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Global Digital Music Studies Conference

11-12 April 2023

TONALITIES: Musical Systems and their Histories Revisited Through
Modelling and Collaborative Score Annotation.

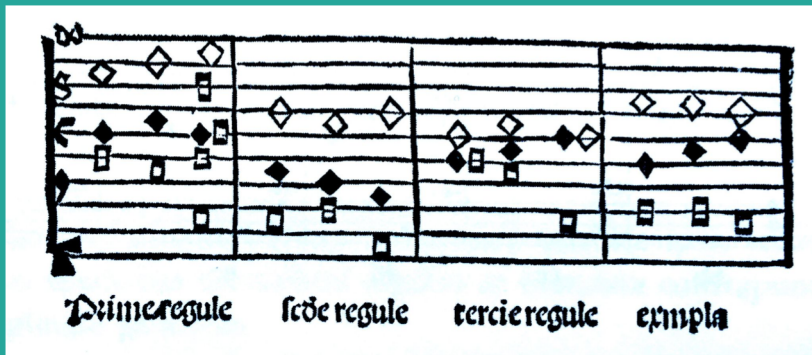
A Case Study on “Directed Progressions” in the Secular Works by Josquin
and His Contemporaries.

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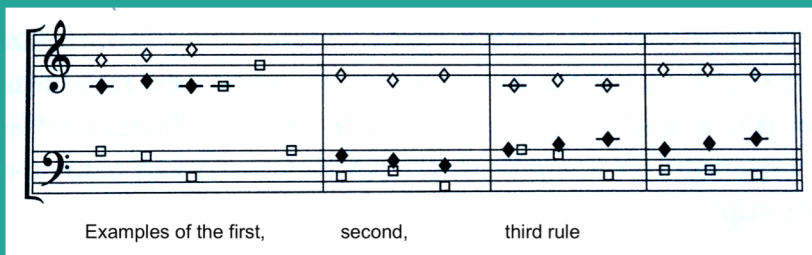
The plagal “complex”



Cochlaeus, Cologne, 1507, III, 15.

Viewed with modern eyes, the ultima could easily be interpreted as a sound lacking the third, and the entire cadence would then be a plagal cadence with IV-I progression to aa. But the self-evidence with which [the theorists consider] the *mi*-cadence on e shows that the essential aspect is the interval progression from the sixth f-d' to the octave e-e' [...].

Schwind (2009, 172)



Sachs, Hildesheim, 2015, 195.

(Mit modernen Augen betrachtet könnte die Ultima problemlos als ein a-Klang interpretiert werden, dem die Terz fehlt, und die gesamte Kadenz wäre dann eine Plagalkadenz mit IV-I Fortschreitung nach aa. Aber die Selbstverständlichkeit, mit der [die Theoretiker die] *mi*-Kadenz auf e betrachtet[en], zeigt, dass das Wesentliche in der Intervallfortschreitung von der Sexte f-d' in die Oktave e-e' liegt [...].)

The plagal “complex”

18

S

Sx

Ct

Q

T

B

C

C

T

T

P

P

Josquin Desprez, *Nymphes, nappées, Circumdede runt me*, 18-35

The "plagal complex" – i.e. a bass progression a fifth upwards or a fourth downwards in phrygian or non-phrygian cadences – confronts us with a major problem of conceptualization and interpretation.

The plagal complex tackled through Tonalities

As part of the **Polifonia project (EU Horizon 2020 Programme, RIA)**, Tonalities provides ontologies of music theories and applies them through a dedicated score annotation interface to:

- Grasp how distinct theoretical viewpoints bring to light different musical structures;
- Confront analytical interpretations;
- Look “inside” theories and works;
- Understand how both evolve in time;
- Uncover parts of the work’s underlying system

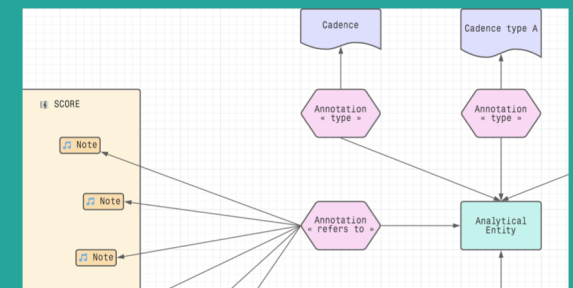


The plagal complex tackled through Tonalities

Tonalities a) makes use of theoretical models (left window), which (b) can be associated with arbitrary selections on the score (middle window) and (c) lead to critical analyses through collaborative approaches (right window).

