

# Contrapuntal Style

## Josquin Desprez vs. Pierre de la Rue

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with Peter Schubert and Nathaniel Condit-Schultz



## Pierre de la Rue and Music at the Habsburg-Burgundian Court

Mechelen, Belgium, November 23, 2018

**SIMSSA** | Single Interface for Music  
| Score Searching and Analysis

*Fonds de recherche  
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# Research questions

- What musical characteristics distinguish the styles of Josquin and La Rue?
  - Focusing specifically on duos drawn from masses
- How can computational methods help us approach such problems?

## Josquin Desprez

- 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.”

# Josquin and La Rue: Conflicting attributions according to NJE

NJE 3.3: *Missa De beata virgine* (Josquin)

NJE \*\*3.4: *Missa Sub tuum presidium* (La Rue)

NJE \*\*14.13: *Si dormiero*

NJE 20.3: *Magnificat Quarti toni 4v*

NJE \*28.2: *Ach hülff mich leid*

NJE \*28.10: *Dictez moy bergere*

NJE \*28.21: *Leal schray tante*

NJE \*\*28.34: *Tous les regretz*

NJE \*\*29.1: *Cent mille regretz*

NJE \*\*29.9: *Incessament mon pouvre cueur*

# Willem Elders, NJE 4, p. 102, on La Rue's authorship of *Missa Sub tuum presidium*

“The style of this four-part Mass also argues against Josquin's authorship.

For example, in the *Christe*, the rhythmic motion and continuous repetition of the main melodic motif in mm. 45-66 lack the vitality characteristic of Josquin. ...

More generally, even though the score manifests flawless contrapuntal skill, it rarely suggests Josquin's untiring and ingenious constructive power.”

Can we do a better job of describing stylistic differences between Josquin and La Rue?

# 44 duos from 24 secure La Rue Masses with duos

Almana (1) Assumpta es Maria (2) Ave sanctissima Maria (4) Conceptio tua (2) De feria (2) De sancta Anna (2) De sancto Antonio (1) De sancto Job (2) De septem doloribus (2)	De virginibus (3) Incessament (3) Inviolata (1) Ista est speciosa (1) L'homme armé I (1) Nunca fue pena mayor (1) O gloriosa domina (3) O salutaris hostia (2) Pascale (2)	Pro fidelibus defunctis (2) Sancta dei genitrix (1) Sine nomine I (2) Sub tuum presidium (1) Tandernaken (2) Tous les regretz (1)
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33 Duos from 11 secure Josquin Masses

27 Duos from 11 not secure Josquin Masses (aka Josquin?)

Secure Josquin Masses		Not Secure Masses (Rodin)	
Credo De tous biens (1)	L'homme armé sexti toni (5)	Credo vilayge I (1)	L'homme armé quarti toni (1)
Ave maris stella (3)	L'homme armé super voces (3)	Ad fugam (3)	Mater patris (3)
De beata virgine (1)	La sol fa re mi (1)	Allez regretz I (1)	Mi mi (3)
Gaudeamus (4)	Malheur me bat (3)	Da pacem (2)	Missus est
Hercules dux Ferrariae (4)	Pange lingua (3)	Di dadi (3)	Gabriel (2)
	Sine nomine (5)	L'ami baudichon (7)	Quem dicunt homines (1)



# Corpus Creation (by Jonathan Stuchbery)

- Most of the symbolic files came from the Josquin Research Project (Rodin and Sapp, Stanford).
  - We extracted the duos from mass movements using Sibelius
- Also manually transcribed additional duos from the La Rue edition
  - We restored the original note values
- Created a template for consistent and correct rhythmic durations, time signatures, clefs, MIDI playback settings, etc.
  - Applied to duos from both sources
  - Consistent transcription is essential when constructing symbolic corpora (ISMIR, International Society for Music Information Retrieval 2018)
- Generated machine readable files (MIDI and MusicXML)
  - Using a script created by Jason Mile

# Why duos from Masses?

- Comparison of music in the same genre makes for a clearer picture
- Duos generally free of cantus firmus
- Purest form of Renaissance counterpoint
  - Basic training for composers
- Relatively easy to study contrapuntal patterns

