Contrapuntal Style
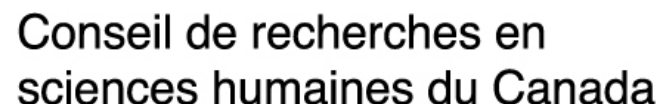# Pierre de la Rue vs. Josquin Des Prez

Julie Cumming, Cory McKay, Peter Schubert, Néstor Nápoles López, and Sylvain Margot

McGill | Schulich School of Music / École de musique Schulich | CIRMMT Centre for Interdisciplinary Research in Music Media and Technology | MARIANOPOLIS COLLEGE

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ed. David Burn, Honey Meconi, and Christiane Wiesenfeldt

SIMSSA | Single Interface for Music Score Searching and Analysis | DDMAL | Fonds de recherche Société et culture Québec

Social Sciences and Humanities Research Council of Canada | Conseil de recherches en sciences humaines du Canada | Canada

Research questions

- What musical characteristics distinguish the styles of Josquin and La Rue?

- How can computational methods help us approach such problems?

Difficult task!

Josquin Des Prez

- c. 1450-55 to 1521
- Varied career in France and Italy

Pierre de la Rue

- c. 1452 to 1518
- Hapsburg-Burgundian chapel, Low Countries and Spain

Meconi, *Grove*: "Despite differences in style, La Rue's music was probably most strongly influenced by that of Josquin. … There are curious parallels between the works of the two."

11 conflicting attributions to the two composer in the NJE

Even experts in the period cannot identify the composer for pieces they don't know

Our corpus: comparing apples to apples

Same texture, same genre

Duos from securely attributed Masses by the two composers:

- 44 duos by La Rue

- 33 duos by Josquin

Duos are:

- The purest form of Renaissance counterpoint, and basic training for composers

- Relatively easy to study

Most were excerpted from the files in the Josquin Research Project; some of the La Rue duos were transcribed from the La Rue *Opera Omnia,* with original note values restored

Formats: MIDI and MusicXML

Three approaches to computer-aided style analysis, plus comparison

- Part 1: Vertical intervals and contrapuntal 3-grams (Néstor Nápoles López and Julie Cumming)
- Part 2: Measuring imitation (Sylvain Margot and Peter Schubert)
- Part 3: Feature extraction and machine learning (Cory McKay)
- Part 4: Comparison of each method in an attribution task

