

Computational Corpus Analysis of Expressive Timing in Galician and Irish Folk Traditions

Master's in Multimedia Dissertation

Mário Pereira, 2025

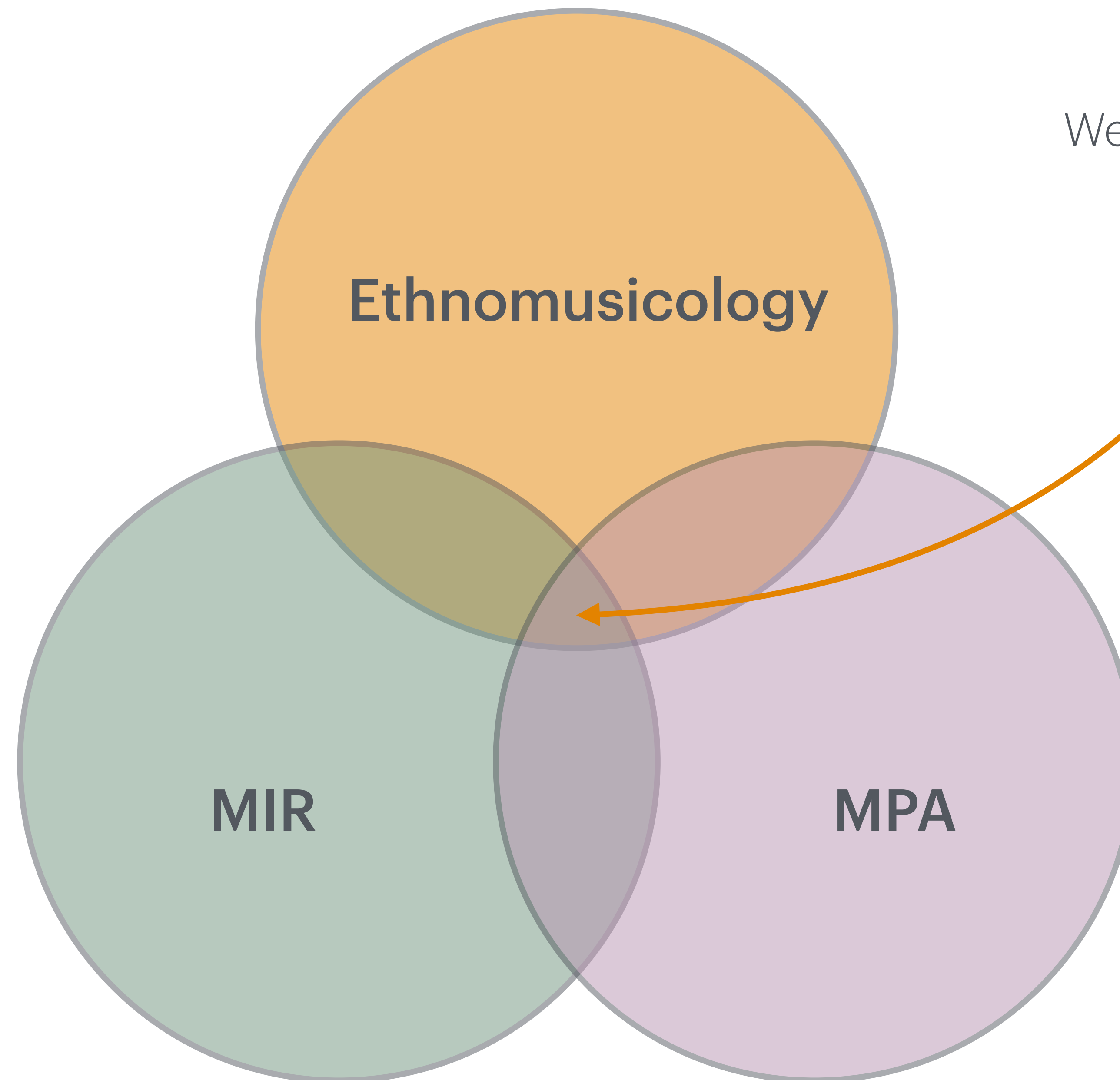
Presentation contents

- Introduction - **why** we are doing this
 - Context, Objectives, Dataset
- Methodology - **how** we did it
 - Extraction and Interpreting Temporal Information, Tempo Estimation and Deviation
- Conclusion - **what** we found
 - Results, Final Remarks, Future Work

Objectives and Context

Context

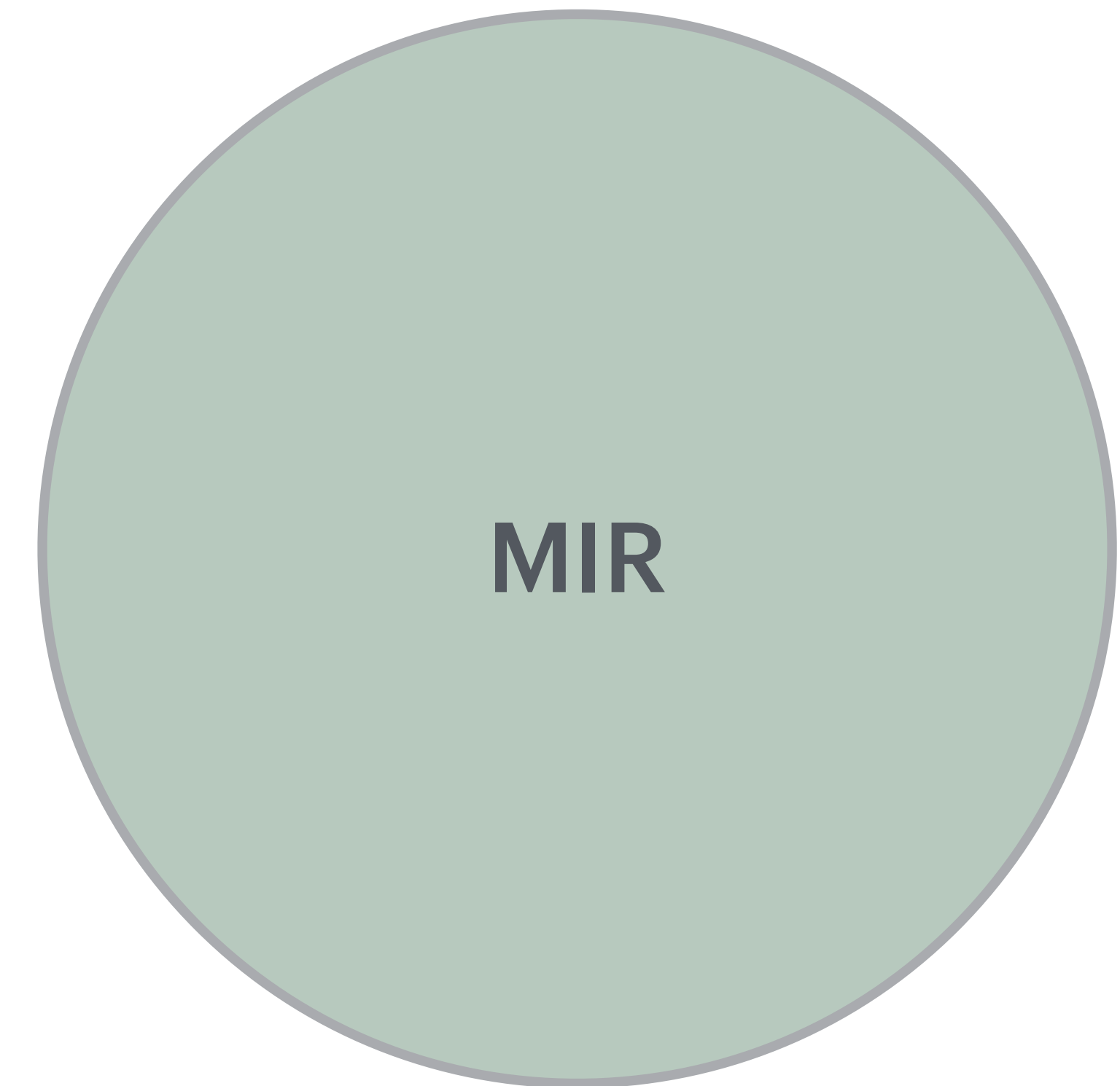
- EA-DIGIFOLK
- Music Information Retrieval (MIR)
- Music Performance Analysis (MPA)
- Ethnomusicology
- Research gap in their intersection



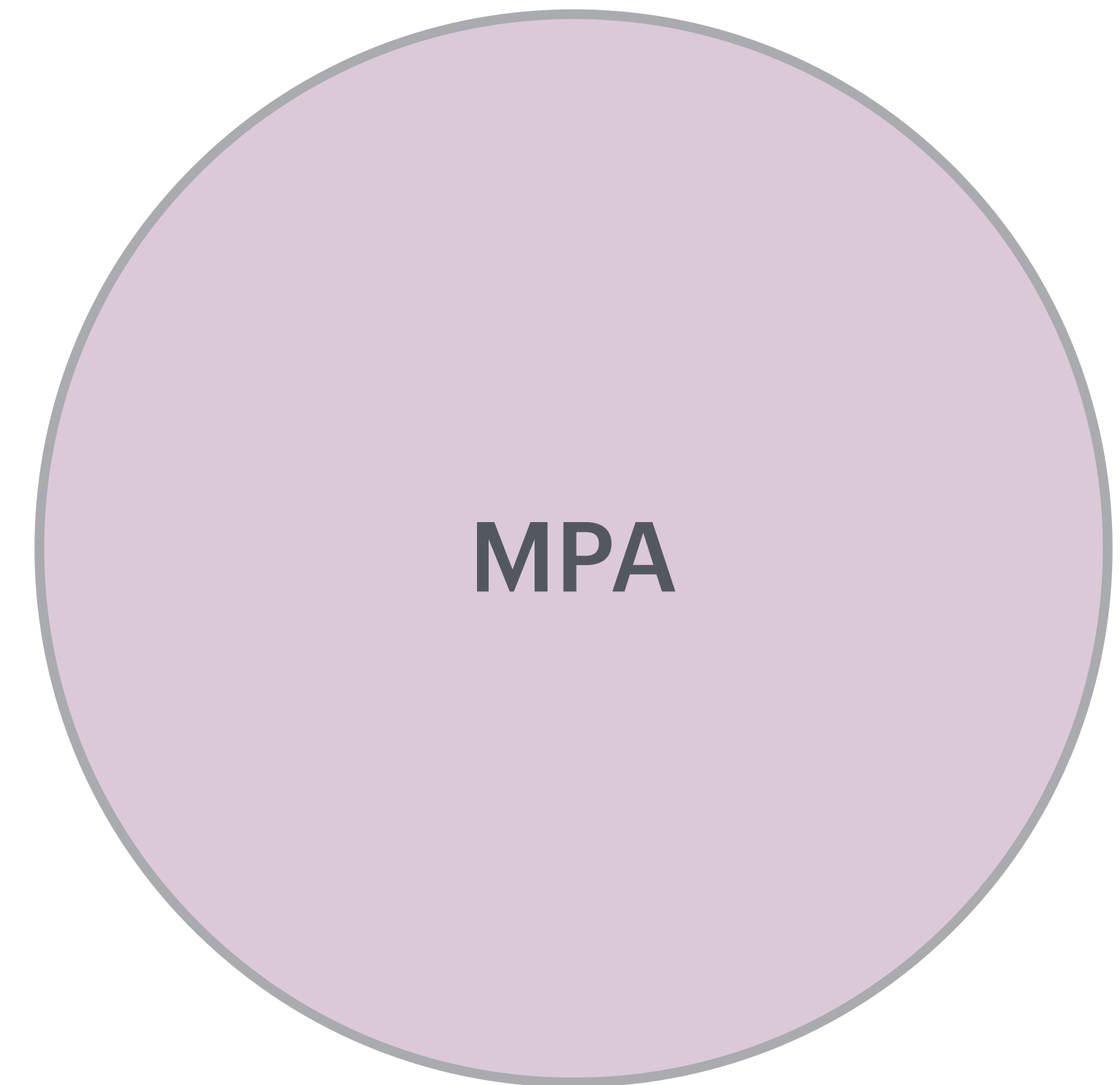
We are somewhere in
here

There is still a lot of uncharted territory
in computational analysis of folk music
(Panteli et al. 2018)

- There is a disconnect between MIR research for its own sake and its practical applications (*Schreiber et al. 2020*)
- Algorithm performance in tempo related tasks varies a lot across genres (*McKinney et al. 2007*)



- Often involves comparative analysis with a reference - like a score sheet - which naturally generates a bias towards classical music (*Lerch et al. 2020*)
- Expressive timing examples: *Fabian (2008)* - Dotting perception & *Repp (1991)* - Phrase-level expressive timing. Both using classical performances



Galician and Irish folk music

Two good
datasets
available

+

Common *celtic*
origin

=

Great
contribution
opportunity

Datasets

Irish

- Collected from youtube
- Great variability in recording quality and settings
- 19 songs
- 4-14 performances per song
- 154 performances

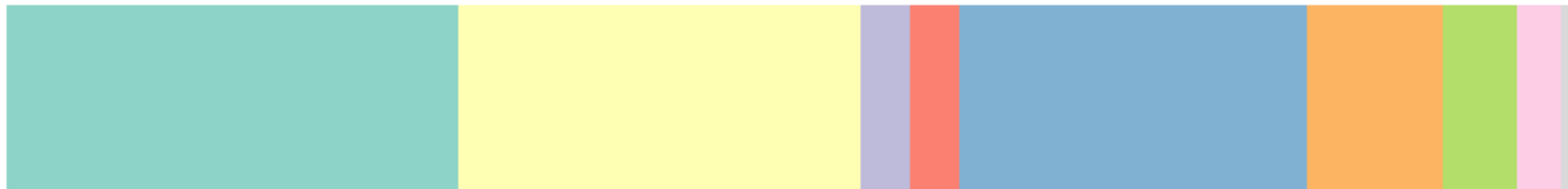
Galician

- Recorded for analysis purposes
- Consistent recording quality
- 30 songs
- 2-7 performances per song
- 99 performances

Ireland (154) Galicia (99)



Reel (73) Jig (65) Polka (8) Hornpipe (8) Muiñeira (56) Jota (22) Foliada (12) Danza (7) Golpe (2)



