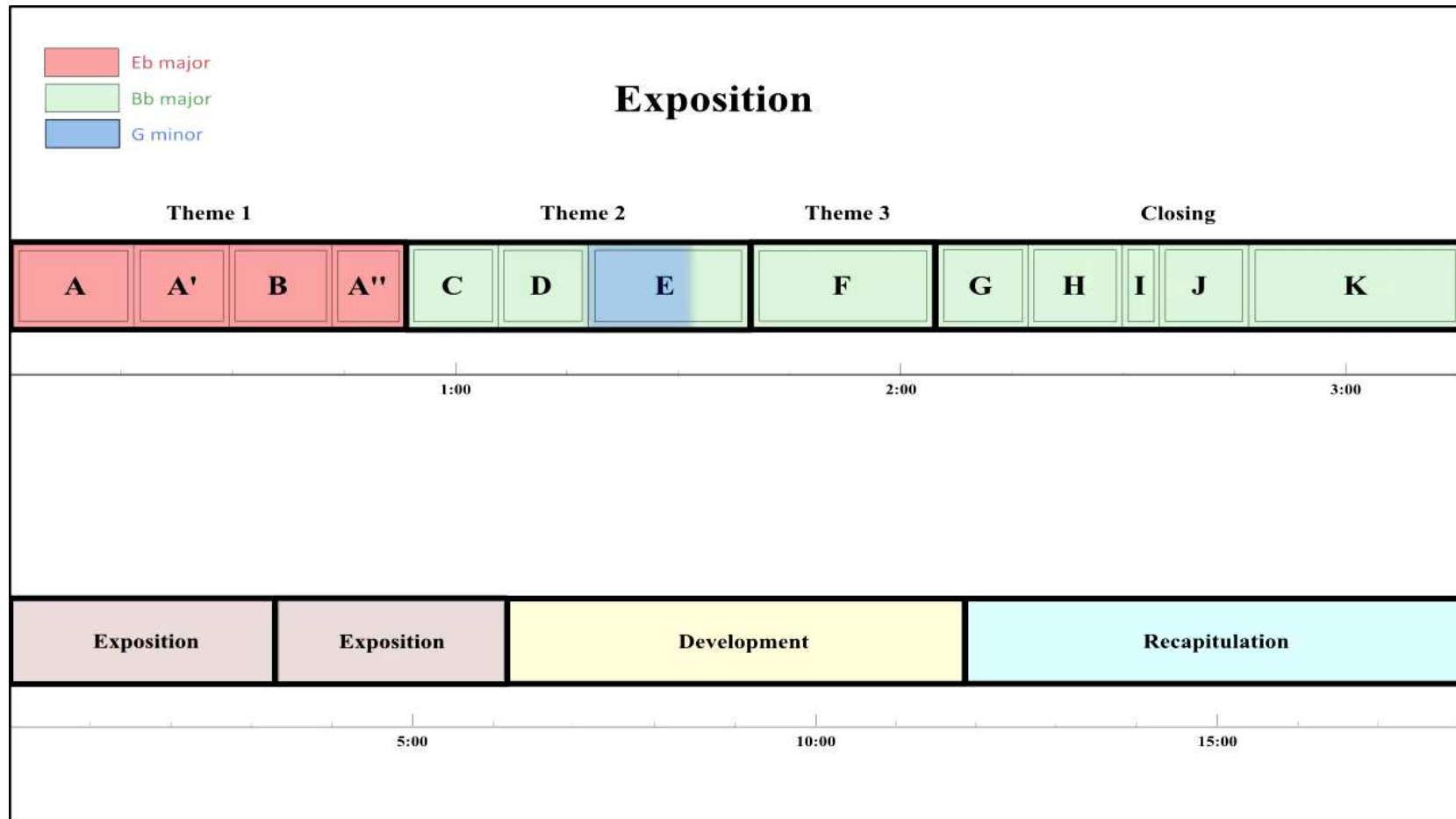
# Visualizations for classical music

## Structure Visualization



# Visualizations for classical music

## Structure Visualization



# 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 9<sup>th</sup> 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 ( $p < 0.03$ ):

