

Studying Large Plainchant Corpora Using chant21

Bas Cornelissen, Willem Zuidema & John Ashley Burgoyne

Institute for Logic, Language and Computation

University of Amsterdam

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2 corpora

CantusCorpus

GregoBaseCorpus

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1 Python package

Convert gabc and

Volpiano to music21



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• **2 corpora**

CantusCorpus

GregoBaseCorpus

• **1 Python package**

Convert gabc and

Volpiano to music21

- **2 case studies**

Melodic arch

Differentiæ–antiphons

CantusCorpus

github.com/bacor/CantusCorpus

source

Cantus database

music

Medieval manuscripts

goal

Chant scholarship

size

~60,000 melodies

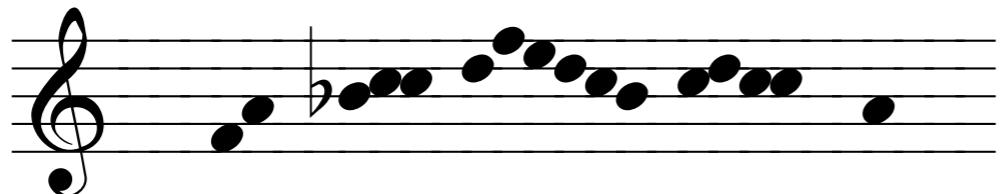
format

Volpiano

code

1---fh-ijkk-lnmlkj-klkk---h---

rendition



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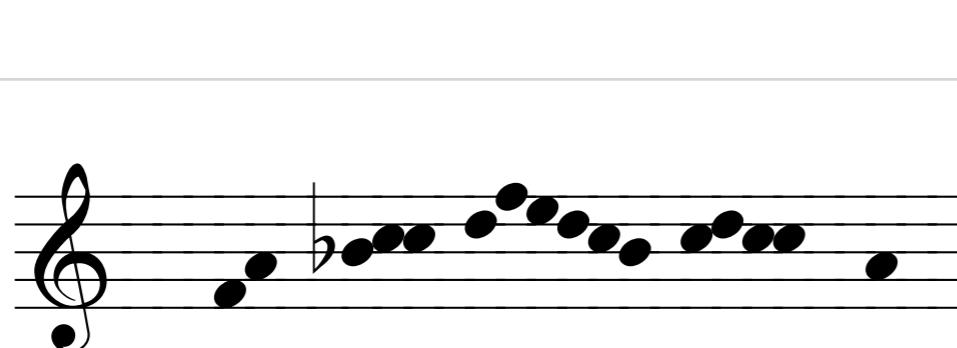
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GregoBaseCorpus

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GregoBase

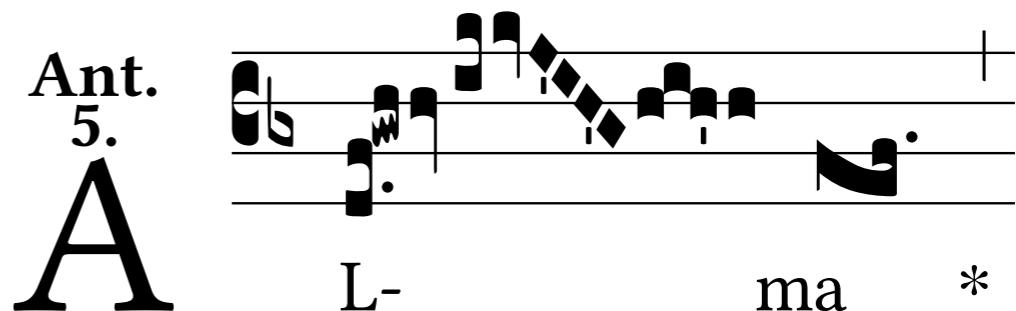
Modern chant books

Performance

~9,000 melodies

gabc

(cb3) AL(d.f!gwhhv//ikkvJ' IH' Ghih'h)
ma(fef.) *(*,) Re(h)dem(h') ptó(d)...



Chant21

Aims

- ✓ Hierarchical representation: sections, words, sylls, neumes
- ✓ A gabc converter for music21
- ✓ A Volpiano converter with text alignment
- ✓ Quick chant visualisation in Jupyter notebooks using Volpiano

```
[1]: import chant21
from music21 import converter
kyrie = converter.parse('kyrie.gabc')
kyrie.show('html', showOptions=True)
```

Show: metadata sections words syllables neumes

The image displays two musical staves. The top staff shows the beginning of a chant with the text "KY- ri- e * e- lé- i- son.". The bottom staff shows the continuation with the text "iij. Chrí- ste e- lé- i- son.". Both staves use a soprano C-clef and common time. Vertical dashed red lines align the text under each note. The first note in each staff has a single dot above it, while subsequent notes have double dots above them.

Related

gabc exporter & Volpiano in music21
several other gabc converters.

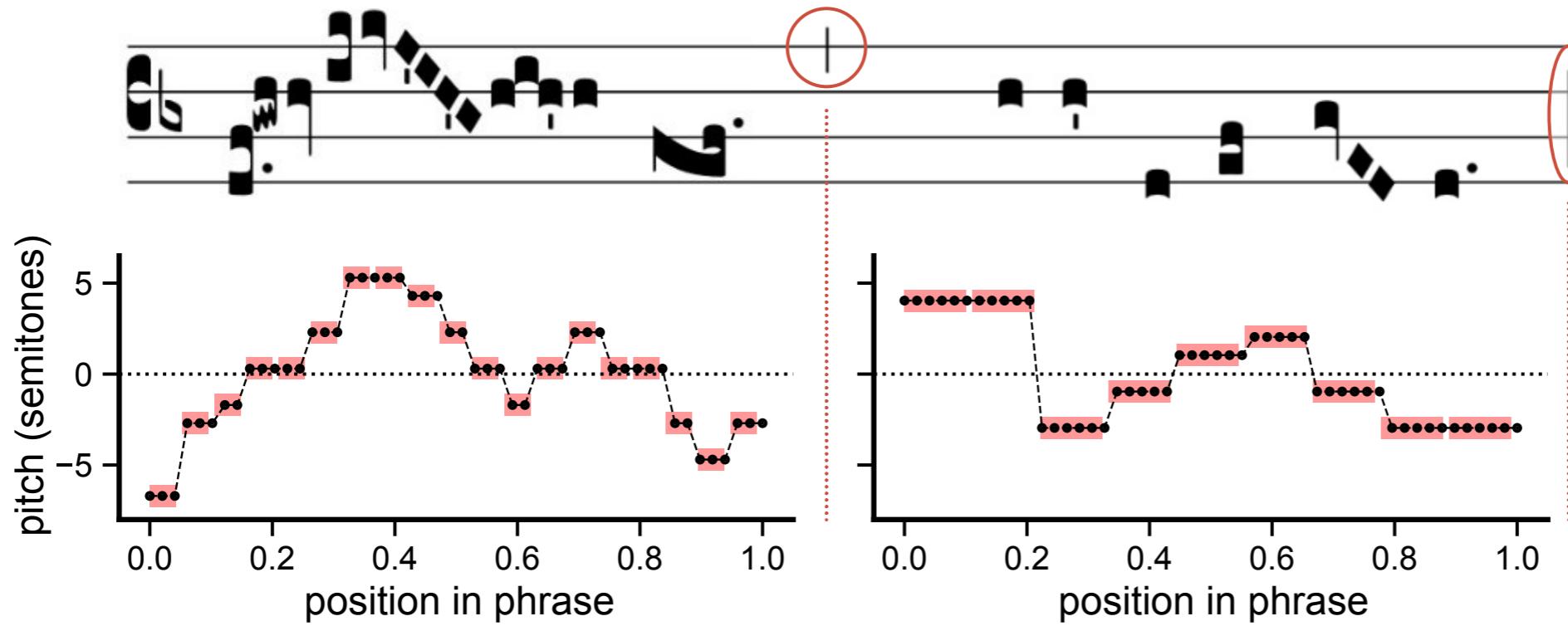
Implementation

Custom PEG grammars with Arpeggio, a Python PEG parser

Case 1: melodic arch hypothesis

Are phrases in plainchant on average arch-shaped?

e.g. Huron 1996



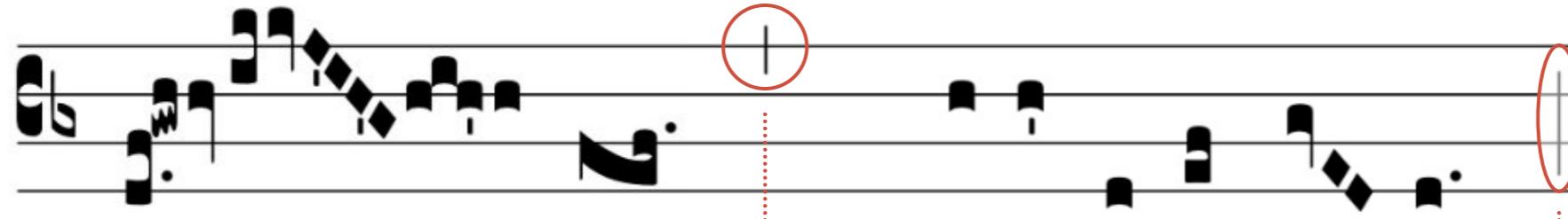
Phrase contours

1. GregoBaseCorpus: phrases delimited by *pausas*
2. Contour: 50 equidistant pitches from the phrase
3. Phrases transposed to have mean pitch 0
4. All notes equal duration; total duration normalised

Similar to what is used in:
[Savage et al 2017 Mus Perc](#)
[Tierney et al 2016 PNAS](#)
[Juhász 2015 J New Mus Res](#)

