



MTO 26.4 Examples: Desmond, Hopkins, Howe, and Cumming, Computer-aided Analysis of Sonority in the French Motet Repertory, ca. 1300–1350

(Note: audio, video, and other interactive examples are only available online)

<https://mtosmt.org/issues/mto.20.26.4/mto.20.26.4.desmond.html>

Example 1. Voice-reduction graph of Machaut's *Bone pastor/Bone pastor/BONE PASTOR* from Fuller 1986, 62

a)

12

b)

c)

Example 2. Categorization of sonorities according to Fuller 1986 and Hartt 2010

Fuller 1986		Hartt 2010	
Perfect	perfect intervals above lowest voice	Perfect	perfect intervals above the lowest voice
Imperfect	a perfect interval and an imperfect interval above lowest voice	Mixed	a perfect interval and an imperfect interval above the lowest voice
Doubly imperfect	two different imperfect intervals above lowest voice	Imperfect	only imperfect intervals, although may include unisons and compounds
		Dissonant	contains a dissonant interval between any two voices

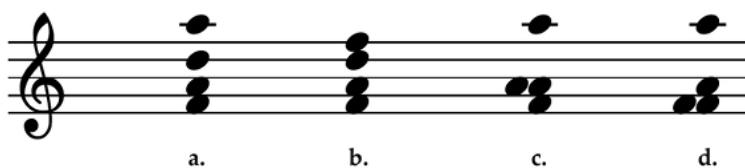
Example 3. Rules for our categorizations of sonorities that expands on Fuller 1986 and Hartt 2010

Category	Rule	An illustrative example
Perfect (P)	must contain only perfect intervals above the lowest sounding note	an 8-5 sonority
Mixed (M)	must contain at least one perfect and one imperfect interval above the lowest-sounding note	a 5-3 sonority
Imperfect (I)	must contain two of the same imperfect interval (i.e., two thirds, or two sixths) above the lowest sounding voice <i>and</i> no perfect intervals (other than unisons) above the lowest-sounding note	a 10-3 sonority
Doubly Imperfect (DI)	must contain both types of imperfect interval (i.e., a 3rd and a 6th) above the lowest sounding voice <i>and</i> no perfect intervals (other than unisons) above the lowest-sounding note	a 6-3 sonority
Dissonant (D)	has any of these dissonant intervals (2nd, 7th, augmented, diminished) between any two voices, or a 4th in two upper voices <i>not</i> supported by a fifth below	a 7-5 sonority

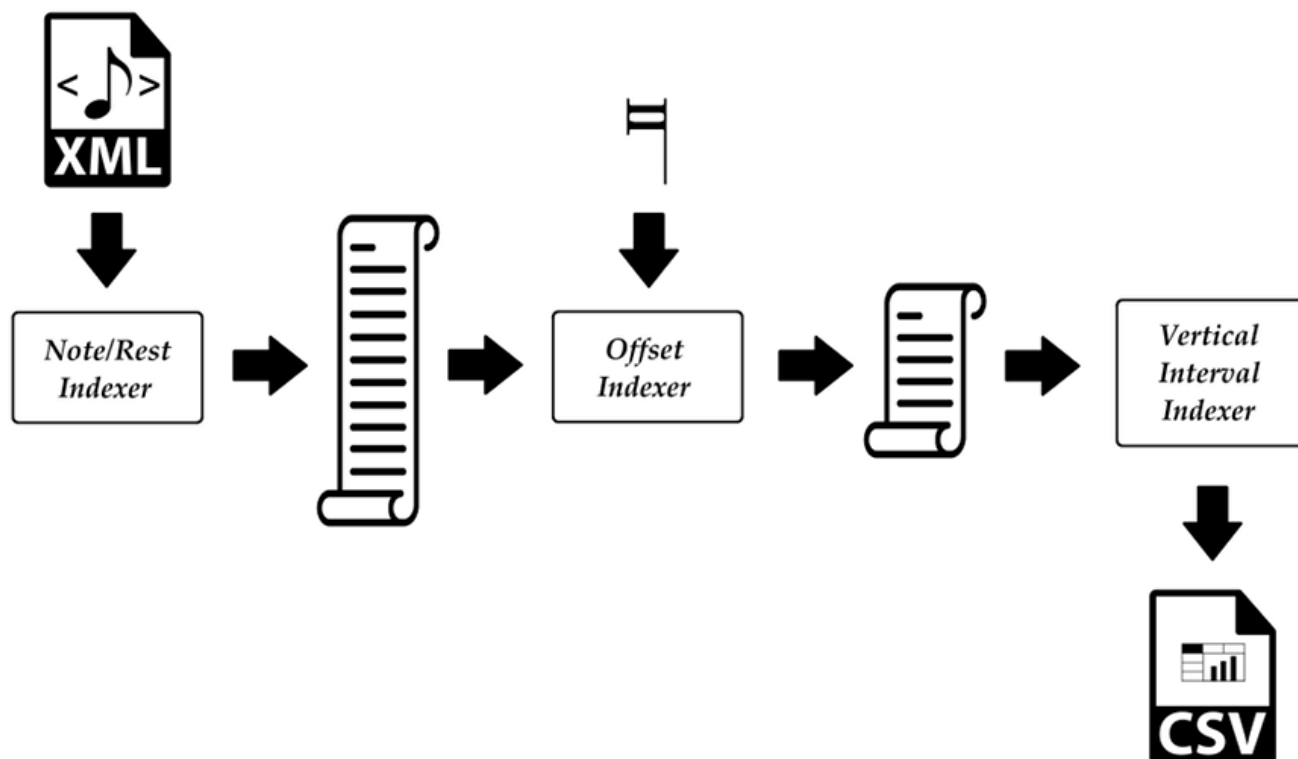
Example 4. (a) Fuller: — / Hartt: Imperfect (a-c-c'); (b) Fuller: Imperfect / Hartt: Mixed (a-a'-c'); (c) Fuller: Imperfect / Hartt: Imperfect-I (a-a-c)



