

“The Olde Ghost” – Acoustic Correlates of Historic Perception of “Eerie” Music

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Background

Previously, we proposed that written accounts of 19th-century listeners provide ecologically valid data on **historic music perception**, by analyzing 381 written accounts of musical passages described using the expressive qualities (codes) “*uncanny*” or “*eerie*” (Hentschel & Cui, 2022).

Building on this approach, semantic music dimensions can be **modeled** by extracting **audio features** from musical signals, offering a link between subjective descriptions and objective acoustic properties (see e.g. Czedik-Eysenberg, 2021).

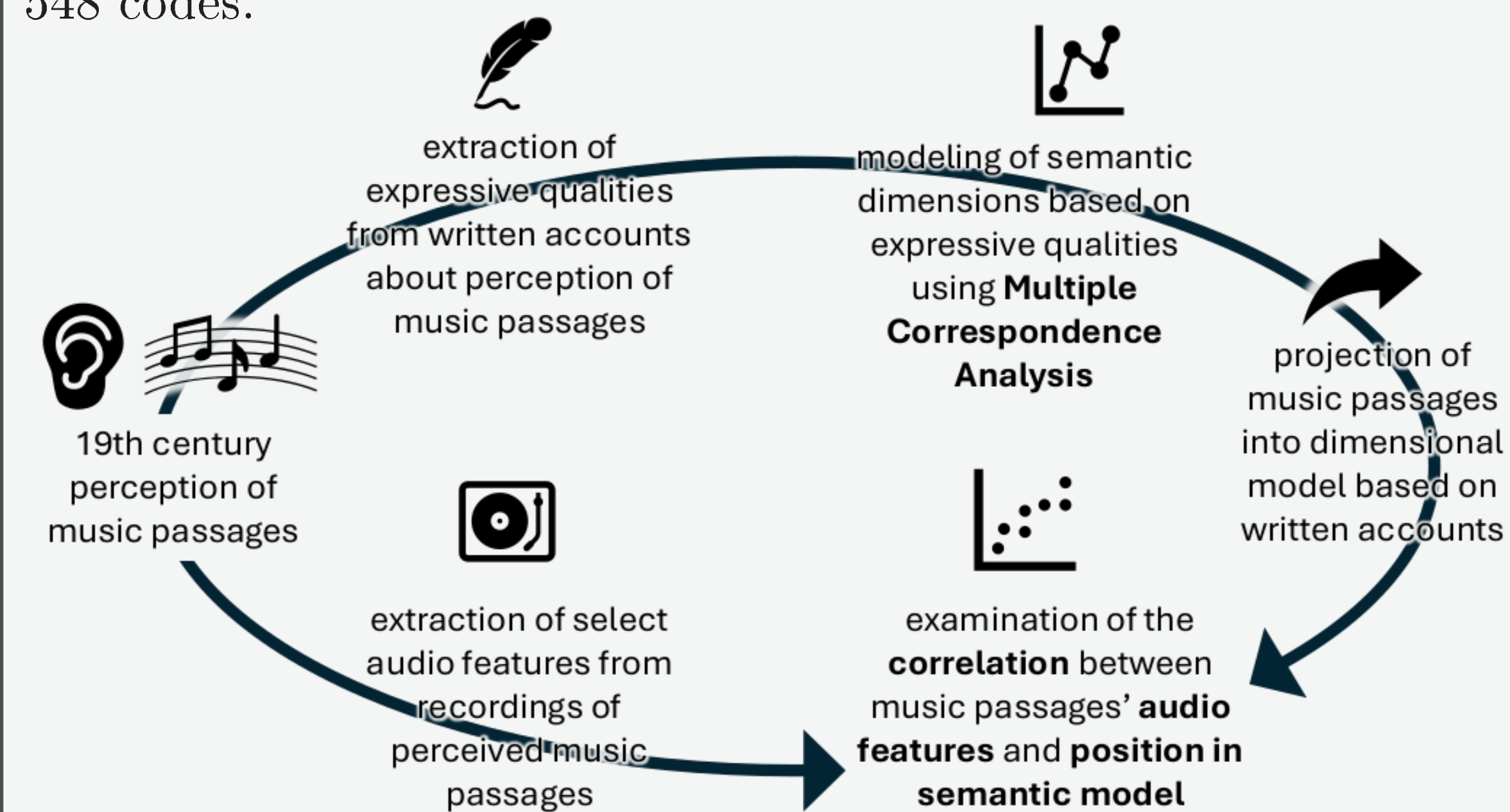
Aims

To address this, we investigate the following questions:

- What are the primary **semantic dimensions** that structure the described expressive qualities based on their co-occurrence in descriptions of the same musical works?
- How do the historical descriptions **manifest acoustically** with regards to specific **audio features** (e.g. *dynamics*, *timbre measures*, *usage of specific instruments*, ...)?