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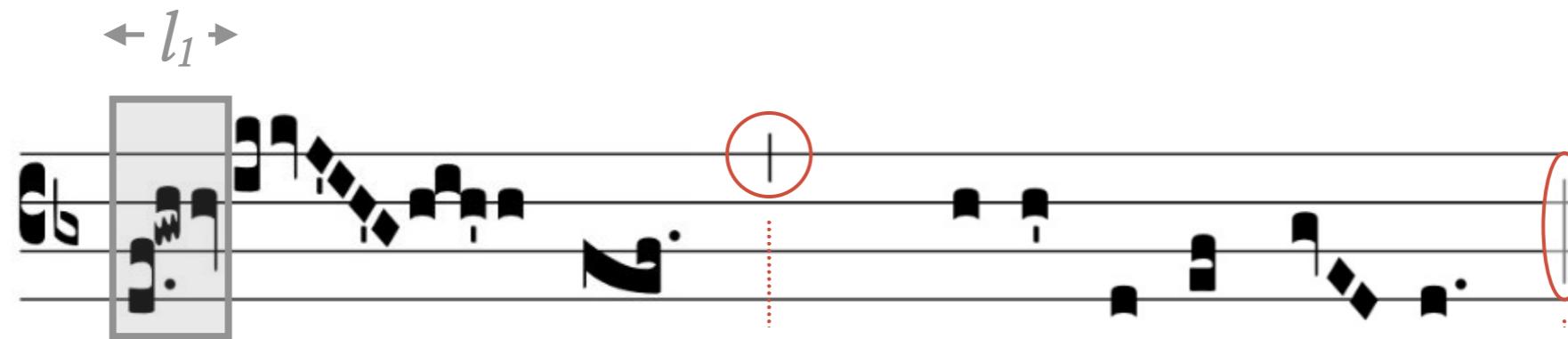
Baseline: contours of random segments

1. Sample segment lengths l_1, l_2, l_3, \dots that are distributed like to actual phrase lengths
2. Discard initial and final random segment

This is *different* from
Savage et al 2017 Mus Perc
who shuffles pitches.
We keep the melody intact.

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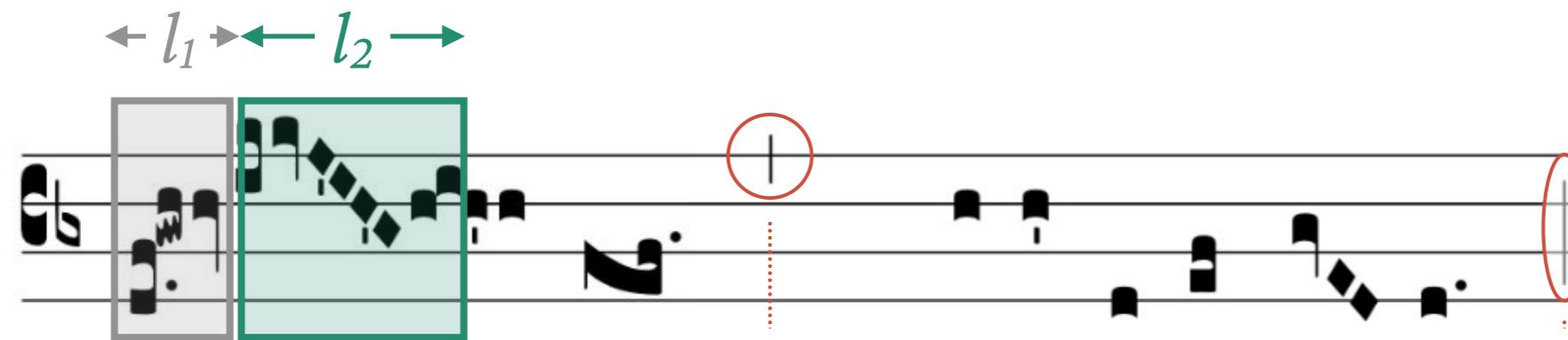
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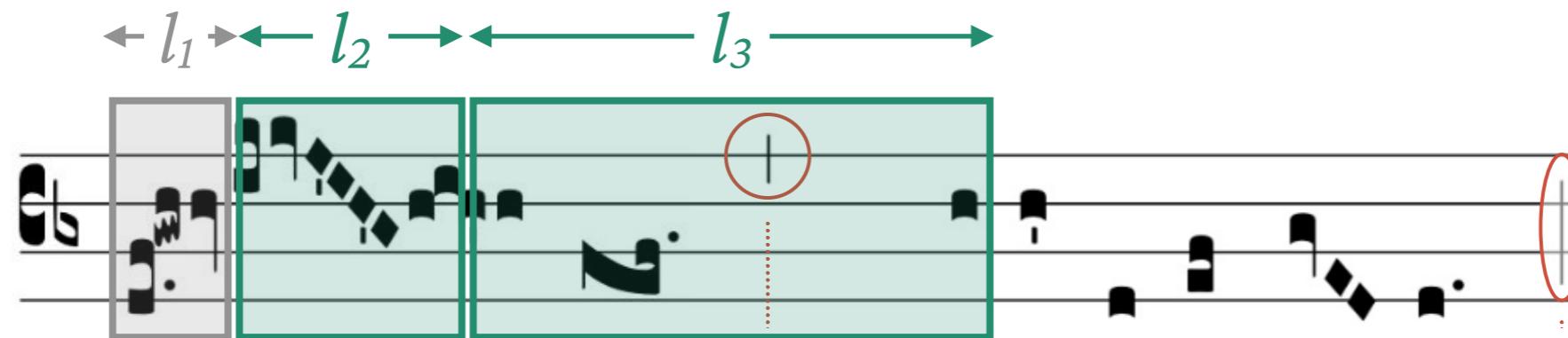
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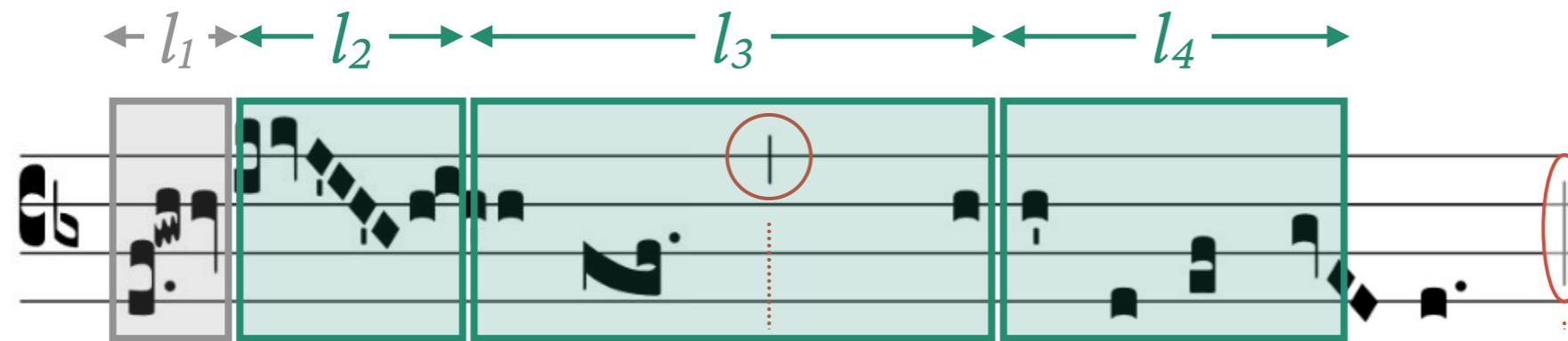
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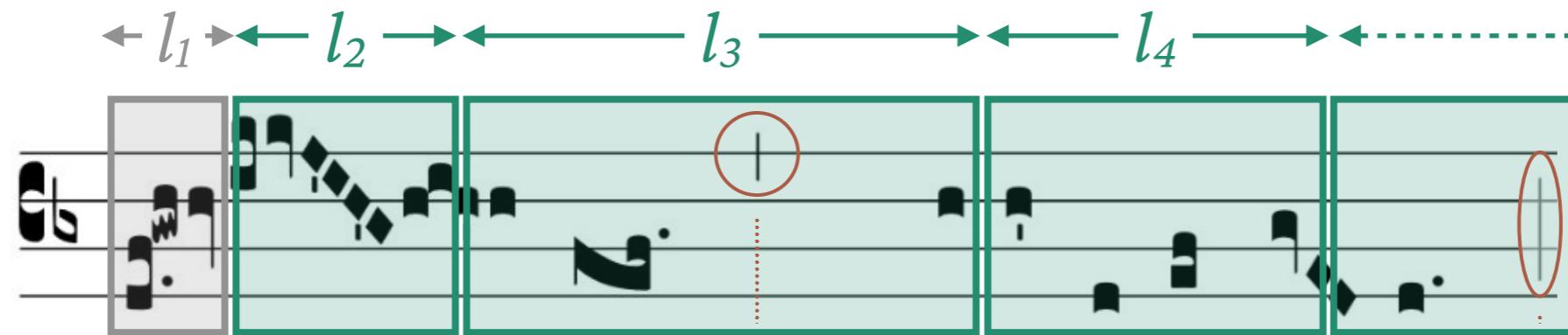
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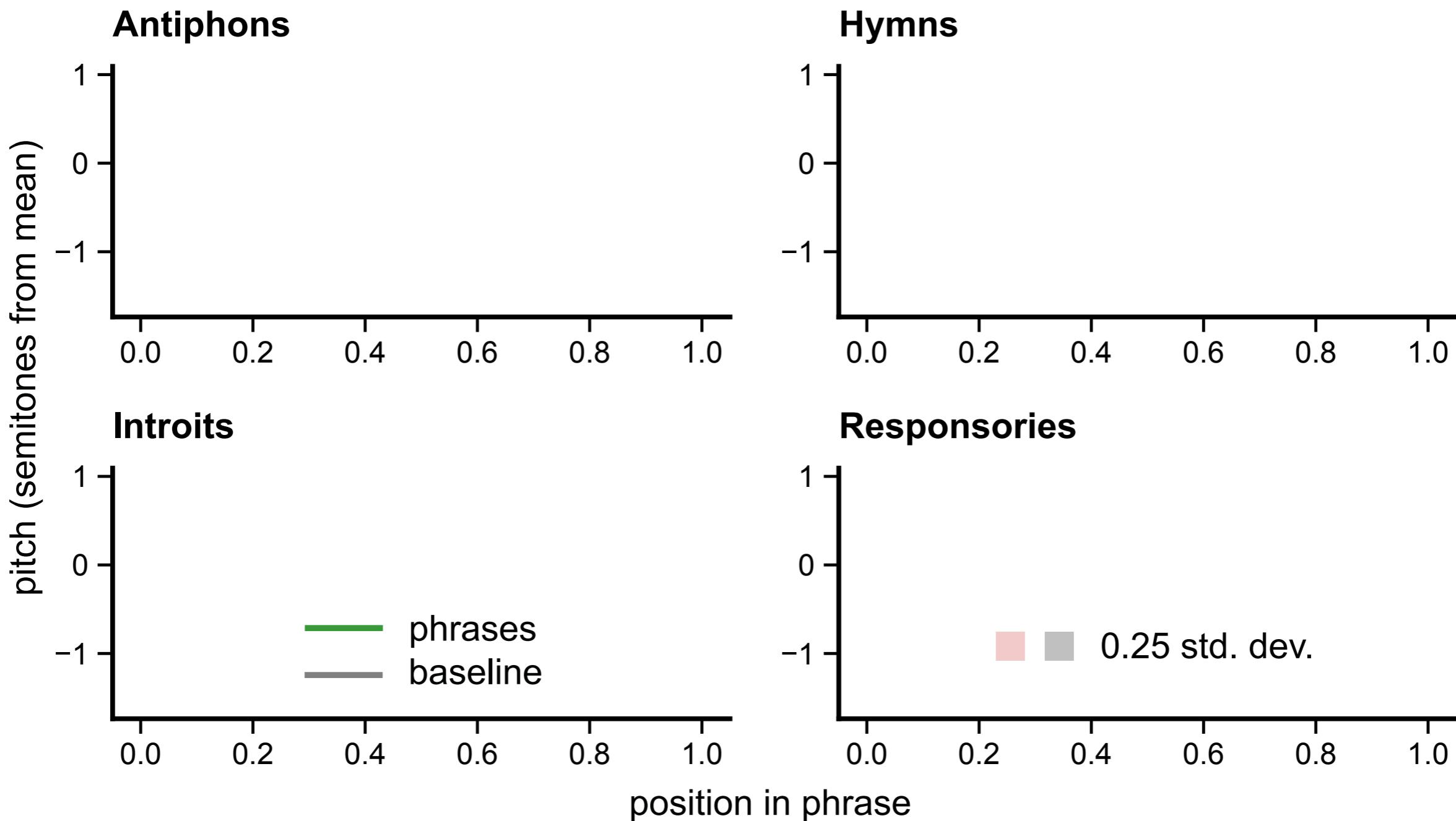
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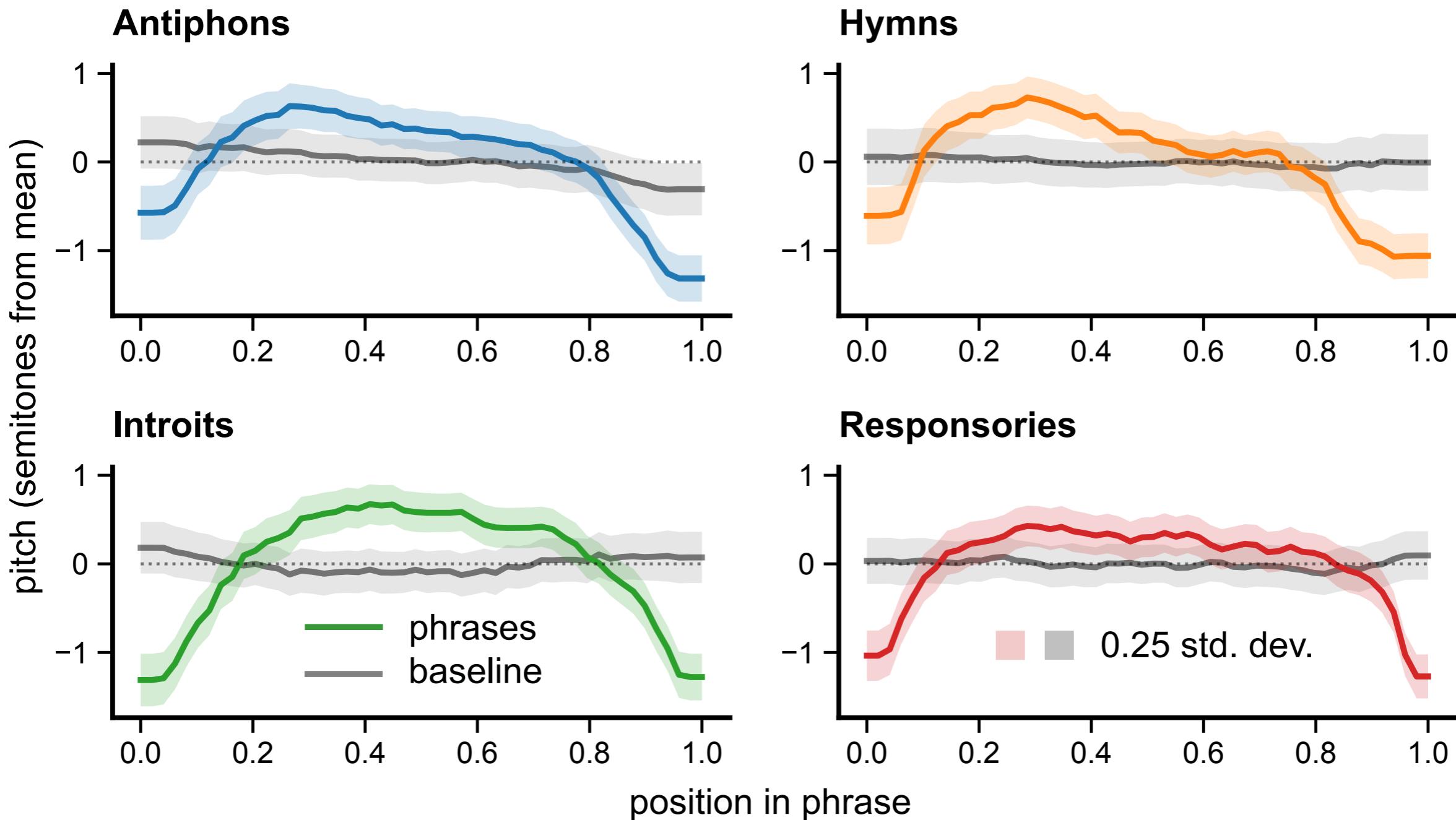
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Are phrases in plainchant on average arch-shaped?



