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**Melodic Mode in Notre Dame *Organum Duplum***

by

**Asher Vijay Yampolsky**

Thesis for the degree of Doctor of Philosophy

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# ABSTRACT

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## MELODIC MODE IN NOTRE DAME *ORGANUM DUPLUM*

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One of the three principal genres to flourish at the Notre Dame Cathedral in Paris during the late twelfth and early thirteenth centuries was *organum*. Two-part organum, termed *organum duplum*, was preponderant. In its main texture, *organum purum*, the tenor elongates the notes of a plainchant melody, while the other voice, the *duplum*, sings a newly composed line predominantly above the tenor. The central question of this thesis is: are the duplum melodies in passages of *organum purum* structured according to the melodic modes?

Chapter 1 surveys the Notre Dame treatises for passages connecting polyphony with mode or with plainchant, for which modal theory was developed. Mixed attitudes are revealed, highlighting the need for analysis, for which working definitions and parameters of mode are needed.

Contrary to the standard method of modal determination by reference to a final, Chapter 2 argues, based on close readings of medieval modal treatises, that mode was heard throughout each chant, that many chants modulate, and that perceptual modal determination relied on pervasive, abstract structures, most of which remain unidentified. Rereading modal treatises through the lens of music perception, Chapter 3 argues that the treatises suggest that mode-dependent pitch class hierarchies constituted by mode degrees are cognitively in competition with or blended with mode-independent pitch affinities. From these observations, the analytical methodology of the subsequent chapters is derived: three computer-assisted statistical analyses: Mode Profiles (pitch class frequencies), Tendency (probabilities of successive pitch classes), and Leaps and Melodic Outlines.

Because the form of modal results is unknown, Chapter 4 applies the analyses to two chant repertories (responsorial chants and twelfth-century Parisian sequences) to create modal reference points. The styles of organum and of the chant repertories are first compared. Beyond the creation of reference points, the analyses' results suggest that final-dependent pitch class hierarchies exist, but with few well-defined levels, some of which are shared by multiple pitch classes. Additionally, in one sub-analysis, the results are secondarily determined by a unique coordination of sets of pitch class and mode degree outlines.

Chapter 5 analyzes organum, but with two sampling methods: organa by final and organum phrases by tenor pitch class, the latter based on the concepts of dronality and the continuous perception of mode. The results are compared to Chapter 4's results and analyzed to ascertain whether pitch classes or mode degrees were the primary determinant of musical material, and if the latter, whether mode or consonance best explains the results. It is argued that the results show that mode was the primary determinant of melodic material, except for one analysis whose results are explained primarily by consonance. Additionally, the same coordination of pitch class and mode degree outlines found in Chapter 4 is observed in organum. These findings answer the central question of modality while also supporting a dronal hearing of *organum purum*. Faults and limitations to the analyses as well as avenues for future research are also discussed.

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# Academic Thesis: Declaration of Authorship

I, Asher Vijay Yampolsky

declare that this thesis, entitled

*Melodic Mode in Notre Dame* Organum Duplum,

and the work presented in it are my own and have been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. Parts of this work have been published as:

   Yampolsky, Asher Vijay. "Carolingian Conceptions of Mode: Exploring Modal Significance and Signification." In *Chant: Old and New/ Plain-chant : l'ancien et le nouveau: Proceedings of the 6th Annual Colloquium of the GIC (Halifax NS, 2011),* edited by William Renwick, 137-147. Ottawa, ON: Institute of Medieval Music, 2012.

Signed:

Date:

# Acknowledgements

"Step by step, the longest march
Can be won, can be won
Many stones can form an arch
Singly none, singly none
And by union what we will
Can be accomplished still
Drops of water turn a mill
Singly none, singly none"

-Pete Seeger, "Step by Step," track 1 on *Songs of Struggle & Protest: 1930-1950*, Smithsonian Folkways Records FH 5233, 1964, LP; re-released 2006, CD.

All research is collaborative, but this project feels much more collaborative than usual. There are so many people who have contributed to my PhD that I am certain I cannot include them all, though I am grateful to them all.