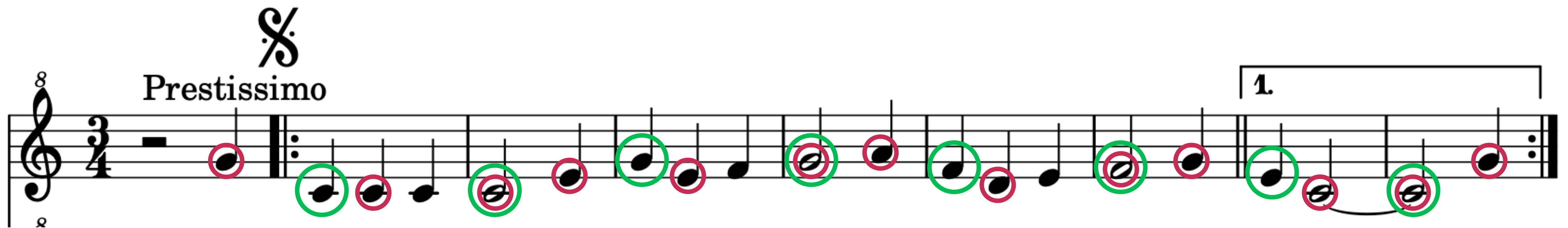
Ensemble (86) Flute (45) Bagpipe (39) Whistle (29) Violin (16) Clarinet (13) Accordion (7) Other (18)



culture	title	id	style	file_name	instrumentation	instrument	segmentation	manual_beats
galicia	Danza das Patelas	ga004	danza	ga004_v01.mp3	solo	flute	[7.444897959, 14.463015]	[0.456734694, 1.313378685, 2
galicia	Danza das Patelas	ga004	danza	ga004_v02.mp3	solo	flute	[7.867210884, 15.044087]	[0.514535147, 1.380498866, 2
galicia	Danza das Patelas	ga004	danza	ga004_v03.mp3	solo	sax	[7.949365079, 15.493038]	[0.504217687, 1.391020408, 2
galicia	Danza das Patelas	ga004	danza	ga004_v04.mp3	solo	sax	[10.755736961, 20.66755]	[0.822857143, 2.113129252, 3
galicia	Danza das Patelas	ga004	danza	ga004_v05.mp3	solo	whistle	[7.958503401, 15.121995]	[0.535102041, 1.458503401, 2
galicia	Danza das Patelas	ga004	danza	ga004_v06.mp3	solo	whistle	[8.02952381, 15.3959410]	[0.499229025, 1.418185941, 2
galicia	Danza das Patelas	ga004	danza	ga004_v07.mp3	solo	whistle	[7.97968254, 15.2780045]	[0.457142857, 1.53106576, 2.4
galicia	Foliada 2	ga006	foliada	ga006_v01.mp3	solo	flute	[12.3138322, 24.2416326]	[0.274285714, 1.110204082, 1
galicia	Foliada 2	ga006	foliada	ga006_v02.mp3	solo	flute	[12.307301587, 24.26920]	[0.279365079, 1.098390023, 1
galicia	Foliada de Elvina	ga007	foliada	ga007_v01.mp3	solo	flute	[7.694943311, 15.862857]	[0.65015873, 1.515102041, 2.4
galicia	Foliada de Elvina	ga007	foliada	ga007_v02.mp3	solo	bagpipe	[7.115283447, 15.288888]	[0.596643991, 1.457777778, 2
galicia	Foliada de San Fins do Castro	ga008	foliada	ga008_v01.mp3	solo	flute	[7.002267574, 13.526870]	[0.362811791, 1.168253968, 2
galicia	Foliada de San Fins do Castro	ga008	foliada	ga008_v02.mp3	solo	flute	[6.907936508, 13.430907]	[0.281632653, 1.042902494, 1
galicia	Foliada de San Fins do Castro	ga008	foliada	ga008_v03.mp3	solo	flute	[6.385487528, 12.453990]	[0.241043084, 1.023877551, 1
galicia	Foliada de San Fins do Castro	ga008	foliada	ga008_v04.mp3	solo	bagpipe	[6.617687075, 12.678095]	[0.280816327, 1.052154195, 1
galicia	Foliada de San Fins do Castro	ga008	foliada	ga008_v05.mp3	solo	bagpipe	[6.660045351, 13.059433]	[0.300408163, 1.041496599, 1
galicia	Foliada de San Fins do Castro	ga008	foliada	ga008_v06.mp3	solo	whistle	[7.327346939, 14.524087]	[0.373038549, 1.253877551, 2
galicia	Foliada de San Tirso	ga009	foliada	ga009_v01.mp3	solo	flute	[7.372335601, 13.695986]	[0.632789116, 1.431678005, 2
galicia	Foliada de San Tirso	ga009	foliada	ga009_v02.mp3	solo	whistle	[7.172063492, 13.633015]	[0.653356009, 1.46952381, 2.2
galicia	Golpe do Carballino	ga010	golpe	ga010_v01.mp3	solo	flute	[9.183492063, 17.902585]	[0.32968254, 0.898843537, 1.4
galicia	Golpe do Carballino	ga010	golpe	ga010_v02.mp3	solo	whistle	[10.32707483, 19.818237]	[0.400589569, 1.060498866, 1
galicia	Churrusqueira	ga011	jota	ga011_v01.mp3	solo	bagpipe	[7.48968254, 15.1278004]	[0.596235828, 1.439637188, 2
galicia	Churrusqueira	ga011	jota	ga011_v02.mp3	solo	violin	[10.993469388, 19.90427]	[0.843877551, 1.904512472, 3
galicia	Churrusqueira	ga011	jota	ga011_v03.mp3	solo	whistle	[7.916371882, 15.687987]	[0.674739229, 1.567346939, 2
galicia	Fogueteira	ga012	jota	ga012_v01.mp3	solo	bagpipe	[7.435487528, 14.099024]	[0.635646259, 1.480272109, 2
galicia	Fogueteira	ga012	jota	ga012_v02.mp3	solo	whistle	[7.942086168, 16.138730]	[0.690793651, 1.60521542, 2.5

Beat Tracking

Foliada de San Fins do Castro



Additional help

- Transcriptions from *The Session* and *Folkoteca Galega*
(<https://thesession.org/> ; <https://folkotecagalega.gal/>)
- Performances with *percussive* elements
- *Specialists* in each culture

Listener's
perspective

VS

Performer's
perspective

Phrase Segmentation


Jota Roubada

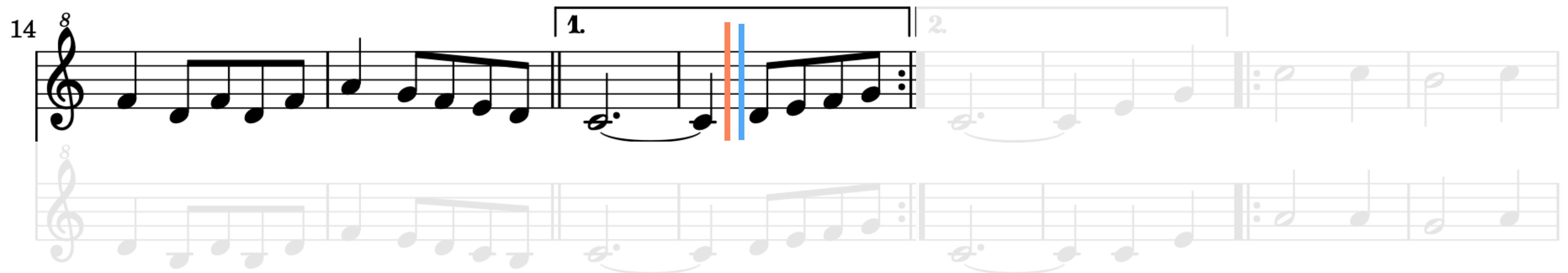
8 **Prestissimo** 



7 



14 



Extracting Tempo Information

- We now have the **beat information** in lists like these

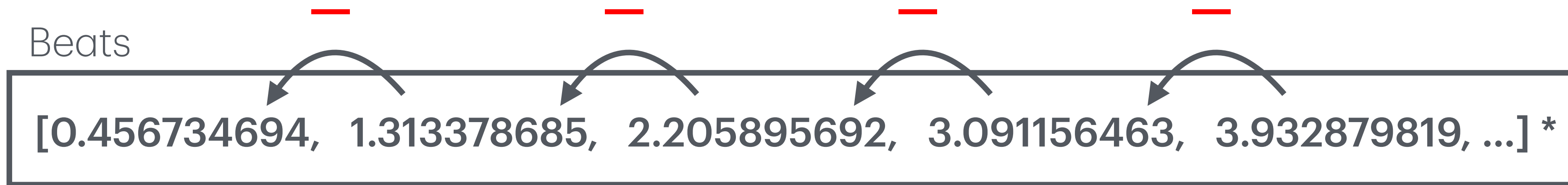
[0.456734694, 1.313378685,
2.205895692, 3.091156463,
3.932879819, 4.789115646,
5.623582766, 6.522154195,
7.444897959, 8.279365079,
9.157369615, 10.042630385,
10.891609977, 11.755102041,
12.62585034, 13.522721088,
14.463015873, 15.328639456,
16.03047619, 16.958707483,
17.711020408, 18.607891156,
19.400272109, 20.314557823,
21.134013605, 22.001564626,
22.86585034, 23.745623583,
24.485442177, 25.425102041,
26.226938776, 27.150997732]

[0.504217687, 1.391020408, 2.344489796, 3.245510204, 4.175963719, 5.067755102,
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11.781927438, 12.673151927, 13.640022676, 14.557120181, 15.493038549, 16.377709751,
17.335396825, 18.223968254, 19.155555556, 20.041678005, 21.012244898, 21.936326531,
22.906122449, 23.787324263, 24.771950113, 25.662653061, 26.617687075, 27.457687075,
28.371655329, 29.32244898]

[0.514535147, 1.380498866, 2.295873016,
3.196326531, 4.040272109, 4.929115646,
5.93414966, 6.857142857, 7.867210884,
8.681496599, 9.556825397, 10.455873016,
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14.105396825, 15.044081633, 15.984126984,
16.833015873, 17.735419501, 18.57015873,
19.462562358, 20.307301587, 21.243514739,
22.183061224, 23.11122449, 23.97968254,
24.880362812, 25.732585034, 26.621995465,
27.453968254, 28.348571429]

[0.822857143, 2.113129252, 3.313424036, 4.546077098,
5.782176871, 7.04521542, 8.263968254, 9.449637188,
10.755736961, 12.014376417, 13.213628118, 14.462403628,
15.753673469, 16.985306122, 18.23430839, 19.417687075,
20.66755102, 21.957052154, 23.170589569, 24.474489796,
25.711564626, 26.981405896, 29.139591837, 30.311269841,
31.55952381, 32.786122449, 33.999591837, 35.182653061,
36.519183673, 37.739591837, 39.039297052, 40.25260771]

- We want to turn them into something **more interpretable**



$$\downarrow b_n - b_{n-1} = ibi_n$$

Inter-beat intervals

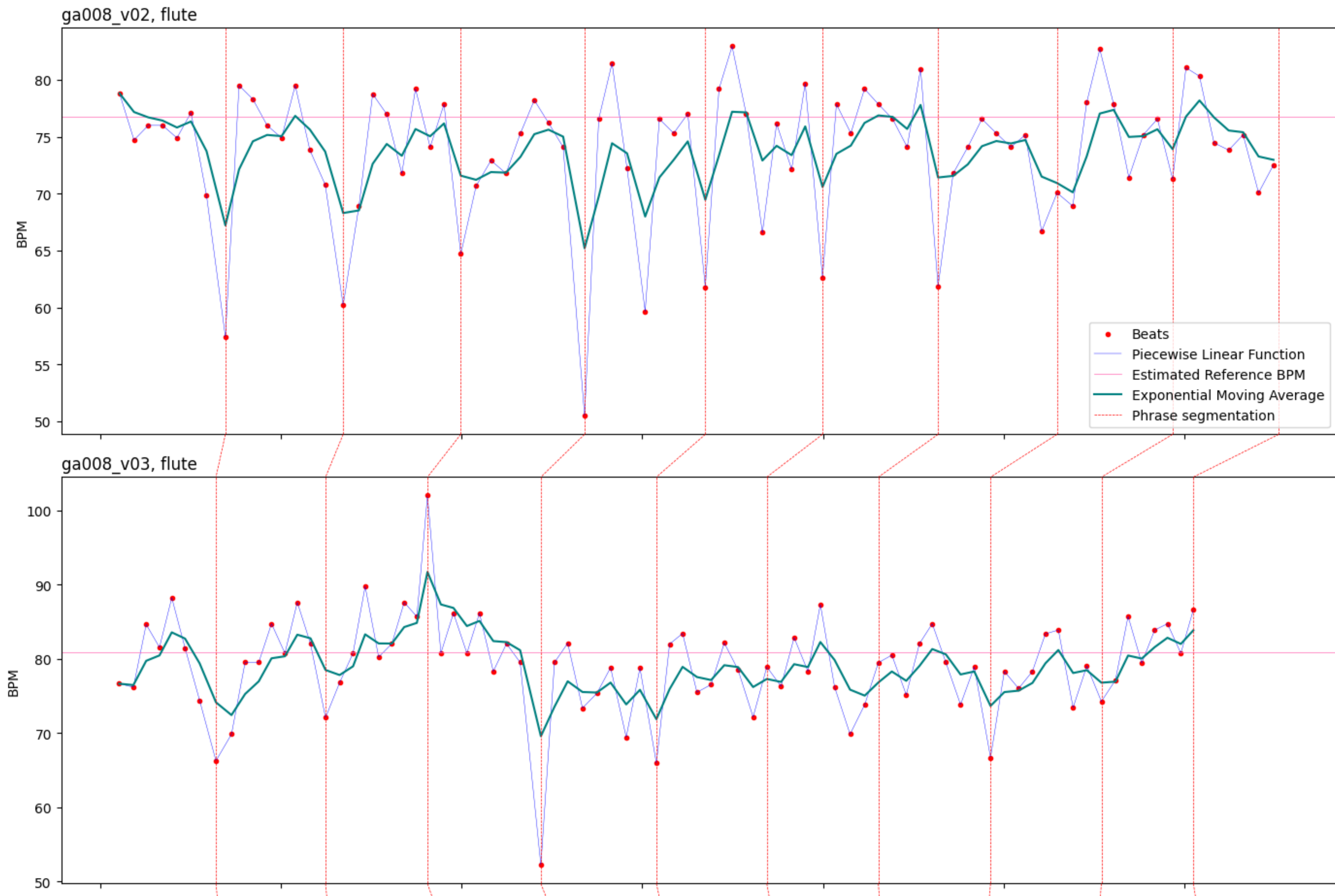
[0.85664399, 0.89251701, 0.88526077, 0.84172336, ...]