The screenshot displays a music analysis software interface. On the left is a 'Navigator' panel with a search bar and tabs for 'LECTIONS', 'CONTRIBUTORS', 'CONCEPTS', and 'PROPERTIES'. Below these is a list of 'Current treatise' with 'Zarlino_1558#' selected. A list of 'Properties' follows, including 'ambitusExceedsInterval', 'ambitusSmallerThanInterval', 'hasAffinityWithMode', 'hasAmbitus', 'hasAntepenultima', 'hasAssociationToPlanet', 'hasCadence', 'hasClef', 'hasDenotation', 'hasEthos', 'hasFinalis', 'hasInitialNote', and 'hasIrregularCadenceOn'. The middle window shows a musical score with five staves (B, C, A, T, Q, B) and lyrics. A red box highlights a 'G' annotation on the C staff, and a blue box highlights a 'ci' annotation on the B staff. The right window is an 'Inspector' panel titled 'VERTICALITY' showing a list of 'Positioned note' annotations with their IDs and coordinates.

a) **Theoretical models:** owl ontologies provide concepts and properties that formalize theoretical knowledge, for example on the modes or cadences.



The plagal complex tackled through Tonalities

Tonalities a) makes use of theoretical models (left window), which (b) can be associated with arbitrary selections on the score (middle window) and (c) lead to critical analyses through collaborative approaches (right window).

The screenshot displays a music analysis software interface with three main panels:

- Navigator (Left):** Shows a search bar and tabs for LECTIONS, CONTRIBUTORS, CONCEPTS, and PROPERTIES. The current treatise is "Zarlino_1558#" with the URL <http://modality-tonality.huma-num.fr/>. A list of properties is shown, including `ambitusExceedsInterval`, `ambitusSmallerThanInterval`, `hasAffinityWithMode`, `hasAmbitus`, `hasAntepenultima`, `hasAssociationToPlanet`, `hasCadence`, `hasClef`, `hasDenotation`, `hasEthos`, `hasFinalis`, `hasInitialNote`, and `hasIrregularCadenceOn`.
- Score (Middle):** Shows a musical score with lyrics. A red box highlights a selection in the Soprano (S) part, and a blue box highlights a selection in the Bass (B) part. The score includes parts for Soprano (S), Alto (A), Tenor (T), and Bass (B).
- Inspector (Right):** Shows a list of verticality selections. The first selection is "Vertically 65-1.0" with ID "957d5328-27ff-4d91-86c2-eeb719ffcd-e-d1e31204-65-1.0". Other selections include "Positioned note B4 measure 65 beat 1.0", "Positioned note G4 measure 65 beat 1.0", "Positioned note B3 measure 65 beat 1.0", "Positioned note B3 measure 65 beat 1.0", and "Positioned note B3 measure 65 beat 1.0".

b) Selections on the score :

- All musical elements at any level (ranging from a single note to complex segments) can be selected and associated with theoretical concepts
- The linking of concepts with selections can be done manually and/or via knowledge extraction routines.
- Selections can be nested: a cadence, may contain melodic lines, composed of different steps, etc.

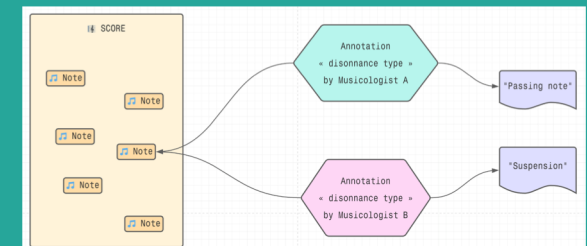
The plagal complex tackled through Tonalities

Tonalities a) makes use of theoretical models (left window), which (b) can be associated with arbitrary selections on the score (middle window) and (c) lead to critical analyses through collaborative approaches (right window).