# Two approaches to computer-aided style analysis

## Machine learning

**Cory McKay**

- Used software (jSymbolic) to extract a broad range of statistical descriptors (“features”)
- Used machine learning (Weka) to “learn” the respective styles of the composers
- Statistically analyzed which features best distinguish them
  - Without making any assumptions ahead of time

## Contrapuntal patterns

**Nathaniel Condit-Schultz**

**Néstor Nápoles López**

- Used software (Humdrum, VIS, R) to identify and count specific contrapuntal patterns in the music of the composers
- Manually examined this data
- Used our expertise to interpret differences in contrapuntal style that this analysis revealed

# What are “features”?

- Pieces of information that can characterize something (e.g. a piece of music) in a simple and consistent way
- Numerical values
  - A feature can be a single value, or it can be a set of related values (e.g. a histogram)

# Example: A basic feature

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

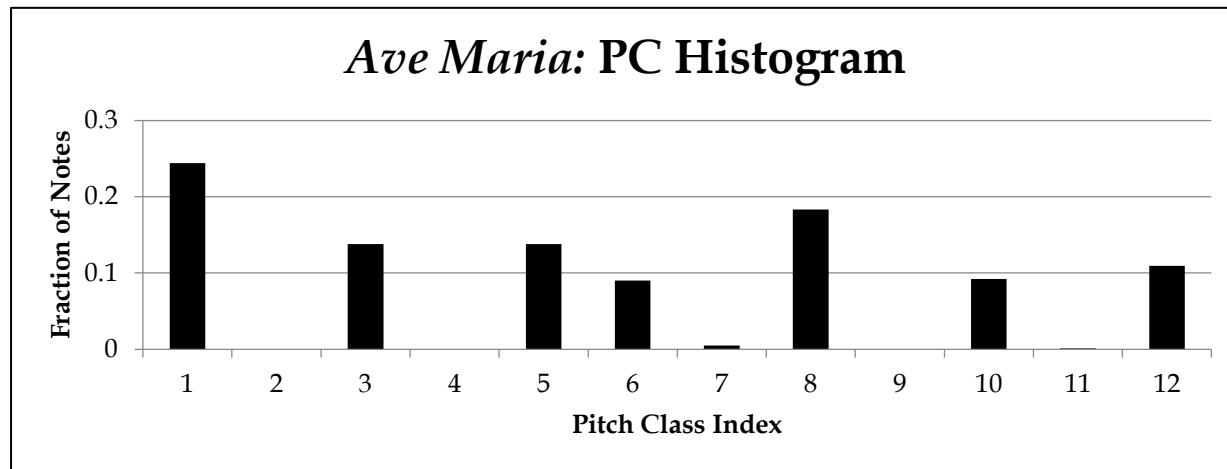


Value of this feature: 7

G - C = 7 semitones

# Josquin's *Ave Maria . . . virgo serena*

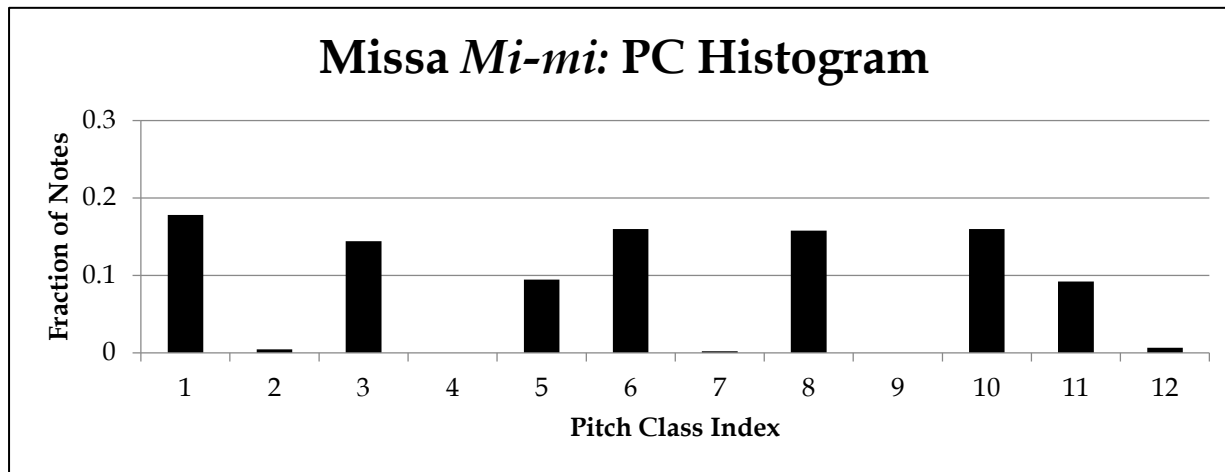
- Range: 34 (semitones)
- Repeated notes: 0.181 (18.1%)
- Vertical perfect 4<sup>ths</sup>: 0.070 (7.0%)
- Rhythmic variability: 0.032
- Parallel motion: 0.039 (3.9%)