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# Introduction

Parisian sacred music from the mid twelfth- to the mid thirteenth-century, commonly referred to as *Notre Dame Polyphony*, is some of the most monumental in Western music history.[1] During the first hundred years that the Notre Dame Cathedral was being built, new polyphonic genres were developed in styles befitting the awe-inspiring grandeur of Notre Dame itself. The scale of this repertory exceeded all predecessors both in terms of length and polyphonic complexity. It is here, for example, that we find the first notated four-part works. Moreover, at a time when music travelled relatively little, Notre Dame Polyphony reached Italy, Spain, England, and Scotland,[2] and even Sweden and Denmark,[3] demonstrating Notre Dame Polyphony's then-unparalleled popularity. Rhythmic notation was invented for this repertory; it is here that rhythm was notated for the first time, a development in the history of Western classical music notation whose significance would be difficult to overestimate. Notre Dame Polyphony is also known for popularizing and proliferating (though not inventing) the musical technique of imitation, which is another of its lasting contributions to the Western classical tradition. It is also here we see the invention of the musical device of hocket: arranging notes and rests in one voice with complementary arrangements in other voices so that the parts rest and sing in an interlacing fashion – a technique that continued to be used through the fourteenth century.

Within the Notre Dame repertory, there are three main genres: organum, conductus, and later, motet. Organum is the genre studied in this thesis. Organum has a long history, originating in the ninth century, but in Notre Dame Polyphony, an organum consists of a polyphonic setting of a responsorial chant (e.g. a gradual, alleluia, or responsory) that were composed for the highest feasts of the liturgical year. Responsorial chants are so named because, in their traditional manner of performance, they alternate singing by the whole choir with singing by a soloist; the choir and soloist respond to each other. These chants were composed of a refrain, called the *respond*, and *verses*, though frequently there was only one verse. In Notre Dame *organa* (plural of *organum*), those parts of the chant that were sung by a single soloist (much of the verses of the

[1] For a brief overview of the mystery of the precise chronology of Notre Dame Polyphony, see Mark Everist, "The thirteenth century," in *The Cambridge Companion to Medieval Music*, ed. Mark Everist (Cambridge: Cambridge University Press, 2011), 72-73. I will broach the topic in more depth in the first chapter.
[2] For just a few prominent examples, see: Edward H. Roesner, "The Origins of W1," *Journal of the American Musicological Society* 29 (1976): 337-380; Rebecca Baltzer, "Notre Dame Manuscripts and Their Owners: Lost and Found," *Journal of Musicology* 5 (1987): 380-399; Mark Everist, "From Paris to St. Andrews: The Origins of W1," *Journal of the American Musicological Society* 43 (1990): 1-42.
[3] See Eva M. Maschke, "Testaments of Canons and Fragments of Manuscripts: Organum Reception in Scandinavia" (paper presented at the 42nd annual Medieval and Renaissance Music Conference, Birmingham, UK, 3-6 July 2014).

chant as well as parts of the responds) were set polyphonically as a kind of elaboration of the chant; these polyphonic settings would be sung by a group of soloists. As a result, they are especially ornate and virtuosic.[4]

There are organa in two parts, as well as in three and four parts, giving us the subgenres of *organum duplum*, *organum triplum*, and *organum quadruplum*, respectively. The manuscript I-Fl Pluteo 29.1, known as *Florence* or *F* for short,[5] the most comprehensive and extensive source of Notre Dame Polyphony,[6] contains 103 two-part organa, consisting of 18 graduals, 41 alleluias, 33 responsories, 1 processional antiphon, and 10 *Benedicamus Domino* settings. F also includes two complete four-part organa and 39 three-part organa; they are far fewer in number than two-part organa, demonstrating that two-part organum was the principal subgenre.

Organum only exists in a polyphonic form. With the minimum two parts, there are two distinct roles. One voice, the *tenor*, sings the notes of a chant in order, altering the notes' durations, either by elongating them, sometimes to extreme lengths, or by imposing measured rhythm according to one of the rhythmic modes, a set of six basic rhythmic patterns that were used as the basis of all rhythmically defined music in Notre Dame Polyphony. The second voice, named the *organal voice* or, in two-part organum, the *duplum*, simultaneously sings a newly-composed part that proceeds either in a florid, expansive style or in one of the rhythmic modes.

