Revisiting the Origins of the Italian Madrigal
(with machine learning)

Julie E. Cumming  Cory McKay

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The origins of the madrigal

Current consensus

• The madrigal emerges as a new genre of Italian-texted vocal music in the 1520s
• The Italian-texted works by Verdelot are madrigals
• It originated in Florence (and Rome?) in the 1520s

But where did it come from?

• The frottola (Einstein 1949)
• The chanson and motet (Fenlon and Haar 1988)
• Florentine song: carnival song, and improvised solo song (A. Cummings 2004)
Finding the origins: what happened before Verdelot?

- Verdelot arrived in Florence in 1521
- Earliest sources of the madrigal

New focus: Florence, 1515-1522
Music Prints before Verdelot
Thanks to I. Fenlon, J. Haar, and A. Cummings

Naming of Genres: *Canzona* in 1520s; *Madrigale* 1530

Prints (in or near Rome)

- Pisano, *Musica sopra le Canzone del petrarcha* (partbooks, Petrucci, Fossombrone, 1520) (all Madrigals)
- *Motetti e Canzone I* (partbooks, Rome, 1520)
- *Libro primo de la croce*, choirbook, c. 1522 (surviving copy, later ed., Rome, Pasoti & Dorico, 1526)
  - Mix of frottole, villotte, and madrigals
Music MSS before Verdelot
Thanks to I. Fenlon, J. Haar, and A. Cummings

Florentine Manuscripts (all from Florence)
• Florence, Basevi 2440, choirbook, c. 1515-22; 2 sections:
  • music with multiple stanzas of text (frottole)
  • through-composed works (madrigals & villotte)
• Florence, BNC 164-167, partbooks, c. 1520-22 (4 sections)
  • Florence 164 or F 164 henceforth
My hypothesis

The madrigal was deliberately created as a
• high-style genre of secular music
• that emulates the style of the motet

Why?
• Musical sources
• Texts
• Musical style
• Cultural context (not today)
What do sources tell us?
Madrigals are the first secular genre to be treated like Latin-texted motets in prints and manuscripts

Copied and printed in partbooks (previously used only for Masses and motets)

- *Motetti e Canzone I* (Rome, 1520), partbooks
- Florence 164 (c. 1522), partbooks
- Pisano, *Musica sopra le Canzone del petrarcha* (Petrucci, Fossombrone, 1520) partbooks
- Chicago, Newberry Library (c. 1527) partbooks
What do sources tell us?
Madrigals are the first secular genre to be treated like Latin-texted motets in prints and manuscripts

Madrigals and motets found in the same sources
• *Motetti e Canzone I* (Rome, 1520), a lot of motets, a few madrigals
• Florence 164 (c. 1522), madrigals, villotte and frottole, chansons, and motets
• Chicago, Newberry Library (c. 1527); Verdelot madrigals and motets by many composers, including Verdelot
What do sources tell us?
Madrigals are the first secular genre to be treated like Latin-texted motets in prints and manuscripts

First single-composer print for secular music (earlier single-composer prints are sacred Masses and laude)

• Pisano, Musica sopra le *Canzone del petrarcha* (Petrucci, Fossombrone, 1520)
Similarities between madrigals and motets

• Text: both are “high-style” serious genres
  • Latin-texted sacred music is at the top of the genre hierarchy (Tinctoris and Cortese)
  • Early madrigals set high-style texts: mostly Petrarch, plus new texts

• Form: both are through-composed, and avoid schematic repetition

• Both have varied textures, including imitation and homorhythm
B. Pisano, *Che degg’io far*, Madrigal (from Pisano, *Musica sopra le Canzone del petrarcha*, 1520, and Florence 164, no. 12)

No schematic repetition, varied texture
Carpentras, *Miserere mei deus*, F 164, n. 78
How can we test this hypothesis?