*Ave Maria... Virgo serena*  
Motet  
Josquin Des Prez  
(1440 - 1521)

# Ockeghem's *Missa Mi-mi* (Kyrie)

- **Range:** 26 (semitones)
- **Repeated notes:** 0.084 (8.4%)
- **Vertical perfect 4<sup>ths</sup>:** 0.109 (10.9%)
- **Rhythmic variability:** 0.042
- **Parallel motion:** 0.076 (7.6%)

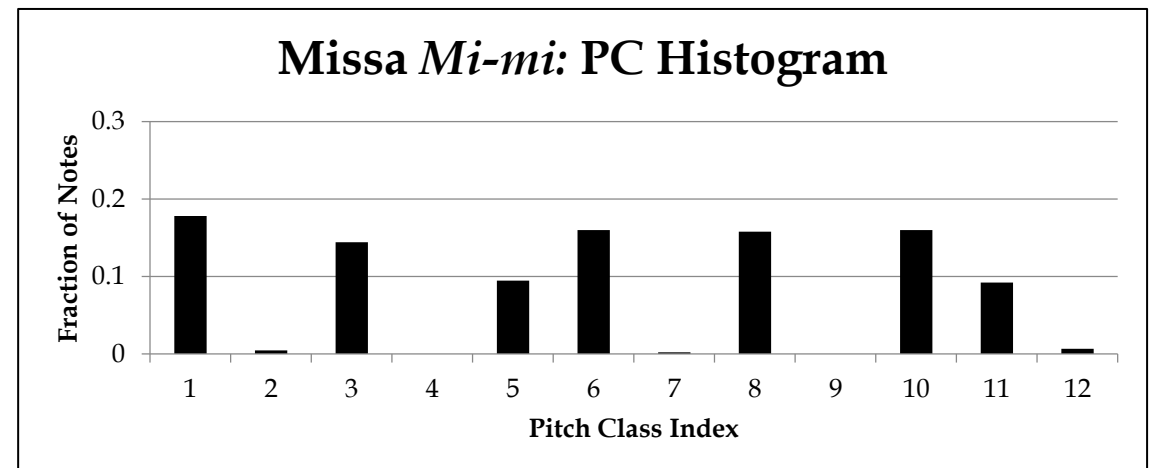
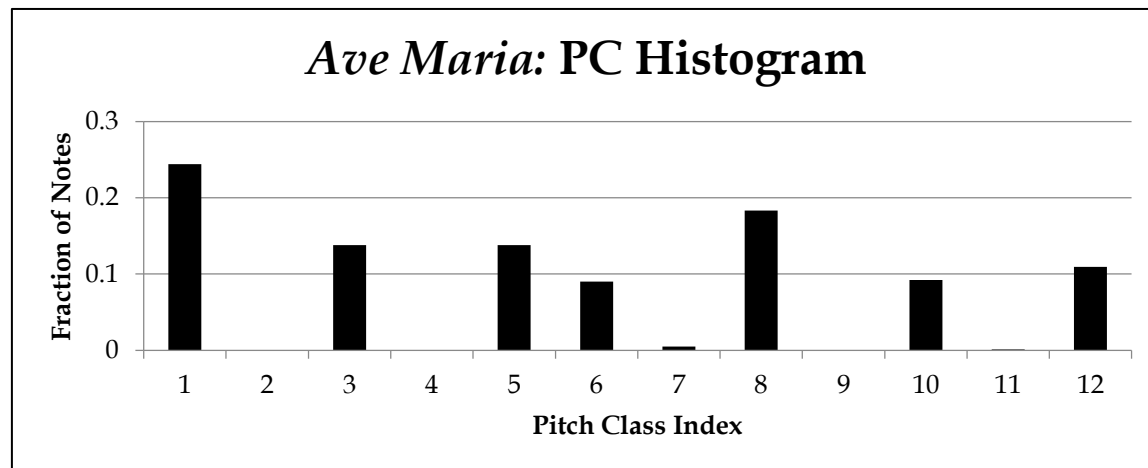