The screenshot displays a music analysis software interface with three main panels:

- Navigator (Left):** Shows a search bar and a list of properties for the current treatise, "Zarlino_1558#". The "PROPERTIES" tab is selected, showing a list of properties such as `ambitusExceedsInterval`, `ambitusSmallerThanInterval`, `hasAffinityWithMode`, `hasAmbitus`, `hasAntepenultima`, `hasAssociationToPlanet`, `hasCadence`, `hasClef`, `hasDenotation`, `hasEthos`, `hasFinalis`, `hasInitialNote`, and `hasIrregularCadenceOn`.
- Score (Middle):** Shows a musical score with five staves (B, C, A, T, Q, B). The score is annotated with a red box around a note in the C staff and a blue box around a note in the B staff. The score is titled "MEI engraved with Célarvio".
- Inspector (Right):** Shows a list of annotations for the selected note. The annotations are: "Positioned note B4 measure 65 beat 1.0", "Positioned note B4 measure 65 beat 1.0", "Positioned note G4 measure 65 beat 1.0", "Positioned note B3 measure 65 beat 1.0", "Positioned note B3 measure 65 beat 1.0", "Positioned note B3 measure 65 beat 1.0", and "Positioned note B3 measure 65 beat 1.0".

c) **Annotations and critical commentaries:** each annotation is expressed as a CIDOC-CRM event, is dated and signed and takes the form of a reification of a RDF triple.



Theoretical models and analytical viewpoints

Our point of departure: Richard Freedman, Alexander Morgan, Daniel Russo-Batterham, *Musicologists and Data Scientists Pull out all the Stops: Defining Renaissance Cadences Systematically*, online < https://richardfreedman.sites.haverford.edu/crim/?page_id=66 >

CRIM
Citations: *The Renaissance Imitation Mass Project*

About Documents Analysis Forum Search Advanced search

Missa Benedicta es: Kyrie (CRIM_Mass_0018_1)
Mass movement
Composer: Cristóbal de Morales, 1551
Editor: Marco Gurrieri, 2017-02-21