Part 1: Vertical intervals

Distribution of vertical intervals in diatonic steps (as a percentage of the total number of vertical intervals for each composer)
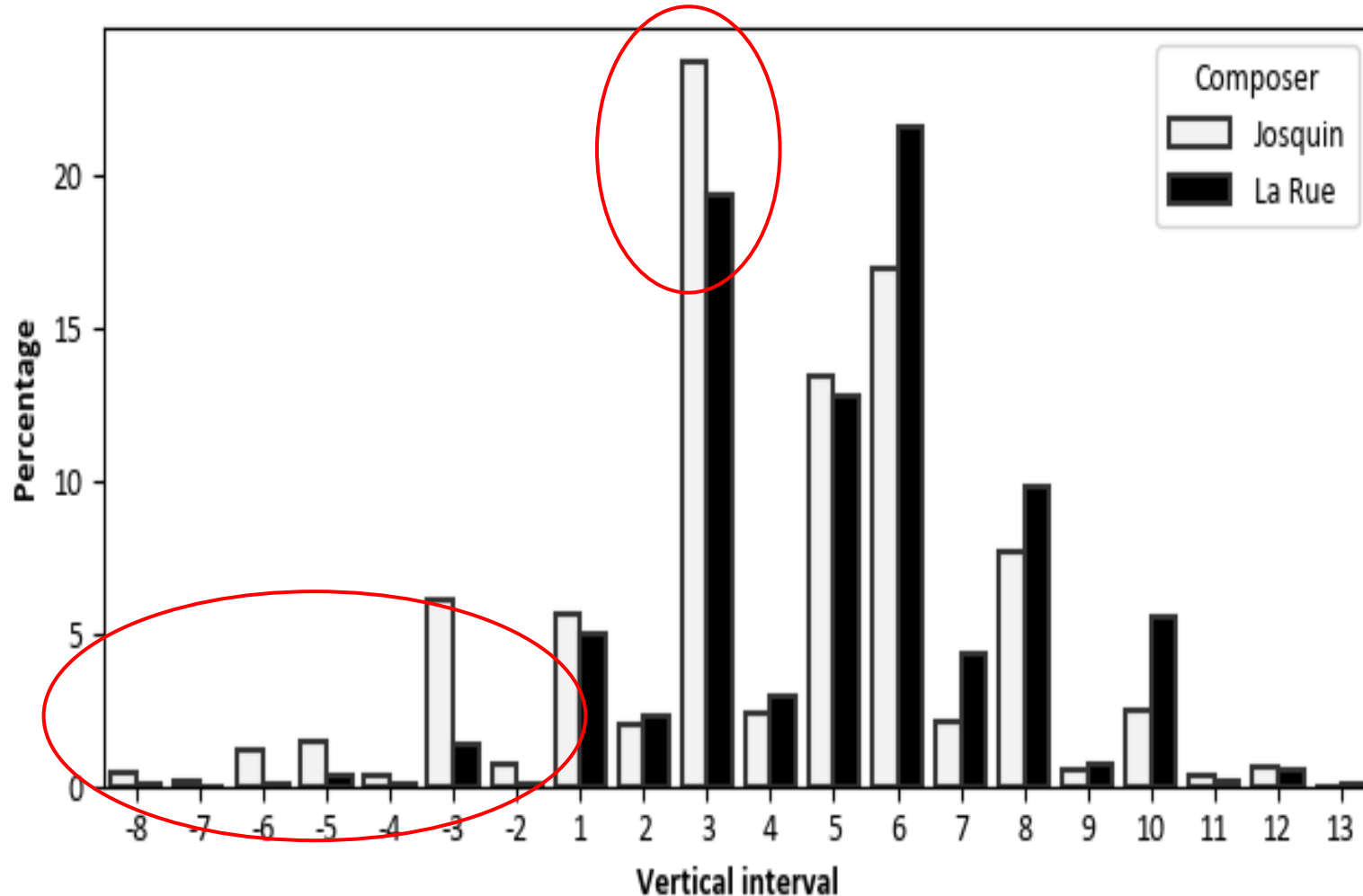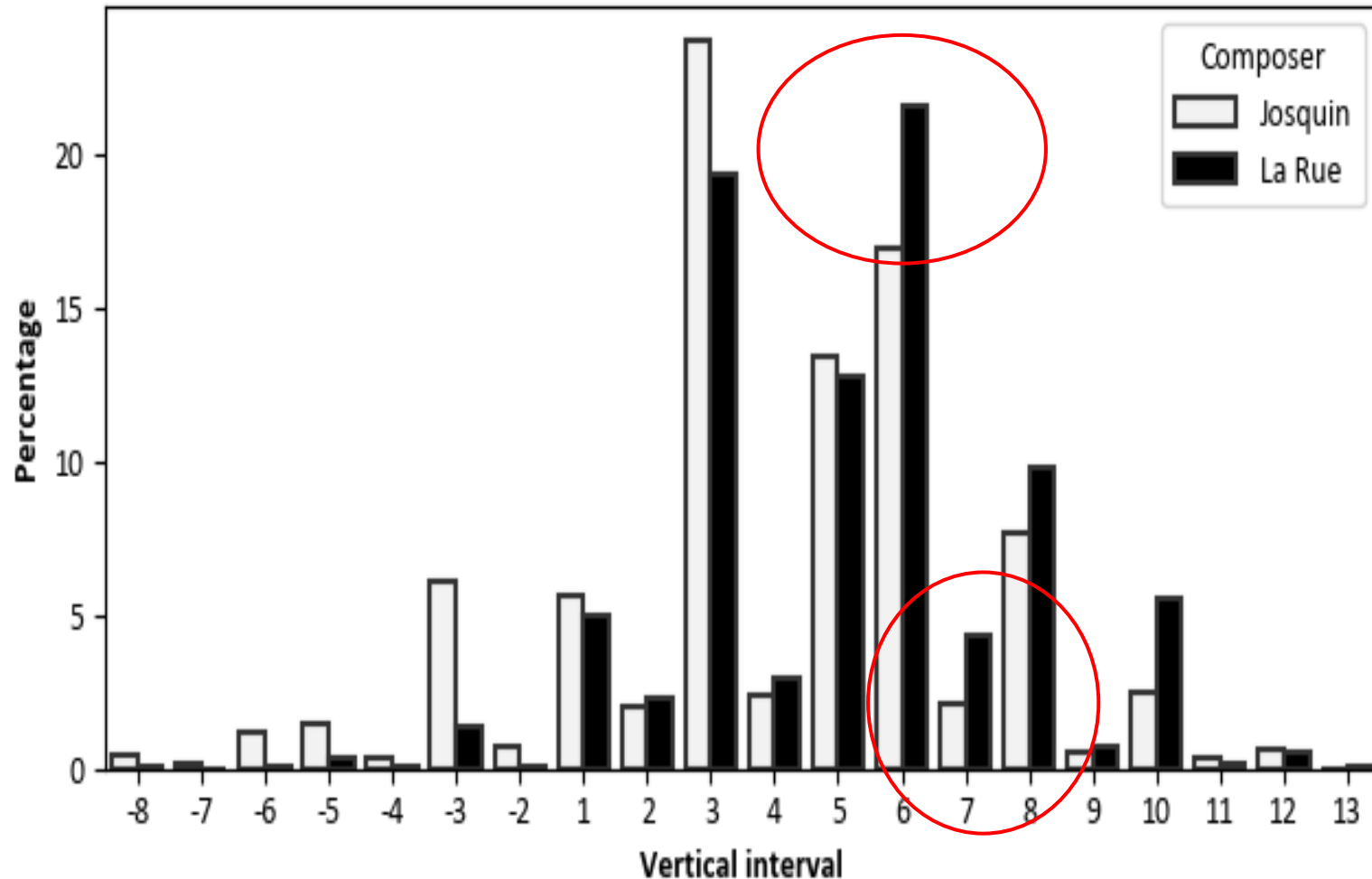