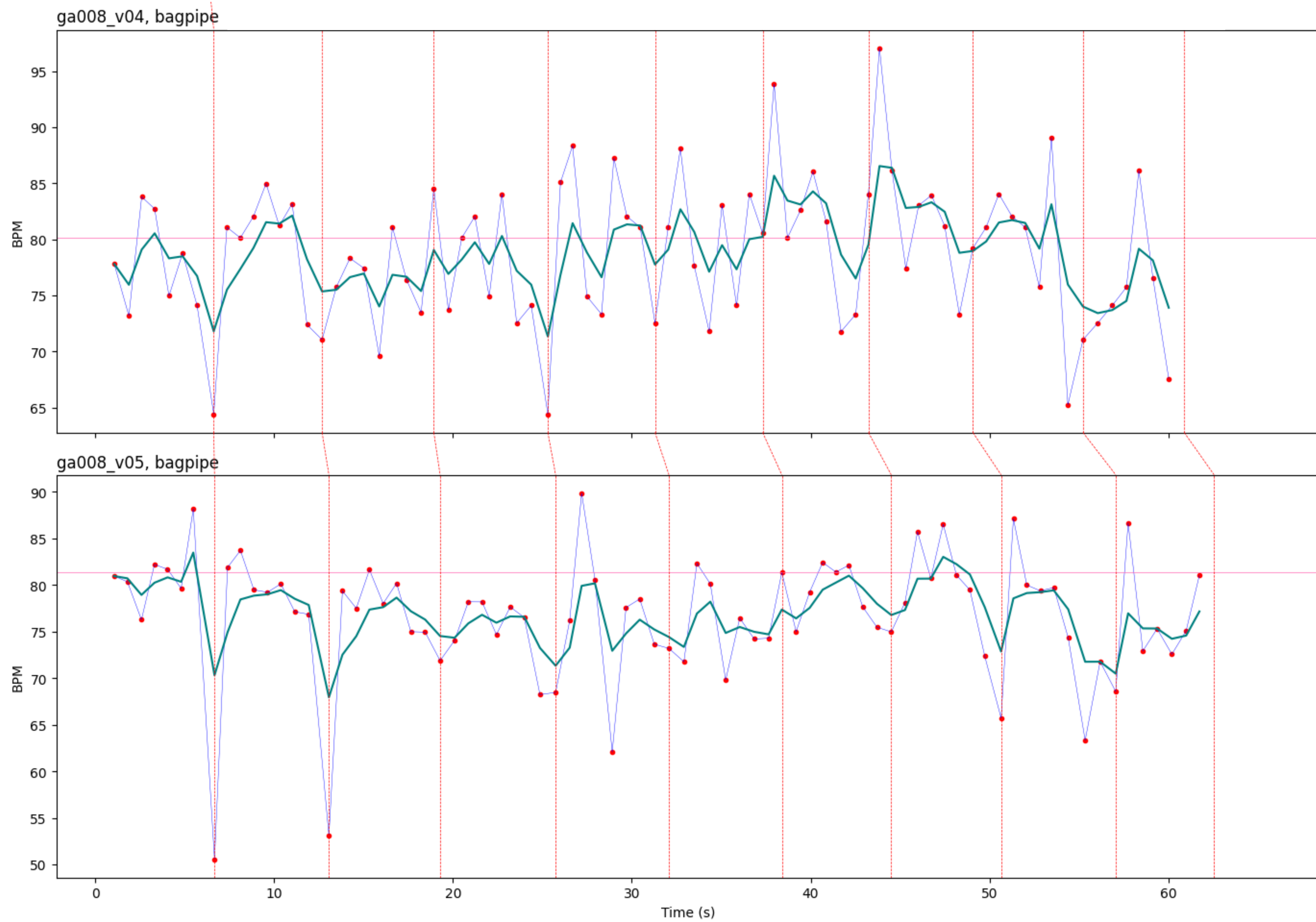
$$\downarrow \frac{60}{ibi_n} = BPM_n$$

Local BPMs

[70.04076446, 67.22560974, 67.77663934, 71.28232759, ...]

TLDR: we get a list of BPMS,
which we can plot





Tempo Deviation

Deviation from **what?**

Global Tempo Estimation

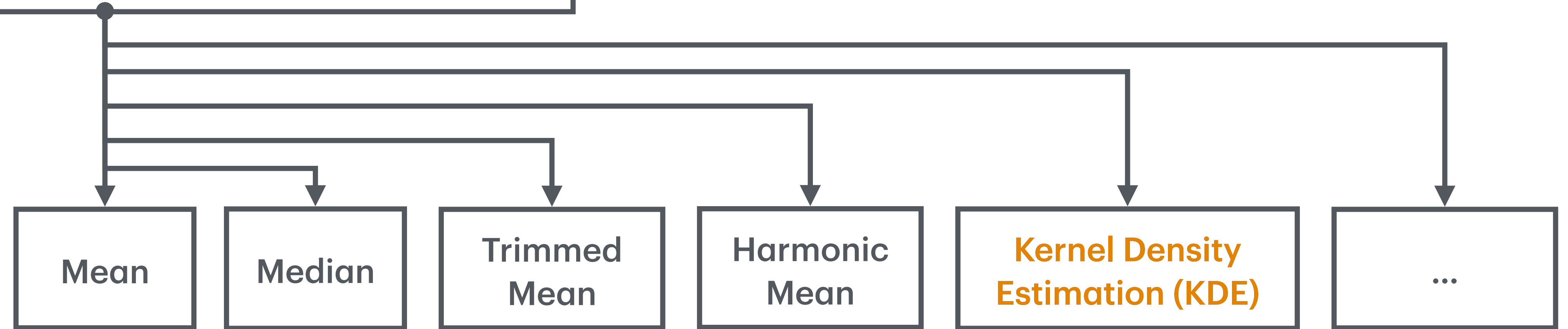
First 10 Local BPMS

[70.04076446034395, 67.22560974123824, 67.77663934235261, 71.28232758697501,
70.07415259674717, 71.90217392867437, 66.7726549761021, 65.02346842194423,
71.90217392867444, 68.336776793144, 67.77663941891379, 70.67307690948601,
69.4852940767733, 68.9062500253016, 66.89927186698692, 63.80977642027448,
69.31419288746437, 85.48996809847775, 64.63906189381187, 79.75404649601114,
66.89927186698692, 75.72115378699684, 65.62500002050768, 73.2193259452773,
69.16019755338397, 69.42148762625494, 68.19939169257057, 81.10096243404242,
63.852892199299085, 74.82820053137108, 64.93092200493756]

(Goebel 2001)

First 10 local BPMS

[70.04076446034395, 67.22560974123824,
67.77663934235261, 71.28232758697501, 70.07415259674717,
71.90217392867437, 66.7726549761021, 65.02346842194423,
71.90217392867444, 68.336776793144]



but that's a distribution,
not a value!

we find the point of
highest density in the
distribution and get its
corresponding value

≈ 67.48

(Ellis et al. 2014)

Tempo Deviation

Local BPMs

[70.04076446, 67.22560974, 67.77663934, 71.28232759, ...]

subtract reference
BPM

−67.48

Local BPM Deviation

[2.5453688303439463, -0.2697858887617599, 0.28124371235260526, 3.7869319569750104, ...]

Mean BPM Deviation

≈ 2.51

Standard Deviation

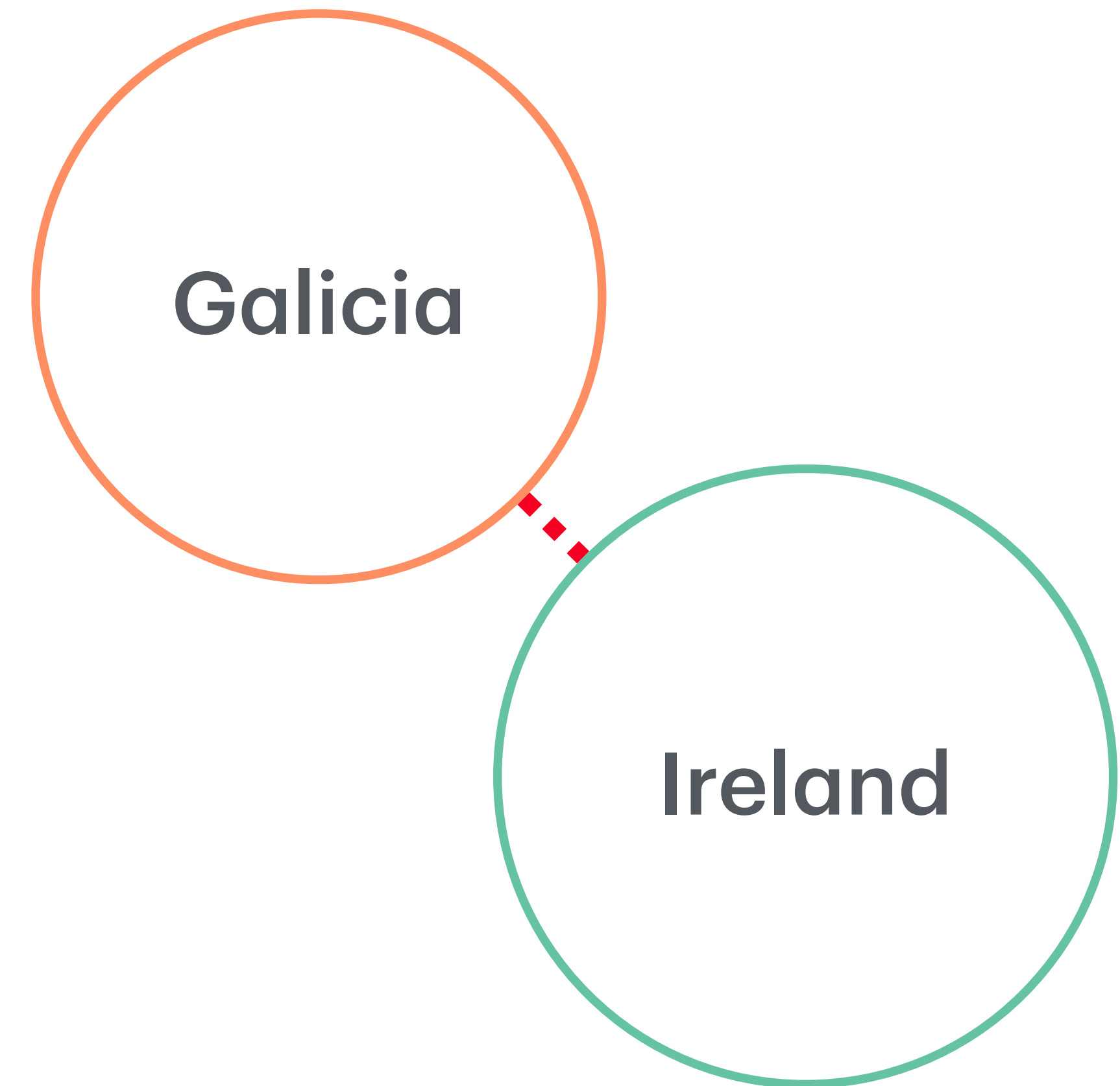
≈ 4.97

With all the performances' mean deviations
we can start grouping and comparing

Groups of Comparison

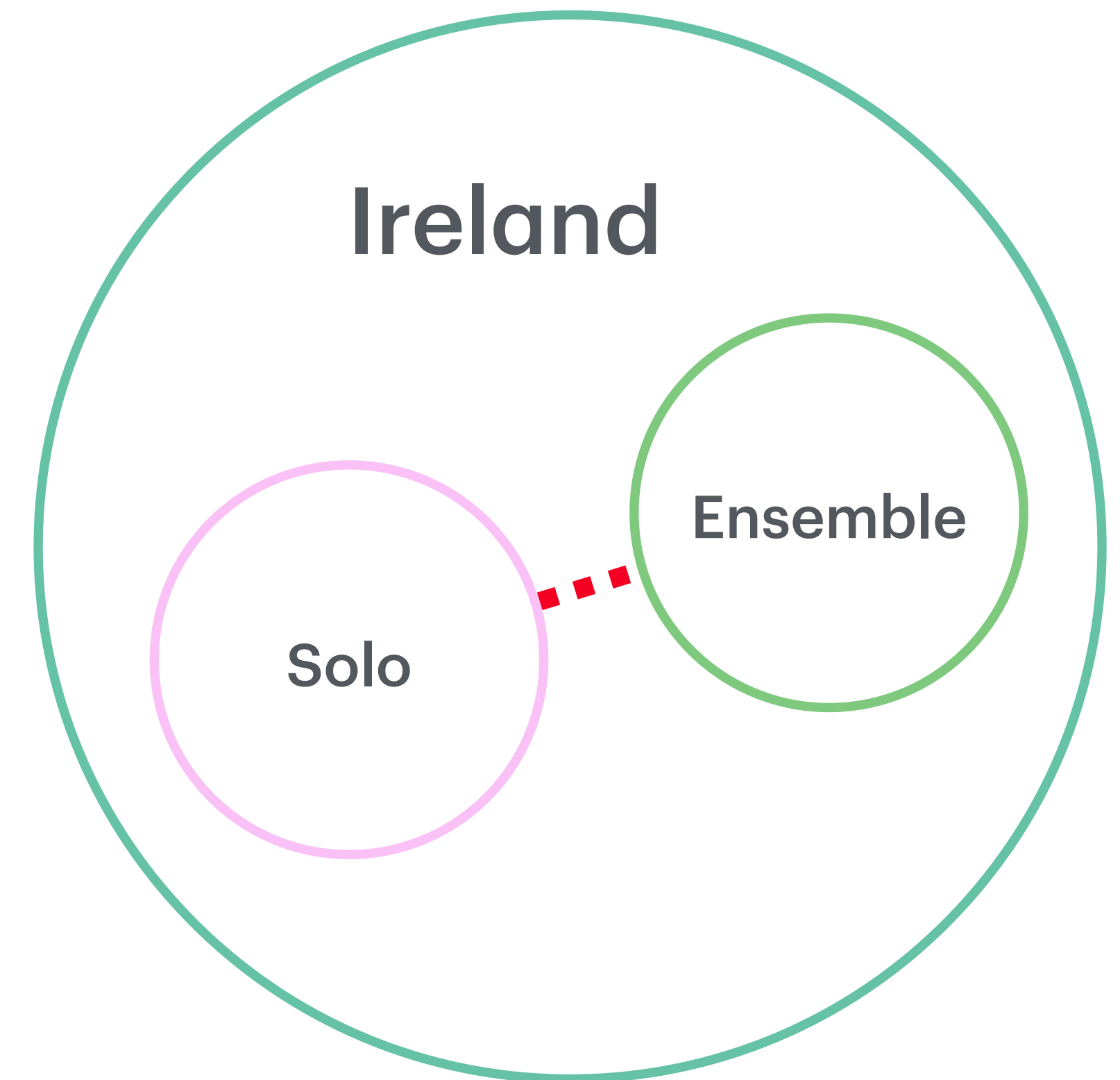
What are we looking for?