## Kyrie

Johannes Ockeghem

# Feature value comparison

Feature	<i>Ave Maria</i>	<i>Missa Mi-mi</i>
Range	34	26
Repeated notes	0.181	0.084
Vertical perfect 4 <sup>ths</sup>	0.070	0.109
Rhythmic variability	0.032	0.042
Parallel motion	0.039	0.076





# When things get interesting . . .

- Comparing hundreds or thousands of features per piece, not just six
- Comparing hundreds or thousands of pieces, not just two
  - Especially if grouped in interesting ways (like composer)

# jSymbolic (1/2)

- jSymbolic is software we have written for extracting features from symbolic music
- Sample previous work:
  - Software overview (ISMIR 18)
  - Renaissance composer attribution (MedRen 17)
  - Josquin attribution (ISMIR 17)
  - Renaissance genres (MedRen 18)
  - Regional style (APM 18)

# jSymbolic (2/2)

- (Version 2.2) extracts 246 unique features
- Some of these are multi-dimensional histograms, including:
  - e.g. pitch and pitch class histograms
- In all, (version 2.2) extracts a total of 1497 separate values from each piece it processes
  - Of these, 173 features (801 values) are safe (resistant to transcription and encoding bias in datasets)

# jSymbolic: Feature types (1/2)

- Pitch Statistics:
  - What are the occurrence rates of different pitches and pitch classes?
  - How tonal is the piece?
  - How much variety in pitch is there?
- Melody / horizontal intervals:
  - What kinds of melodic intervals are present?
  - How much melodic variation is there?
  - What kinds of melodic contours are used?
- Chords / vertical intervals:
  - What vertical intervals are present?
  - What types of chords do they represent?
  - How much harmonic movement is there?

# jSymbolic: Feature types (2/2)

- Texture:
  - How many independent voices are there and how do they interact (e.g. moving in parallel, crossing voices, etc.)?
- Rhythm:
  - Rhythmic values of notes
  - Intervals between the attacks of different notes
  - Use of rests
  - What kinds of meter is used?
  - Rubato?
- Instrumentation:
  - What types of instruments are present and which are given particular importance relative to others?
- Dynamics:
  - How loud are notes and what kinds of dynamic variations occur?

# Machine learning: Josquin vs. La Rue

- Used machine learning (Weka software) to train the software distinguish between (classify) the secure duos of each composer
- Trained on **all** the (bias-resistant) features from the **secure** La Rue and Josquin duos
  - Without prejudging which ones 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:
  - 87% of the time
  - 27 of the 33 secure Josquin duos identified correctly
  - 40 of the 44 secure La Rue duos identified correctly
- Clearly there are indeed measurable stylistic differences between the two composers

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

<b>Some top features (CorrelationAttributeEval)</b>	<b>Josquin</b>	<b>La Rue</b>
Note_Density_per_Quarter_Note	Lower	Higher
Vertical_Dissonance_Ratio	Lower	Higher
Vertical_Sevenths	Less	More
Prevalence_of_Very_Long_Rhythmic_Values	More	Less
Vertical_Thirds (large difference)	More	Less
Vertical_Interval_Histogram_3 (minor 3rd)	More	Less
Range	Narrower	Wider