Example 5. (a) Doubly imperfect: f-a-d-a'; (b) Mixed: f-a-d-f'; (c) Imperfect: f-a-a-a'; (d) Imperfect: f-f-a-a'



Example 6. The Rodan workflow takes an XML file as input, processes it through three indexers, and outputs a CSV file



Example 7. *Colla iugo/Bona condit/LIBERA ME*, first *talea* (breves 1–12). Dashed boxes highlight the sonorities on the first and seventh breves. Arrows above the staff mark the *modus* onset; the sonority category for each breve is noted below the system

Example 8. Excerpt from the beginning of the Rodan-generated CSV file of the **IvTrem** motet *Colla iugo/Bona condit* at the offset of a breve. Dashed boxes highlight the intervals sounding between the voices on the first and the seventh breves

Parts	0,1	0,2	1,2
0.0	P4	P8	P5
12.0	P8	P8	P1
24.0	P4	P8	P5
36.0	M3	P5	m3
48.0	m3	P5	M3
60.0	m3	P5	M3
72.0	M6	M3	P5
84.0	M6	M3	P5
96.0	P5	Rest	Rest
108.0	P1	Rest	Rest
120.0	P4	P8	P5
132.0	P5	M2	P5

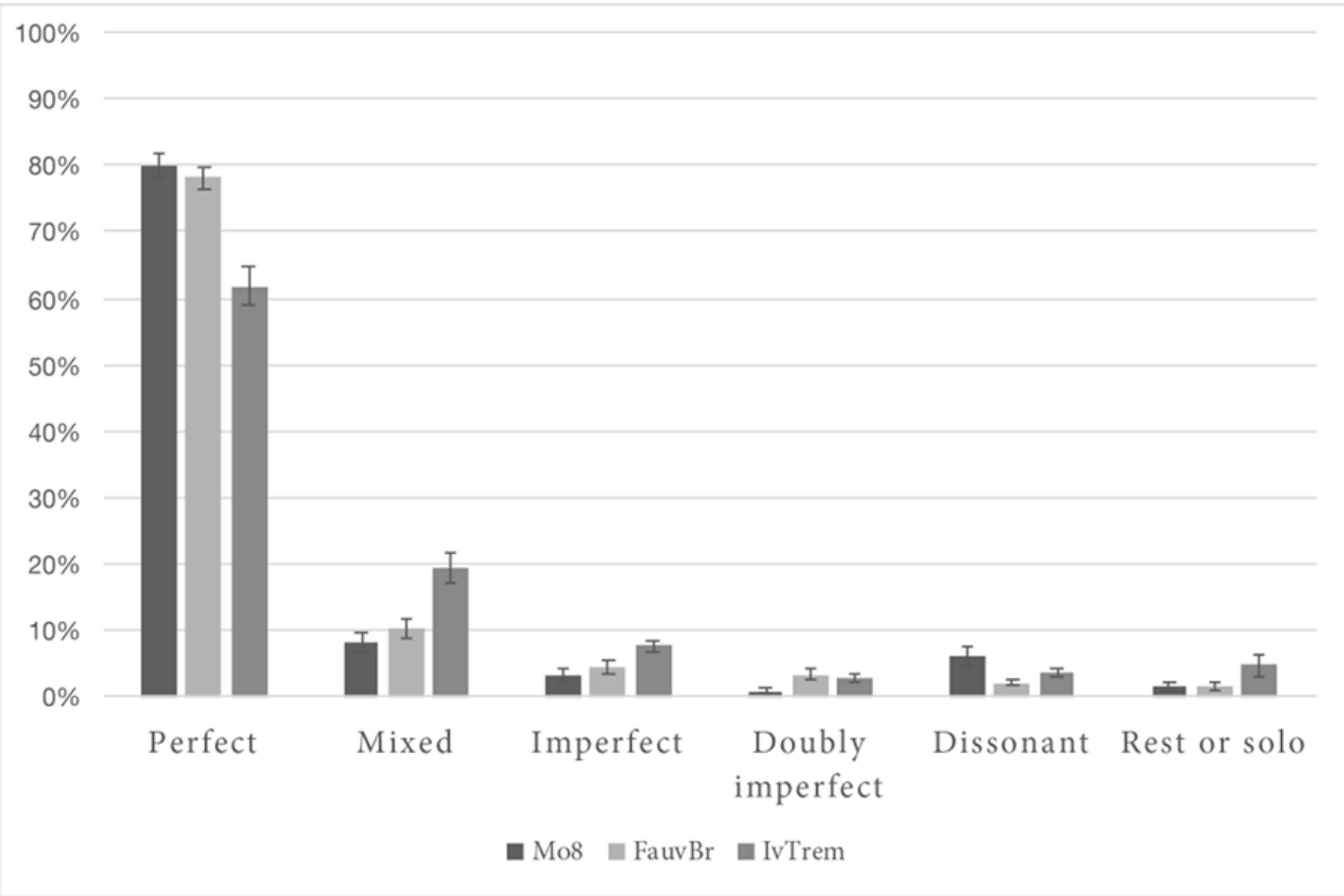
Example 9. Order (from top to bottom) in which we filtered the CSV files output by the Rodan workflow, using a Python script, in order to categorize the sonorities