- Any particular tendencies of each culture
- But **caution**: it's hard to infer anything from such a “zoomed out” point of view. Especially with the datasets' different nature



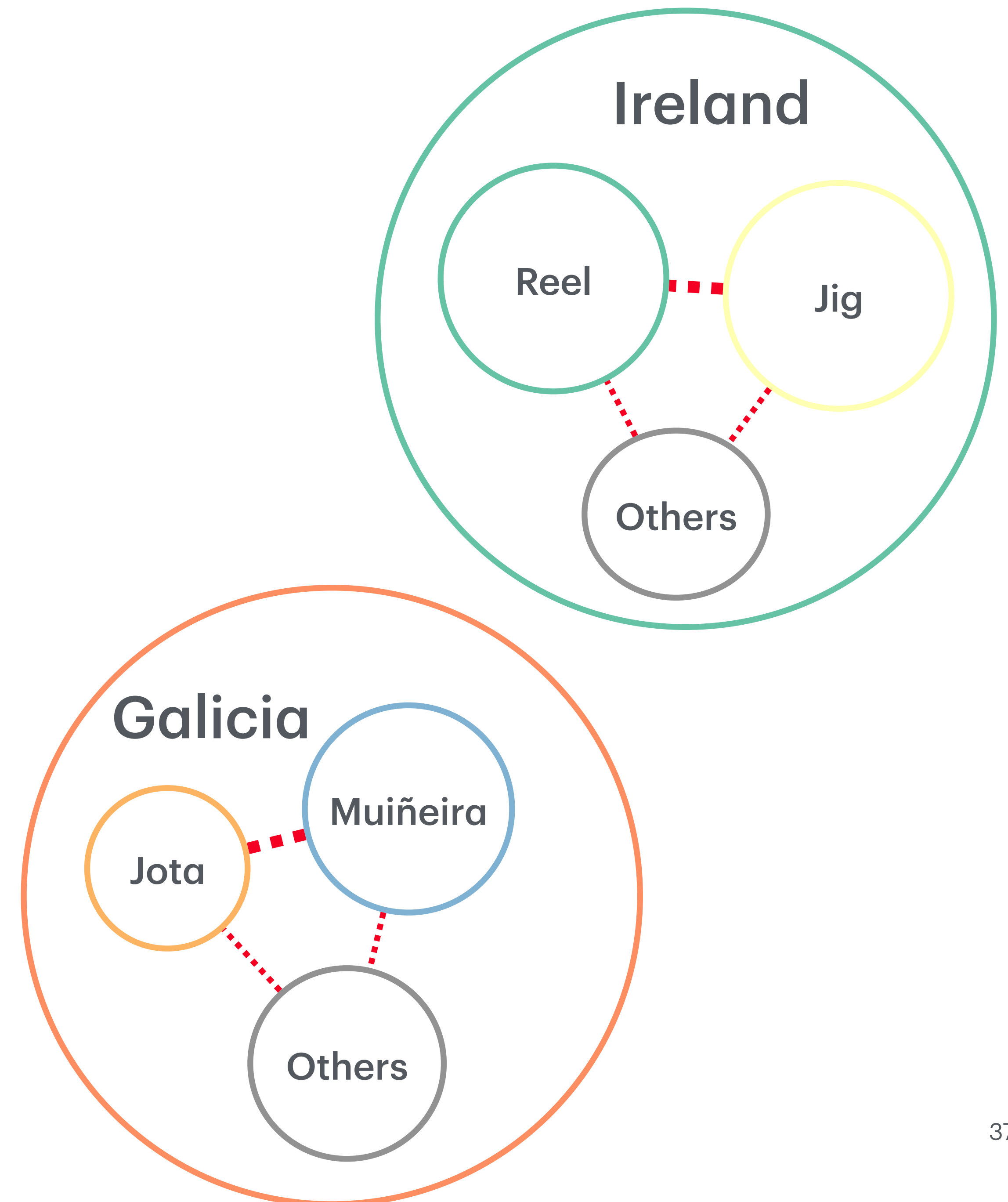
What are we looking for?

- Are there evident differences between solo and ensemble settings?
- **Expectations:** more stability in ensemble



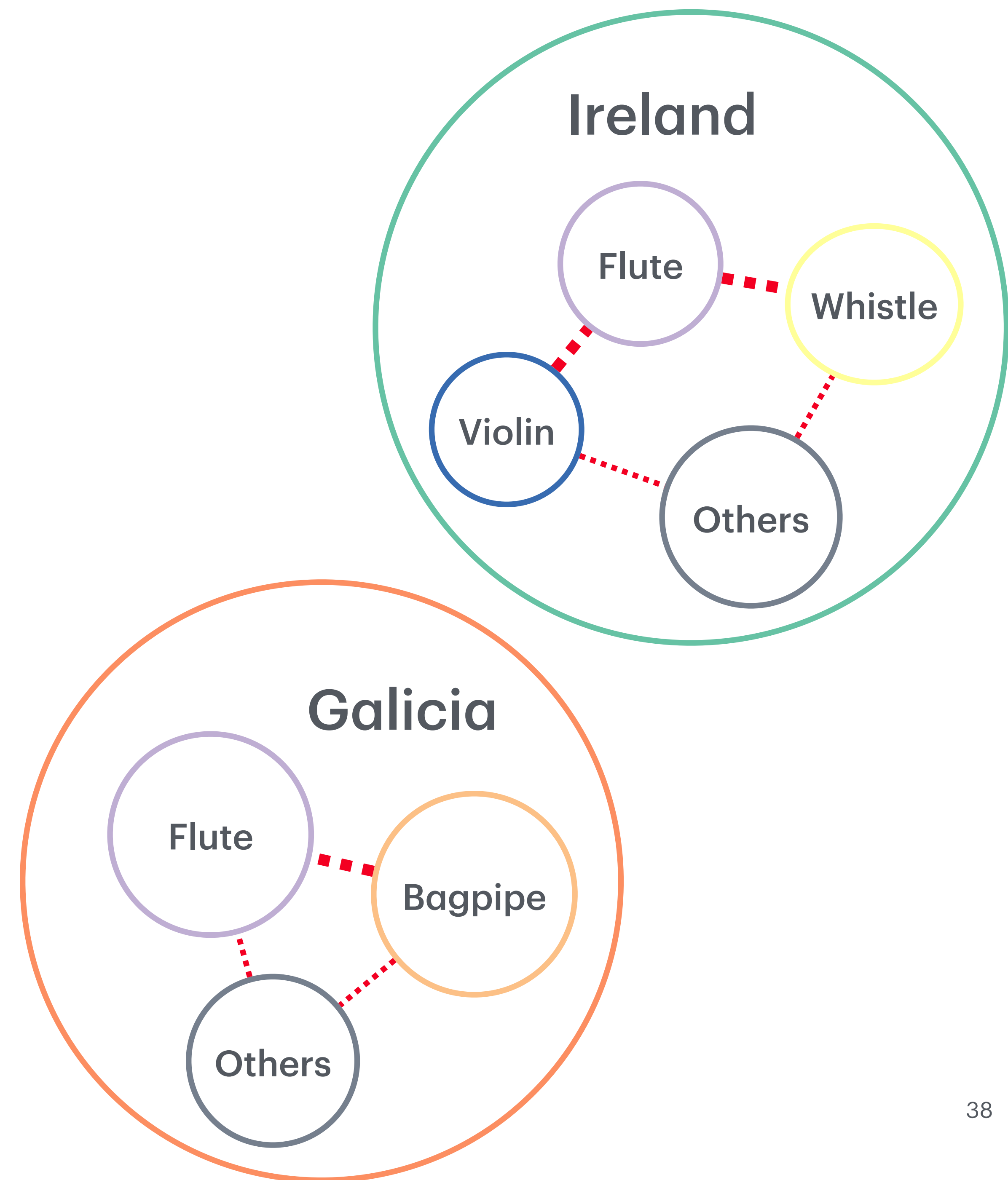
What are we looking for?

- Each style has its time signature and “feel”
- How does that influence expressive timing



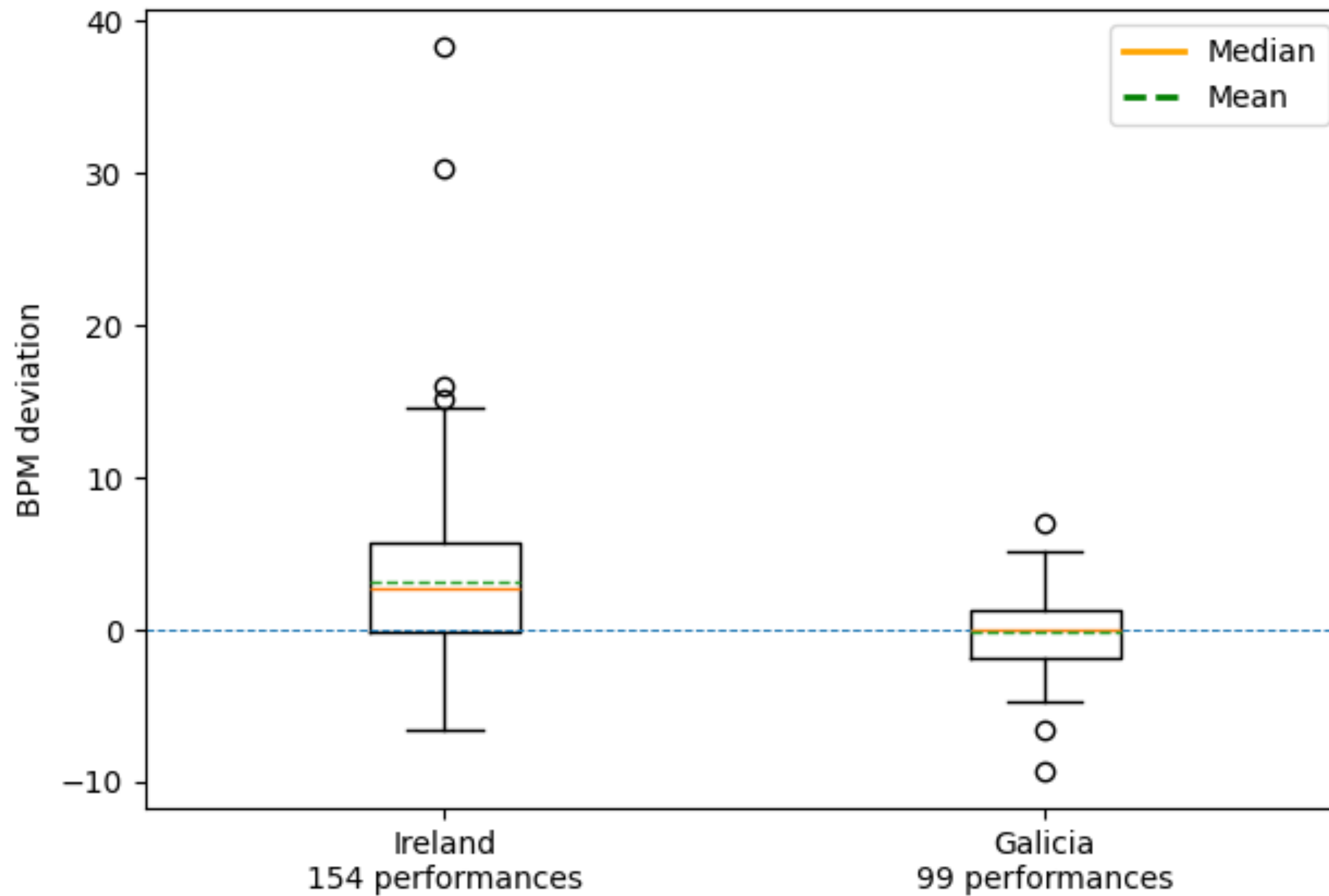
What are we looking for?

- Different instruments have different physical characteristics, timbres and techniques
- How can that affect expressive timing?