Methods

We explore the acoustic manifestation of the codes in these descriptions by analyzing **audio-feature correlations** of the associated 112 musical passages with **semantic dimensions**, obtained from a **multiple correspondence analysis (MCA)** based on 548 codes.

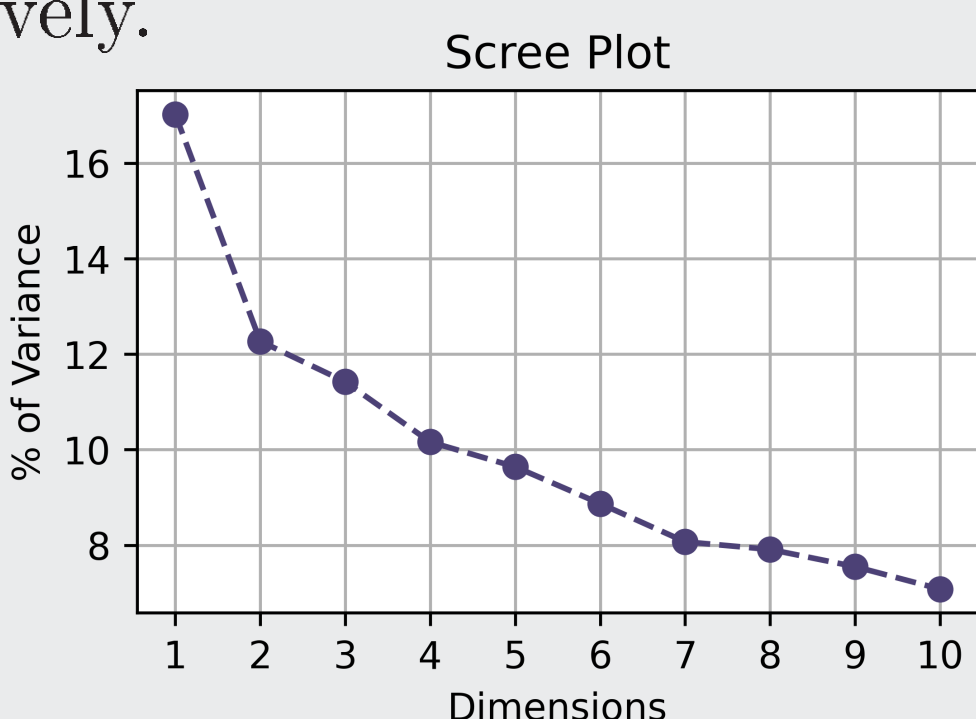


Multiple Correspondence Analysis (MCA)

MCA was conducted via the Prince package (Halford, 2022) in Python. Codes were considered **active** or **passive**, if the expressive qualities were used in reference to at least **5%** or **1%** of the music passages respectively.

Based on the scree plot, we selected the first **two dimensions** of the MCA solution.

Music passages were then projected into the MCA solution based on the descriptive codes used.