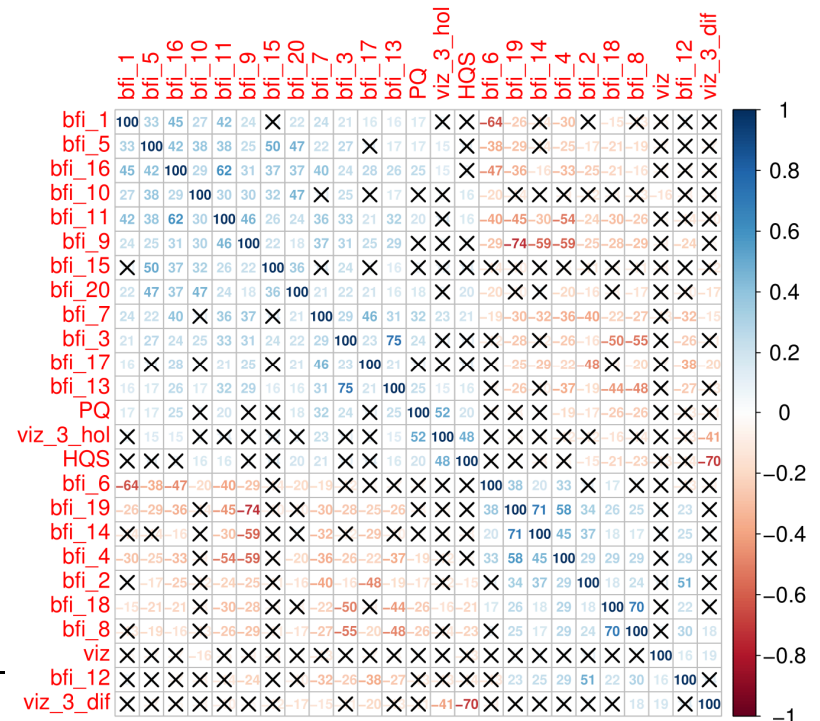
Visualization	Personality Trait	Rating Question	Correlation	p-value
Score Follower	Conscientiousness	cumbersome-direct	0.30	0.02184
Score Follower	Extraversion	pragmatic quality (overall)	0.36	0.00633
Score Follower	Agreeableness	lame-exciting	0.31	0.01727
Score Follower	Agreeableness	pragmatic quality (overall)	0.32	0.01637
Structure Visualization	Extraversion	technical-human	0.30	0.01540
Structure Visualization	Agreeableness	technical-human	0.33	0.00729
Structure Visualization	Agreeableness	impractical-practical	0.45	0.00019
Structure Visualization	Agreeableness	cumbersome-direct	0.38	0.00207
Structure Visualization	Agreeableness	confusing-clear	0.42	0.00052
Structure Visualization	Agreeableness	unruly-manageable	0.42	0.00065

# 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.”

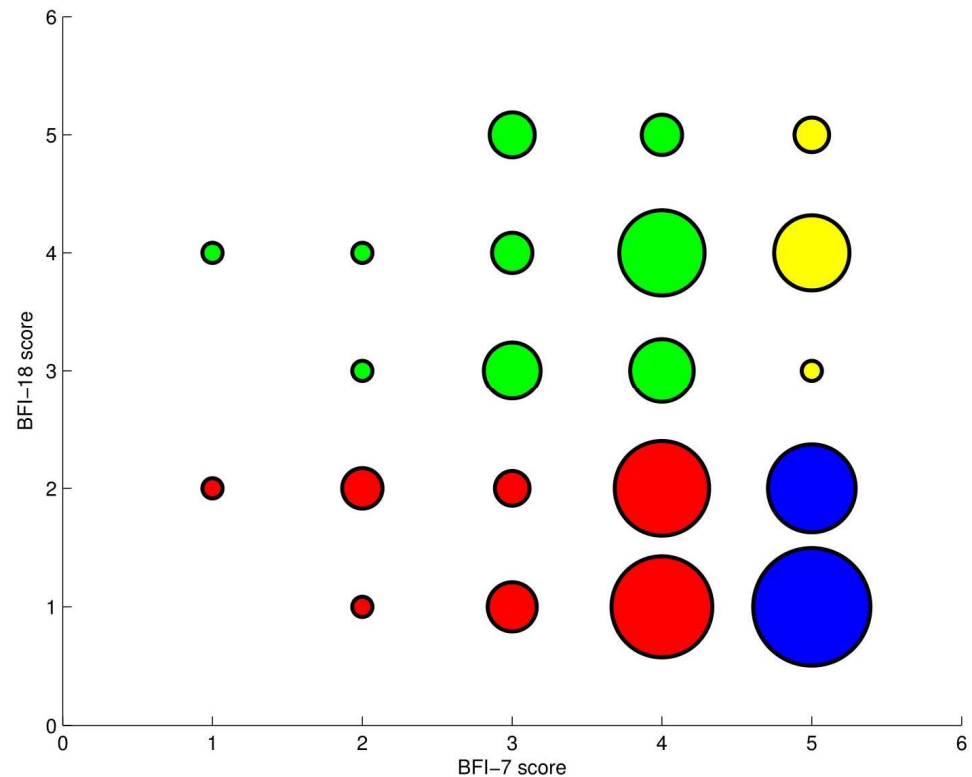
BFI-18: “I see myself as someone who tends to be disorganized.”



# 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





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- Each cluster has its own preferred visualization

Personality Cluster	1 <sup>st</sup> Rank	2 <sup>nd</sup> Rank	3 <sup>rd</sup> Rank
lo-lo	Orchestra Layout	Structure Visualization	Score Follower
lo-hi	Orchestra Layout	Structure Visualization	Score Follower
hi-lo	Structure Visualization	Orchestra Layout	Score Follower
hi-hi	Score Follower	Orchestra Layout	Structure Visualization

# 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
- 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](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)