Case 1: melodic arch hypothesis

Are phrases in plainchant on average arch-shaped?



Case 2: *differentia–antiphon*

*Are *differentia–antiphon* connections systematic?*

— *Rebecca Shaw, DLfM 2018*

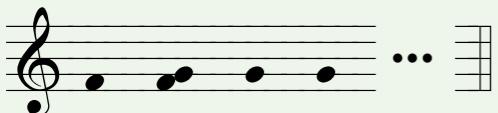
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adapted from Shaw 2018

Antiphon



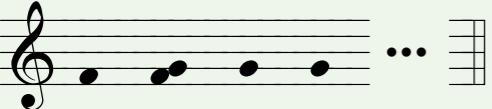
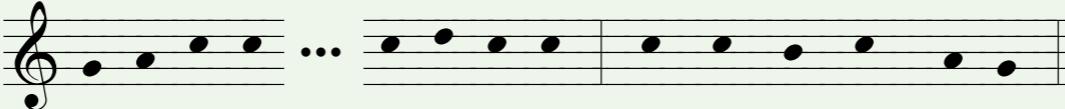
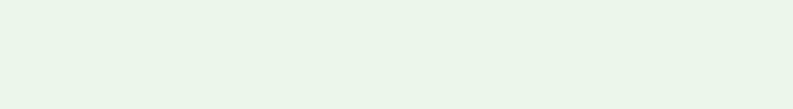
Do-mi-ne in

Case 2: differentia–antiphon

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Antiphon	Psalm	Differentia
		
Do-mi-ne in	(Mode 8 psalm tone)	Sae-cu-lo-rum a-men (euouae)

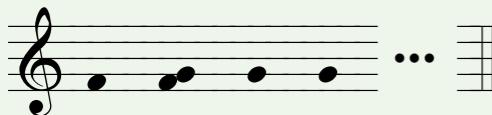
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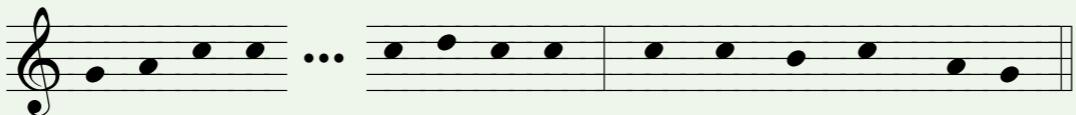
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Antiphon



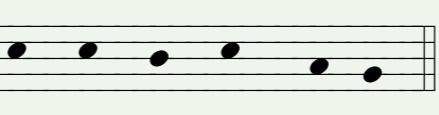
Do-mi-ne in

Psalm



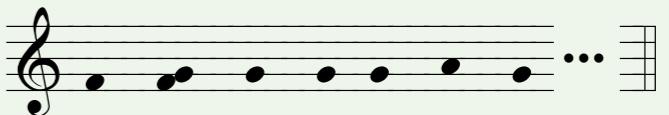
(Mode 8 psalm tone)

Differentia



Sae-cu-lo-rum a-men
(euouae)

Antiphon (again)



Do-mi-ne in vir-tu-te

Case 2: differentia-antiphon

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The diagram illustrates the structure of a liturgical chant. It consists of four horizontal rows. The first row, labeled "Antiphon" in green, shows a musical staff with a treble clef and a melody consisting of quarter notes and rests. The second row, labeled "Psalm" in green, shows another musical staff with a treble clef and a similar melody. The third row, labeled "Differentia" in green, shows a musical staff with a treble clef and a melody that includes a vertical bar line, indicating a change in measure. The fourth row, also labeled "Antiphon" in green, shows a musical staff with a treble clef and a melody that continues from the previous row. A red question mark with a curved arrow points from the end of the "Differentia" staff back to the beginning of the fourth "Antiphon" staff. Below each row, there is corresponding Latin text: "Do-mi-ne in" under the first Antiphon, "(Mode 8 psalm tone)" under the Psalm, "Sae-cu-lo-rum a-men" under the Differentia, and "Do-mi-ne in vir-tu-te" under the second Antiphon.