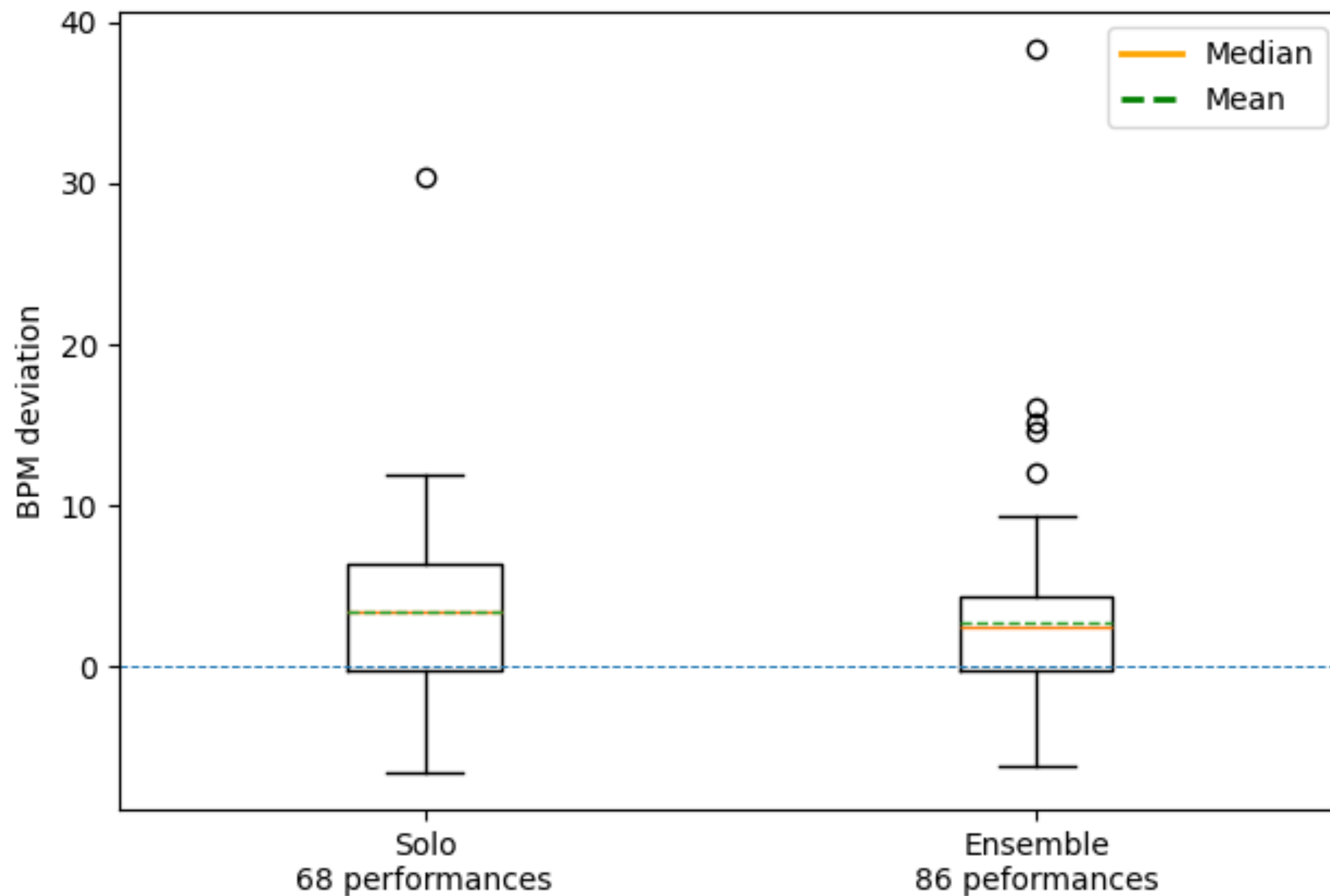


Results

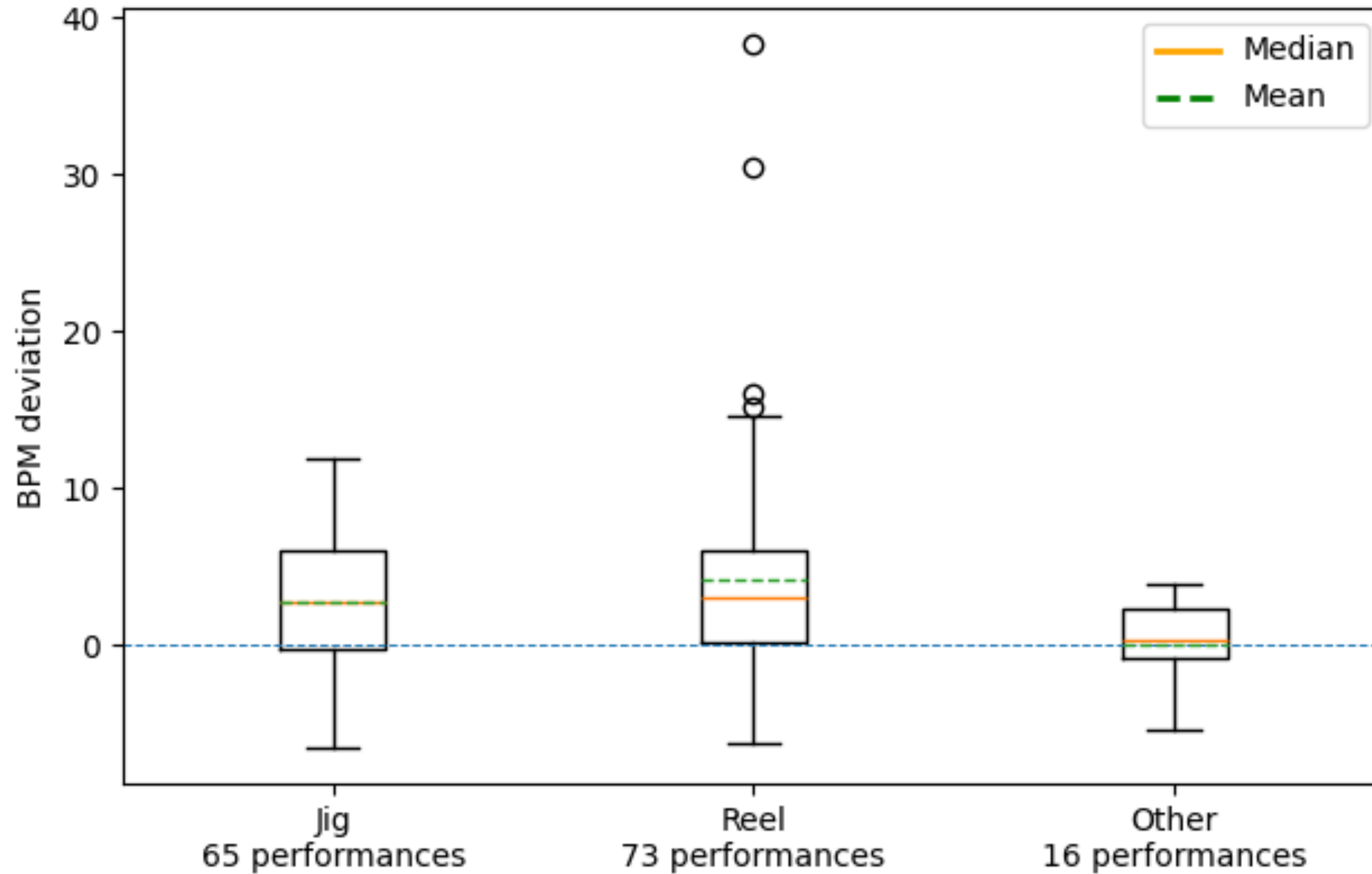
Mean BPM Deviation in Performances, by Culture



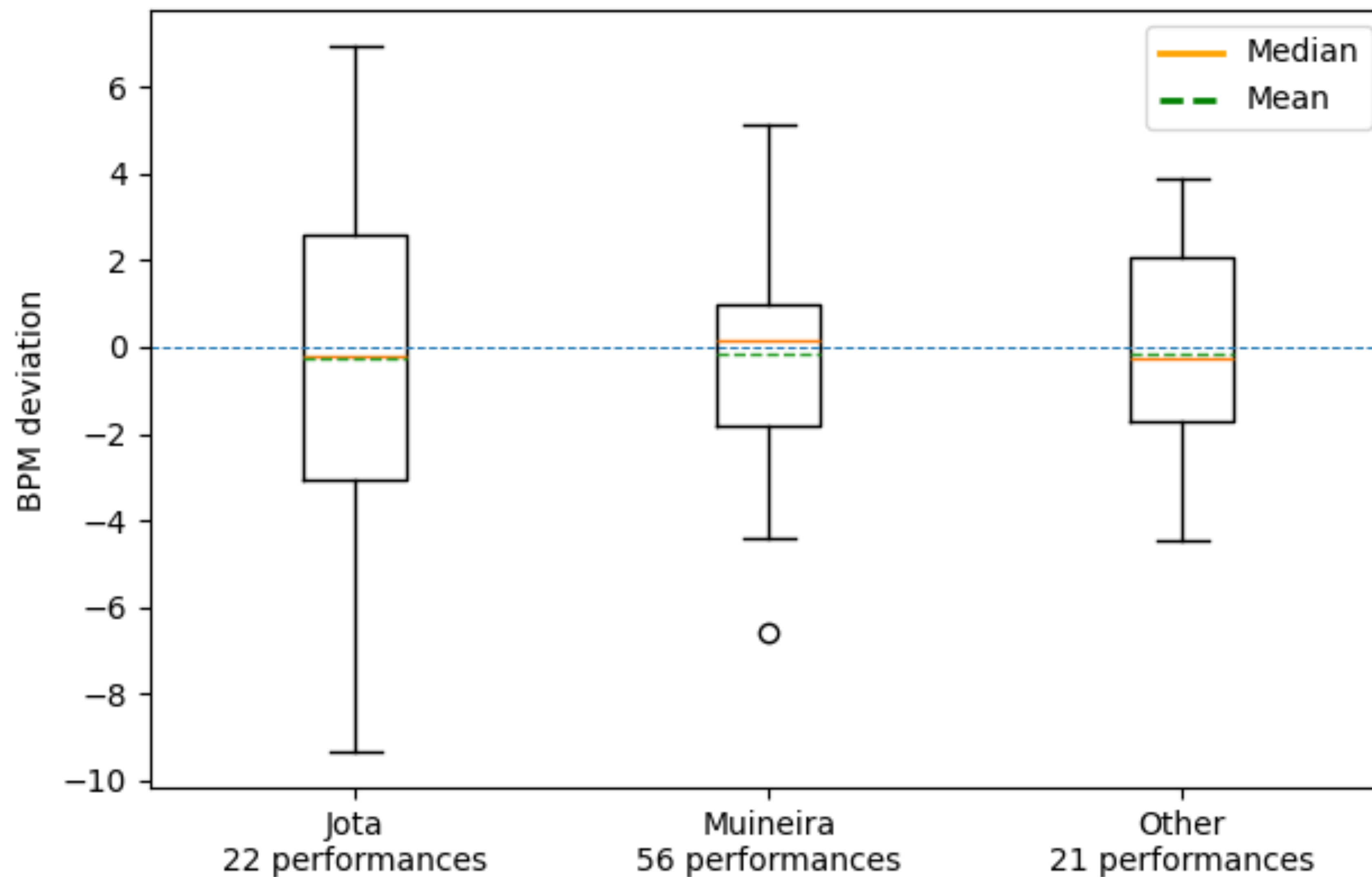
Mean BPM Deviation in Irish Solo and Ensemble Performances



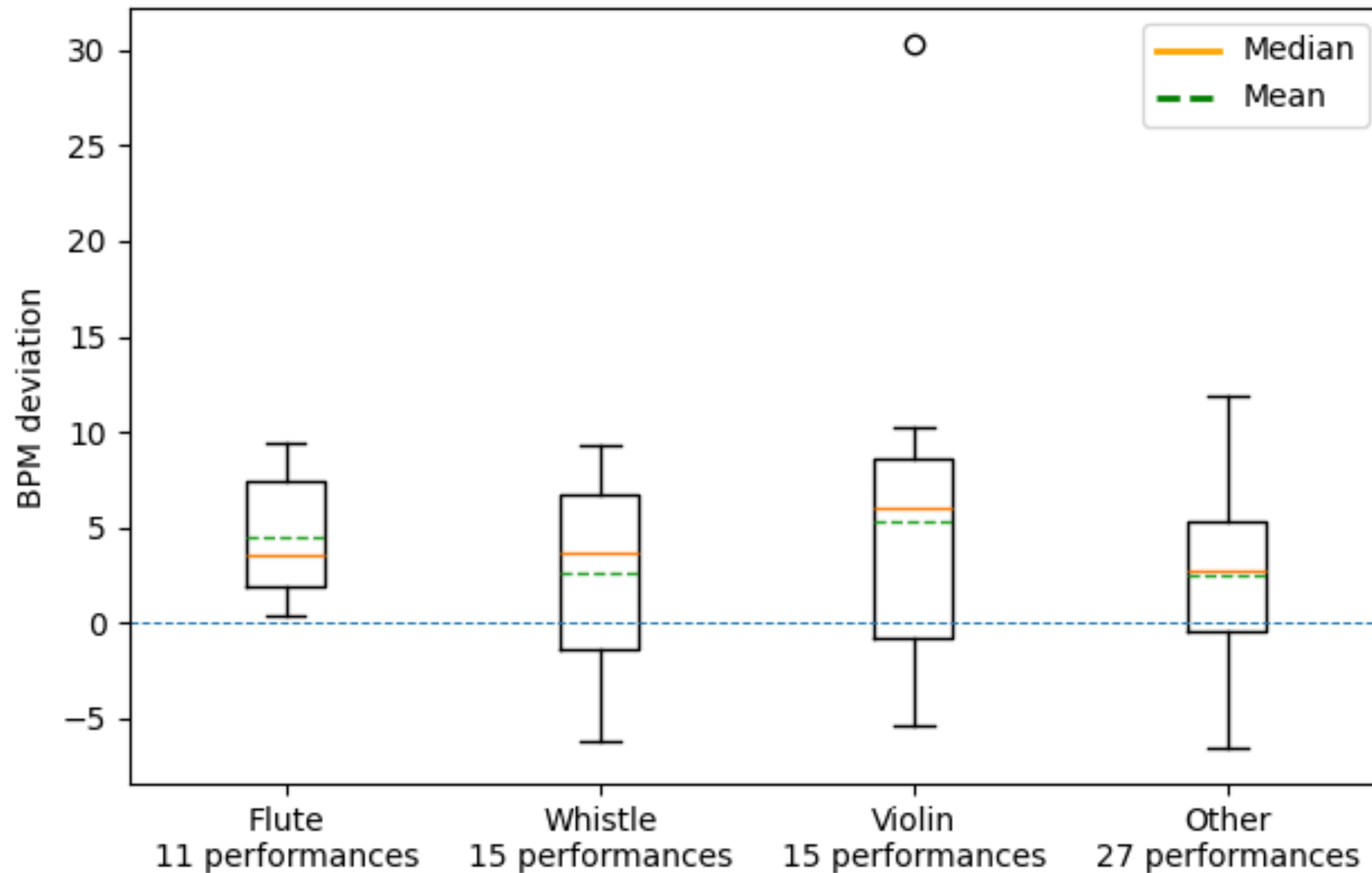
Mean BPM Deviation in Irish Performances
by Style