Two-part organum can be subdivided into three textures:

1. *Organum purum*, which is also called *florid organum*;[7] in this texture, the tenor voice is usually lower than the other voice, and it stretches out the notes of the chant, while the other voice, the organal voice, sings a newly-composed florid line in a plainchant-like rhythm mostly above the tenor;
2. *Discant*, where both voices move in modal rhythms;
3. *Copula*, where the tenor holds long, sustained notes as in *organum purum*, and the organal voice moves in modal rhythm as in discant; copulae frequently have an antecedent-consequent phrase structure or consist of a melodic sequence.[8]

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[4] Craig Wright, *Music and Ceremony at Notre Dame of Paris 500-1550* (Cambridge: Cambridge University Press, 1989), 235.
[5] Florence, Biblioteca Medicea-Laurenziana, Plut. 29.1.
[6] Mark Everist, "The thirteenth century," 72.
[7] It is also called *organum per se*, however, Roesner has made a compelling case that the term *organum per se* most likely referred to the duplum part except where it was used once in error by the Anonymous of St. Emmeram. See Edward H. Roesner, "Johannes de Garlandia on organum in speciali," *Early Music History* 2 (1982): 139-141.
[8] Everist, "The thirteenth century," 74.

Although the genre of *organum* includes discant and copula sections, it is sometimes also referred to as *florid organum*, since this is the pre-eminent texture in the repertory.

In this work, I seek to address one aspect of the fundamental melodic structure of the extensive sections of *organum purum* in Notre Dame *organum duplum*. The central question of this thesis is: are the duplum melodies in *organum purum* passages structured according to the melodic modes?

## Notre Dame Polyphony Research Overview

Most of the existing scholarship on Notre Dame Polyphony can be broadly organized into four main areas: historical-cultural and performative contexts,[9] manuscript sources,[10] historical theory,[11] and notation, a subcategory of the historical-theoretical approach that largely focuses on decoding rhythm.[12] There has also been some limited but important attention given to performance practice.[13] Analytical studies are conspicuously scarce. In fact, while there has been a recent increase in analytical work on Notre Dame Polyphony in the past two decades, much of

[9] E.g. Roesner, "The Problem of Chronology"; Wright, *Music and Ceremony at Notre Dame of Paris 500-1550*.

[10] E.g. Rebecca Baltzer, "Thirteenth-Century Illuminated Miniatures and the Date of the Florence Manuscript," *Journal of the American Musicological Society* 25 (1972): 1-18; Baltzer, "Notre Dame Manuscripts and Their Owners"; Roesner, "The Origins of W1"; Everist, "From Paris to St. Andrews: The Origins of W1"; Hans Tischler, "The evolution of the *Magnus liber organi*," *The Musical Quarterly* 70 (1984): 163-174.

[11] E.g. Hans Tischler, "The Structure of Notre-Dame Organa," *Acta Musicologica* 49 (1977): 193-199; Ernest H. Sanders, "Consonance and Rhythm in the Organum of the 12th and 13th Centuries," *Journal of the American Musicological Society* 33 (1980): 264-286; Mark Everist, "Music and Theory in Late Thirteenth-Century Paris: The Codex Paris, Bibliothèque Nationale f. lat. 11266," *Royal Musical Association Research Chronicle* 17 (1981), 42-64; Steven C. Immel, "The Vatican Organum Treatise Re-examined," *Early Music History* 20 (2001): 121-172; Sarah Fuller, "*Organum-discantus-contrapunctus* in the Middle Ages," in *The Cambridge History of Western Music,* ed. Thomas Christensen (Cambridge: Cambridge University Press, 2002), 477-502; Jeremy Yudkin, "The Anonymous Music Treatise of 1279: Why St. Emmeram?" *Music and Letters* 72:2 (May 1991): 177-196.