Case 2: differentia–antiphon

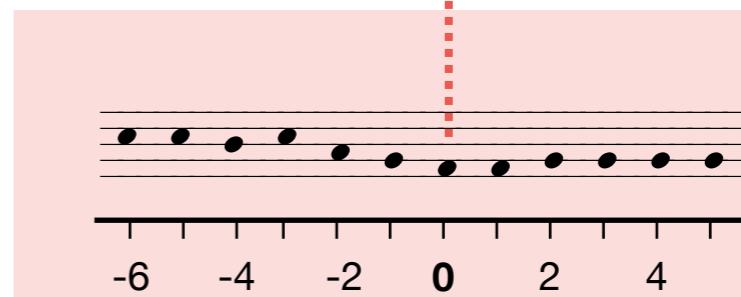
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adapted from Shaw 2018

The diagram illustrates the musical connection between four parts: Antiphon, Psalm, Differentia, and Antiphon (again). The Antiphon and Psalm are shown in G clef, while the Differentia and Antiphon (again) are in C clef. Red dashed boxes highlight the end of the Differentia and the beginning of the Antiphon (again). A red question mark with an arrow points from the end of the Differentia to the beginning of the Antiphon (again). The lyrics are as follows:

- Antiphon:** Do-mi-ne in
- Psalm:** (Mode 8 psalm tone)
- Differentia:** Sae-cu-lo-rum a-men
(euouae)
- Antiphon (again):** Do-mi-ne in vir-tu-te



Connections

End of differentia
+ opening of antiphon

Case 2: differentia-antiphon

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adapted from Shaw 2018

Antiphon

Psalm

Differentia ?

Antiphon (again)

Do-mi-ne in ...

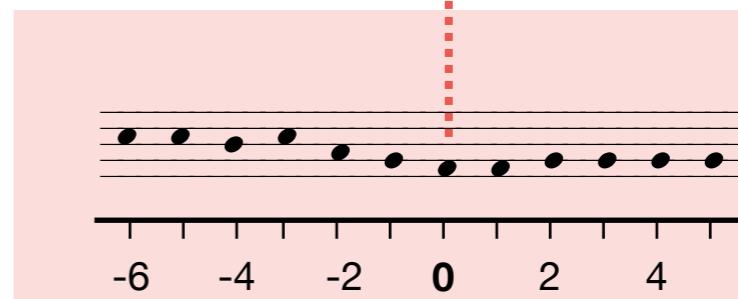
(Mode 8 psalm tone)

Sae-cu-lo-rum a-men
(euouae)

Do-mi-ne in vir-tu-te

Data

We extract **connections** in
7102 antiphons (ending on *euouae*)
from the CantusCorpus



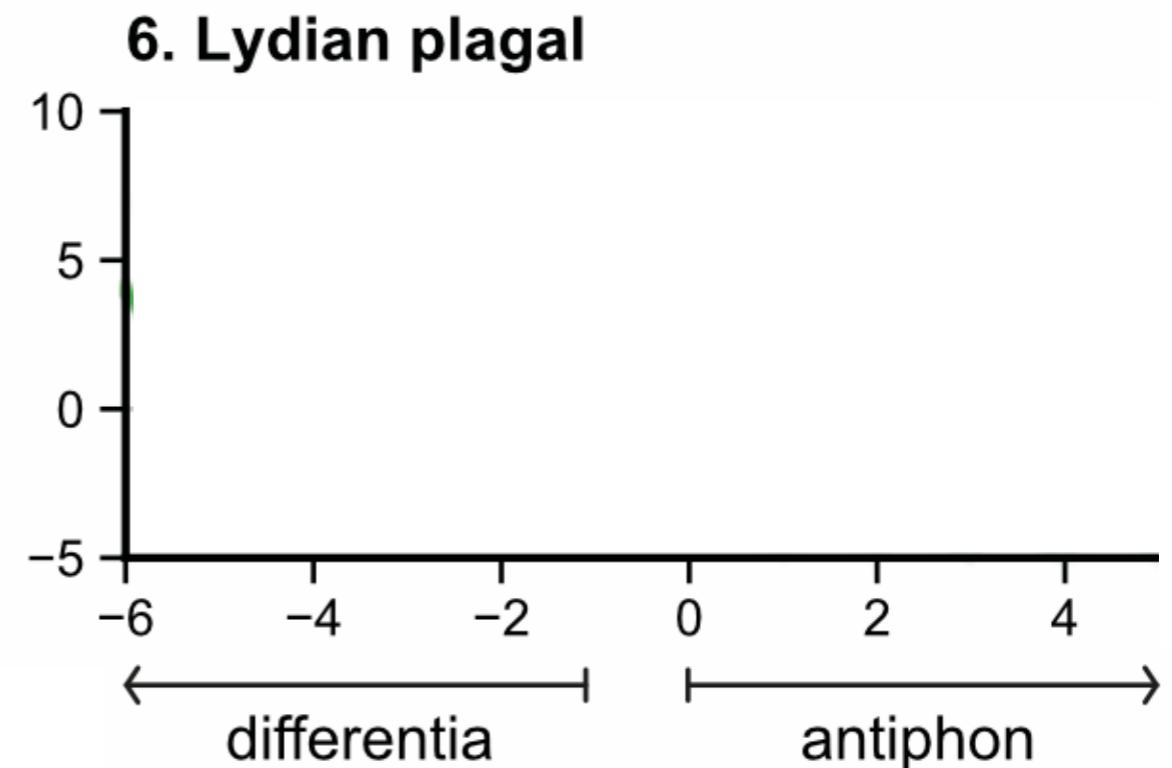
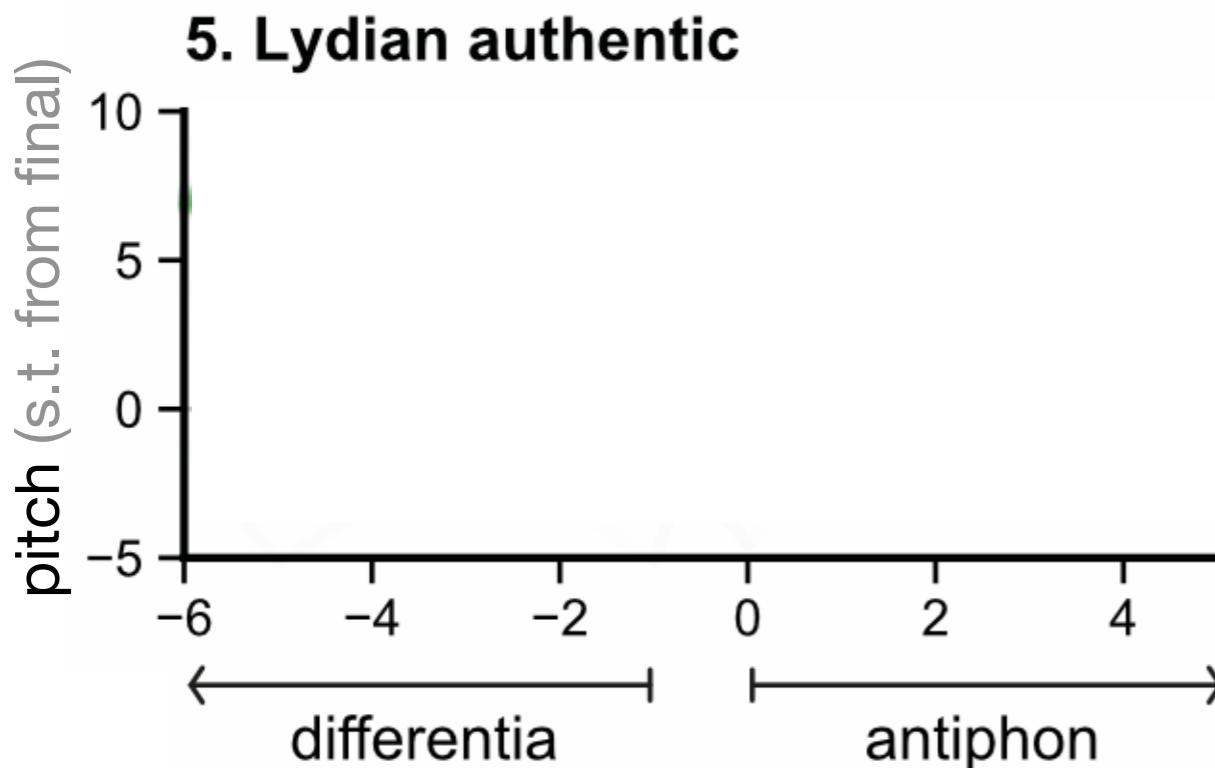
Connections