Audio Feature Extraction & Correlation Analysis

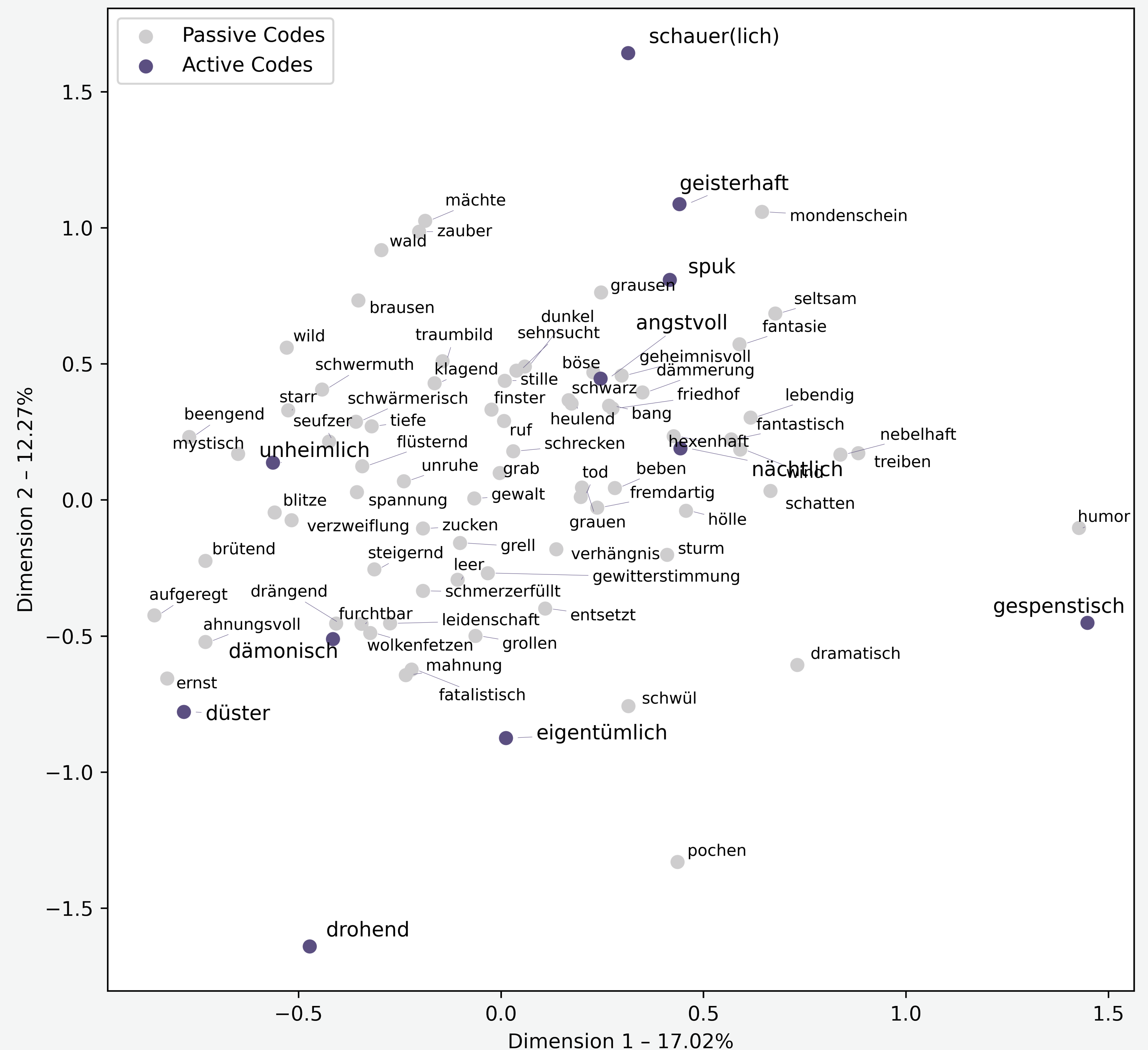
Music passages' coordinates along the resulting MCA dimensions were tested for **correlations (Pearson)** with audio features extracted from recordings of the passages.

The following variables were included in the analysis: **loudness** (ITU-R BS.1770-4), **spectral centroid**, **spectral bandwidth**, **spectral contrast**, **mode** (minor to major) **harmonic clarity** (based on Tonnetz representation), **tempo**, **inter-onset variability** (standard deviation of inter-onset intervals) and the estimated probability of occurrence of **flute**, **violin**, **piano**, **harp**, **drums**, **strings** and **voice**.