# Additional classifications, requested by Honey Meconi

**Agnus II of Missa *de Feria*** is not in all court manuscripts, including the earliest one. **Is it by La Rue?**

***Le renvoye*** (contrafactum *Num stultum est mortem*), 2-voice chanson. The only attribution is to La Rue, but Meconi has doubts. **Is it by La Rue?**

# Closer to La Rue or to Josquin?

We trained a La Rue vs. Josquin classifier on the 76 secure Josquin and La Rue duos (omitting *De FERIA Agnus II*):

- Missa *de FERIA* (Agnus II): classified as La Rue
- Chanson *Le renvoye* (contrafactum *Num stultum est mortem*): classified as La Rue

This indicates that these two pieces are closer in style to La Rue than to Josquin (although still not necessarily by La Rue)

# Related future research

Do a broader La Rue duos vs. other composers duos experiment

- i.e. broader comparison than just secure Josquin

Test Missa *Tous les regrets* (Benedictus)

- JRP version only includes the three-voice version, we will need to digitize the two-voice version from the complete works first

# Our second approach to looking at style

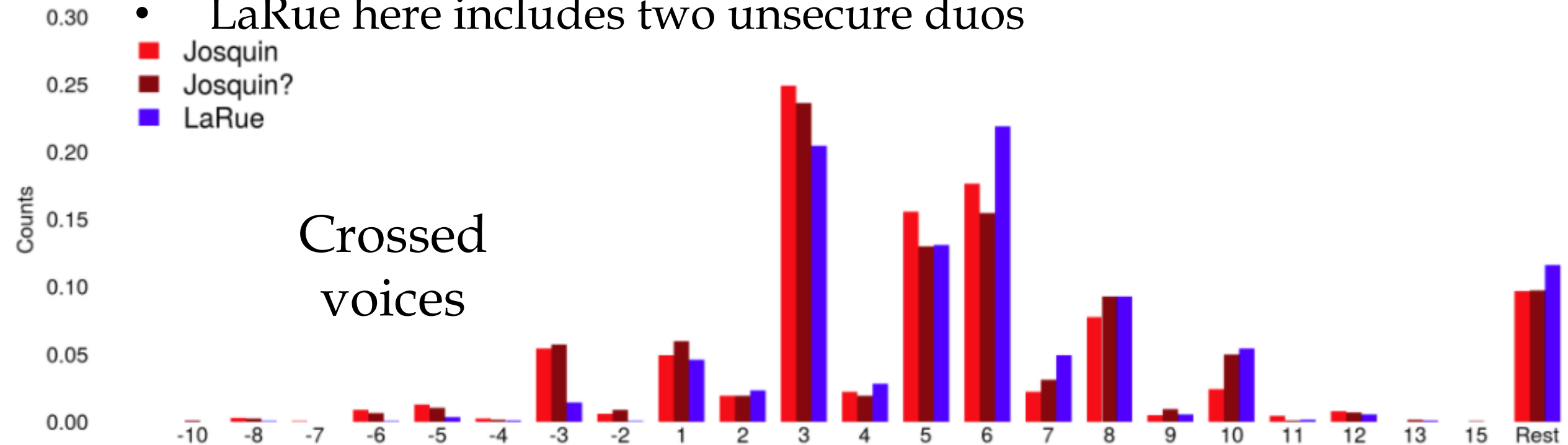
- Look specifically at characteristics **that we expect to be important** in Renaissance music (and possibly things that a composer would have consciously tried to do)
- Try to make sense of what our computational analysis finds

What's the most important thing about Renaissance music?

- Counterpoint, of course!