• Compare the music of different genres as understood during the period
Florence 164 (set of 4 partbooks); all for 4 voices
Physical organization reveals genre distinctions between madrigals and other genres

Section divisions are shown by
  • gathering structure
  • blank pages between sections in partbooks

Part 1: 27 Madrigals
Part 2: 19 Villotte and Frottole
Part 3: 24 Chansons (not today)
Part 4: 12 Motets

No composer attributions; composer names are found in concordant sources
Florence 164 as a guide to genre

• Snapshot of notated musical culture in Florence c. 1520
• The concordant sources for each section confirm the genre attributions – madrigals are found in other sources devoted to madrigals, frottole are found in frottola prints…
Madrigal, B. Pisano, *Che deggio far*, cantus
Florence 164 no. 12 (Part 1, madrigal section)
Motet by Josquin Desprez, Missus est Gabriel angelus (no. 79)

Cantus and Bassus partbooks Florence 164, Part 4, motet section
Florence 164, Part 1: 27 Madrigals

Part 1A: Pisano
• 14 secure Pisano
• 5 probably Pisano

Part 1B: Sebastiano Festa
• 5 secure Festa
• 2 probably Festa

Added to the end of the section slightly later
• Anon. (maybe Festa)
Florence 164, Part 2: 19 pieces, 13 Villotte, 4 Frottole

4 “Northern proto-villotte” (arrangements of Italian popular tunes by northern composers, from c. 1500)
  • Isaac, Compere (Che fa la ramazina), Obrecht, Josquin (Scaramella)

6 Villotte (northern Italian polyphonic arrangement of a popular song)
  • 3 Pesenti
  • 2 F.P[atarvino?]?
  • 1 S. Festa, 1 Anon.

3 anon. Zibaldoni (quodlibets; a subgenre of the villotta)

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• 4 Frottole (2 Tromboncino; 2 Anon.)
• 1 Unclassified (anon.) (a voci pari; imitative; literary text)
Pesenti, Villotta, *Quando lo pomo* (quotes “O traditora”); Florence 164, no. 32

Imitation and homorhythm; repeated notes; cites popular song in Tenor

Presumably

Petrucci Frottole XI (1514)
Antico Frottole II (1516 or 1520)
Florence 230, 337, and 2440
Venice 10653-6
Florence 164, Part 4: 12 Motets

Composed between 1485 and 1515
• 4 Josquin
• 3 Mouton
• 1 Isaac

Composed c. 1515-20, composers associated with Medici popes in Rome
• 1 de Silva, 1 Carpentras (78)
• 2 Anon. (one may be by Medici Pope Leo X)
Our corpus: 12 composers, + 10 anon. pieces

<table>
<thead>
<tr>
<th>Section</th>
<th>1) Madrigal</th>
<th>2) V&amp;F</th>
<th>4) Motet</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pisano</td>
<td>19</td>
<td></td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>Festa, S.</td>
<td>7</td>
<td>1</td>
<td></td>
<td>8</td>
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<td>FP</td>
<td>2</td>
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<td></td>
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<tr>
<td>Pesenti</td>
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<td>3</td>
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<tr>
<td>Tromboncino</td>
<td>2</td>
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<td>2</td>
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<tr>
<td>Anon</td>
<td>1</td>
<td>7</td>
<td>2</td>
<td>10</td>
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<tr>
<td>Compere</td>
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<td>Obrecht</td>
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<tr>
<td>Isaac</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
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<tr>
<td>Josquin</td>
<td>1</td>
<td>4</td>
<td></td>
<td>5</td>
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<tr>
<td>Mouton</td>
<td></td>
<td>3</td>
<td></td>
<td>3</td>
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<tr>
<td>Carpentras</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
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<tr>
<td>de Silva</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>19</td>
<td>12</td>
<td>58</td>
</tr>
</tbody>
</table>
Genre classification – using the computer

How can we describe the differences between genres in terms that a computer can understand?

Extract musical features that can be quantified, with
  • jSymbolic 2.2, developed by Cory McKay

  • Text and text-setting are NOT considered in jSymbolic
What is a “feature”?

• A piece of information that statistically characterizes a piece of music in a simple way
• Usually has a numerical value
  • Can be a single value, or it can be a set of related values
• Features can be automatically calculated by computers
  • From hundreds or thousands of pieces of music – or dozens!
• Features can then be used to gain empirical insights:
  • Manually examined
  • Processed using statistical tools or machine learning
Example: Range

- **Range (Feature 1-D):** Difference in semitones between the highest and lowest pitches

\[ \text{Range} = G - C = 7 \text{ semitones} \]
Example: Pitch Class Histogram (set of related values)

- **Pitch Class Histogram (Feature 12-D):** values represent the percentage of notes with a particular pitch class

  ![Musical staff with notes]

  - **Pitch Class Histogram:** see graph
    - **Note counts:** C: 3, D: 10, E: 11, G: 2
    - **Most common note:** E (11/26 notes)
      - Corresponding to 0.423 of the notes

