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ADVENTURES IN TIME: WORKING AT THE LIMITS OF MUSIC NOTATION

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In our latest blog post, Dr Christian Goursaud, Research Fellow at Royal Birmingham Conservatoire, provides a fascinating insight into some of the challenges presented by medieval and renaissance music notation and how as part of an AHRC-funded research project, one member of the research team was able to solve a musical puzzle that had defeated musicologists for over five centuries.

Our team of researchers at Royal Birmingham Conservatoire have been addressing challenging questions surrounding the interpretation of the mensural system of music notation in use around 1400–1700. The journey so far has involved introducing Johannes Tinctoris (c.1430/35–1511; Figure 1), one of the greatest late medieval and renaissance music-theoretical minds, to the cutting-edge of machine learning and artificial intelligence. Along the way we have been breathing new life into neglected musical repertoires and have found the answer to a musical puzzle that had lain unsolved for more than 500 years.

First, some necessary technical background. In mensural music, longer notes can be divided into either two or three of the next shortest value. A decision either way must be taken at each of the four levels, termed major *modus* (division of the *maxima* into the shorter long), minor *modus* (division of the long into the shorter breve),

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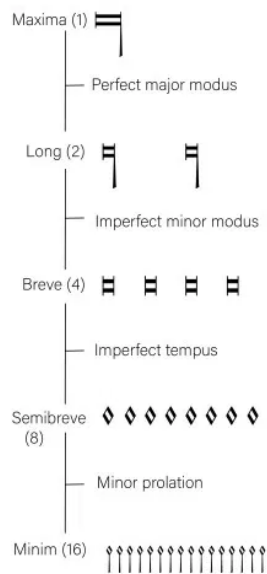
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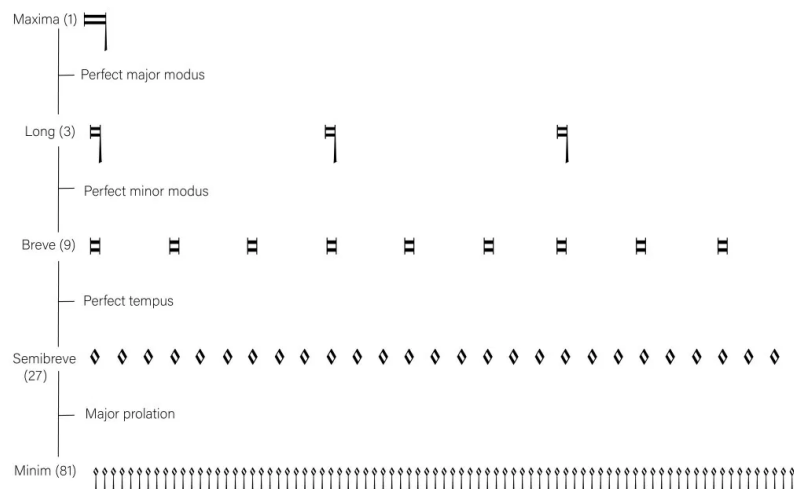
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tempus (division of the breve into the shorter semibreve), and prolation (division of the semibreve into the shorter minim). At the top of the hierarchy, therefore, the composer must decide whether to make the longest-available notes worth two or three of the next shortest notes. If the composer were to decide to divide into two at every level then the *maxima* would be worth sixteen of the smallest value, the minim (Example 1).



Example 1. Mensural structure of imperfect major modus, imperfect minor modus, tempus, and prolation

If the division were into three at every level then the number of minims per *maxima* would escalate to eighty-one (Example 2).



Example 2. Mensural structure of perfect major modus, perfect minor modus, perfect tempus, and major prolation

Tinctoris, one of the foremost witnesses to mensural notation in the late fifteenth century, tells us in his music-theoretical treatise *De regulari valore notarum* that ‘the value of the minim ... remains stable and fixed in all quantities, never receiving

either increase or decrease. For that note is of an indivisible value, because it is simple and entirely uncomposed.' Given this theoretical invariability of the minim, it is clear that a mensural structure worth eighty-one minims is something of a quite different length to one worth only sixteen.