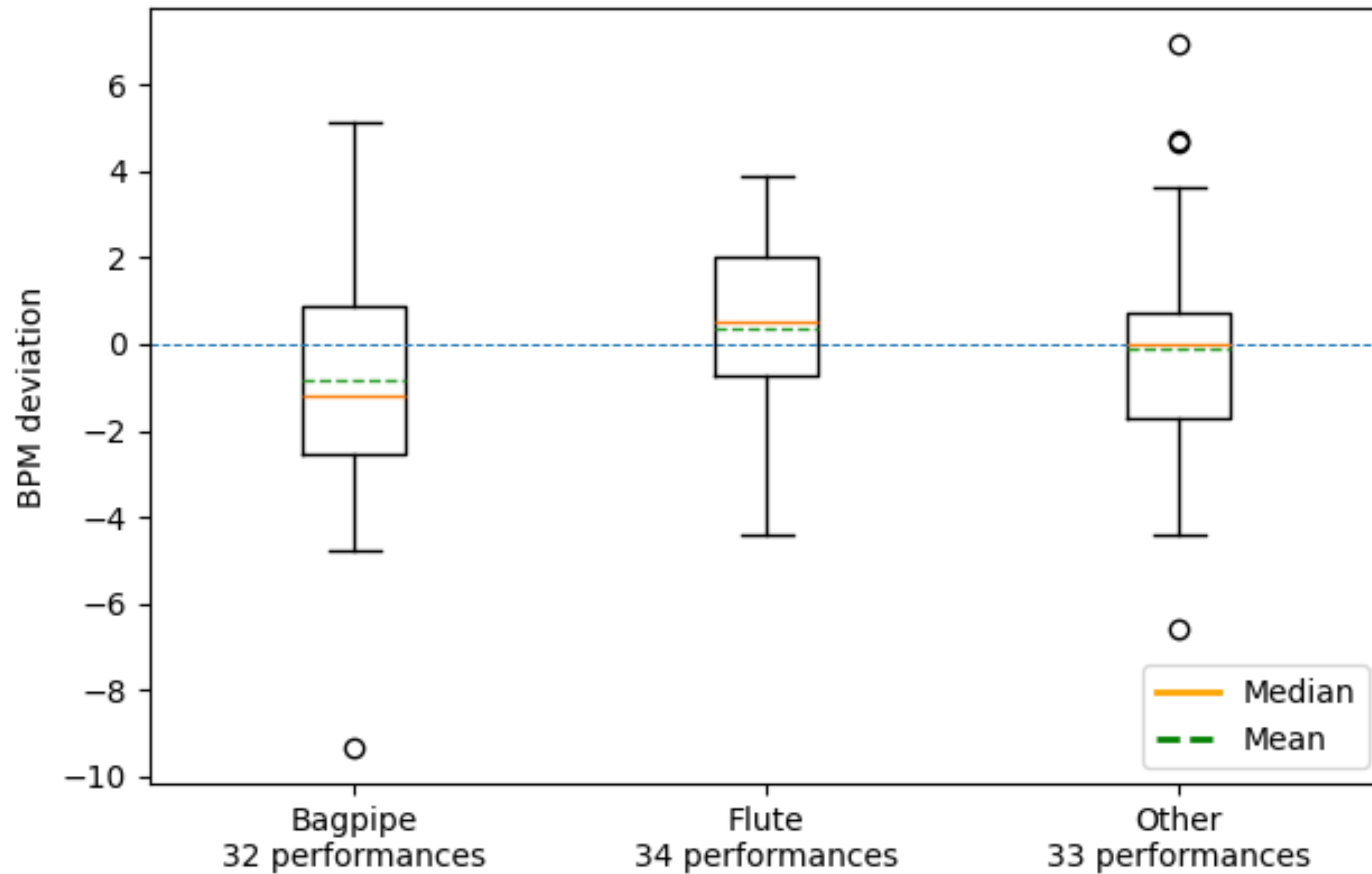
Mean BPM Deviation in Galician Performances
by Style



Mean BPM Deviation in Irish Solo Performances
by Instrument



Mean BPM Deviation in Galician Solo Performances
by Instrument



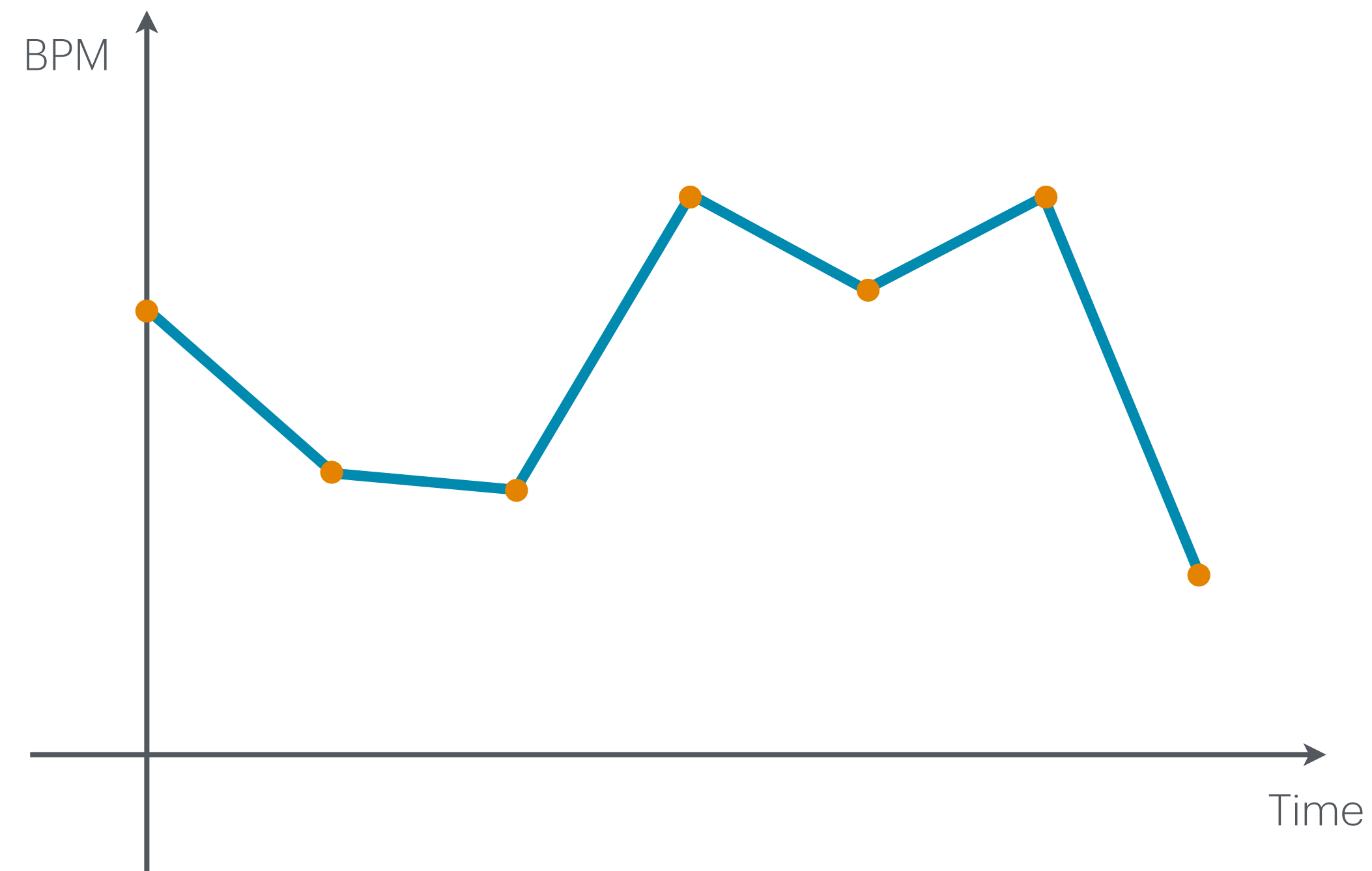
Phrase-level Analysis

but first...

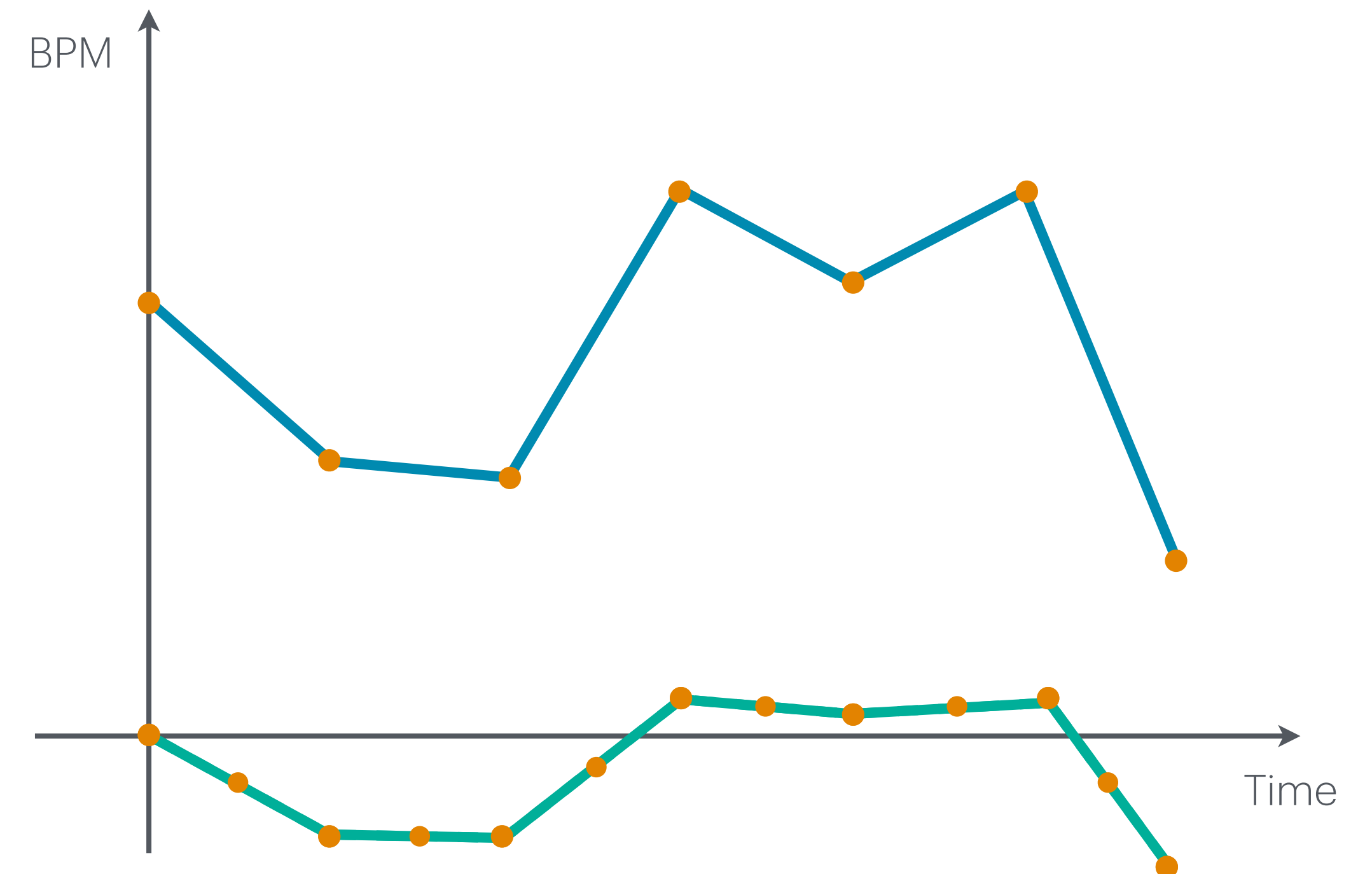
Phrase Preparation

[70.04076446034395, 67.22560974123824, 67.77663934235261, 71.28232758697501,
70.07415259674717, 71.90217392867437, 66.7726549761021, 65.02346842194423,
71.90217392867444, 68.336776793144, 67.77663941891379, 70.67307690948601,
69.4852940767733, 68.9062500253016, 66.89927186698692, 63.80977642027448,
69.31419288746437, 85.48996809847775, 64.63906189381187, 79.75404649601114,
66.89927186698692, 75.72115378699684, 65.62500002050768, 73.2193259452773,
69.16019755338397, 69.42148762625494, 68.19939169257057, 81.10096243404242,
63.852892199299085, 74.82820053137108, 64.93092200493756]

[70.04076446034395, 67.22560974123824, 67.77663934235261, 71.28232758697501,
70.07415259674717, 71.90217392867437, 66.7726549761021]



- Subtract the first value from all values - offset everything to **start at 0**
- Exponential average - **smooth** the curve
- Resample - all phrase should have the **same number of points**