  ![Bar chart showing pitch class distribution]
jSymbolic 2.2

- Software we have produced for automatically extracting features
- And developing new features
- In all, extracts a total of 1497 separate feature values
  - Pitch statistics
  - Melody + Horizontal intervals
  - Chords + Vertical intervals
  - Rhythm
  - Texture
  - Dynamics
  - Instrumentation
jSymbolic 2.2

• More information (http://jmir.sourceforge.net)

• MedRen 2017: “Using Statistical Feature Extraction to Distinguish the Styles of Different Composers”
• ISMIR 2018: “jSymbolic 2.2: Extracting Features from Symbolic Music for use in Musicological and MIR Research”
Our experiment: pieces from F 164

• Began by constructing our dataset, consisting of 58 MIDI files:

<table>
<thead>
<tr>
<th>Genre</th>
<th>Pieces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt. 2: Villotte&amp;frottole</td>
<td>19</td>
</tr>
<tr>
<td>Pt. 1: Madrigals</td>
<td>27</td>
</tr>
<tr>
<td>Pt. 4: Motets</td>
<td>12</td>
</tr>
</tbody>
</table>

• Extracted features from each of these pieces using jSymbolic
  • Excluded features not relevant to this corpus
    • Associated with tempo, dynamics, instrumentation, etc.
  • 801 feature values were extracted per piece
Methodology

• Used machine learning to teach a classifier to automatically distinguish the music belonging to each of the genres
  • Based on the jSymbolic features
  • Using Weka’s SMO SVM implementation
## Genre Classification results

<table>
<thead>
<tr>
<th>Genre Group</th>
<th>Classification Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Villotte&amp;frottole vs. Madrigals</td>
<td>68.4%</td>
</tr>
<tr>
<td>Villotte&amp;frottole vs. Motets</td>
<td>64.6%</td>
</tr>
<tr>
<td>Villotte&amp;frottole vs. Motets</td>
<td>84.8%</td>
</tr>
<tr>
<td>Madrigals vs. Motets</td>
<td>99.1%</td>
</tr>
</tbody>
</table>

![Classification Accuracy Graph](image_url)
First set of experimental conclusions

• The madrigals and motets are the most different genres
  • Because they can be easily distinguished with features and machine learning (99.1% success rate)

• Villotte&frottole and madrigals are the most similar genres
  • Because they are harder to tell apart (only 64.6% success rate)

• Villotte&frottole and motets are in between (84.8% success rate)
  • More similar than motets and madrigals
  • But less similar than villotte&frottole and madrigals
Caveats

• There are relatively few pieces in the dataset (58)
  • Statistical patterns found in this dataset may not necessarily generalize to all relevant music in the three genres

• There are relatively few composers represented (12 & 10 anon.)
  • Detected patterns may be linked to differences in composers’ compositional style rather than genre

• Nonetheless, the results are certainly meaningful within the scope of this study
But **how** do the genres differ?

- We can look at particularly important specific feature values . . .
A priori expectations (1/3)

- What characteristics might an expert musicologist (Julie Cumming) expect to differentiate the genres?
  - Before actually examining the feature values

- Once formulating these expectations, we can then see if the feature data confirms or repudiates these expectations
  - Both are useful!
A *priori* expectations (2/3)

• What do *you* think might distinguish the three genres?
  • Villotte&frottole vs. Madrigals vs. Motets
• According to our (*a priori*) expectations . . .
A *priori* expectations (3/3)

- **Length of piece?:**
  - V&f shortest, then Madrigals, Motets longest
- **Melodically repeated pitches:**
  - Motets fewer; V&f + Madrigals more
- **Variation in range between voices:**
  - V&f more variety; Madrigals + motets less
- **Variation in size of melodic leaps per voice:**
  - V&f more variety; Madrigals + motets less
- **Variation in number of notes per voice:**
  - V&f more variety; Madrigals + motets less
- **Number of voices sounding simultaneously:**
  - V&f mostly 4; Motets mostly 1 to 3; Madrigals a mix of both
Were our expectations correct?