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Case 2: *differentia–antiphon*

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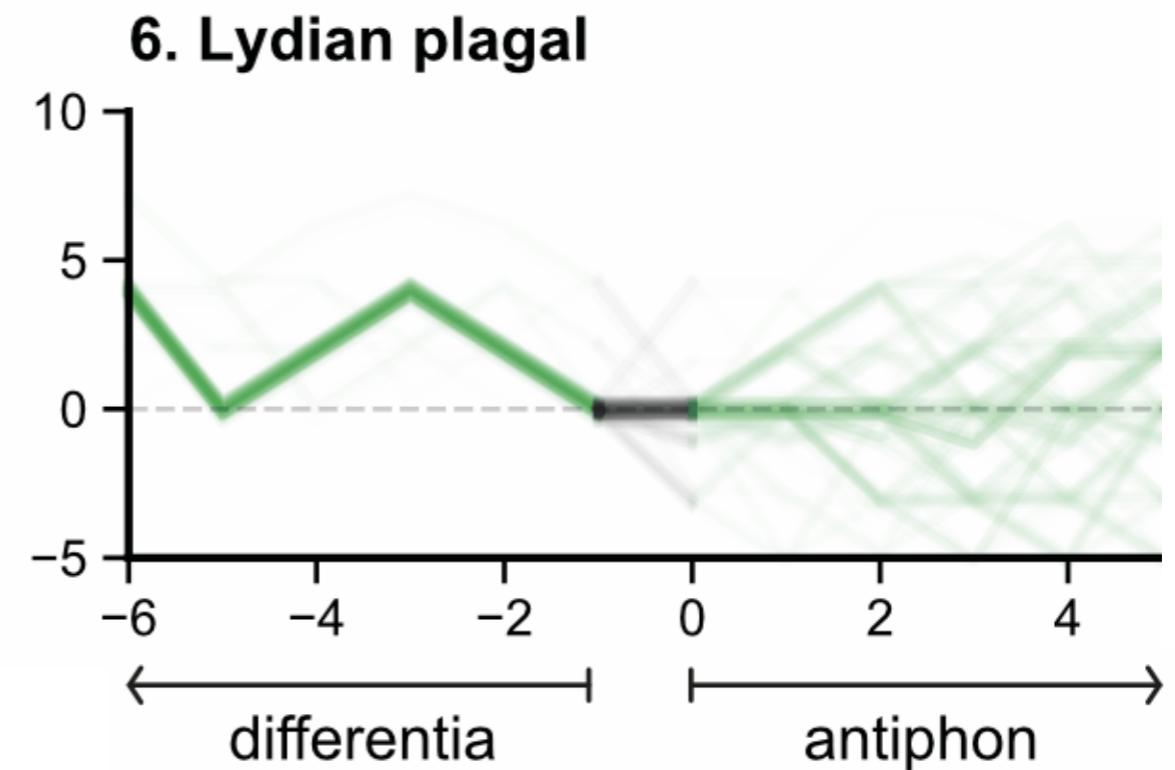
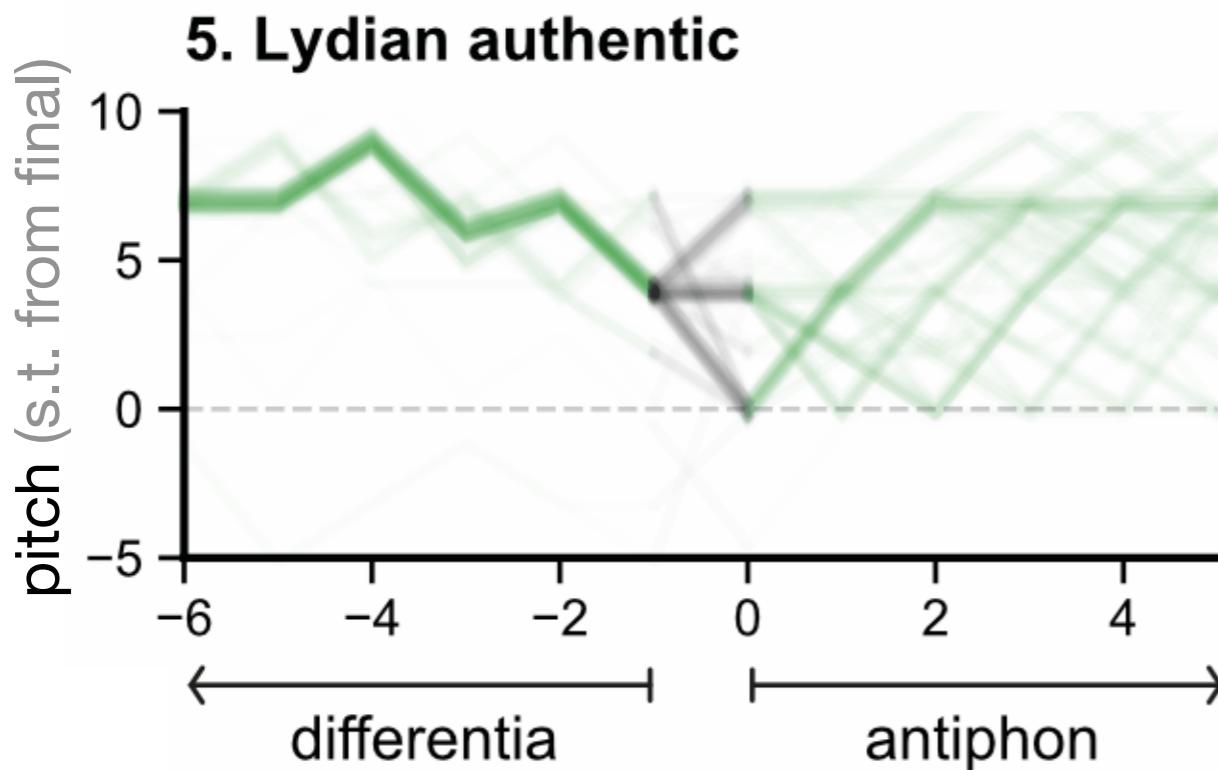
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Case 2: differentia–antiphon

Are differentia–antiphon connections systematic?

