

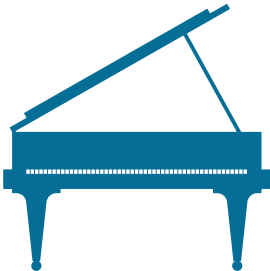




**JOHANNES KEPLER  
UNIVERSITY LINZ**







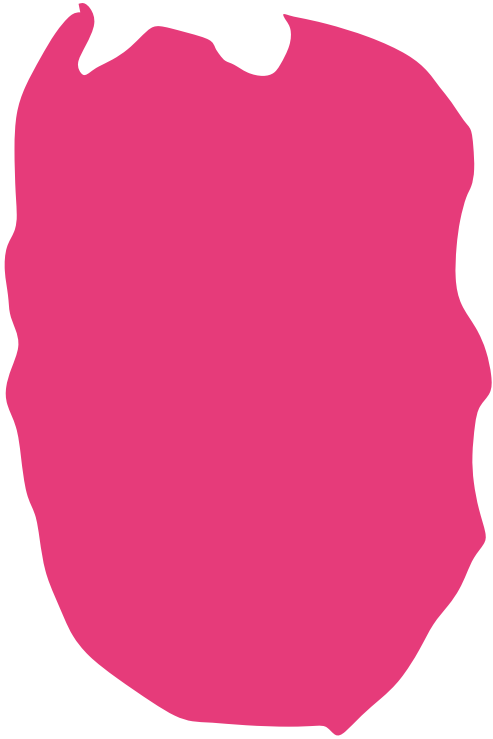
Introduction































# Adagio sostenuto.

Si deve suonare tutto questo pezzo delicatissimamente e senza sordini.

The musical score is written for piano on a grand staff. The key signature is D major (two sharps: F# and C#). The time signature is common time (C). The tempo is Adagio sostenuto. The first staff (treble clef) contains three measures of music. The first measure has a common time signature 'C' and a key signature change to D major. The second and third measures each contain a triplet of eighth notes, indicated by a '3' above the notes. The second staff (bass clef) contains three measures. The first measure has a common time signature 'C' and a key signature change to D major. The second and third measures each contain a half note, indicated by a '1/2' below the note. The text *sempre pp e senza sordini.* is written below the first staff. The entire score is enclosed in a large bracket on the left side.

*sempre pp e senza sordini.*

Composer

Score

Performer















# Introduction

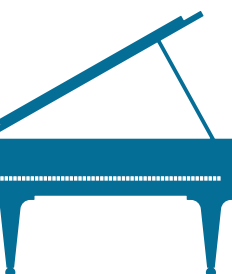
Composer



Score



Performer





# Sorting Musical Expression: Characterization of Descriptions of Expressive Piano Performances

Carlos Cancino-Chacón<sup>1,4</sup>, Silvan Peter<sup>1</sup>, Shreyan Chowdhury<sup>1</sup>, Anna Aljanaki<sup>2</sup> and Gerhard Widmer<sup>1,3</sup>

<sup>1</sup>Institute of Computational Perception, Johannes Kepler University Linz, Austria

<sup>2</sup>Institute of Computer Science, University of Tartu, Estonia

<sup>2</sup>LIT AI Lab, Linz Institute of Technology, Linz, Austria

<sup>4</sup>RITMO Centre for Interdisciplinary Studies in Rhythm, Time and Motion, University of Oslo, Norway



## The *Con Espressione* Game

**Research Aims:** Find the dimensions of musical expression that can be attributed to a performance, as perceived and described in natural language by listeners

- Web based questionnaire: verbal descriptors of expressive performance.
- Different performances of 9 classical piano pieces (45 performances)
- Dataset enriched with score-to-performance alignments