Josquin has has
- More 3rds
- More voice crossing

Part 1: Vertical intervals

Distribution of vertical intervals in diatonic steps (as a percentage of the total number of vertical intervals for each composer)

La Rue has
- More 7ths and 9ths
- More 6ths

Part 1: Contrapuntal 3-grams

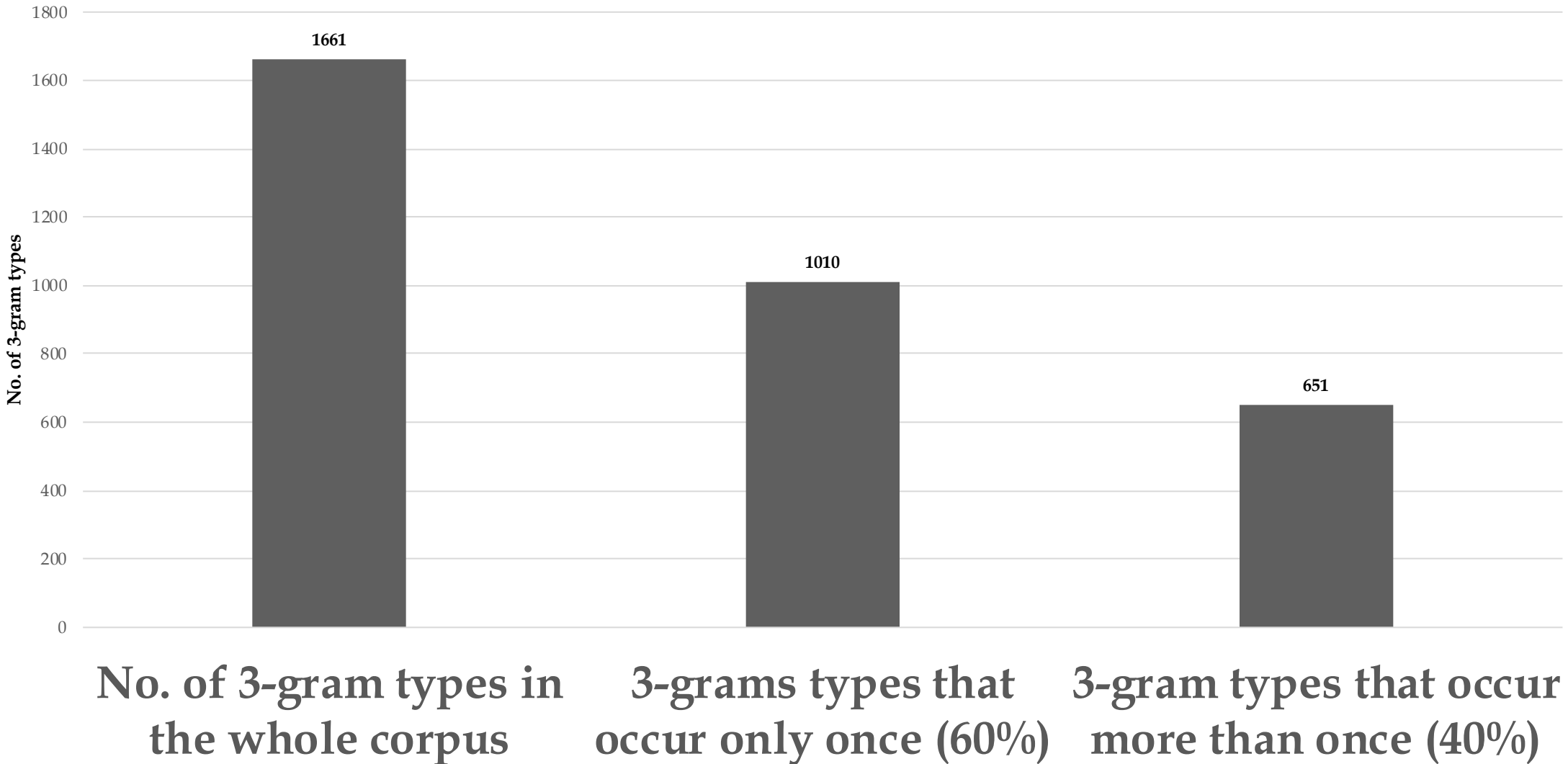**Cadential 3-gram** (La Rue, *Missa Inviolata*, 'Pleni', bb. 20-21)

[7] (1 -2) [6] (-2 2) [8]

Top 5 3-gram types in the corpus.