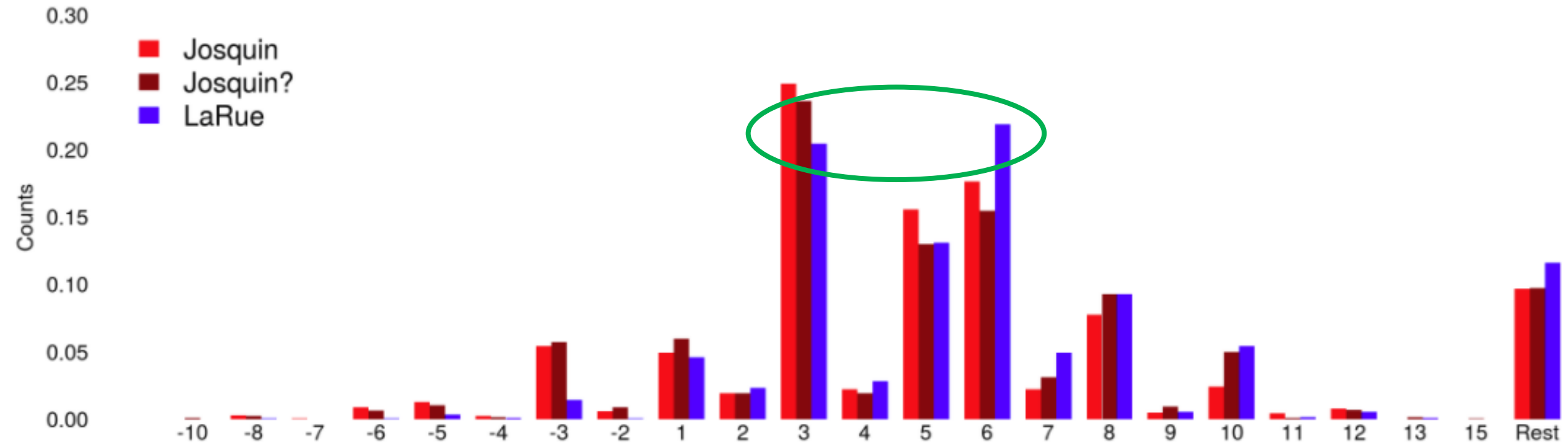
# Vertical Diatonic Intervals: comparison (Nathaniel Condit-Schultz)

- Melodic intervals are very similar in all 3, so we focus on vertical intervals
- LaRue here includes two unsecure duos



# Vertical Diatonic Intervals: comparison

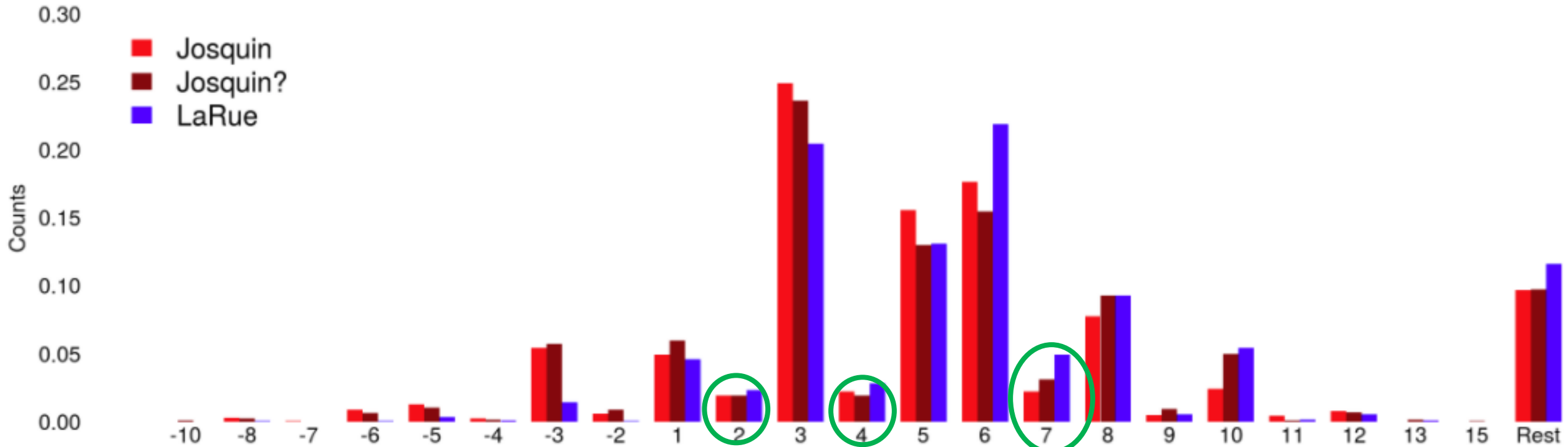
La Rue has more sixths, and more sixths than thirds; Josquin has more thirds