Category	Rule
Rest/Solo (R)	Does not have at least one vertical interval (two sounding voices)
Dissonant (D)	Contain any augmented, diminished, and/or contrapuntally dissonant interval. The combination of a perfect fifth and a sixth of any quality above the lowest note is also categorized as “Dissonant.”
Perfect (P)	Contain only perfect intervals, e.g., [P5 P8]
Mixed (M)	Contain at least one perfect and one imperfect interval, e.g., [P5 M3]
Doubly Imperfect (DI)	Contain two different imperfect intervals, e.g., [M3 M6]
Imperfect (I)	Any remaining sonorities (which will be equivalent to those containing only imperfect intervals)

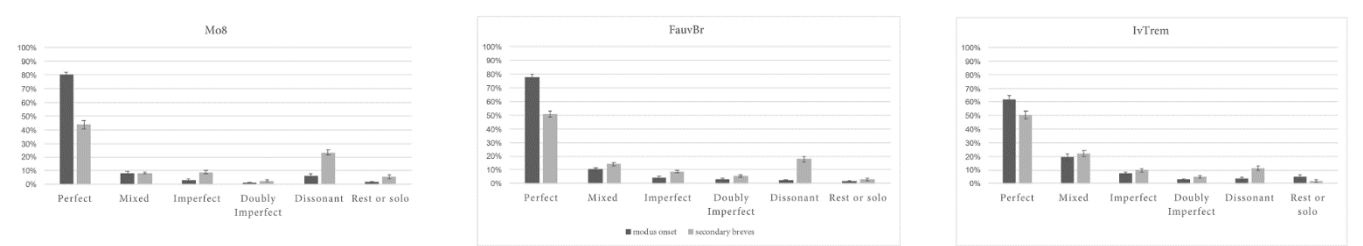
Example 10. Aggregation of sonorities in *Colla iugo/Bona condit/LIBERA ME* at the offset of a medieval breve (first row) and a medieval long (second row, the first breves of a *modus* unit), and the secondary breves or each *modus* unit (third row)

	P	M	I	DI	D	R	Total
On every breve	82	31	6	5	9	0	133
On first breves of each <i>modus</i> unit	35	6	2	0	2	0	45
On the secondary breves of each <i>modus</i> unit	47	25	4	5	7	0	88

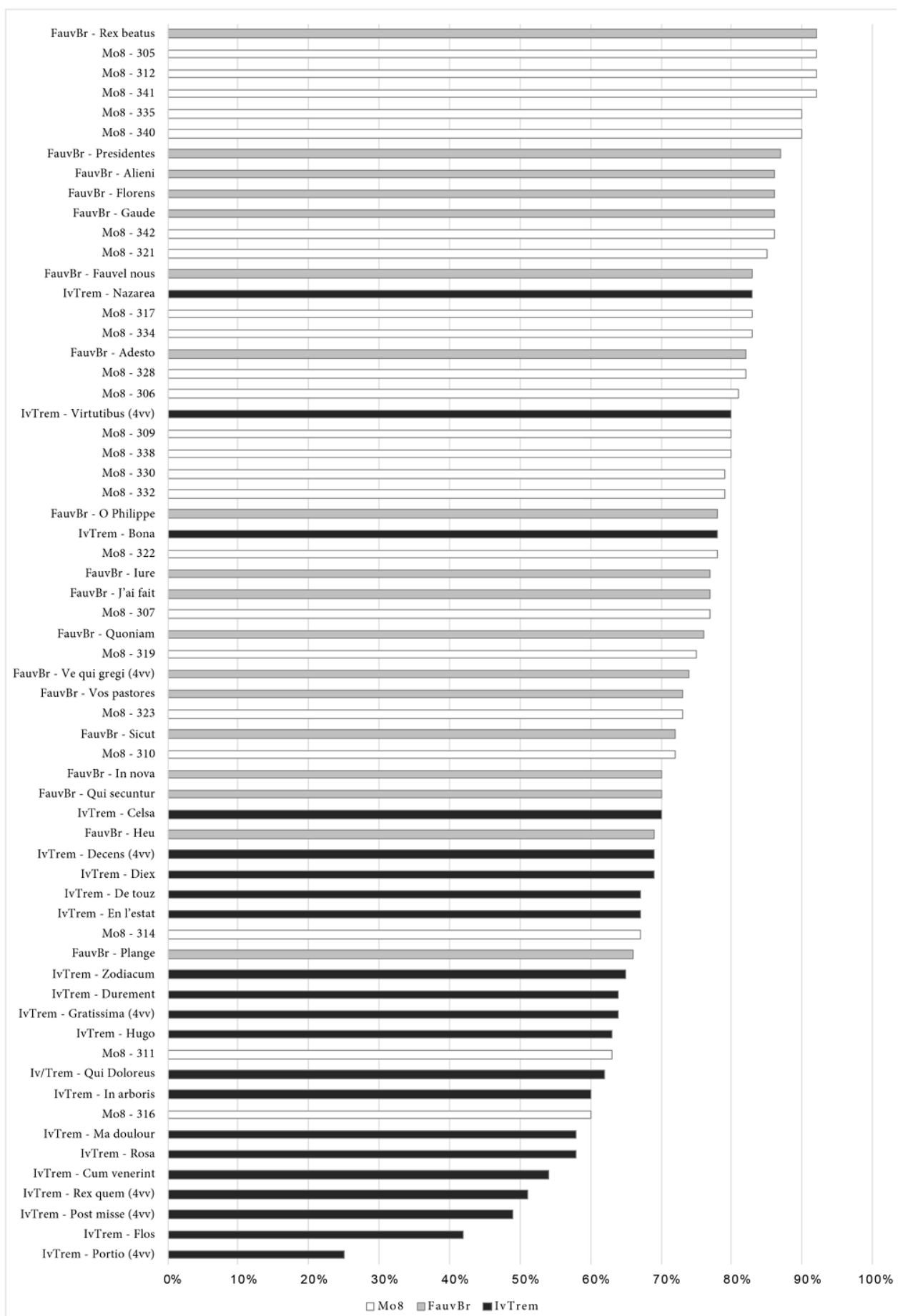
Example 11. Bar graph with standard error bars that displays the means for each motet group (Mo8, FauvBr, IvTrem) for each sonority category at *modus* onset