Row number	Occurrences	3-gram type	Description	Occurrences in La Rue	Occurrences in Josquin
1	111	[7] (1 -2) [6] (-2 2) [8]	Cadential 7-6-8 to the 8ve with suspension	85	26
2	45	[2] (-2 1) [3] (2 -2) [1]	Cadential 2-3-1 to the unison with suspension	30	15
3	41	[6] (-2 1) [7] (1 -2) [6]	Incomplete cadence: 6-7-6 with suspension	22	19
4	32	[8] (2 1) [7] (1 -2) [6]	Incomplete cadence: 8-7-6 with suspension	26	6
5	30	[6] (-3 -2) [7] (1 -2) [6]	Incomplete cadence: 6-7-6 with suspension: La Rue fingerprint	30	0

3-gram types in the corpus

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Cadential figure found only in duos by La Rue ('La Rue fingerprint')
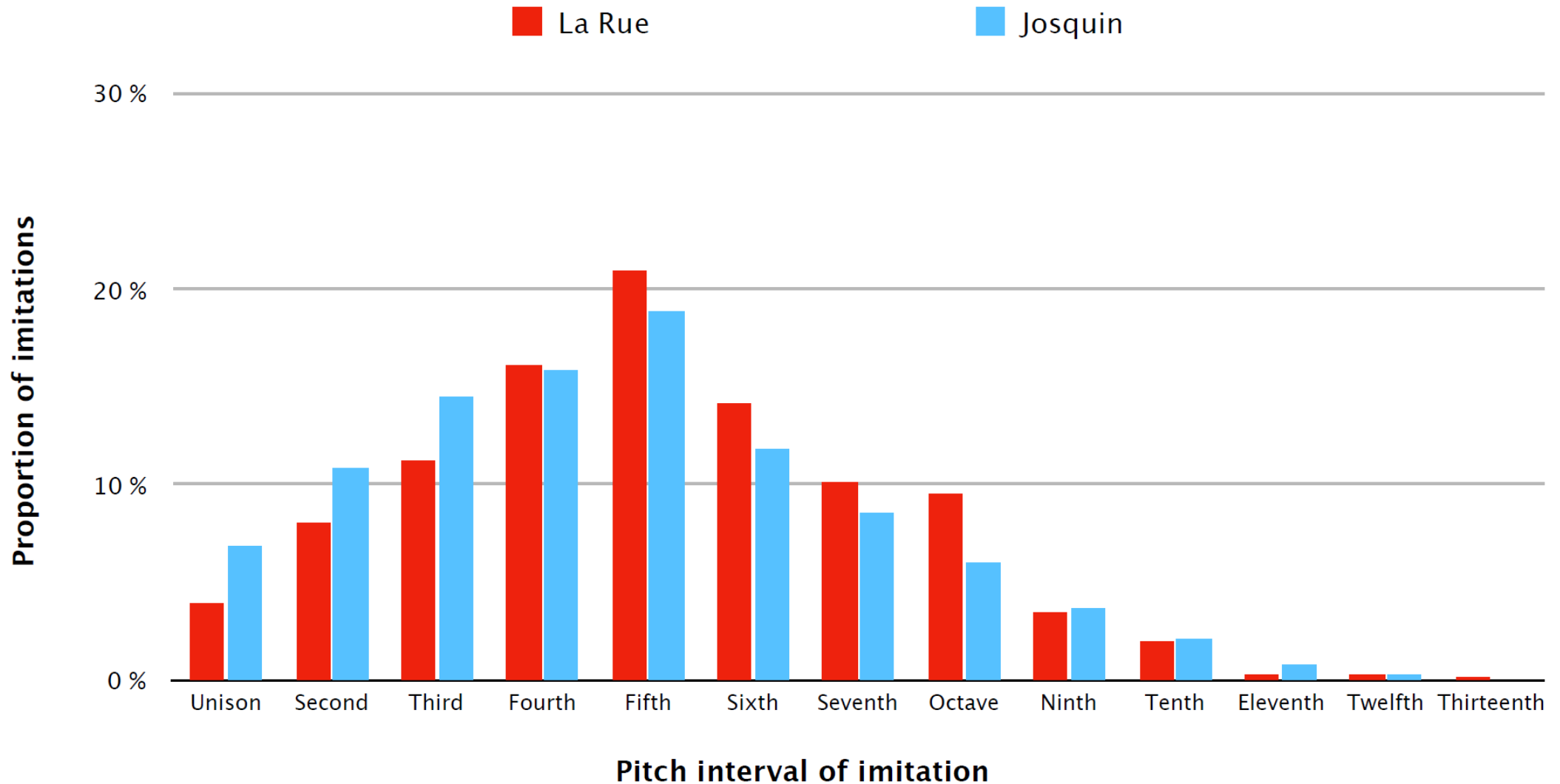

Extra dissonance

Part 2: Measuring imitation

Core: a musical unit that is diatonically and rhythmically exactly the same when it recurs in the other voice