• Length of piece:
  • V&f shortest, then Madrigals, Motets longest **YES (strongly)**
• Melodically repeated pitches:
  • Motets fewer; V&f + Madrigals more **YES**
• Variation in range between voices:
  • V&f more variety; Madrigals + motets less **PARTLY**
• Variation in size of melodic leaps per voice:
  • V&f more variety; Madrigals + motets less **YES**
• Variation in number of notes per voice:
  • V&f more variety; Madrigals + motets less **NO**
• Number of voices sounding simultaneously:
  • V&f mostly 4; Motets mostly 1 to 3; Madrigals a mix of both **PARTLY**
Expectations vs. reality

• Variation in range between voices:
  • Expectation: V&f more variety; Madrigals + motets less
  • Reality: V&f + motets more variety; Madrigals less

• Variation in number of notes between voices:
  • Expectation: V&f more variety; Madrigals + motets less
  • Reality: Motets (much) more variety, then Madrigals, V&f least variety

• Number of voices sounding simultaneously:
  • Expectation: V&f mostly 4; Motets mostly 1 to 3; Madrigals a mix of both
  • Reality: V&f and Madrigals mostly 4; Motets mostly 3
(Free) diving into the feature values

- We can also explore the feature data to see if it reveals unexpected insights as to which features are particularly effective
  - Based purely on the data itself, not on our expectations
- We used ten statistical techniques to find the features most consistently statistically effective at distinguishing the genres
  - We then manually examined these feature subsets to find the features likely to be the most musicologically meaningful
Novel insights revealed (1/3)

- Madrigals vs. motets (99.1%):
  - Rhythm-related features are extremely powerful
- In particular:
  - Half notes (minims) and eighth notes (fusae) are both much more common (relative to other rhythmic values in a given piece) in madrigals
  - Series of notes of the same rhythmic value in a voice tend to be longer overall in madrigals, and also vary more in the number of notes in each series
  - Madrigals tend to have a higher note density
  - Motets have more long notes (breves and longs)
Novel insights revealed (2/3)

• Villotte&frottole vs. madrigals (64.6%):
  • The differences are less pronounced, but there are still certain patterns, especially relating to rhythm

• Details:
  • Madrigals tend to have a much lower note density in the highest voice
  • Madrigals tend to have a greater difference between the shortest and longest note durations in a piece
    • Madrigals tend to have longer note durations in the lowest voice (relative to durations in other voices in the same piece)
    • The minimum rhythmic value in a piece tends to be shorter in madrigals
Novel insights revealed (3/3)

• Villotte&frottole vs. motets (84.8%):
  • Features based on rhythm (and texture) dominate

• Details:
  • Note density is important once again:
    • Motets tend to have a lower variability in note density in a given piece
    • Motets tend to have a much lower note density in the highest voice
    • The most common rhythmic value tends to be longer in motets
  • Rests are particularly significant:
    • Motets tend to have more rests in general
    • In particular, motets tend to have more points where at least one voice is silent while at least one other is sounding
Second set of experimental conclusions

• The particular musical characteristics an expert might think differentiate the genres are generally correct, but not perfect
• The (statistically) most effective features at distinguishing the three genres are overwhelmingly rhythmic
What does jSymbolic tell us about the origins of the madrigal?

• Rhythm is a key feature in genre identification
• The villotta emerges as an important genre for the origins of the madrigal – even though it has almost never been considered in this role before
  • The villotta emerges only slightly earlier than the madrigal, though it has roots in the “northern proto-villotte” from the turn of the century
  • It is associated with northern Italy, but it is often found in Florentine manuscripts
  • It appears both in frottola and madrigal sources, suggesting that it has a flexible generic identity
What does jSymbolic tell us about the origins of the madrigal?

- I was (at least partly) wrong about similarities between the madrigal and motet – they are very different.

- However – the madrigal does share some features with the motet – which lend themselves to the “high style”
  - Madrigals are longer than other secular Italian genres
  - All voices are similar in terms of the size of leaps

- Some of the similarities that I saw (such as imitation) are things that jSymbolic does not yet include as features;

- The motets mostly earlier than madrigals (affecting ranges, rhythm)

- Cory’s jSymbolic has forced me to reconsider my hypotheses, and taught us a great deal about a key moment in music history.
Thank you!
And thanks to:

• Ian Lorenz, Jonathan Stuchbery, and Vi-An Tran, for creating our symbolic corpus
• Zoey Cochran, for her ideas on the early madrigal
• Florentine libraries: the Biblioteca Nazionale Centrale and the Conservatorio di Musica Luigi Cherubini