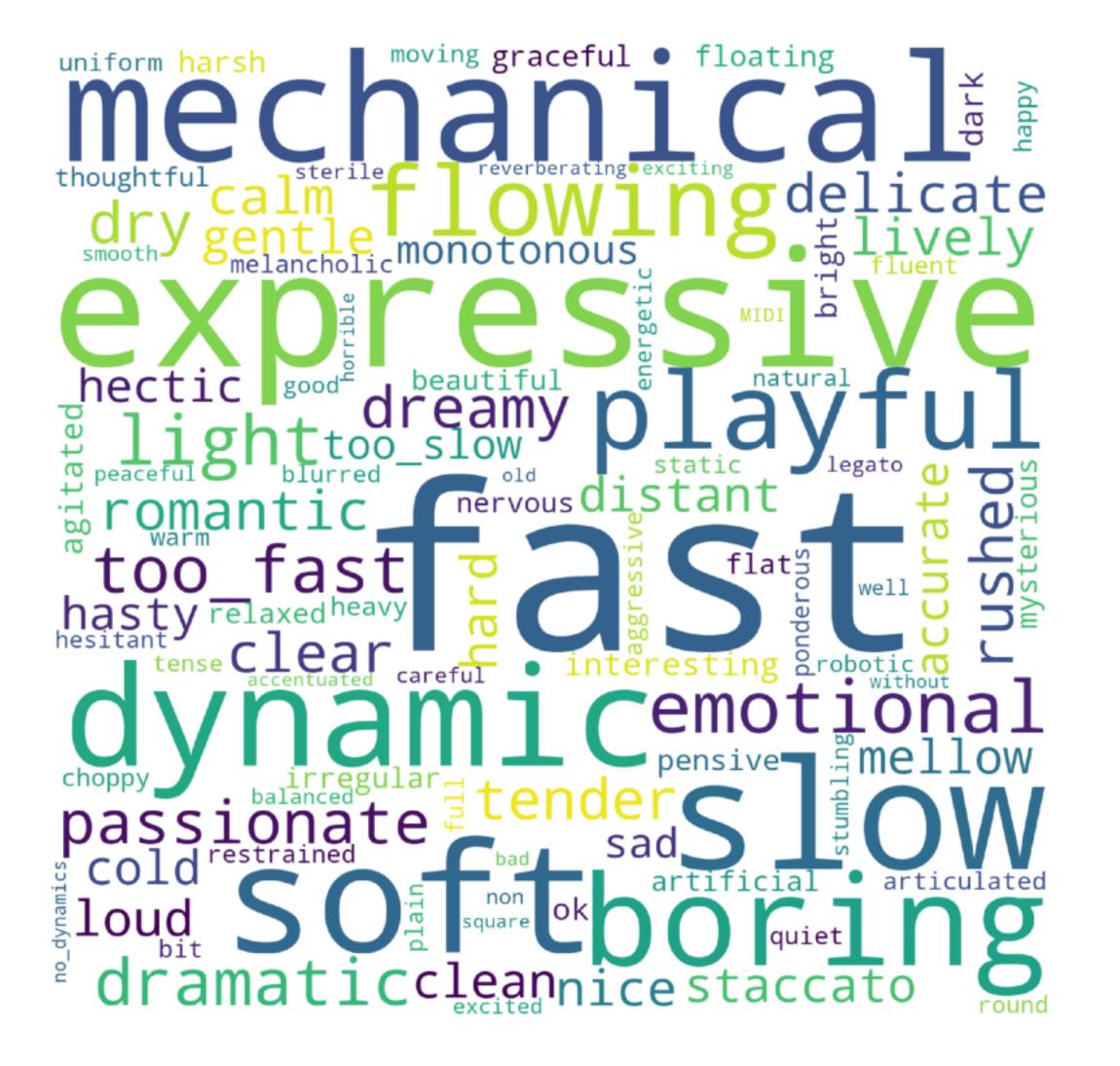
# **Participants**

- 190 participants
- 88% with musical education (median: 9 years)
  - 71% play the piano, 35% play the piano "quite well"
- 49% frequently listen to Western classical music



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

- >1,500 individual descriptions
  - >3,100 terms
  - >1,400 are unique (around 45%)





# 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>

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















# 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

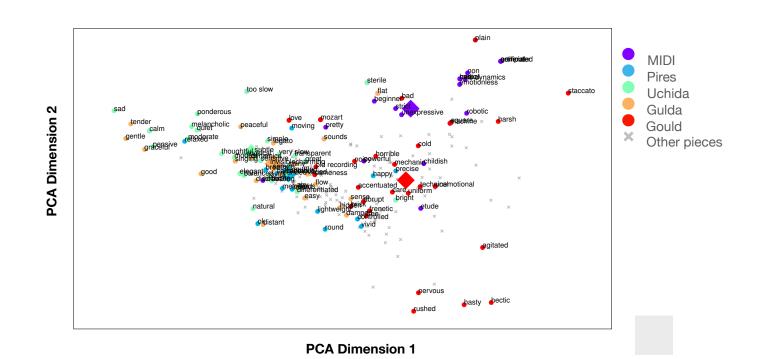
- · Web based questionnaire: verbal descriptors of expressive performance.
- Different performances of 9 classical piano pieces (45 performances)
- Dataset enriched with score-to-performance alignments

Composer	Piece	#	Pianists
Bach	Prelude No.1 in C, BWV 846 (WTC I)	7	Gieseking, 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

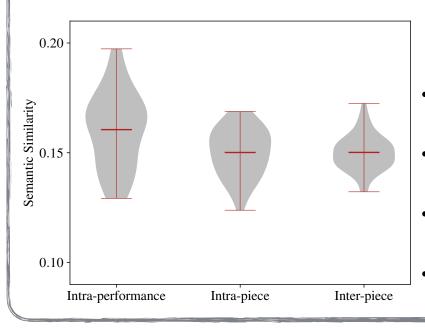
	Dimer	nsion 1		Dimension 2				
positive correlation		negative correlation		positive correlation		negative correlation		
hectic	0.17	sad	-0.20	rushed	0.22	hard	-0.19	
staccato	0.15	gentle	-0.18	nervous	0.20	stumbling	-0.18	
hasty	0.15	tender	-0.18	too fast	0.17	staccato	-0.17	
agitated	0.14	calm	-0.16	bit	0.16	ponderous	-0.14	
irregular	0.14	graceful	-0.16	hasty	0.15	monotonous	-0.13	
	Dime	nsion 3		Dimension 4				
positive com	relation	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!**



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Council (ERC) under the European Union's Horizon 2020 research and 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.