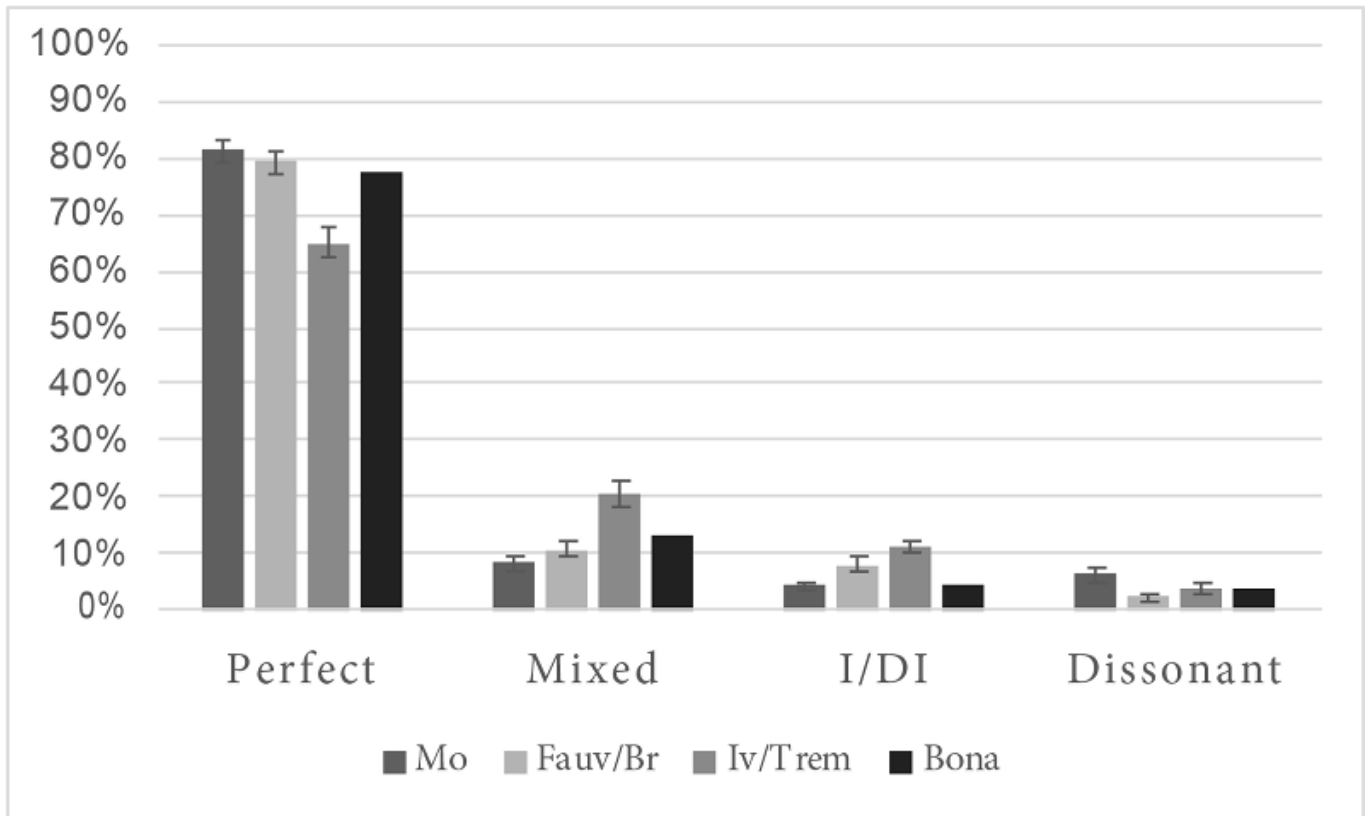
Example 12. Bar graphs with standard error bars that display the means for each motet group (Mo8, FauvBr, IvTrem) for each sonority category at *modus* onset, and for the secondary breves of each *modus* unit