[12] E.g. William G. Waite, *The Rhythm of Twelfth-Century Polyphony: its Theory and Practice* (New Haven, CT: Yale University Press, 1954); Fritz Reckow, ed., *Der Musiktraktat des Anonymus 4*, Beihefte zum Archiv für Musikwissenschaft 4 and 5 (Wiesbaden, 1967); Ernest H. Sanders, "Consonance and Rhythm in the Organum of the 12th and 13th Centuries," *Journal of the American Musicological Society* 33 (1980): 264-286; Jeremy Yudkin, "The Rhythm of Organum Purum," *The Journal of Musicology*, 2: 4 (1983), 355-376; Charles Atkinson, "Franco of Cologne on the Rhythm of Organum Purum," *Early Music History* 9 (1990): 1-26.

[13] For detailed coverage of performance practice, see e.g. Edward Roesner, "The Performance of Parisian Organum," *Early Music*, 7:2 (1979), 174-189; Mark Everist, ed., *Les Organa à deux voix pour l'office du manuscrit de Florence, Biblioteca Medicea-Laurenziana, Plut. 29.1*, Vol. 2 of *Le Magnus liber organi de Notre Dame de Paris* (Monaco: Éditions de l'Oiseau-Lyre, 2003), lxxxix-xc; Solomon Guhl-Miller, "The Performance of Notre Dame Organum: Three Readings from Iudea et Iherusalem" (paper presented at Cantum pulcriorem invenire: Music in Western Europe, 1150-1350, University of Southampton, Southampton, UK, 9-11 September 2013). For a more general overview, see also Wright, *Music and Ceremony,* 317-354.

the focus has been on the conductus and the motet;[14] organum has garnered the least amount of analytical attention. Guillaume Gross' work is one exception, but he has analyzed three- and four-part organa in terms of rhetoric, and has entirely omitted two-part organa, which, as noted, comprises a significant majority of the organum repertory.[15] Fritz Reckow, whose work on historical theory is well known, explored form and genre, but not melody nor the pitch-relationships within each part or between parts.[16] Anna Maria Busse Berger's work has connected orality and memory to the process of medieval composition, improvisation, and transmission, but her work, like Reckow's, has not explored pitch-relationships in depth.[17] In general, the analytical literature has served more to examine and clarify historical theory and sometimes subsequently connect it with the repertory than it has to develop new, historically-informed theories of style and composition.[18]

One reason for the paucity of analytical work is the paucity of information passed down to us by historical writers. Regarding organum specifically, the Vatican Organum Treatise from the mid-thirteenth century lists many rules that initially seem to apply only to discant, but they are set alongside passages of organum, which suggests that its rules can apply to how we understand something of the structure of organum.[19] Additionally, the Vatican Organum Treatise contains

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[14] E.g. Catherine Anne Bradley, "Comparing Compositional Process in Two Thirteenth-Century Motets: *Deus omnium/REGNAT* and *Ne m'oubliez mie/DOMINO*," *Music Analysis* 33/3 (2014): 263-90; Mark Everist, *French Motets in the Thirteenth Century* (Cambridge: Cambridge University Press, 2004); Gaël Saint-Cricq, *Le motet du treizième siècle: structure, analyse, poétique* (PhD diss., University of Southampton, 2010); Daniele Sabaino, "Tonal Organisation in some F Two-Voice Motets" (paper presented at Cantum pulcriorem invenire: Music in Western Europe, 1150-1350, University of Southampton, Southampton, UK, 9-11 September 2013). See also the recent *Musica Disciplina* 58 (2013), which is dedicated to *Ars Antiqua* (NDP) papers.

[15] Guillaume Gross, *Chanter en polyphonie à Notre-Dame de Paris aux 12e et 13e siècles* (Turnhout: Brepols, 2008); Guillaume Gross, "Organum at Notre-Dame in the Twelfth and Thirteenth Centuries: Rhetoric in Words and Music", *Plainsong and Medieval Music* 15 (2006): 87-108.

[16] One more relevant example is Fritz Reckow, "Processus und Structura: über Gattungstradition und Formverständnis im Mittelalter," *Musiktheorie* 1 (1986): 5-29.