Statistically, La Rue is about 32%–56% more likely to use sixths than Josquin

# Vertical Diatonic Intervals: comparison

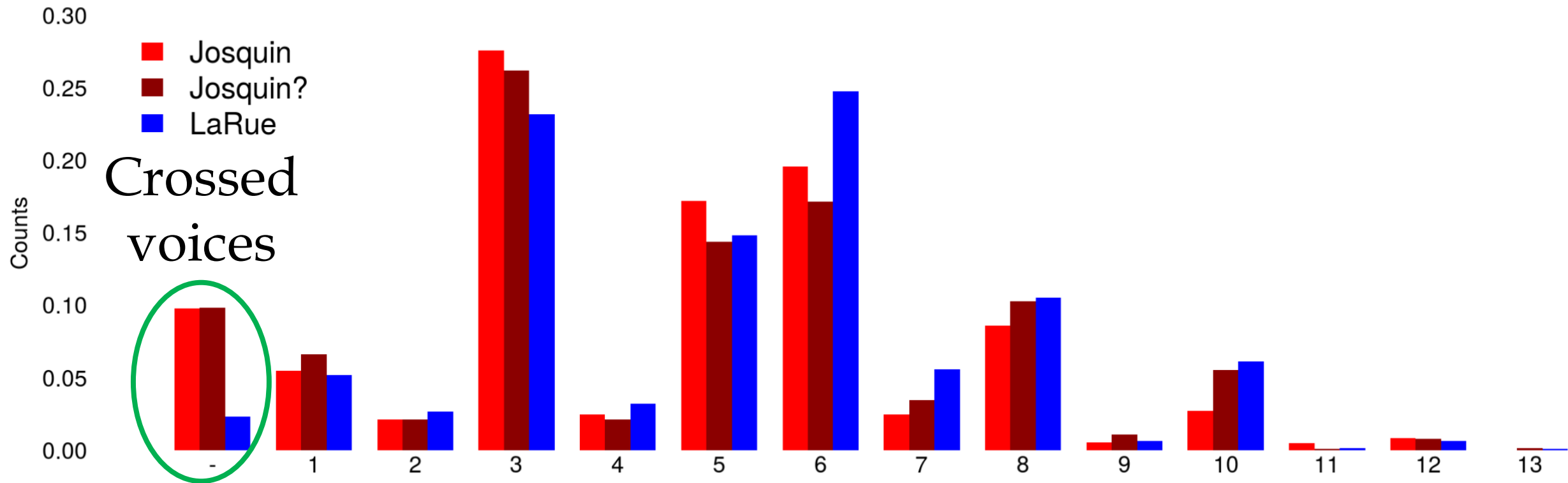
## La Rue has more dissonance: 2nds, 4ths, 7ths



Statistically, La Rue uses dissonances about 8%–30% more than Josquin

# Vertical Diatonic Intervals: comparison

## Josquin has significantly more voice crossing



Statistically, Josquin and Josquin? are about 235%–322% more likely to cross voices than La Rue



# N-grams

- The bar graphs on the previous slides give us nice summary information
  - But do not take into account the **sequence** in which vertical intervals occur
- **Contrapuntal n-grams** do allow us to study sequence
  - Each n-gram is a set of  $n$  numbers
  - Each such number represents a vertical interval between two voices, measured at a regular rhythmic interval
  - Can also indicate melodic intervals for each voice

# Contrapuntal 2-grams: Simple illustrative example

2-grams in Tinctoris: Motion from unison to 6th

1 {-3 +4} 6

*Motion of upper voice:* +5      +4      +3      +2

Exempla

Vertical Intervals:      1      6      1      6      1      6      1      6

*Motion of lower voice:*      -2      -3      -4      -5

# Contrapuntal 3-grams: What we used in this study

Cadential 3-gram:  $7 \{1 -2\} 6 \{-2 +2\} 8$

The image displays a musical score for two staves in bass clef, with a key signature of one flat. The top staff contains a melodic line with a slur over the first three notes. The bottom staff contains a bass line. A large black box highlights a three-measure segment. Above the top staff, the interval between the first and second notes is labeled '-2' (orange), and between the second and third notes is '+2' (orange). Below the top staff, the notes are labeled with their scale degrees: 7, 6, and 8. Below the bottom staff, the interval between the first and second notes is labeled '1' (blue), and between the second and third notes is labeled '-2' (blue).