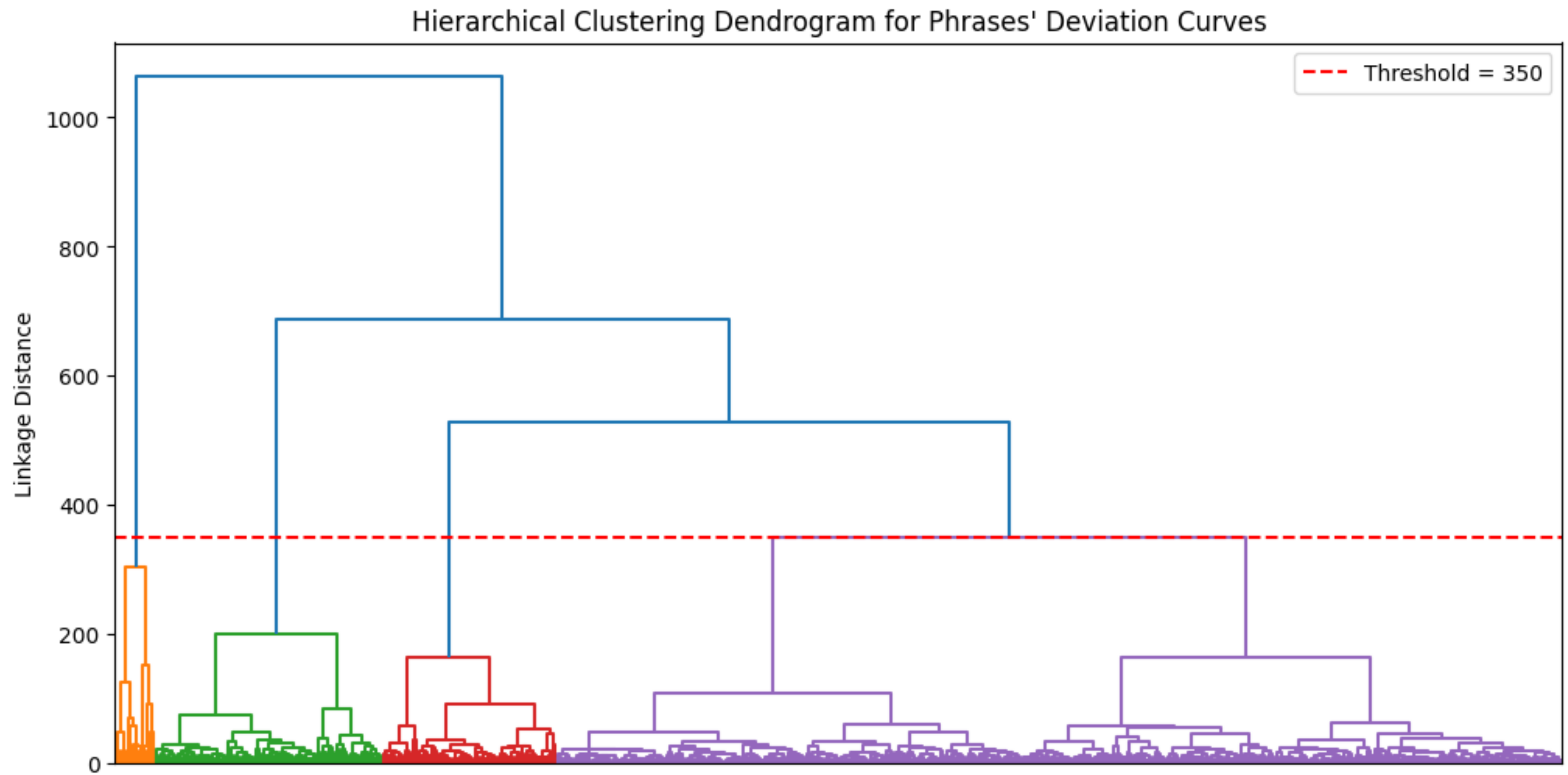
ALL THE PHRASES



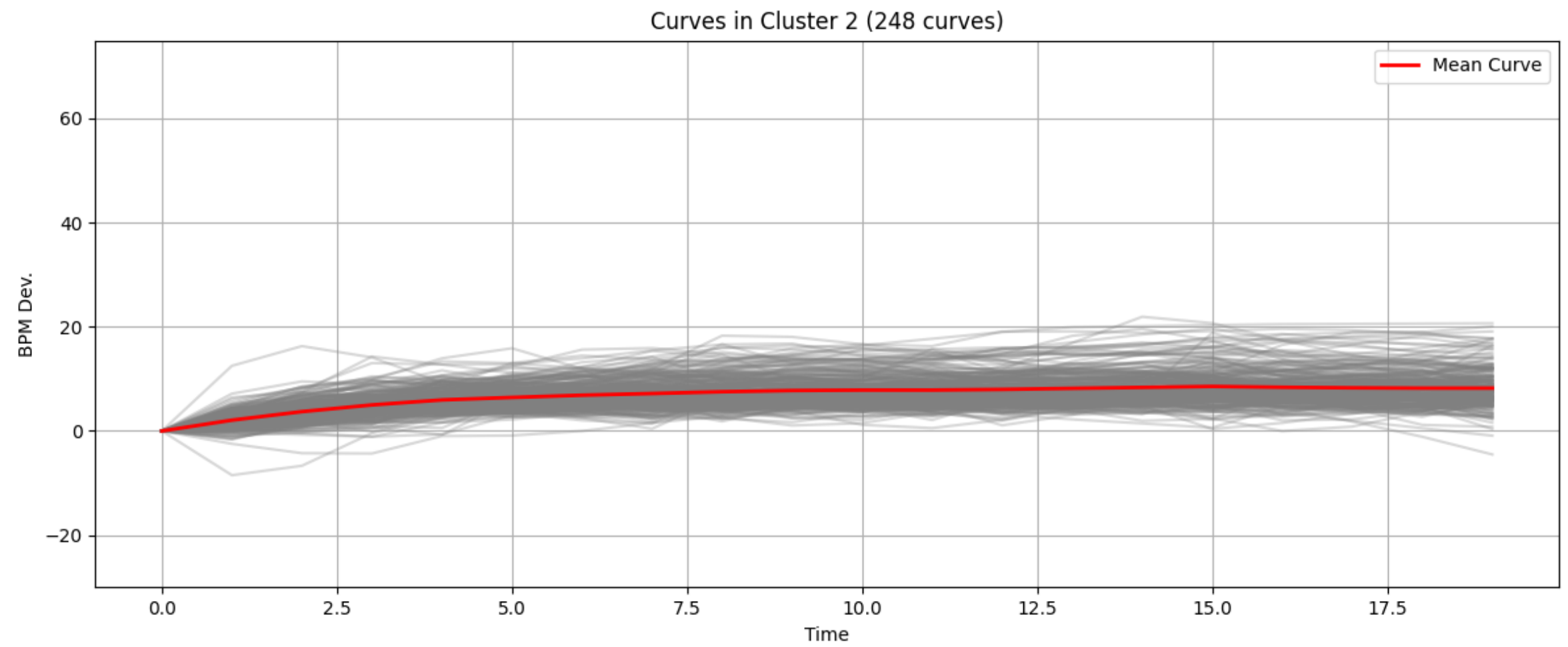
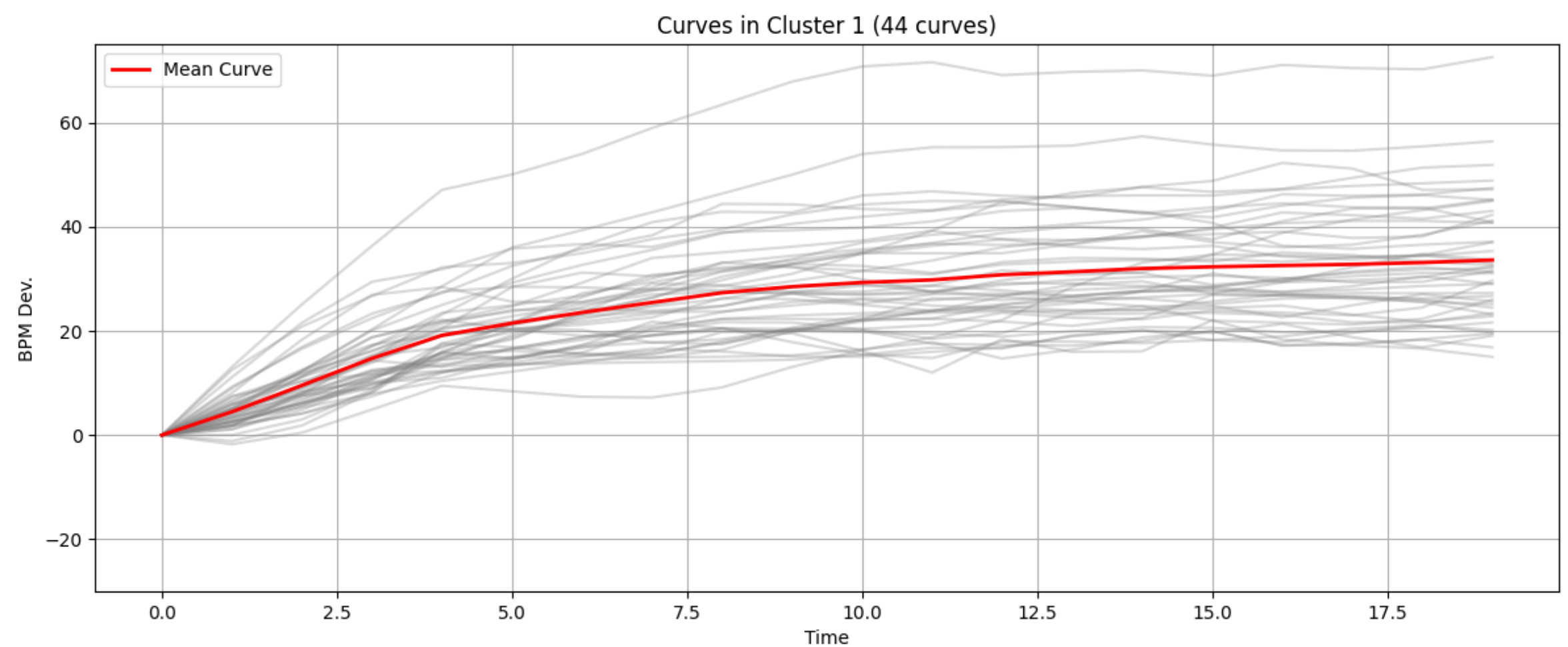
Linkage matrix



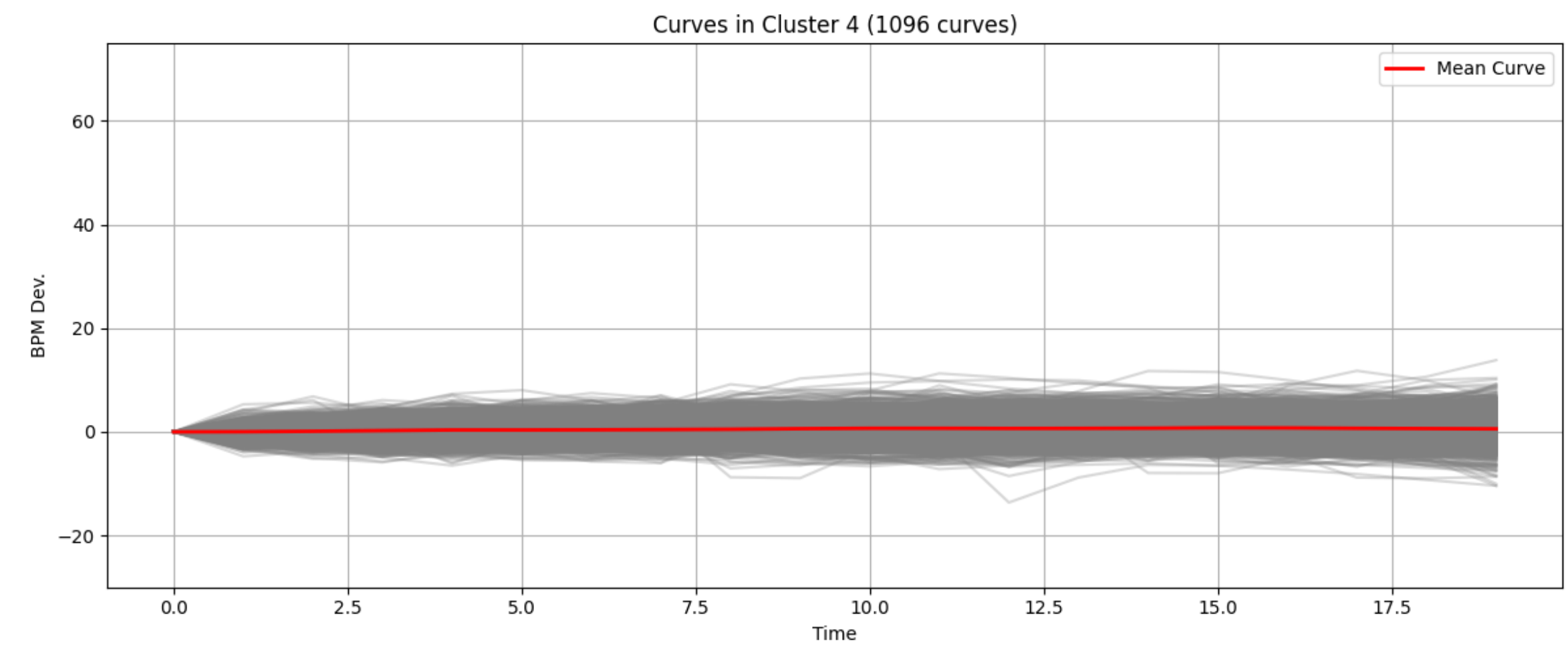
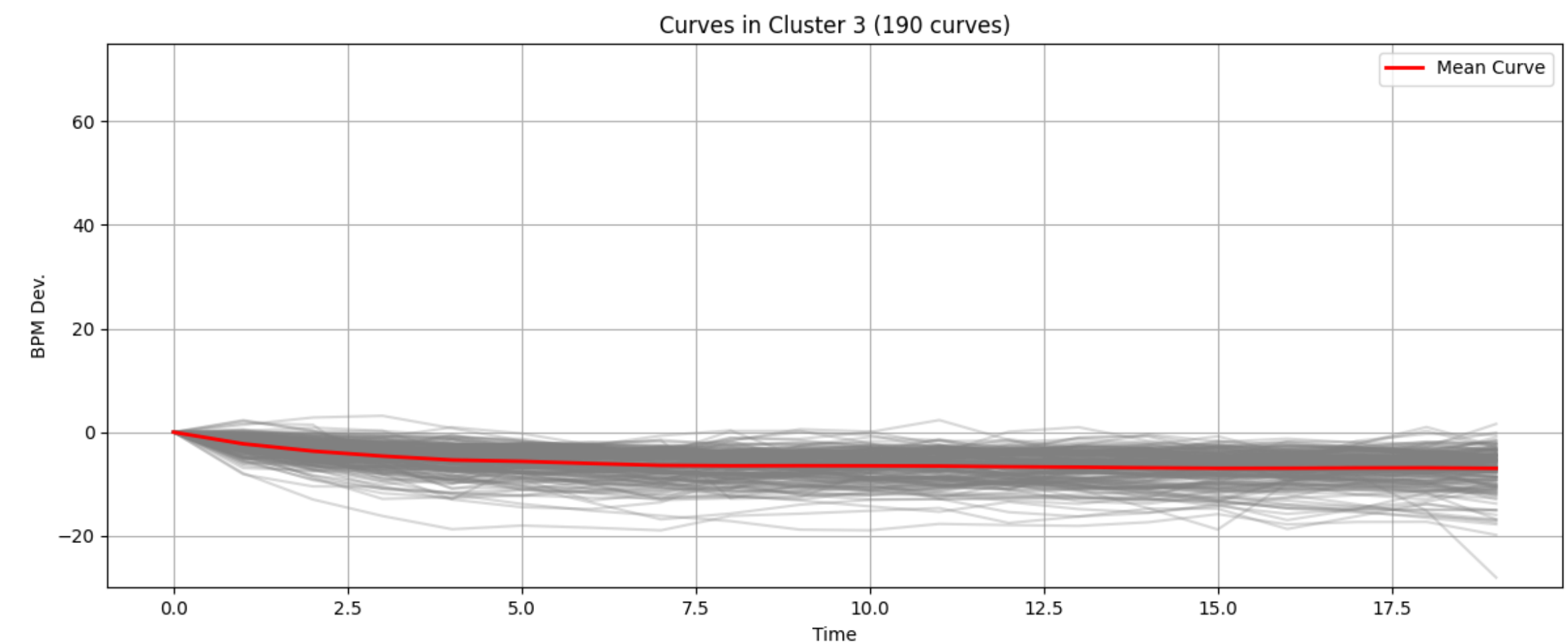
Dendrogram