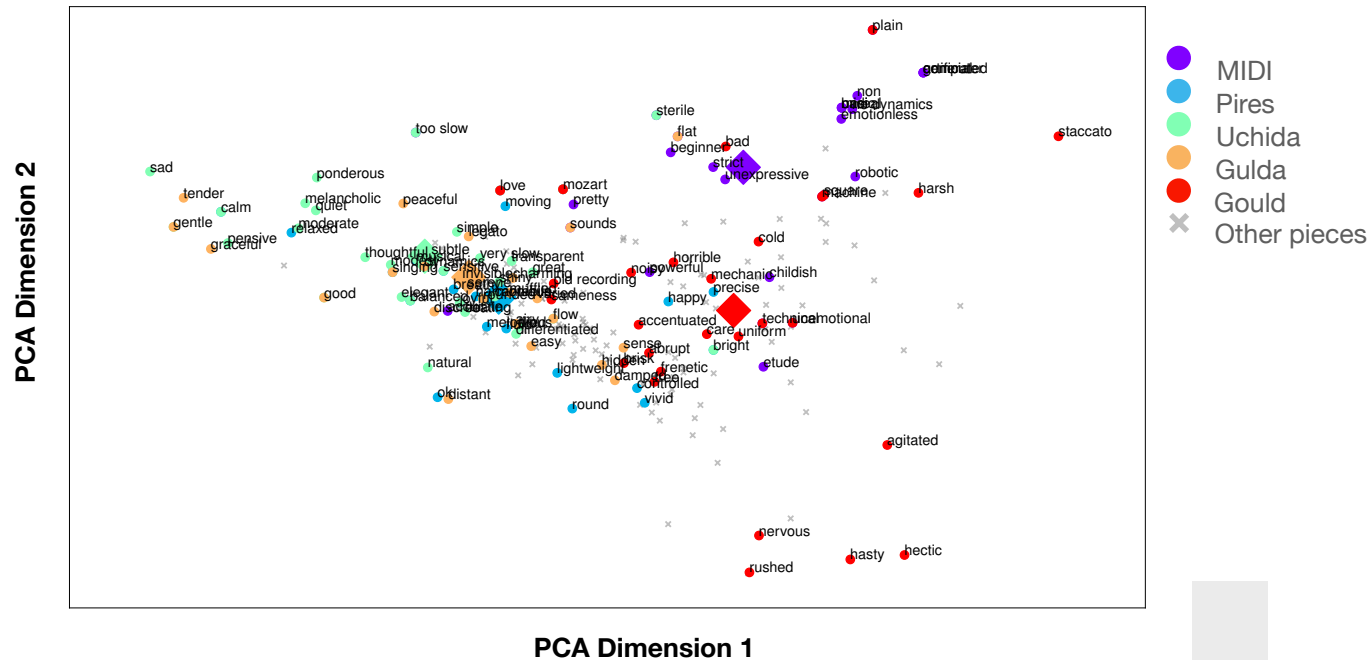
Composer	Piece	#	Pianists
Bach	Prelude No.1 in C, BWV 846 (WTC I)	7	Giesecking, Gould, Grimaud, Kempff, Richter, Stadtfeld, MIDI
Mozart	Piano Sonata K.545 C major, 2nd mvt.	5	Gould, Gulda, Pires, Uchida, MIDI deadpan
Beethoven	Piano Sonata Op.27 No.2 C# minor, 1st mvt.	6	Casadesus, Lazić, Lim, Gulda, Schiff, Schirmer
Schumann	Arabeske Op.18 C major (excerpt 1)	4	Rubinstein, Schiff, Vorraber, Horowitz
Schumann	Arabeske Op.18 C major (excerpt 2)	4	Rubinstein, Schiff, Vorraber, Horowitz
Schumann	Kreisleriana Op.16; 3. Sehr aufgeregt (ex 1)	5	Argerich, Brendel, Horowitz, Vogt, Vorraber
Schumann	Kreisleriana Op.16; 3. Sehr aufgeregt (ex 2)	5	Argerich, Brendel, Horowitz, Vogt, Vorraber
Liszt	Bagatelle sans tonalité, S.216a	4	Bavouzet, Brendel, Katsaris, Gardon
Brahms	4 Klavierstücke Op.119, 2. Intermezzo E minor	5	Angelich, Ax, Serkin, Kempff, Vogt

## What are the main dimensions for expressive character?

Principal component analysis (PCA) on the occurrence matrix of the terms and find 4 principal dimensions

Dimension 1				Dimension 2			
positive correlation		negative correlation		positive correlation		negative correlation	
hectic	0.17	sad	-0.20	rushed	0.22	hard	-0.19
staccato	0.15	gentle	-0.18	nervous	0.20	stumbling	-0.18
hasty	0.15	tender	-0.18	too fast	0.17	staccato	-0.17
agitated	0.14	calm	-0.16	bit	0.16	ponderous	-0.14
irregular	0.14	graceful	-0.16	hasty	0.15	monotonous	-0.13