Example 13. Bar graph of percentage of perfect sonorities at *modus* onset across all three motet groups (Mo8, FauvBr, IvTrem)



Example 14. Bar graph with standard error bars that displays the means for each motet group (**Mo8**, **FauvBr**, **IvTrem**) for each sonority category at *modus* onset, and that includes a fourth bar that shows the distribution of these sonorities in the motet *Colla iugo/Bona condit/LIBERA ME*. The imperfect, and doubly imperfect categories of sonority have been collapsed into the single category I/DI



Example 15. *Se ie sui liés et chantans/Jolietement/OMNES* (**Mo8**, no. 316), longs 4–17 (in modern note values, where a medieval breve is transcribed as a modern breve). Arrows above the staff mark the *modus* onset; and the sonority classification for each breve is noted below the system.

Dashed boxes highlight the dissonant sonorities that occur at the *modus* onset

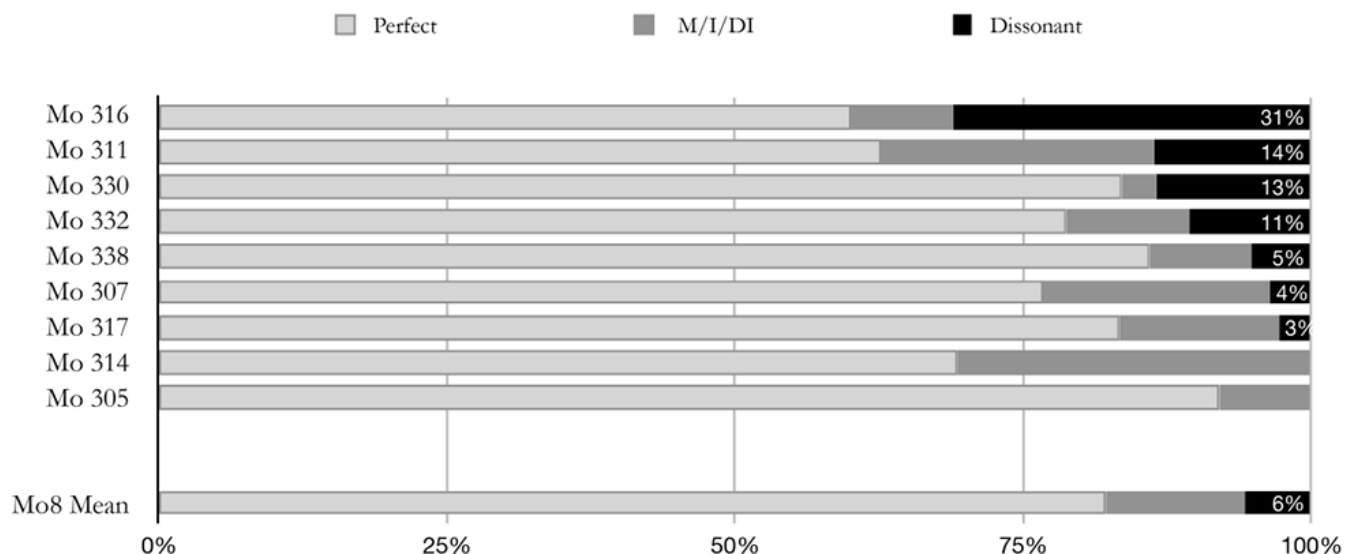
triplum
son par uns iex uairs et ri - ans hou-neur pro-me-tans et le no - ble guer-re-don des fins a - mans et si croi com uoir di sans

motetus
de cuer bo - ne - ment au dou - cet de cors gent

tenor
qu'en si - cle nen re - li - gi - on nest pe - tis ne grans pour quil soit bien con nois - sans que pour si be - le fa - chon ne le - uast le cha - pe - ron

sonority classifications: P I D P P D P P D D P P D D D P D D P R R

Example 16. Sonority categories at *modus* onset for the individual **Mo8** motets that have a “stratified” texture shown in comparison to the mean value for the entire **Mo8** group. The mixed, imperfect, and doubly imperfect categories of sonority have been collapsed into the single category M/I/DI



Example 17. *Cum statua Nabucodonasor/Hugo, Hugo, princeps invidie/TENOR CUM STATUA*, longs 1–10 (in modern note values, where a medieval breve is transcribed as a modern dotted breve). Arrows above the staff mark the *modus* onset, and the sonority classification for each breve is noted below the system

The musical score is divided into two systems, each with three staves: triplum, motetus, and tenor. The first system (measures 1-5) features the following lyrics and sonority classifications:

Triplum: Cum sta - tu - a Na - bu - co - do - na - sor me - - tal - li - na suc - ces - si - ve Sy - on