Composers often wished to write, for example, a breve worth only two semibreves when the prevailing mensuration allowed only for breves worth three semibreves. It was possible to achieve this through 'imperfection', whereby the note reduces in length by one third. It was also possible to achieve the same duration by doubling the value of a semibreve through 'alteration'. The challenge of mensural imperfection and alteration is that neither is explicitly notated, though dots are sometimes used to clarify ambiguous situations. To interpret this context-dependent notation, it is necessary to understand how the system and its rules were supposed to operate, and how individual composers applied them.

In his theoretical treatises, Tinctoris explains more than just the essentials of the mensural system. His musical examples in some cases require a considerable application of time and patience in the comprehension of the various operations necessary to arrive at the solution. They are the products of great intellectual curiosity, and amply demonstrate the subtlety and power of the mensural system (Figure 2).

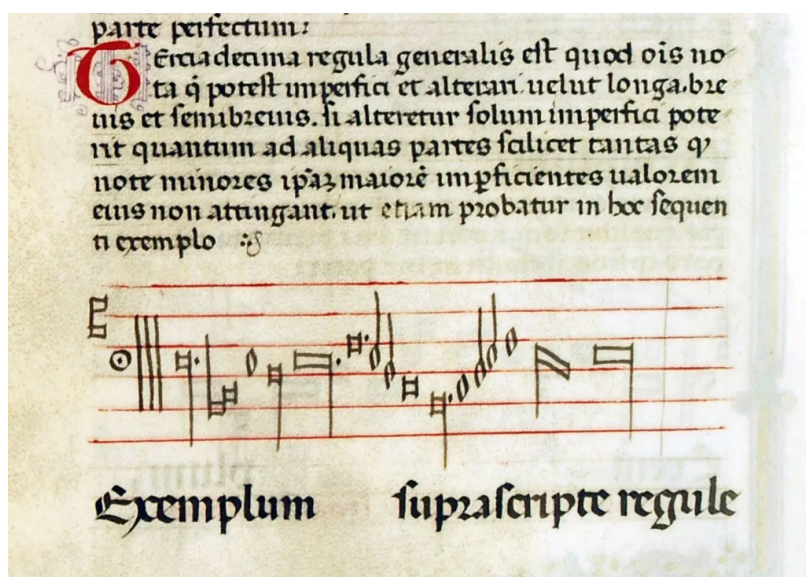


Figure 2. Johannes Tinctoris, *De imperfectione notarum*, Book 1, chapter 3: the thirteenth general rule of imperfection. Bologna, Biblioteca Universitaria, MS 2573, fol. 68^r (detail)

Central to our research project is the development of an expert software that is capable of modelling these cognitive procedures, according to Tinctoris's rules, and to learn from the process. This is no simple task, since Tinctoris describes scenarios resulting from the application of an implicit rule-based system, rather than giving clear instructions on how to navigate the decision-making process. My colleagues, Dr Jeffrey J. Dean, Dr David Lewis, Emeritus Professor Ronald Woodley, and Dr Anna Plaksin have and will have contributed to this effort. The expert system needs mensural music in a machine-readable format, and hence we have been preparing fresh digital critical editions of all Tinctoris's own compositions in the original notation, encoded according to the Music Encoding Initiative standard such that others may re-use our open-source data in the future.

It was in the process of developing this corpus that Dr Jeffrey J. Dean solved a musical puzzle that had until now defeated musicologists. Tinctoris’s *L’homme armé* mass, one of more than forty based on the secular melody named in its title, survives in one single source, the manuscript Cappella Sistina 35 in the Vatican Library. The scribe of that manuscript omitted the Tenor parts in some sections of the mass, leaving a later scribe to fill in the gaps with their own solution. Having observed that these lines were not what Tinctoris wrote, Dr Dean embarked on a quest to solve the musical conundrum, and the results were better than anyone could have expected, for he discovered a solution that is demonstrably what Tinctoris must have written. Finally, after more than 500 years, the mass is once more complete.

Not everyone played by the rules in late fifteenth-century music, not least Antoine Busnoys (c.1430–1492), whose notational idiosyncrasies provoked Tinctoris’s criticism in the *Proportionale musices*. For that reason, I am preparing a major new digital critical edition of Busnoys’s own *L’homme armé* mass, which is structured around the same secular tune as Tinctoris’s. Through this research, we expect to be able to learn even more about the rules of mensural polyphony by investigating how, when, and why they were broken.

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