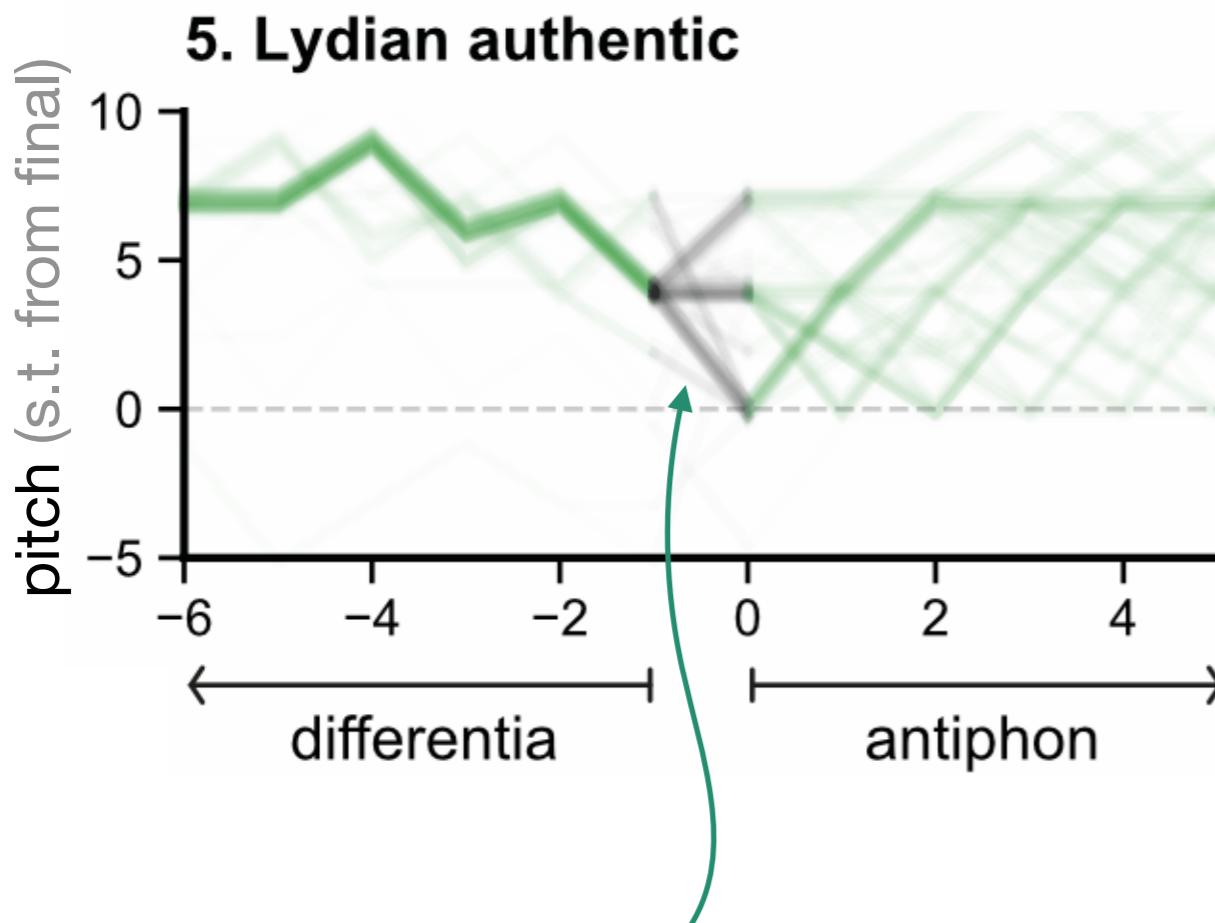
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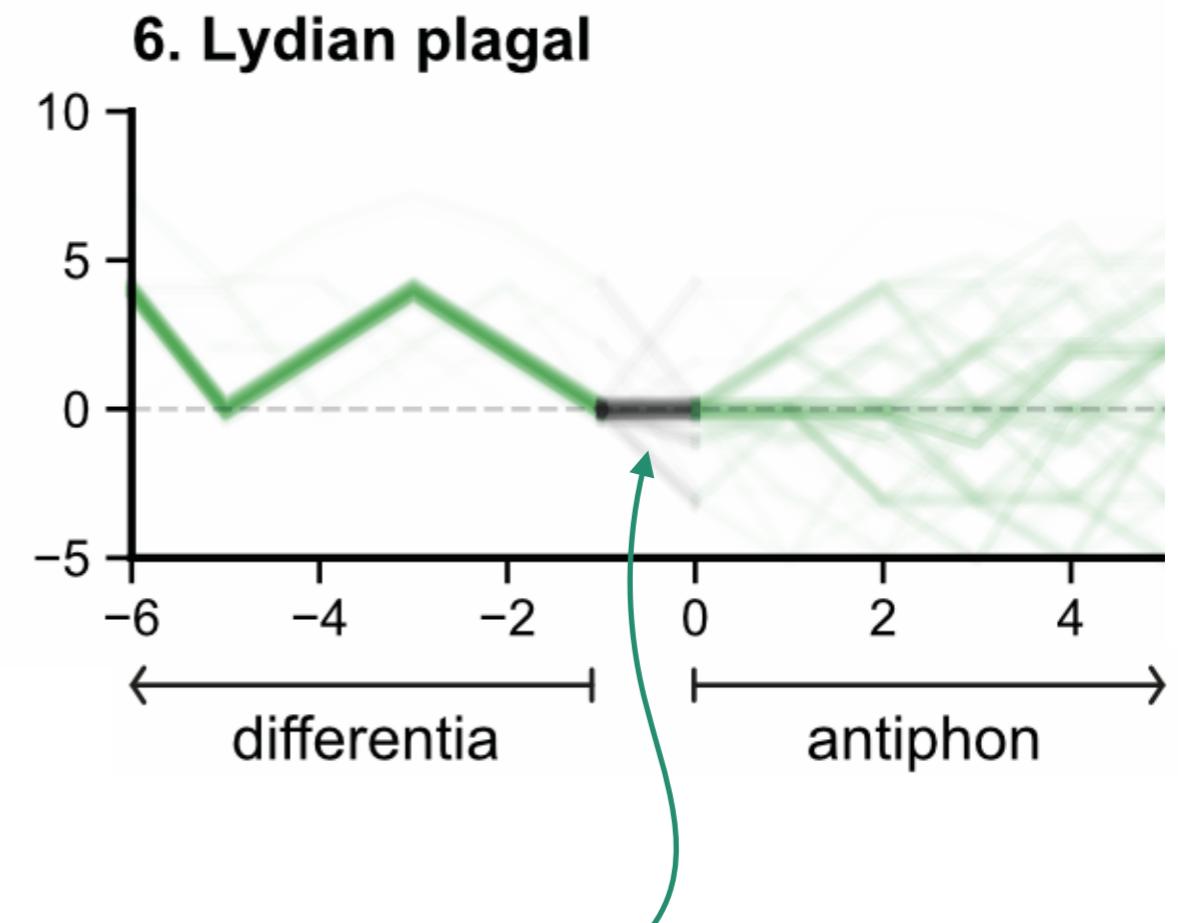
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Not so systematic
less predictable connection
higher entropy?

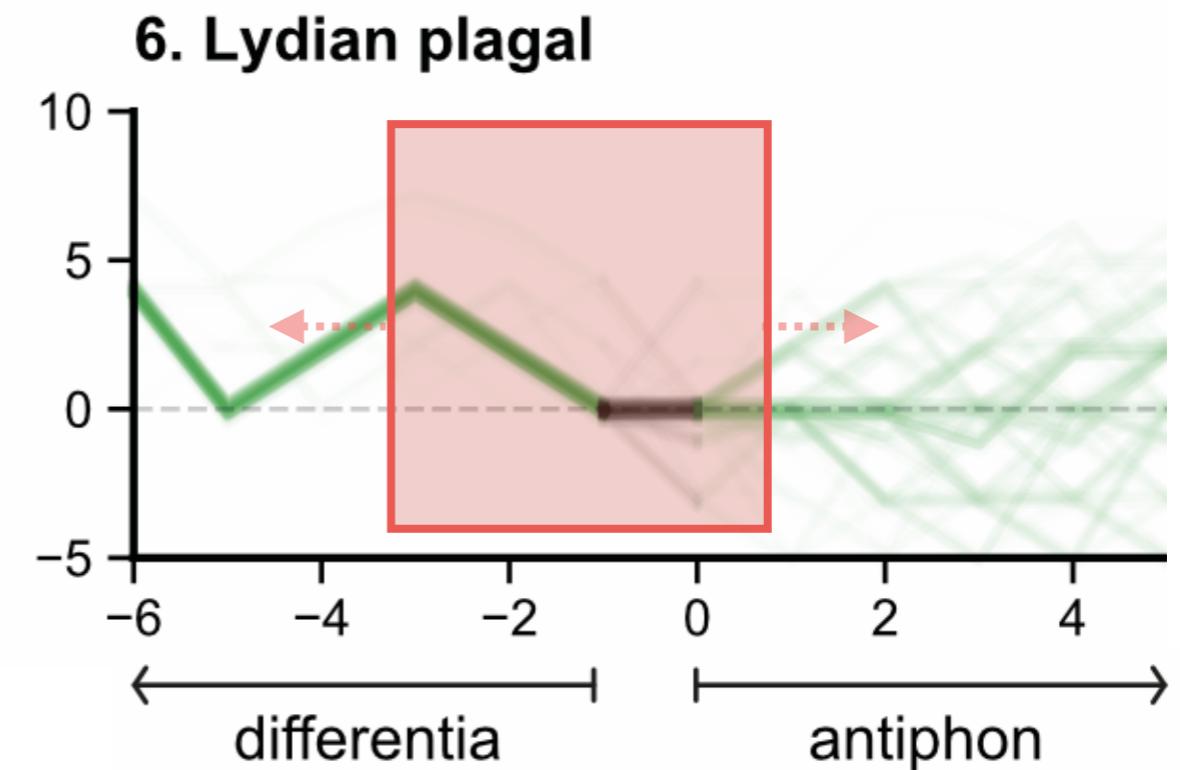
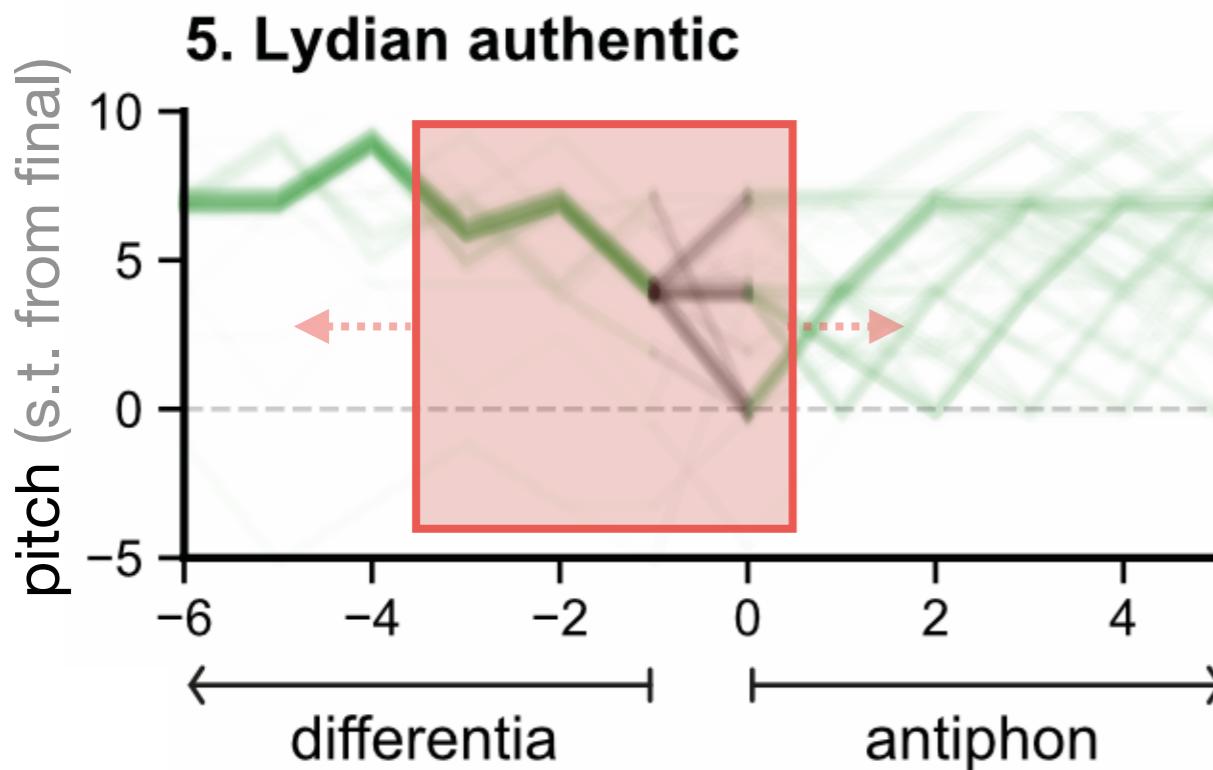


Very systematic
predictable connection
lower entropy?