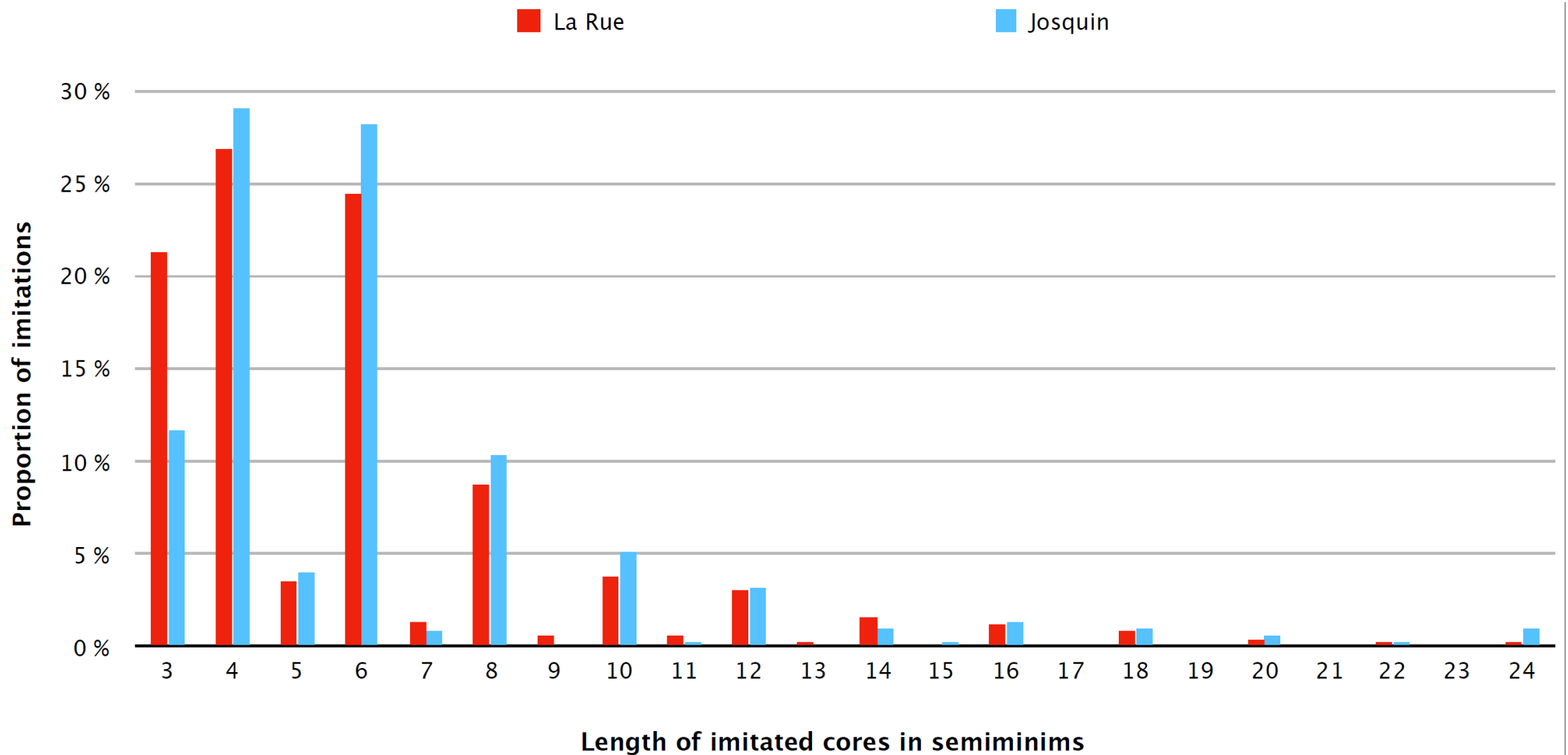Smallest musical unit that can count as the core: at least three semiminims, and at least three notes (attacks)