Score < start >

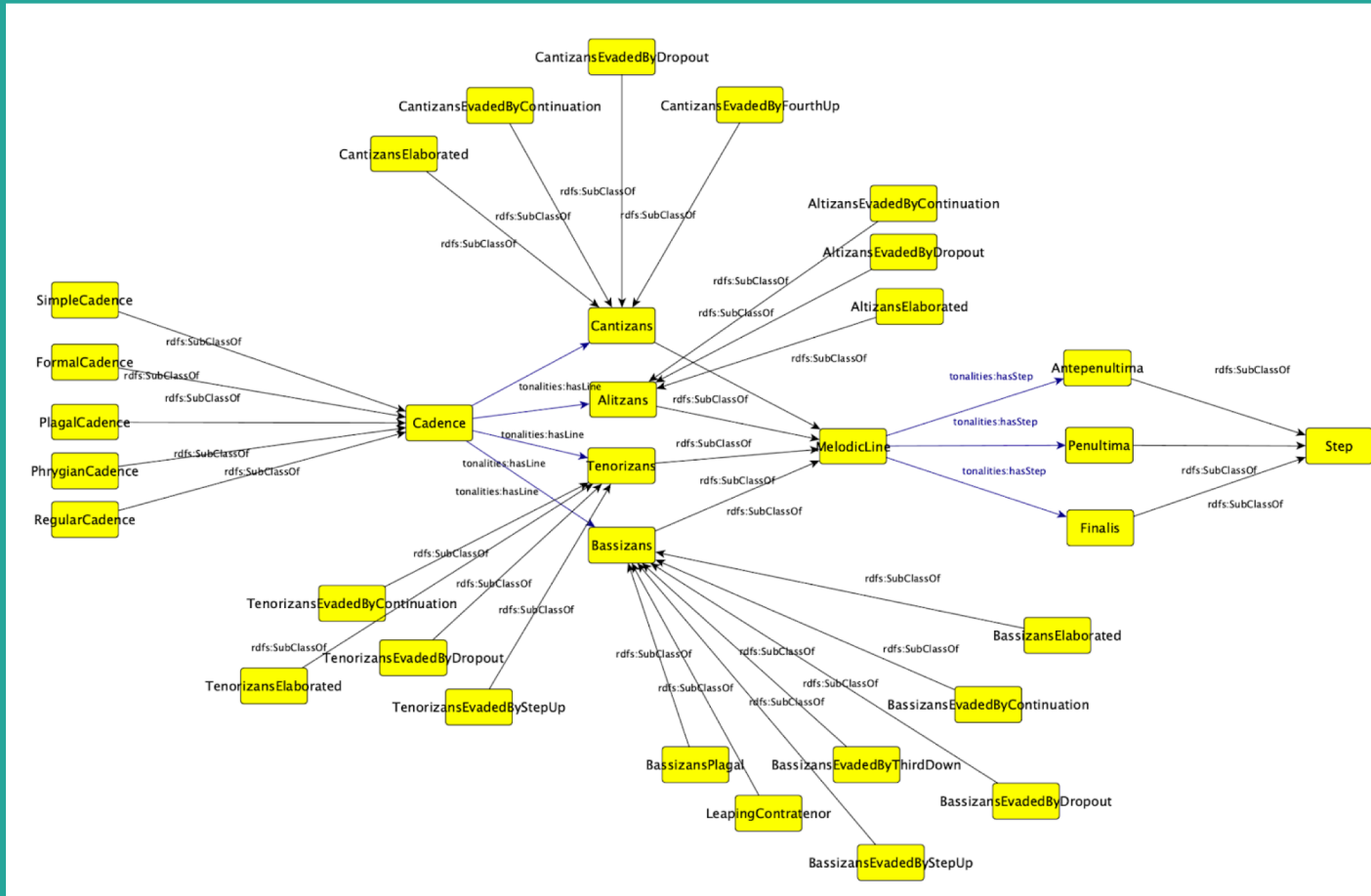
[Cantus] Ky - ri - e - lei - son, Je - le - i -
[Altus] Ky - rie e - lei - son,
[Tenor] Ky - ri - ee - le - i -
[Bassus] Kyri - ee - le - i -

Score
Text and sources
Relationships
Forum discussions
Link to audio

Mass movements
Kyrie
Gloria
Credo
Sanctus
Agnus Dei

Label	Cadential Voice Function	Label	Evaded Cadential Voice Function
A	Altizans	b	Bassizans evaded by step up
B	Bassizans	c	Cantizans evaded by fourth up
C	Cantizans	t	Tenorizans evaded by step up
L	Leaping Contratenor	u	Bassizans evaded by third down
P	Plagal Bassizans	x	Bassizans evaded by dropout
T	Tenorizans	y	Cantizans evaded by dropout
		z	Tenorizans evaded by dropout

Theoretical models and analytical viewpoints



- 4 cadence classes: simple, formal (suspension), plagal, phrygian
- 4 melodic function classes: cantizans, altizans, tenorizans, bassizans
- 4 melodic function variants: dropout, melodic evasion, continuation, elaboration (in all 18 classes)
- 3 cadence step classes: antepenultima, penultima, finalis