Case 2: differentia–antiphon

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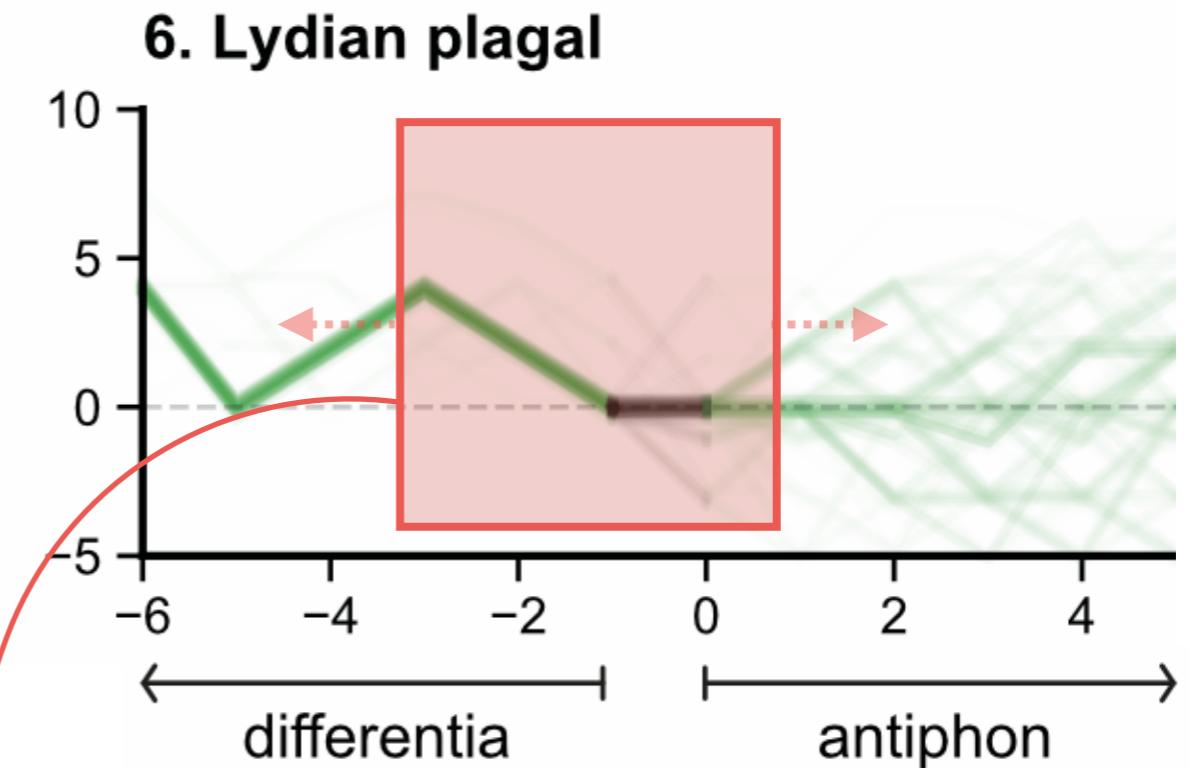
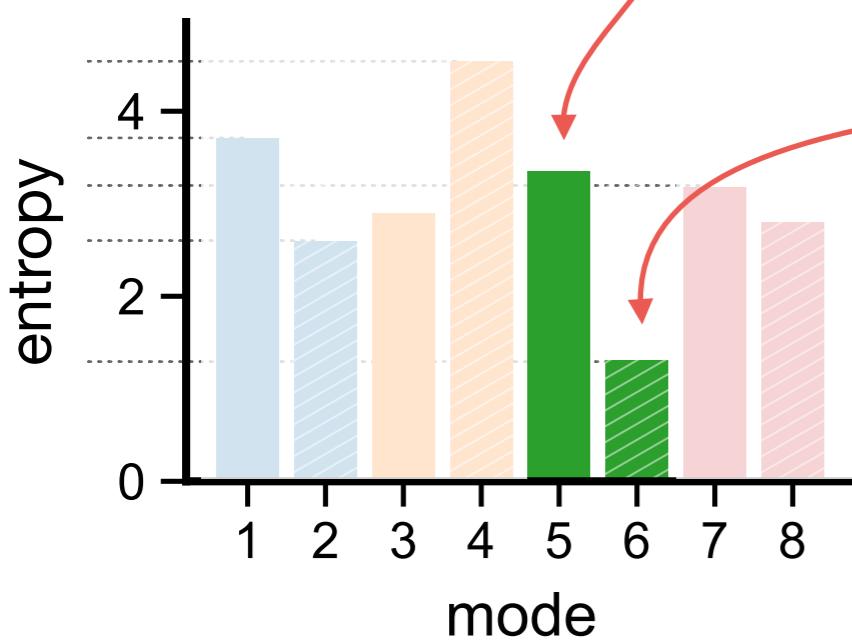
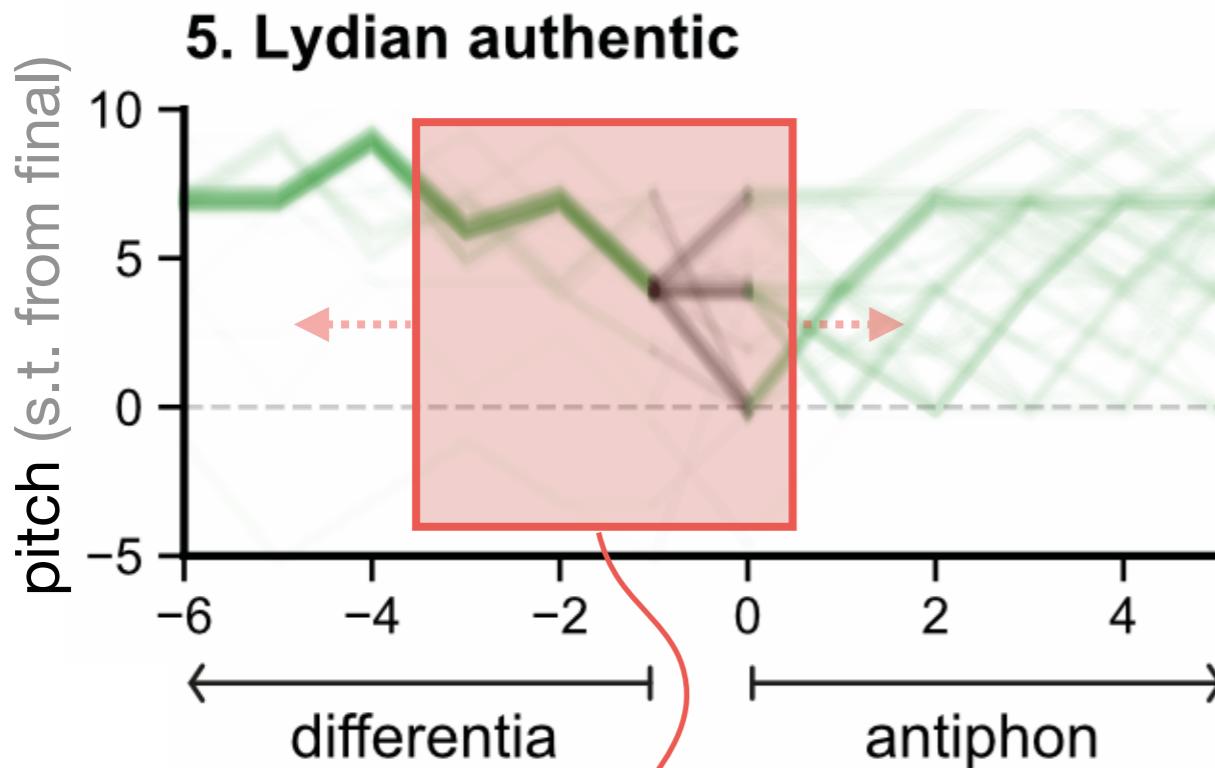