Motetus: Hu - - - go,

Tenor: TENOR CUM STATUA
P P P P I M P M M P M DI DI P P

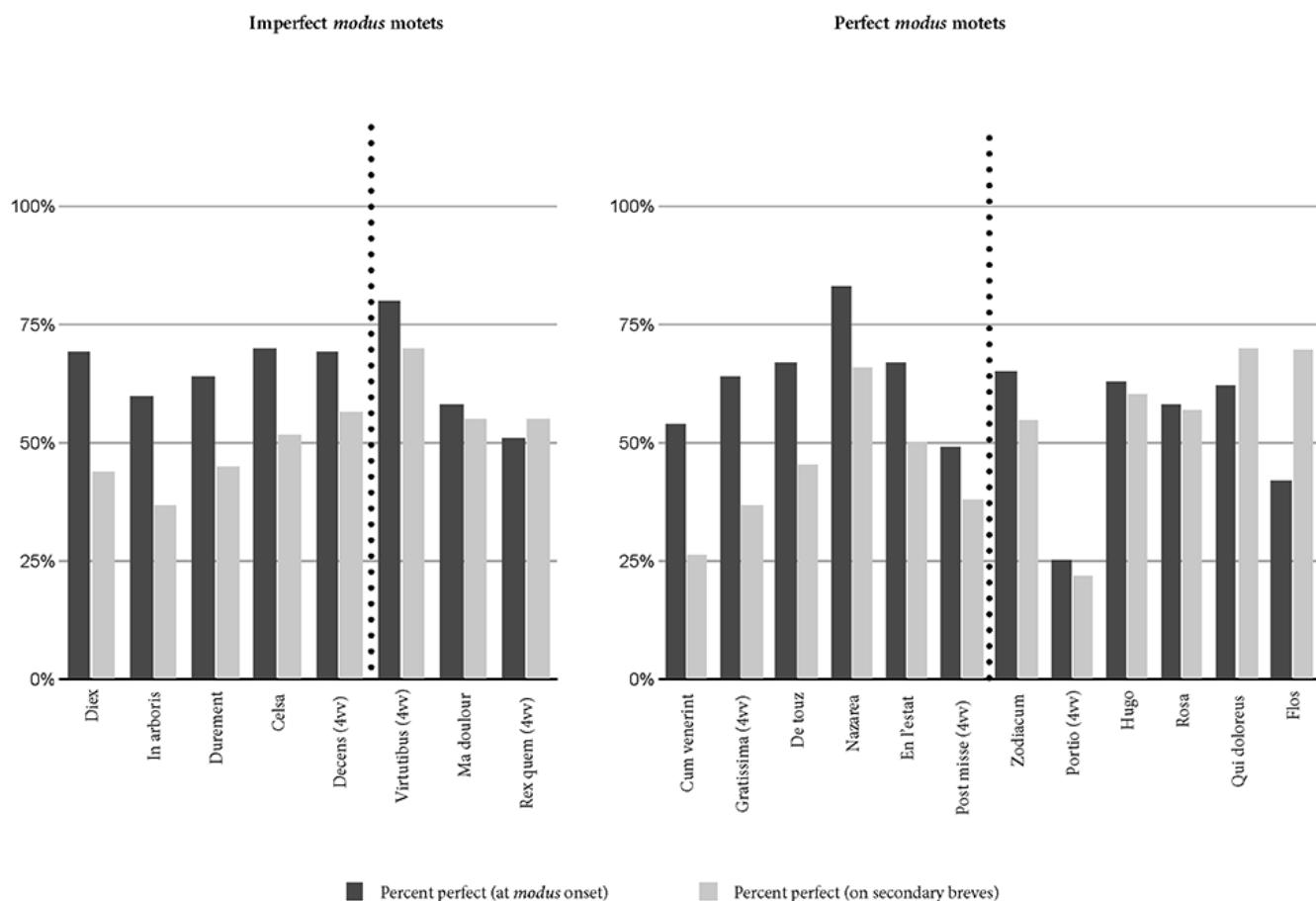
The second system (measures 6-10) features the following lyrics and sonority classifications:

Triplum: ac gra - da - tim de - du - ci ac mi - nus fi - e - ri co - lis pas - sus est do - mi - nus