Measured every minim

# Why 3-grams?

Vertical intervals are like letters (Tinctoris)

An n-gram is like a word in a composer's vocabulary

- 2-grams are too short – not enough musical content
- 3-grams capture the cadential progression 7-6-8
- 4-grams (and longer n-grams) are less frequent; not enough data

# To what extent do the three composers share the same vocabulary?

Total number of 3-grams (counting repeats): 9,231

Total number of **different** (or unique) 3-grams: 1,939

Unique 3-grams that appear in

- All 3 composers (Josquin, Josquin?, LaRue): 10%
- 2 composers: 20%
- Only 1 composer: 70%

## Seven 3-grams (of the top 20) shared by all 3 composers

Rank	No.	3-gram	Description
1	151	7 {1 -2} 6 {-2 2} 8	Cadence to 8ve
3	55	2 {-2 1} 3 {2 -2} 1	8ve inversion of cadence (to unison)
2	60	6 {-2 1} 7 {1 -2} 6	Approach to cadence
4	49	3 {1 -2} 2 {-2 1} 3	8ve inversion of approach to cadence
5	48	3 {2 2} 3 {2 2} 3	Ascending parallel thirds
7	38	6 {2 1} 5 {1 -3} 3	Oblique motion (top holds, then bottom)
12	31	3 {1 3} 5 {-2 1} 6	Retrograde of the previous

The last two 3-grams result from improvisable canon after one beat (stretto fuga)



# Repeated 3-grams found in only one composer

Josquin is more likely to use a repeated 3-gram in a **single duo**

- And he is more likely to repeat it more often, resulting in an extended sequence

La Rue is more likely to use a repeated 3-gram in **different duos**

- Fewer sequences, and not as long

# Josquin, Missa *L'homme arme sexti toni*, Pleni

6 {2 1} 5 {1 -3} 3 [no. 7; stretto fuga at the 5<sup>th</sup> below]

12

6 5 3 6 5 3 6

16

5 3



# Josquin, *Missa Hercules Dux Ferrariae*, Pleni 3 {1 3} 5 {-2 1} 6 [no. 12; stretto fuga at the 5<sup>th</sup> above]

Altus  
Ple - ni sunt ce - - li et ter - ra, ple - ni

Bass  
7 Ple - ni sunt ce - - li et ter - ra, ple - ni sunt

8  
sunt ce - - li et ter - ra, ple - ni sunt ce - -

ce - - li et ter - ra, ple - ni sunt ce - -

The image displays a musical score for the 'Pleni' section of Josquin's Mass. It features two systems of staves, each with an Altus (soprano) and Bass (bass) part. The lyrics are 'Pleni sunt caeli et terra, pleni sunt'. Three specific musical phrases are highlighted with red boxes and labeled with numbers 3, 5, and 6. The first box is in the Altus part, the second in the Bass part, and the third in the Altus part. The numbers 3, 5, and 6 are written in red above the notes in each box.

# Conclusions

Thanks to computational tools, we now know that:

- The contrapuntal styles of duos by Josquin and La Rue are different
- Some of the features that differentiate them are:
  - La Rue uses more dissonance, more sixths, wider range, smaller rhythmic values
  - Josquin uses more thirds, more voice crossing, and more sequences
- We also know more about the language of 2-voice counterpoint
  - There is a relatively small number of 3-grams shared by all
  - There is a large number of three-grams unique to each composer
  - The most common patterns are cadences, parallel 3rds, and stretto fuga
- This is only the beginning!

# Thank you!

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And to all of you

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