[17] Anna Maria Busse Berger, *Medieval Music and the Art of Memory* (Berkley, CA: University of California Press, 2005), especially "Introduction," 1-8, "Prologue: The First Great Dead White Male Composer," 9-44, and "Compositional Process and the Transmission of Notre Dame Polyphony," 161-197.

[18] E.g. Immel, "The Vatican Organum Treatise Re-examined"; Michael Friebel "Modal Rhythm and Hoquetus" (paper presented at Cantum pulcriorem invenire: Music in Western Europe, 1150-1350, University of Southampton, Southampton, UK, 9-11 September 2013); Solomon Guhl-Miller, "The Performance of Notre Dame Organum"; Hans Tischler, "The Structure of Notre-Dame Organa," *Acta Musicologica* 49 (1977): 193-199.

[19] Immel, "The Vatican Organum Treatise Re-examined," 121. See also Busse Berger, *Medieval Music and the Art of Memory* 165-174. For an edition, see Irving Godt and Benito Rivera, trans., "The Vatican Organum Treatise – A Colour Reproduction, Transcription, and Translation," in *Gordon Athol Anderson (1929-1981) In Memoriam*, ed. Irving Godt and Hans Tischler, 2 vols, (Henryville, PA: Institute of Medieval Music, 1984), 2:264-345.

melodic formulas that have been found in the repertory. However, the basic structures underlying the melodic material, whether formulas or otherwise, have yet to be studied.[20] Most other historical theorists, though, explore discant in some detail but only mention or acknowledge *organum purum*, leaving a relative dearth of contemporaneous perspectives to direct our attention and understanding.[21] This is a point to which I will return in Chapter 1.

Another reason for the paucity of analytical work is the unfortunate division between music historians and music theorists that took place in the first half of the twentieth century, which also divided the repertories that each camp studied; by historical accident, pre-tonal repertories were almost entirely left to historians.[22] Thankfully, this divide has in many ways shrunk.

The last decade has seen a resurgence of Notre Dame Polyphony scholarship, specifically with three sister conferences, the first held at Princeton University in 2011, hosted by Rob Wegman, the second at the University of Southampton in 2013, hosted by Mark Everist, and the third at The Centro Studi Opera Omnia Luigi Boccherini of Lucca, hosted by Massimiliano Sala.[23] At all three conferences, papers on historical theory were presented. Additionally, in Princeton,

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[20] For a catalogue of formulas found in Notre Dame *organum duplum*, see Hans Tischler, *Parisian Two-Part Organa: The Complete Comparative Edition, Volume 1*, (Hillsdale, NY: Pendragon Press, 1988). On formularity and memory, see Leo Treitler, "Written Music and Oral Music," in *With Voice and Pen* (Oxford: Oxford University Press, 2007), 39-67*;* Busse Berger, *Medieval Music and the Art of Memory,* especially Section II. "Compositional Process in Polyphonic Music," 159-254. There is a great deal we still do not know about the formulas in Notre Dame Polyphony, even in the case of organum, where formulas and formularity's role in shaping Notre Dame Polyphony has been most keenly observed. We do not know, for example, how commonly each formula appears or whether or not the formulas abide by a syntax, that is, an ordering and a hierarchy, nor whether or not each one's use is constrained by the tenor pitches.

[21] I return to this dearth with my discussion of historical support for exploring melodic mode in Notre Dame Polyphony.

[22] Patrick McCreless, "Contemporary Music Theory and the New Musicology: An Introduction," *Music Theory Online* 2.2, (1996). <http://www.mtosmt.org/issues/mto.96.2.2/mto.96.2.2.mccreless.html>. A noteworthy exception to this from before "the great divide" would be Jeppesen's 1927 work on Palestrina, which Temperley and VanHandel cite as "perhaps the earliest true example [of musical corpus research]"; David Temperley and Leigh VanHandel, "Introduction to the Special Issues on Corpus Methods," *Music Perception*, 31:1 (2013), 1; Knud Jeppesen, *The style of Palestrina and the dissonance* (Mineola, NY: Dover Publications, 2005).