shorter than 3 semi-minims   shorter than 3 notes

La Rue vs. Josquin: Pitch intervals of imitation

Length of core melodies in imitation

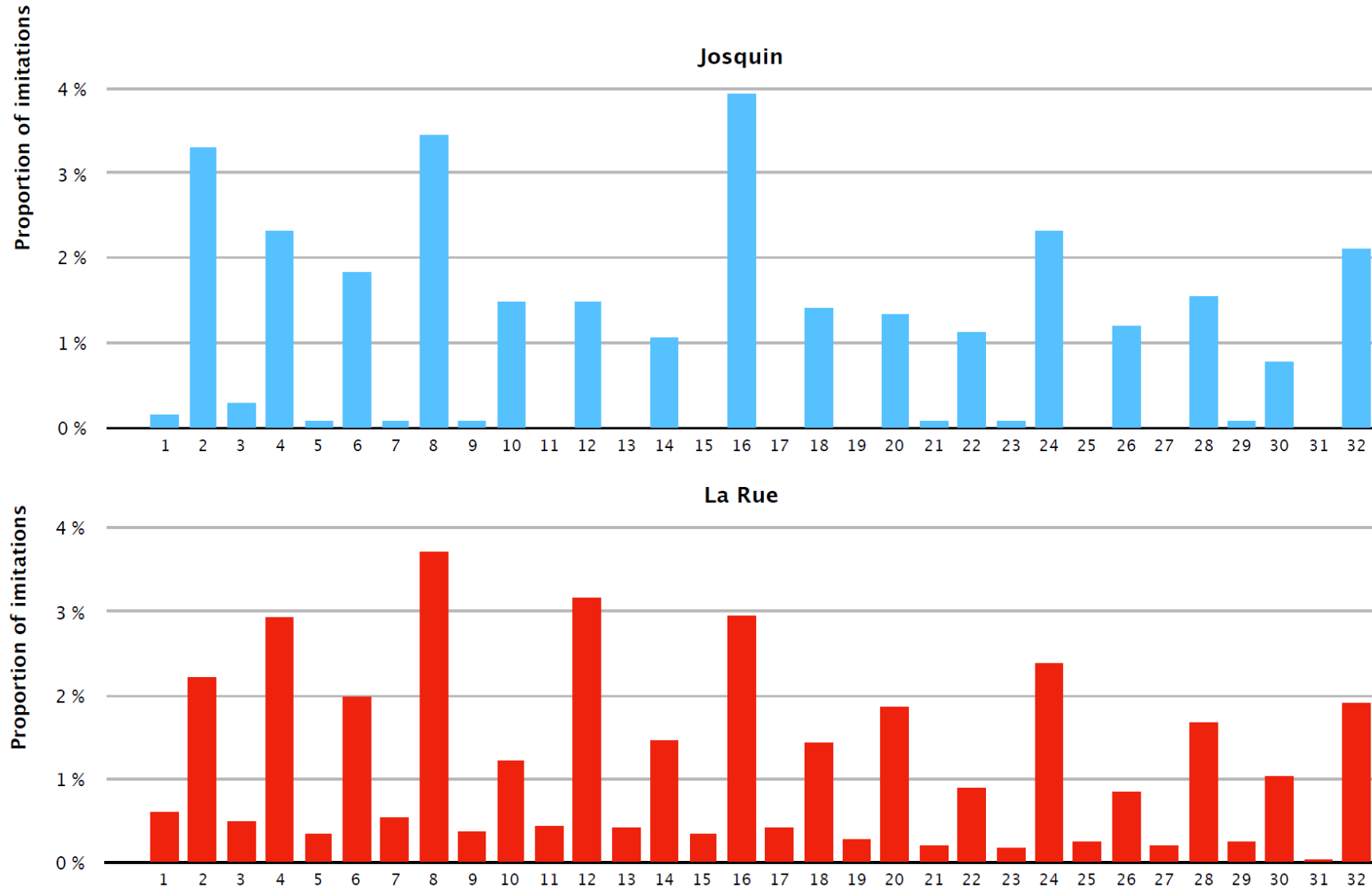# Number of imitations per piece in canonic duos

	All duos *Josquin 33 - La Rue 44*	Canonic duos *Josquin 7 - La Rue 7*	Non-canonic duos *Josquin 26 - La Rue 37*
Josquin	68	116	55
La Rue	78	68	80