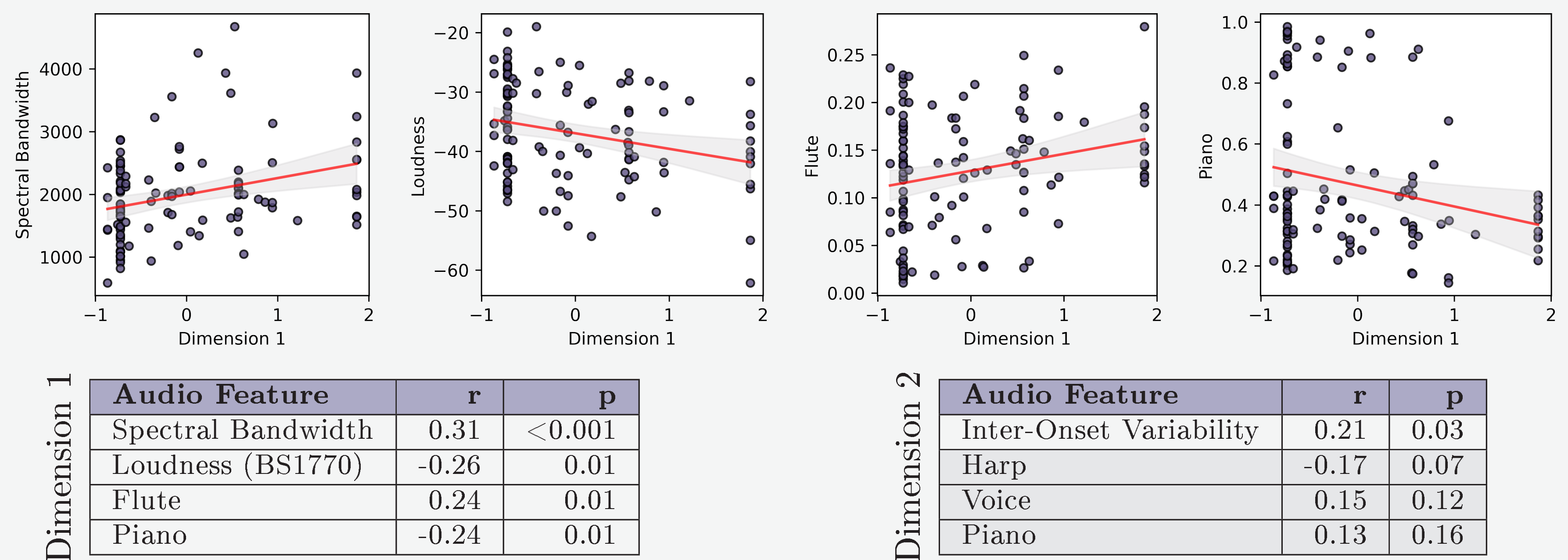
Audio features were extracted via pyloudnorm (Steinmetz & Reiss, 2021), LibROSA (McFee et al., 2015), as well as **Essentia Tensorflow Models** (Alonso-Jiménez, 2020).

Results

The analysis suggested a solution with **dimension 1** spanning from *sinister* (“*düster*”) to *eerie* (“*gespenstisch*”) and **dimension 2** spanning from *threatening* (“*drohend*”) to *horrible* (“*schauerlich*”).



The first dimension correlated with the **spectral bandwidth**, **loudness**, and the usage of **piano**, **flute**, **harp** ($r = 0.21$, $p = 0.02$) and **violin** ($r = 0.21$, $p = 0.03$). The second dimension correlated with variability of **inter-onset intervals**.



Dimension 1	Audio Feature	r	p
	Spectral Bandwidth	0.31	<0.001
	Loudness (BS1770)	-0.26	0.01
	Flute	0.24	0.01
	Piano	-0.24	0.01

Dimension 2	Audio Feature	r	p
	Inter-Onset Variability	0.21	0.03
	Harp	-0.17	0.07
	Voice	0.15	0.12
	Piano	0.13	0.16

Discussion & Conclusion

These results support, for example, the idea that *eerie* music, in contrast to *sinister* music, as perceived by **19th-century listeners**, is characterized by greater **spectral bandwidth**, **softer dynamics**, and the use of **flutes**, **harps**, and **violins**, instead of the **piano**. This is also reflected in the contemporaneous descriptions and suggests a continuity of semantic music dimensions from the 19th century to today's recordings.

„Über dem ausgehaltenen G1 und einem dumpfen Paukenwirbel intonieren **Violoncelli** und zweite **Geigen** ihren Gang, **Bratschen** und erste **Geigen** treten in einer Art Engführung hinzu: aber nicht im mutigen Forte und staccato wie einst, sondern **pianissimo legatissimo** erklingt **schauervoll** die Melodie... Noch **geheimnisvoller** wird die Szene: *sotto voce* beginnen **Flöten**, **Klarinetten** und **Fagotte** (die klaren, scharfen Oben schweigen bezeichnenderweise) die Antwort, und zwar im **gespensterhaften Unisono**; zweimal stocken sie **angstvoll**, endlich sinken sie hinab und verschwinden in der **Tiefe**... Die **Geistererscheinung** ist vorüber. [...] Die klaren, scharfen Oboen schweigen bezeichnenderweise - sie gehören nämlich dort nicht hin, weil sie die **“geheimnisvolle, gespensterhafte, pianissimo-Stimmung** durch ihren hellen Klang stören würden.“ (Vetter, 1914, p. 142)

“Trug der erste Satz vorwiegend den Charakter ruhiger Heiterkeit, so führt uns der Komponist dagegen in dem nun folgenden Scherzo (*Allegro assai, d-Moll, 6/4*) in **phantastischere** Regionen. Das erste Thema packt uns mit **unheimlicher, fast dämonischer** Gewalt. Von **eigentümlicher** Wirkung ist namentlich das **grelle Aufblitzen des Klavierfigur** in T. 11 und ff. und den Parallelstellen.“ (Kipke, 1872, p. 675)

References

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