measure entropy
of distr. over connections
in a sliding
window of 4 notes

Case 2: differentia–antiphon

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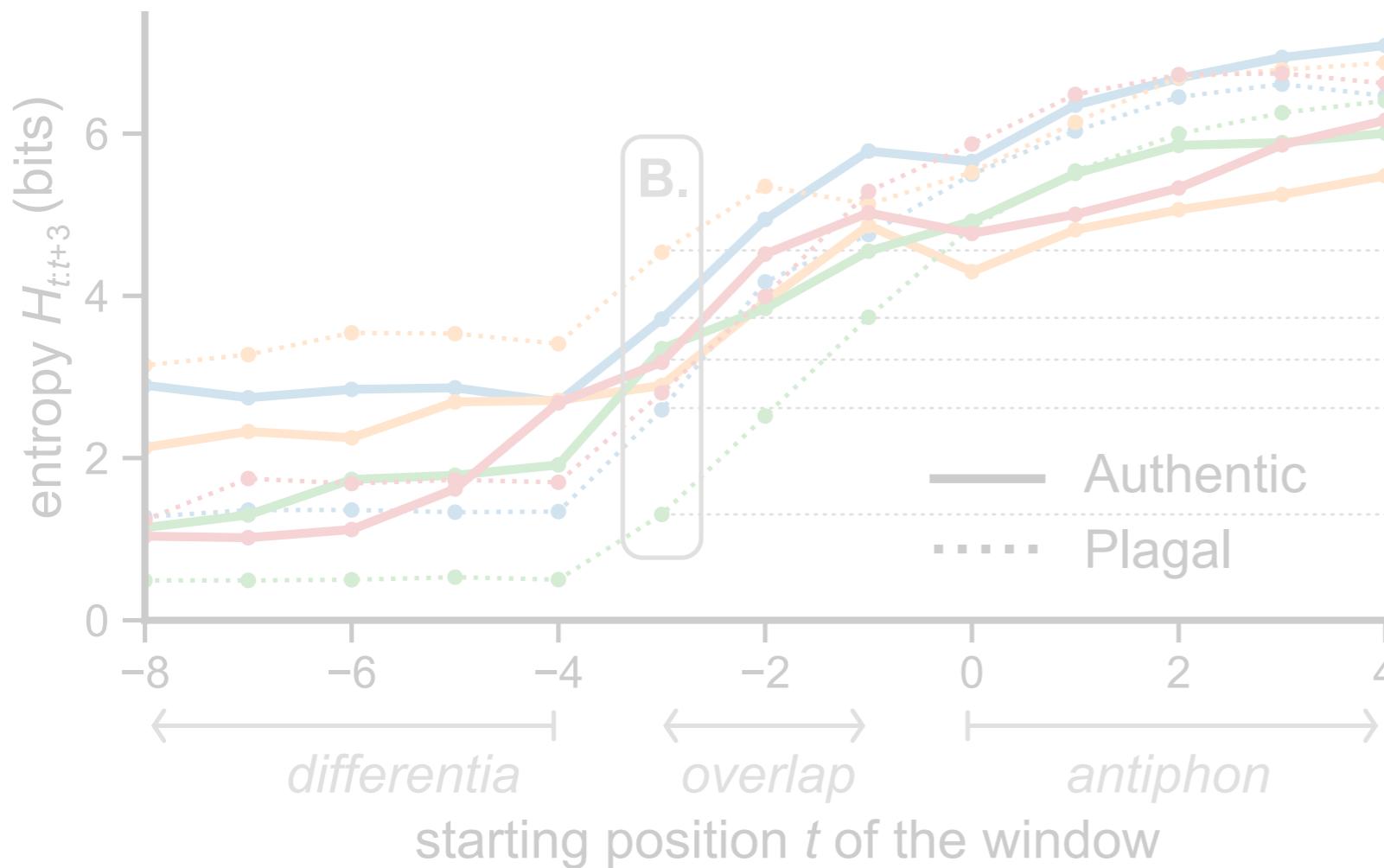
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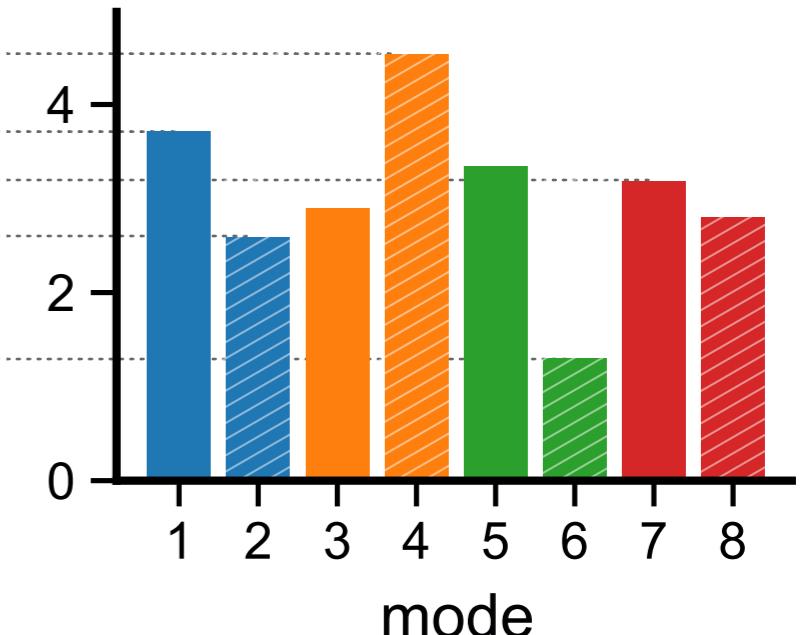
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A. Entropy in a moving window of 4 notes



B. Entropy $H_{3:0}$ of the differentia–antiphon connection

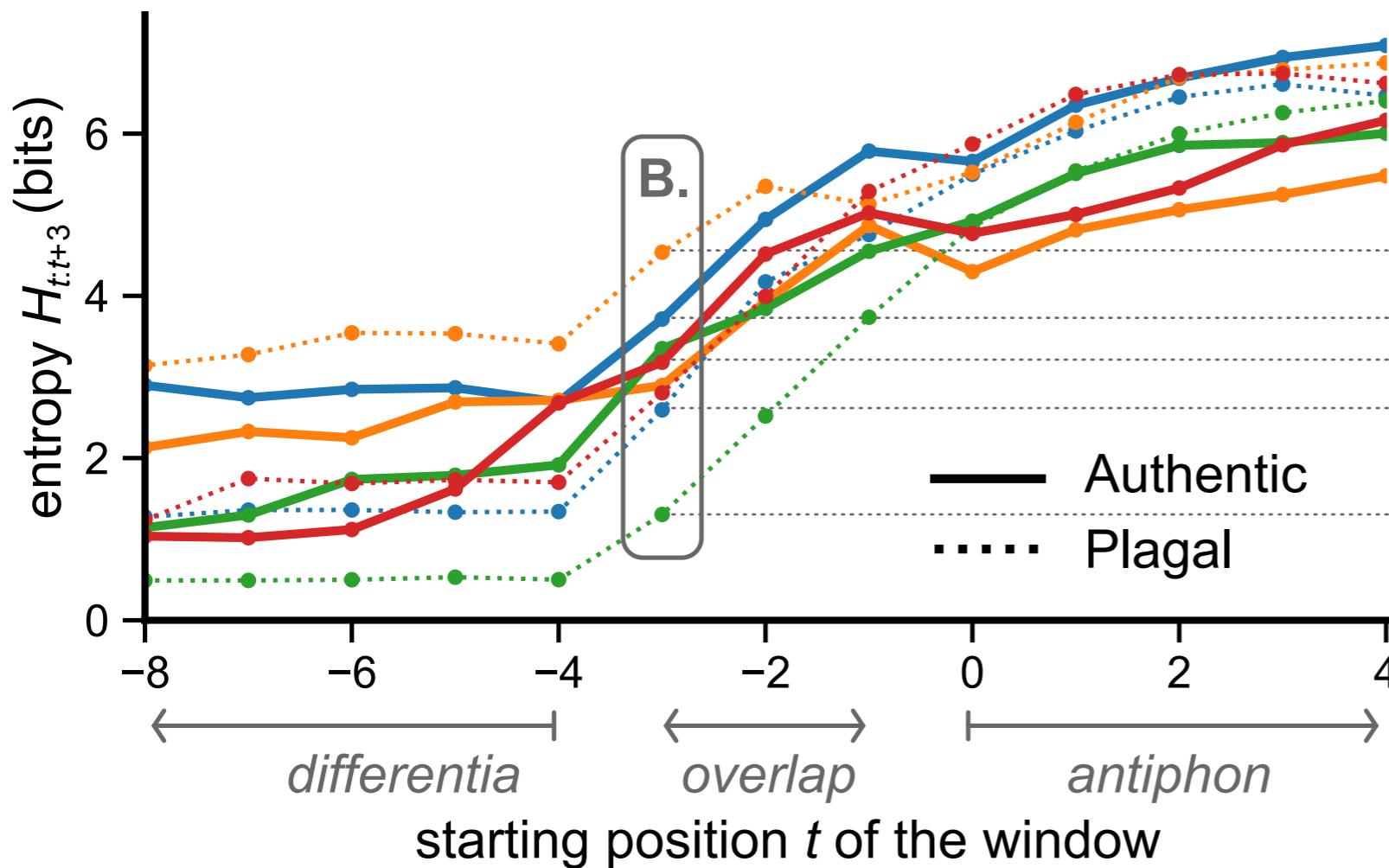


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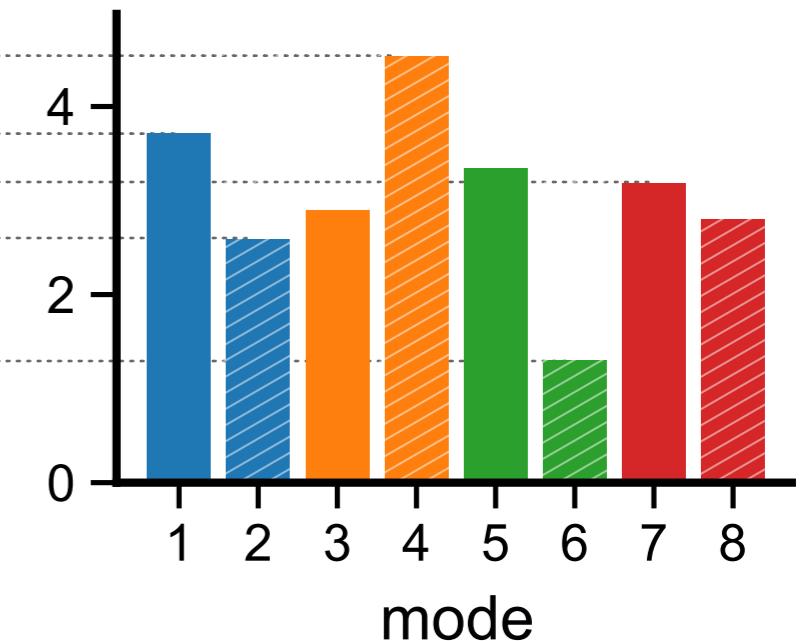
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chant21: github.com/bacor/chant21 or pip install chant21

CantusCorpus: github.com/bacor/CantusCorpus

GregoBaseCorpus: github.com/bacor/GregoBaseCorpus

Case studies: github.com/bacor/DLfM2020

And check out our ISMIR paper
on mode classification on CantusCorpus
at github.com/bacor/ISMIR2020