Time interval of imitation **less** than 32 semiminims long in non-canonic duos

Time interval of imitation **more** than 32 semiminims long in non-canonic duos
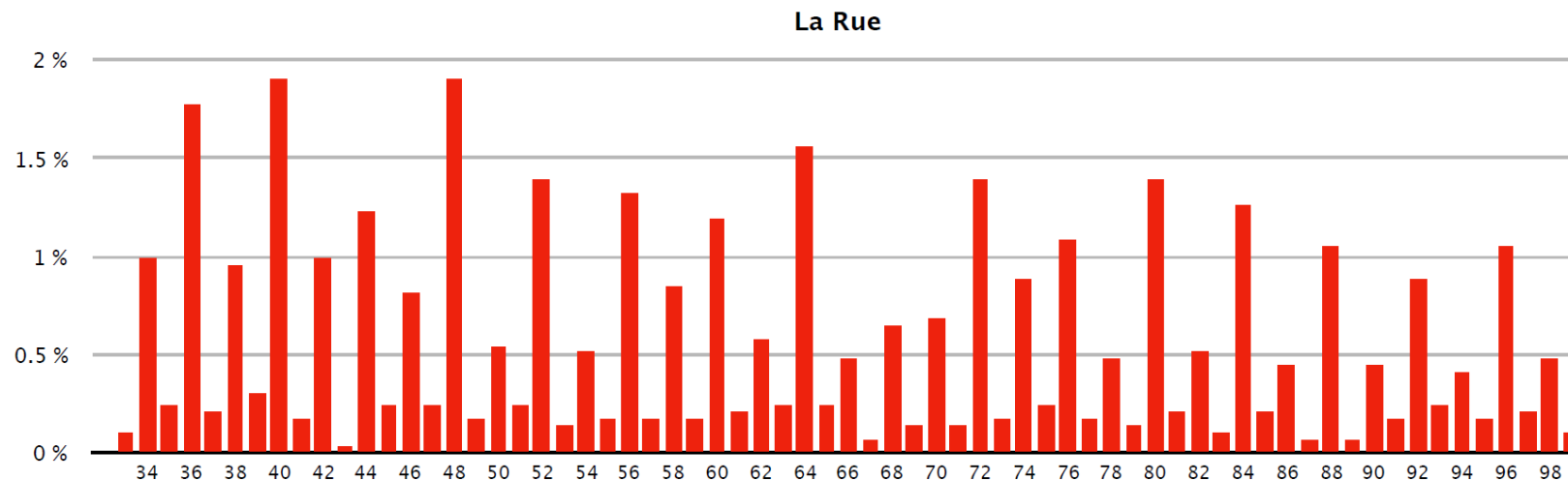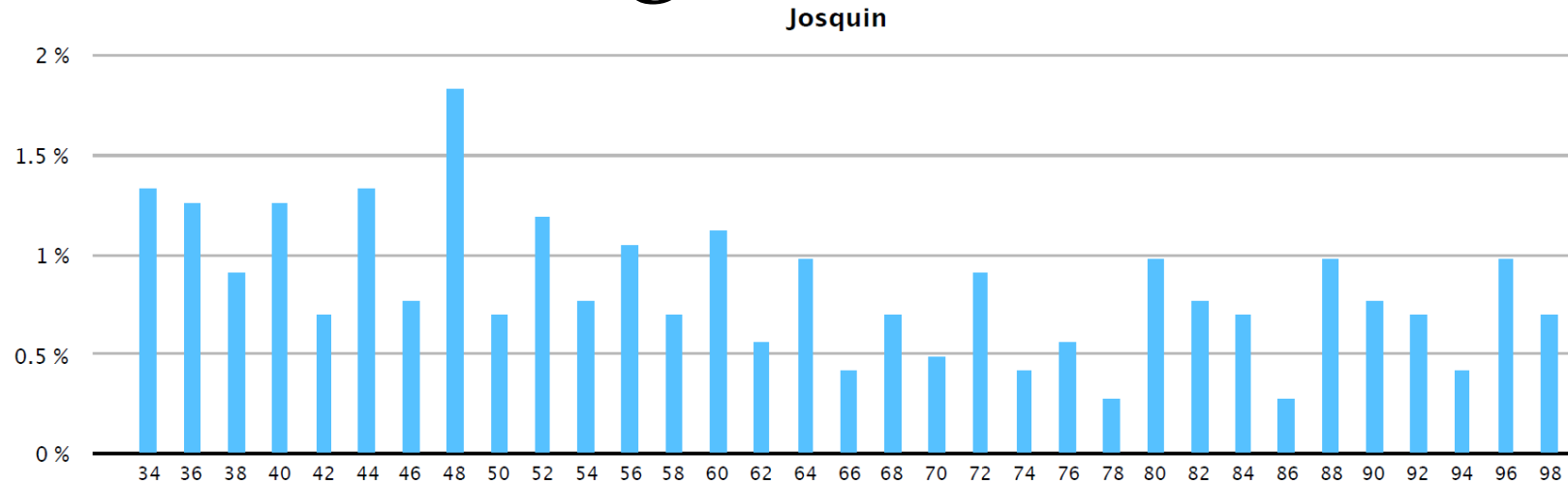
Part 3: Feature extraction and machine learning

What are "features"?

- Pieces of information that can characterize a piece of music in a simple and consistent way
- Numerical values
  - A feature can be a single value
  - Can be a set of related values (e.g. a histogram)
- Provide a summary description
  - Describes the characteristic for the music overall, not locally

Sample one-dimensional feature

Range: Difference in semitones between the highest and lowest pitches in a piece

Value of this feature: 7

G - C = 7 semitones

Sample multi-dimensional feature

- **Pitch Class Histogram:** Consists of 12 values, each representing the fraction of all notes belonging to a pitch class

- **Graph shows feature values:**
  - Note counts: C: 3, D: 10, E: 11, G: 2
  - Most common note is E (11/26 notes), which thus has a feature value of 0.423
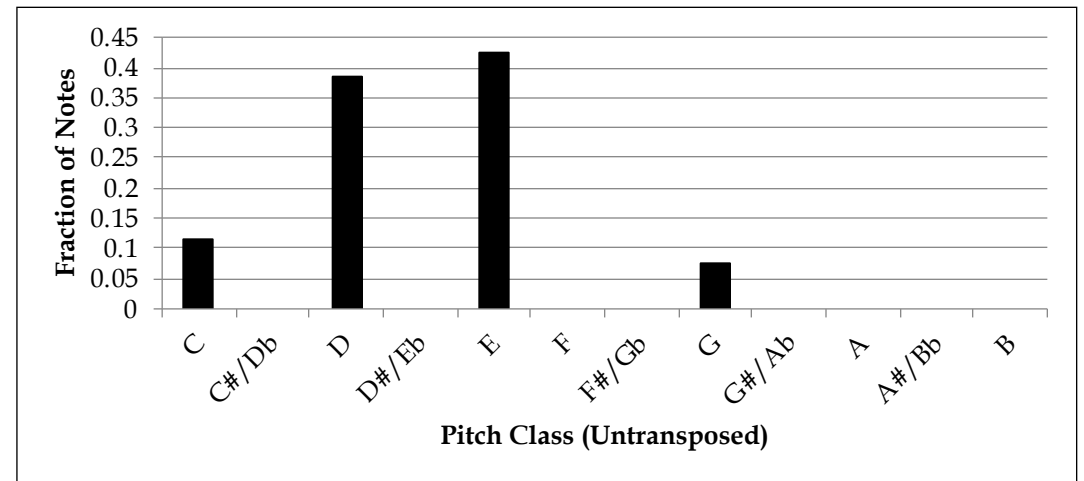
When things get interesting . . .