Motetus: Hu - - - go, prin - ceps in - vi - di - - e

Tenor: P P P I M M P M M M P M P M I

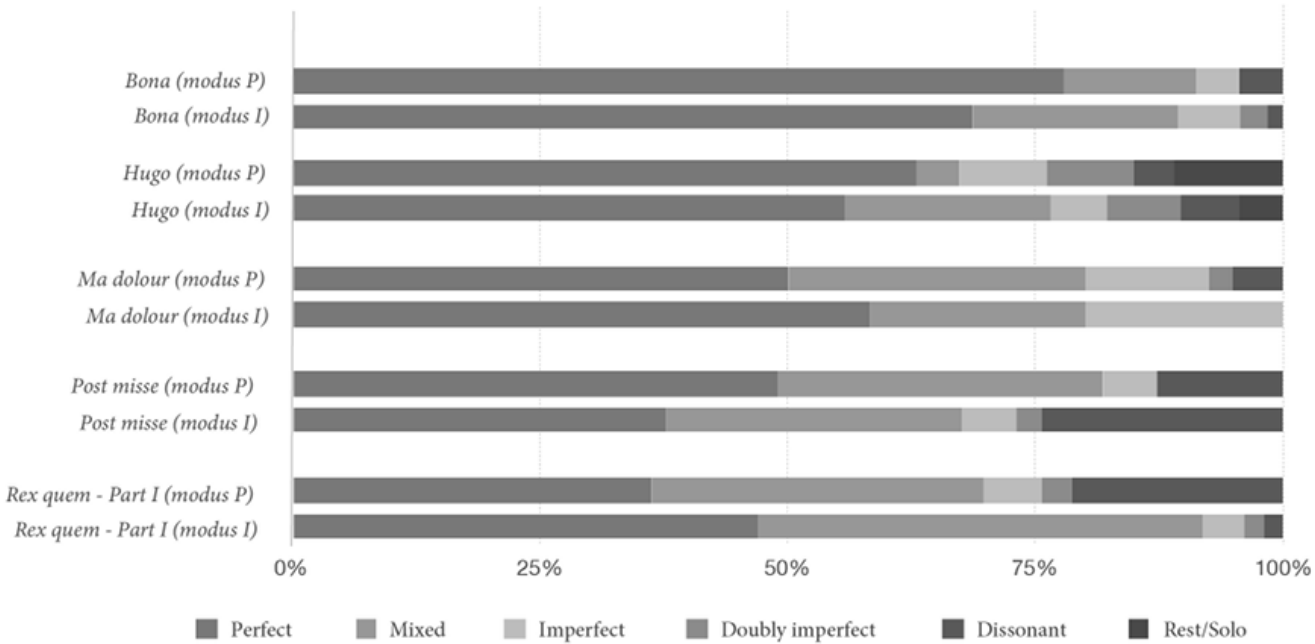
Example 18. The percentage of the perfect sonorities on first breves of the *modus* unit compared to perfect sonorities on secondary breves in the **IvTrem** motets. The bar graphs are sorted according to the degree of difference between these two percentages. The graph on the left shows the imperfect *modus* motets; the graph on the right shows perfect *modus* motets. The motets to the right of the dotted line have less than a 10% difference between perfect sonorities at *modus* onset and on secondary breves



Example 19. Motets in the **IvTrem** group that have mixed mensurations between the voices

Title	Perfect <i>modus</i>	Imperfect <i>modus</i>
<i>Colla iugo/Bona condit/LIBERA ME</i>	motetus	triplum?, tenor
<i>Cum statua Nabucodonasor/Hugo, Hugo, princeps invidie/TENOR CUM STATUA</i>	motetus, tenor	triplum
<i>Fortune mere, à douleur/Ma douleur ne cesse pas/DOLOR MEUS</i>	motetus	triplum?, tenor
<i>Post missarum/Post misse/[TENOR]/[CONTRATENOR]</i>	motetus, tenor	triplum
<i>O canenda/Rex quem/REX REGUM/[CONTRATENOR]</i>	contratenor	triplum, motetus, tenor

Example 20. Bar graph of sonority percentages that compare the motets with mixed mensurations first counting the sonorities as if the motets were in perfect *modus* (modus P), and then as if they were in imperfect *modus* (modus I)



Example 21. *O canenda/Rex quem/REX REGUM/[CONTRATENOR]*, breves 1–14 (in modern values, where a medieval breve is transcribed as a modern dotted breve). Arrows above the system mark the *modus* onset of the triplum, motetus, and tenor; the contratenor *modus* onsets are marked by arrows above its stave. The sonority classification for each breve is noted below the system. The dashed boxes mark the moment when the onset of *modus* coincides in all four voices

triplum
O ca - nen - da vul - go per com - pu - ta ab e - xer - no be - li - al de - di - ta se cu - lo - rum ne - pha - da ra - bi - es et de li - ra ca - num in - sa - ni - es

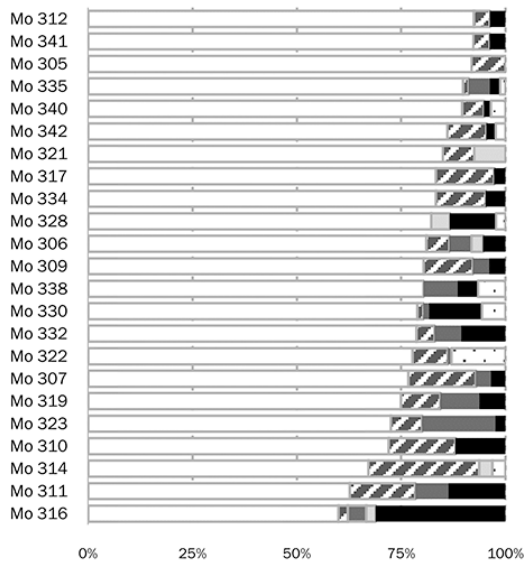
motetus
Rex quem me - tro - rum de - pin - git pri - ma fi - gu - ra