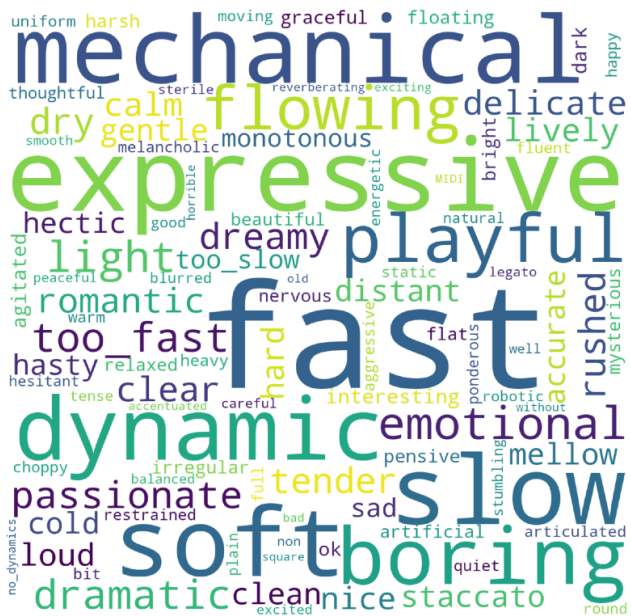
Dimension 3				Dimension 4			
positive correlation		negative correlation		positive correlation		negative correlation	
monotonous	0.22	heavy	-0.14	ok	0.24	cold	-0.15
bad	0.17	graceful	-0.13	happy	0.21	warm	-0.14
warm	0.16	smooth	-0.12	joyful	0.19	floating	-0.14
peaceful	0.16	ponderous	-0.12	free	0.15	blurred	-0.14
beautiful	0.15	soaring	-0.10	breathy	0.14	mysterious	-0.13



## How similarly do listeners describe the performance of a piece?

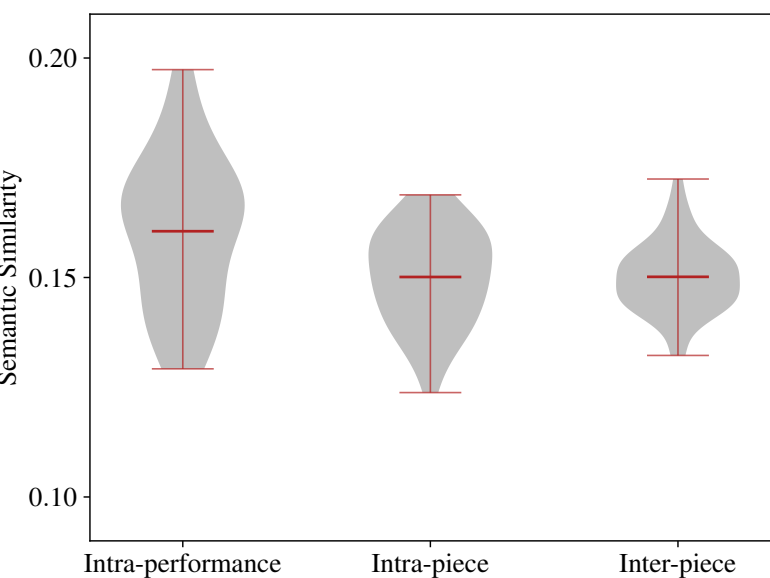
### Distribution of Terms

- 94 participants (on average listened to 4.5 out of 9 pieces)
- 88% had some musical training
- 1,515 individual descriptions, 3,166 terms (45% unique)



### Semantic Similarity

- Semantic similarity for short sentences by [Li et al., 2007]
- **Intra-performance:** same piece, same pianist
- **Intra-piece:** same piece, other pianists
- **inter-piece:** other pieces



