Contrapuntal Style
Josquin Desprez vs. Pierre de la Rue
Julie Cumming and Cory McKay
with Peter Schubert and Nathaniel Condit-Schultz

Pierre de la Rue and Music at the Habsburg-Burgundian Court
Mechelen, Belgium, November 23, 2018
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?
<table>
<thead>
<tr>
<th>Josquin Desprez</th>
<th>Pierre de la Rue</th>
</tr>
</thead>
<tbody>
<tr>
<td>• c. 1450-55 to 1521</td>
<td>• c. 1452 to 1518</td>
</tr>
<tr>
<td>• Varied career in France and Italy</td>
<td>• Hapsburg-Burgundian chapel, Low Countries and Spain</td>
</tr>
</tbody>
</table>

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 povre 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

<table>
<thead>
<tr>
<th>44 duos from 24 secure La Rue Masses with duos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almana (1)</td>
</tr>
<tr>
<td>Assumpta es Maria (2)</td>
</tr>
<tr>
<td>Ave sanctissima Maria (4)</td>
</tr>
<tr>
<td>Conceptio tua (2)</td>
</tr>
<tr>
<td>De feria (2)</td>
</tr>
<tr>
<td>De sancta Anna (2)</td>
</tr>
<tr>
<td>De sancto Antonio (1)</td>
</tr>
<tr>
<td>De sancto Job (2)</td>
</tr>
<tr>
<td>De septem doloribus (2)</td>
</tr>
<tr>
<td>De virginibus (3)</td>
</tr>
<tr>
<td>Incessament (3)</td>
</tr>
<tr>
<td>Inviolata (1)</td>
</tr>
<tr>
<td>Ista est speciosa (1)</td>
</tr>
<tr>
<td>L’homme armé I (1)</td>
</tr>
<tr>
<td>Nunca fue pena mayor (1)</td>
</tr>
<tr>
<td>O gloria domina (3)</td>
</tr>
<tr>
<td>O salutaris hostia (2)</td>
</tr>
<tr>
<td>Pascale (2)</td>
</tr>
<tr>
<td>Pro fidelibus defunctis (2)</td>
</tr>
<tr>
<td>Sancta dei genitrix (1)</td>
</tr>
<tr>
<td>Sine nomine I (2)</td>
</tr>
<tr>
<td>Sub tuum presidium (1)</td>
</tr>
<tr>
<td>Tandernaken (2)</td>
</tr>
<tr>
<td>Tous les regretz (1)</td>
</tr>
</tbody>
</table>
33 Duos from 11 secure Josquin Masses
27 Duos from 11 not secure Josquin Masses (aka Josquin?)

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

\( G - C = 7 \text{ semitones} \)
Josquin’s *Ave Maria . . . virgo serena*

- Range: 34 (semitones)
- Repeated notes: 0.181 (18.1%)
- Vertical perfect 4\(^{ths}\): 0.070 (7.0%)
- Rhythmic variability: 0.032
- Parallel motion: 0.039 (3.9%)
Ockeghem’s Missa Mi-mi (Kyrie)

• Range: 26 (semitones)
• Repeated notes: 0.084 (8.4%)
• Vertical perfect 4ths: 0.109 (10.9%)
• Rhythmic variability: 0.042
• Parallel motion: 0.076 (7.6%)
# Feature value comparison

<table>
<thead>
<tr>
<th>Feature</th>
<th>Ave Maria</th>
<th>Missa Mi-mi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>34</td>
<td>26</td>
</tr>
<tr>
<td>Repeated notes</td>
<td>0.181</td>
<td>0.084</td>
</tr>
<tr>
<td>Vertical perfect 4ths</td>
<td>0.070</td>
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<td>0.039</td>
<td>0.076</td>
</tr>
</tbody>
</table>

### Pitch Class Index Histograms

#### Ave Maria: PC Histogram

- Fraction of Notes
- Pitch Class Index
- 0 to 0.3

#### Missa Mi-mi: PC Histogram

- Fraction of Notes
- Pitch Class Index
- 0 to 0.3
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?
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?

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

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

Vertical Intervals: 1 6

Motion of lower voice: -2 -3 -4 -5
Contrapuntal 3-grams:
What we used in this study

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

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

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

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

• To Canadian granting agencies SSHRC and FRQSC for funding our research, and to Ichiro Fujinaga and the SIMSSA project

• To Peter Schubert (McGill professor), Nathaniel Condit-Schultz (SIMSSA post-doc), Jonathan Stuchbery (McGill undergraduate), and Néstor Nápoles López (McGill PhD student), for all their work on the project

And to all of you

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