The corpus: machine and human annotation

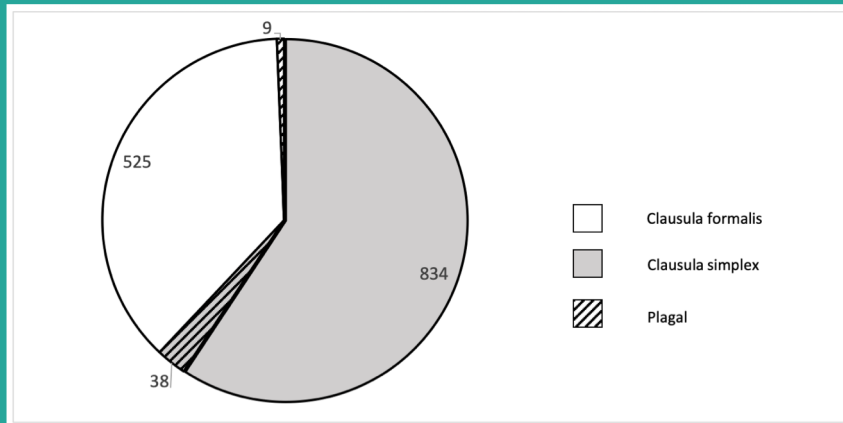
The image shows two overlapping screenshots. The top one is the homepage of the Josquin Research Project, featuring a navigation menu (HOME, BROWSE, SEARCH/ANALYSIS, ABOUT, PERFORMANCE), a logo, and the text 'The Josquin Research Project Search, browse, and analyze complete scores of polyphonic music, ca. 1420–ca. 1520'. Below this is a 'QUICK BROWSE' section with search fields for 'Josquin', 'Songs', and 'Enter Title', and a 'Browse' button. The bottom screenshot is the Verovio Humdrum Viewer interface, displaying a musical score for 'Se congie prens' with staves for Superius, Altus, Tenor, Bassus, and a vocal line (S, A, T, B).

- 111 songs attributed to Josquin Desprez:
 - 3 voices: 37
 - 4 voices: 40
 - 5 voices: 20
 - 6 voices: 14
- Machine annotations: imported from The Josquin Research Project
- Human annotations: 2 analysts (corrections, additions, deletions, extensions)
- 1406 directed progressions
- 4218 labels