Accentuated acceleration

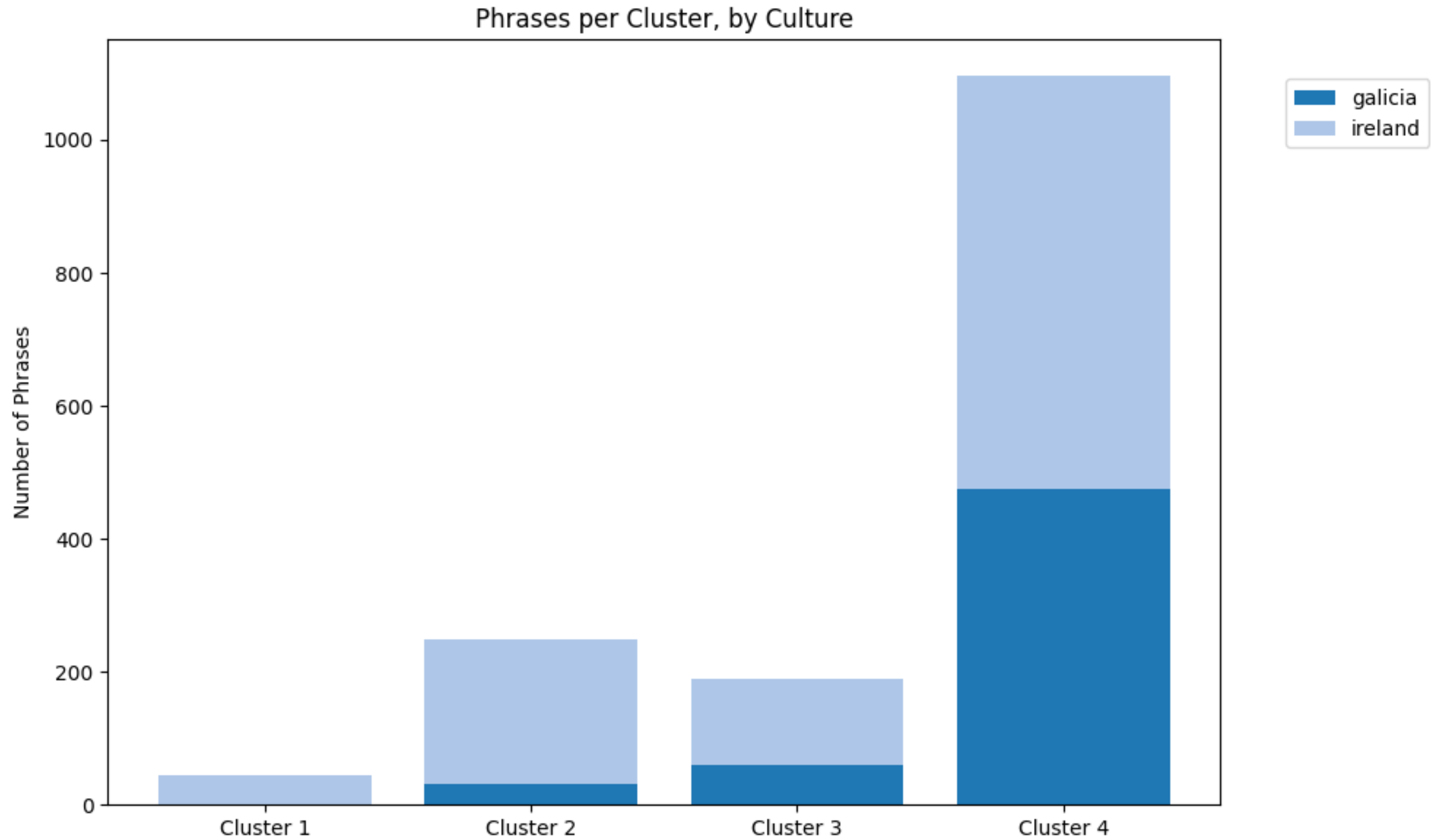


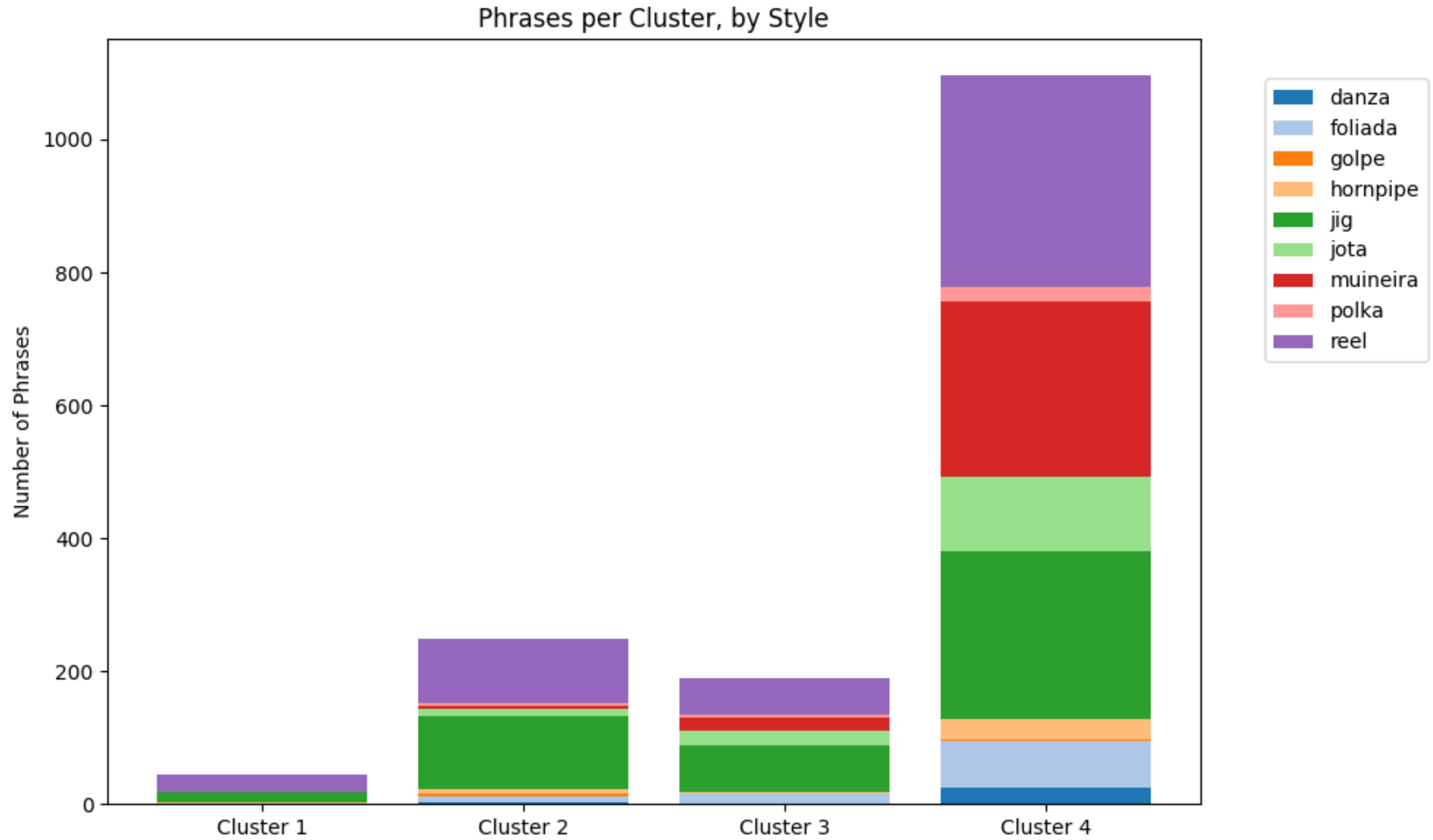
Slight deceleration and stabilisation

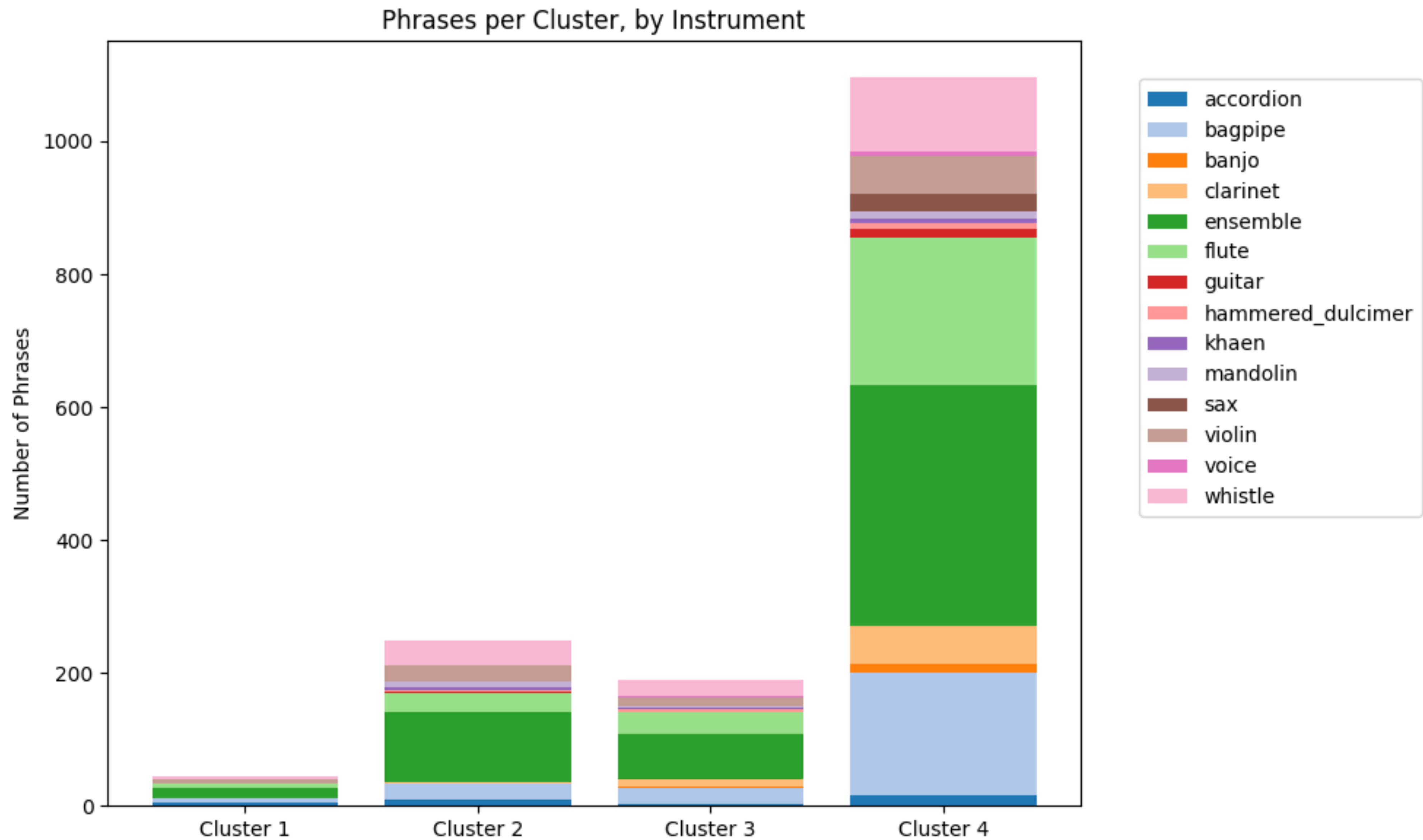


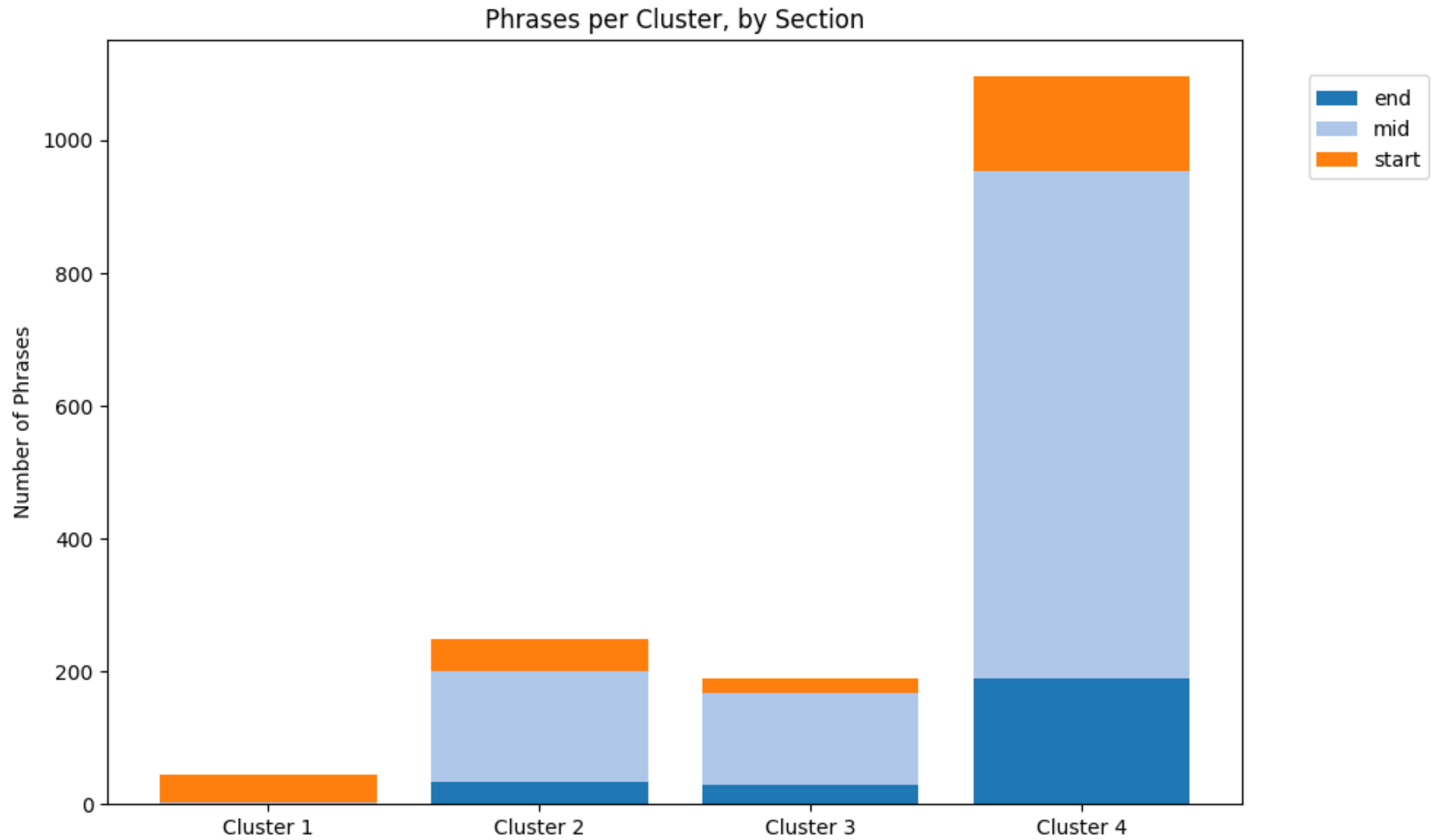
Slight acceleration and stabilisation

Stable tempo









Final remarks

- Interesting results, worth further exploration
- However, we should keep in mind the datasets' sources and sample sizes
- But more importantly, it contributes to the field with a replicable and expandable framework

Future work

- Complete the annotations for the remainder of the datasets
- Expand by adding more material, including other cultures
- Analyse other performance features, e.g. pitch deviation, ornamentation, etc.

Thank you

Questions?