tenor
REX REGUM

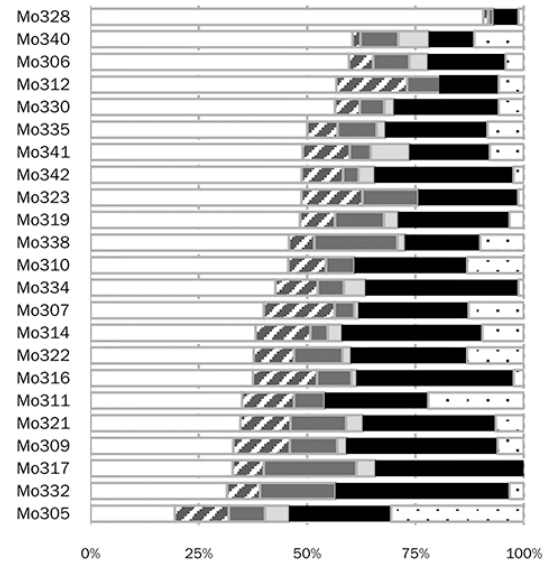
contratenor
P P M P M P M P DI P M

Appendix 2. Sonority percentages at the onset of the *modus* unit (graphs on the left) and on every breve (graphs on the right) of the **Mo8**, **FauvBr**, and **IvTrem** motet groups. Each of the six graphs are sorted according to the percentage of perfect sonorities across the course of each motet from highest to lowest

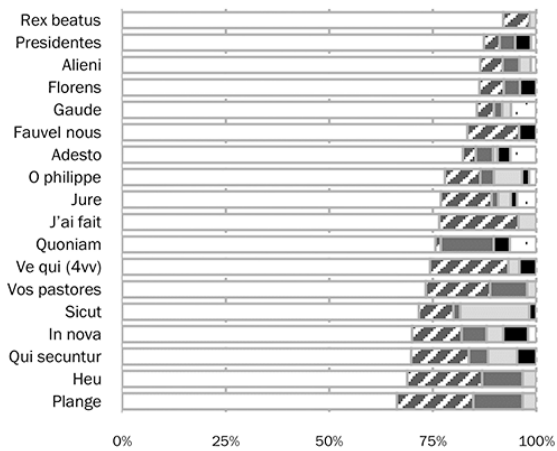
Perfect Mixed Imperfect Doubly imperfect Dissonant Rest or solo



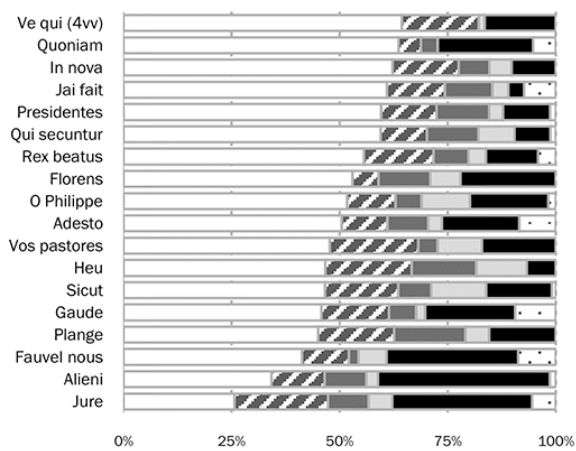
Sonorities on first breve of *modus* unit (Mo8 group)



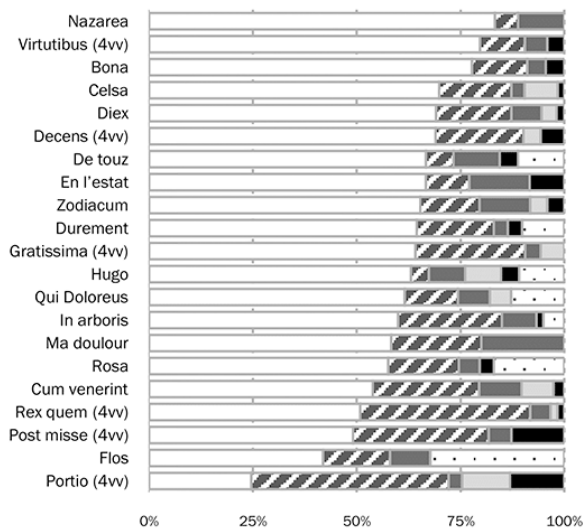
Sonorities on secondary breves (Mo8 group)



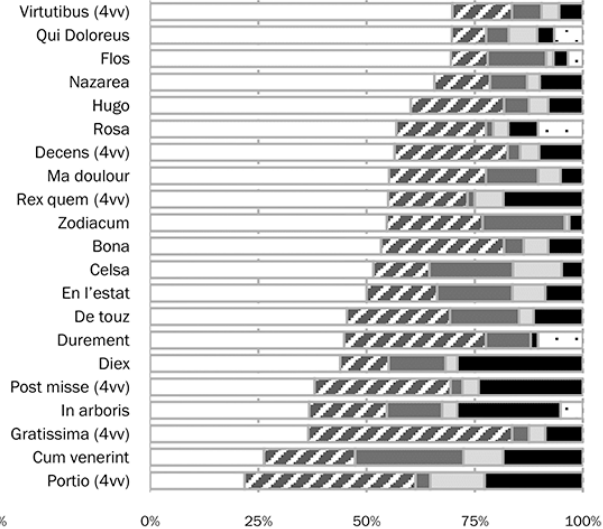
Sonorities on first breve of *modus* unit (FauvBr group)



Sonorities on secondary breves (FauvBr group)



Sonorities on first breve of *modus* unit (IvTrem group)



Sonorities on secondary breves (IvTrem group)