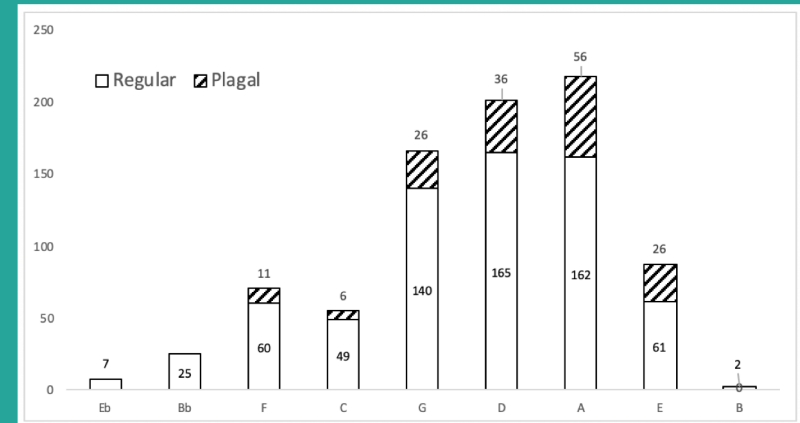


Ground truth for training a neural network

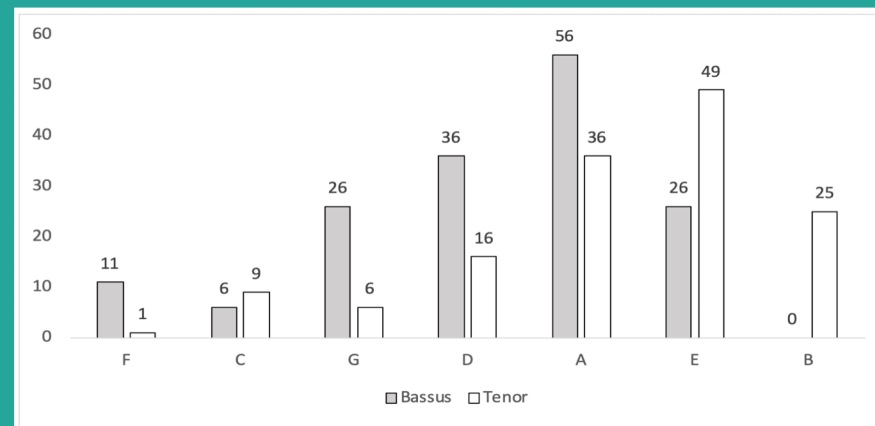
The Plagal Complex: Overall Results



Ratio of authentic and plagal cadences in Josquin's polyphonic songs



Finales of authentic and plagal cadence points – bassus



Finales of plagal cadence points

One model - several interpretations: the plagal complex in detail

Cas 1: Canonical plagal cadence

Musical score for 'Fama malum' (73-82) by Josquin Desprez. The score is in G-clef (treble clef) and 8/8 time. It features four staves: Soprano (S), Alto (A), Tenor (T), and Bass (B). The Soprano part begins with a melodic line that descends from G4 to C4. The Alto part provides harmonic support with a similar descending line. The Tenor part has a more active, rhythmic line. The Bass part has a steady, rhythmic accompaniment. The piece concludes with a canonical plagal cadence, indicated by the letters C, C, T, and P at the end of the respective staves.

Josquin Desprez, Fama malum, 73-82.

Musical score for 'Cueurs desolez' (84-90) by Josquin Desprez. The score is in G-clef (treble clef) and 8/8 time. It features five staves: Soprano (S), Tenor 1 (T1), Tenor 2 (T2), Bass 1 (B1), and Bass 2 (B2). The Soprano part begins with a melodic line that descends from G4 to C4. The Tenor 1 part has a more active, rhythmic line. The Tenor 2 part has a steady, rhythmic accompaniment. The Bass 1 part has a steady, rhythmic accompaniment. The Bass 2 part has a steady, rhythmic accompaniment. The piece concludes with a plagal cadence, indicated by the letters C, T, A, T, T, and P at the end of the respective staves.

Josquin Desprez, Cueurs desolez, 84-90.

One model - several interpretations: the plagal complex in detail

Cas 2: Tenor final harmonized at the lower fifth

Superius
Altus
Tenor
Bassus

Josquin Desprez (?), [Textless piece 4], 1-12.

25
S
T
B

Josquin Desprez, O venus bant, 25-33.

One model - several interpretations: the plagal complex in detail

Cas 3: Tenor final harmonized at the unison

The image shows a musical score for four voices: Superius, Altus, Tenor, and Bassus. The music is in C major and 4/4 time. The Superius part ends with a note labeled 'e'. The Altus part ends with a note labeled 'd' and a sharp sign (#). The Tenor part ends with a note labeled 'C' and a fermata. The Bassus part ends with a note labeled 'P'. The score is written on four staves, with the Superius and Altus parts in treble clef and the Tenor and Bassus parts in bass clef. The Tenor part has an 8va marking below the first staff. The Bassus part has a p marking below the first staff.

Josquin Desprez, Fors seulement II, 1-9.

One model - several interpretations: the plagal complex in detail

Cas 4: Clausula “dissecta”

Musical score for Superius, Tenor, and Contra parts, measures 1-8. The score is in G minor (one flat) and common time. The Superius part begins with a C-clef and a common time signature. The Tenor part begins with a C-clef and an 8-measure rest. The Contra part begins with a bass clef and an 8-measure rest. The music concludes with a final cadence marked 'P' (Plagalus) in the Contra part.

Josquin Desprez, Madame helas, 1-8.

Musical score for Superius (S), Tenor (T), and Contra (C) parts, measures 13-22. The score is in G minor (one flat) and common time. The Superius part begins with a C-clef and a common time signature. The Tenor part begins with a C-clef and an 8-measure rest. The Contra part begins with a bass clef and an 8-measure rest. The music concludes with a final cadence marked 'T' (Tonicus) in the Tenor part.

Josquin Desprez, Madame helas, 13-22.

Conclusion

- The plagal cadence remains mysterious: its ambiguity may have been intentionally exploited by composers and cannot be fully resolved.
- In contrast to historical theory, three out of the four cases considered suggest that the bass ends up on the cadence's finale, while only one case indicates that it could harmonize a finale a fifth above.
- The lack of theorization during the Renaissance may be due to the fact that the plagal cadence is almost necessarily thought of harmonically at a time when the chord concept does not exist.
- By leveraging digital approaches, working on large corpora, crossing interpretative viewpoints, and making theoretical models explicit, Tonalities helps to refine our knowledge about the "plagal complex" and, more generally, about pre-tonal contrapuntal writing.