## Pile Sorting Experiment

### Participants

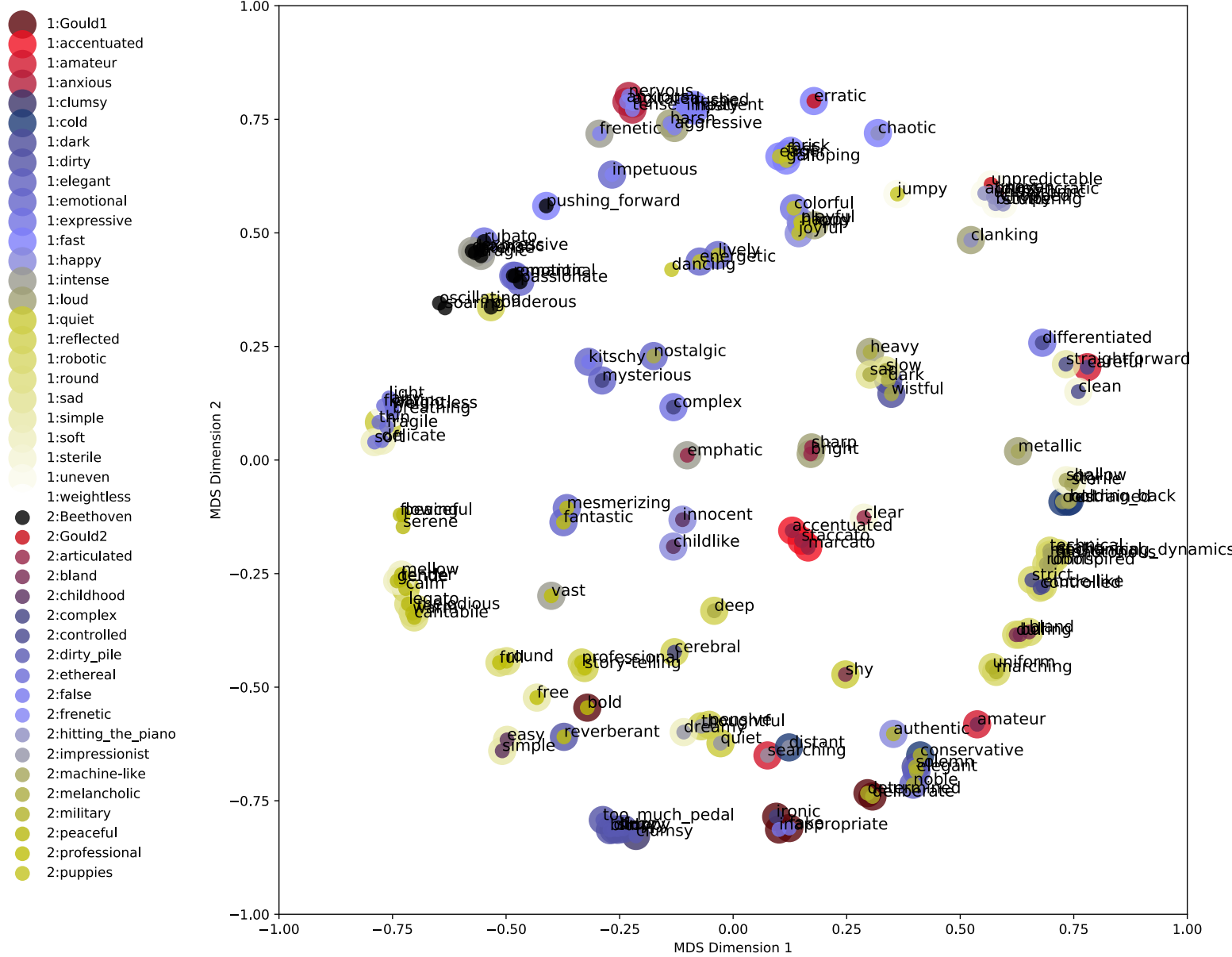
- Two groups of expert musicians (G1 and G2)
- Each group sorted (independently) 150 of the most frequently used terms that had been collected through the CEG.
- The number of piles as well as the types of similarity within the piles were left open.



Explore the interactive visualization!

### Results

- G1 (25 piles), G2 (19 piles)
- Average maximal overlap (Szymkiewicz-Simpson coefficient):
  - 62 % piles G1 with piles G2
  - 65% piles G2 with piles G1
- Multidimensional Scaling (MDS) to explore the structure of the terms



## Get the Dataset!



### Acknowledgements

This research has received support from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme under grant agreement No. 670035 (project "Con Espressione") and by the Research Council of Norway through its Centers of Excellence scheme, project number 262762 and the MIRAGE project, grant number 287152.



# The *Con Espressione* Game

- Online questionnaire where participants listened to several performances of the same classical piano piece.
- <1500 descriptions (by 190 participants)
- 45 piano performances (9 pieces, 4-7 performances per piece)

Composer	Piece	#	Pianists
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