- Comparing hundreds or thousands of features per piece, not just one or two

- Looking for patterns among hundreds or thousands of pieces, not just a few
  - Especially if grouped in interesting ways (like composer)

- Our jSymbolic software lets us do these things quickly and easily . . .

jSymbolic: Feature types

- Pitch statistics
- Melody / horizontal intervals
- Chords / vertical intervals
- Texture
- Rhythm
- Instrumentation
- Dynamics

Number of features (jSymbolic 2.2)

- 246 features are calculated per piece
- 1497 feature values per piece when multi-dimensional features are expanded
  - 801 of these are "secure" (less sensitive to dataset encoding biases or inconsistencies)

Machine learning: Josquin vs. La Rue

- Used machine learning (SVMs) to train models that could distinguish between (classify) the secure duos of each composer
- Trained on **all** the (secure) jSymbolic 2.2 features from the **secure** La Rue and Josquin duos
  - Without prejudging which features are relevant
  - Permits the system to discover potentially important patterns that we might not have thought to look for

Success rate for distinguishing composers

- The system was able to distinguish between the secure Josquin duos and the secure La Rue duos:
  - 85.5% of the time
  - 26 of the 33 secure Josquin duos identified correctly
  - 39 of the 43 secure La Rue duos identified correctly
- Clearly there are indeed measurable stylistic differences in the music of the two composers

Which features best (individually) distinguished Josquin and La Rue?

Feature	Overall Pattern
Relative Note Density of Highest Line	Much higher for Josquin
Prevalence of Very Long Rhythmic Values	Much higher for Josquin
Vertical Sevenths	Higher for La Rue
Distance Between Two Most Common Vertical Intervals	Higher for La Rue
Repeated Notes	Higher for La Rue
Note Density per Quarter Note	Somewhat higher for La Rue
Number of Pitches	Somewhat higher for La Rue
Prevalence of Most Common Pitch	Somewhat higher for Josquin
Range	Somewhat higher for La Rue
Partial Rests Fraction	Somewhat higher for La Rue
Parallel Motion	Somewhat higher for La Rue
Variability of Number of Simultaneous Pitch Classes	Slightly higher for La Rue

Part 4: Three approaches to attribution

Possibly by La Rue:

- The two-voice 'Benedictus' and 'In nomine' from *Missa Tous les regretz*. This Mass has two versions of the 'Benedictus' section of the Sanctus in different sources: a three-voice 'Benedictus' and these two shorter duos. There is some question as to whether these duos are by La Rue

- *Le renvoye / Num stultem est mortem*. This duo is found first with a French text in Vienna, Österreichische Nationalbibliothek, Mus. Hs. 18832/1-2 (VienNB Mus. 18832), a duo collection, without attribution; it is attributed to La Rue in the Montanus and Neuber duo collection of 1549, *Diphona amoena et florida, selectore Erasmo Rotenbucher* (RISM 1549[16]), with a Latin text, *Num stultem est mortem*.

Possibly by Josquin

- 'Crucifixus' (not from any known Mass). This duo is found only in the duo collection containing *Le renvoye / Num stultem* (RISM 1549[16]), where it is attributed to Josquin; both the *New Josquin Edition* and the Josquin Research Project reject it as a Josquin work

Comparison of the attribution results

Duo Title	Source Attribution	Contrapuntal analysis	Analysis of imitation	Feature-based
Missa Tous les regretz ('Benedictus')	La Rue	La Rue (medium confidence)	*Inconclusive*	Josquin
Missa Tous les regretz ('In nomine')	La Rue	La Rue (medium confidence)	*Inconclusive*	La Rue
Le renvoye / Num stultem	La Rue?	Josquin (medium confidence)	La Rue (high confidence)	La Rue
'Crucifixus'	Josquin?	La Rue (low confidence)	La Rue (high confidence)	La Rue

Conclusions

- Part 1: Vertical intervals and contrapuntal 3-grams
  - La Rue fingerprint
  - La Rue uses more dissonance (especially 7ths)
  - Josquin has more voice crossing
  - Josquin has a more limited contrapuntal vocabulary

- Part 2: Measuring imitation
  - Josquin has more more "sub-imitations" in the canonic duos
  - La Rue has much more imitation at long odd-numbered time intervals (in semiminims (half notes)

- Part 3: Feature extraction and Machine Learning
  - Distinguishes the composer of 86% correctly
  - Confirms findings of the other studies
  - Josquin has more long notes, more notes in the top line
  - La Rue has more eighth notes and more repeated notes

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