[23] "The Gothic Revolution: Music in Western Europe, 1100-1300", Princeton University, Princeton, NJ, 4-6 November 2011; "*Cantum pulcriorem invenire*: Music in Western Europe, 1150-1350", University of Southampton, Southampton, UK, 9-11 September 2013; "Ars Antiqua III: Music and Culture in Europe, c1150-c1330", The Centro Studi Opera Omnia Luigi Boccherini of Lucca, Lucca, Italy, 30 November – 2 December 2018.

an entire session was dedicated to organum, as was also the case at the annual Medieval and Renaissance Music Conference of 2014.[24] My work is, of course, part of this resurgence.

In this thesis, I examine the basic structures underlying the melodic material of *organum purum* in *organum duplum* through the lens of mode, which was the primary theory of melodic structure in the middle ages. To do so, I use a combined approach of historical theory and corpus studies, i.e. computer-assisted statistical analyses, a methodology which I outline and justify below.

Please note that throughout this thesis, I refer to *melodic mode*. This is not a historical term. It serves firstly to distinguish between the modes that referred to pitch organization and the rhythmic modes that refer to rhythmic organization, and secondly to broaden mode as a theory beyond the traditional ecclesiastical modes. I explore this more fully in Chapters 2 and 3.

Although I have emphasized the scarcity of music theory research on Notre Dame Polyphony, especially that focused on organum, various scholars have made significant contributions to organum analysis, including some studies that connect Notre Dame organum to the melodic modes. Rebecca Baltzer has shown that "long passages of *organum purum* often appear note-for-note the same in two or more organa whose tenor chant melodies belong to the same modal family."[25] She has thus demonstrated that duplum parts were often composed with an awareness of mode. It is even possible that mode might have been a conscious constraint on organum composition. In addition, Immel, in his work analyzing the Vatican Organum Treatise, has discussed a melodic formula that opens many organa built on chants of the same mode, "as is well known."[26] Immel's observation reinforces the conclusion from Baltzer's findings: an awarenesss of mode, possibly a conscious one, played a role in the making of Notre Dame *organum duplum*.

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[24] Papers presented at the 42nd annual Medieval and Renaissance Music Conference, Birmingham, UK, 3-6 July 2014: Ellen Hünigen, "Measured Time in Aquitanian Polyphony of the 12th Century – a Fata Morgana"; Solomon Guhl-Miller, "A Structural Connection Between Chant and Organum"; Eva M. Maschke, "Testaments of Canons and Fragments of Manuscripts: Organum Reception in Scandinavia."

[25] Rebecca A. Baltzer, "Polyphonic Contrafacts in the *Magnus liber organi de antifonario*", abstract from conference program *Abstracts of Papers Read at the Thirty-Eighth Annual Meeting of the American Musicological Society*, the 38th annual American Musicological Society Conference, Dallas, TX, 2-5 November 1972. See also Rebecca A. Baltzer, "Polyphonic Contrafacts in the Magnus liber organi de antifonario" (paper presented at the 38th annual American Musicological Society Conference, Dallas, TX, 2-5 November 1972). Unfortunately, this paper has remained unpublished.

[26] Immel, "The Vatican Organum Treatise Re-examined," 144.

In both Baltzer's and Immel's studies, the mode in concern is that of the chants upon which the organa were built. In this thesis, though, I study the organization of the duplum melodies themselves. As a result, I do not examine their studies further here.

Most of the rest of this chapter consists of the philosophical premises of this work, in two parts. In the first section, I explore the larger conceptual framework within which I pursue my research; that framework draws on both linguistic analogies and corpus studies. I use analogies to language and linguistics firstly to define the general purpose of this research: namely to develop an understanding of a given musical language. The second use of linguistic analogies is to elucidate the process of learning and developing intuitions for unfamiliar musics, which I apply to develop appropriate methodologies for my purpose. I present numerous principles and phenomena from linguistics to explore and develop musical analogs, especially: musical fluency, musical acquisition vs. second-music learning, positive and negative transfer (interference), fossilization, levels of musical intuition, and musical intuition's limitations for the development of music theories. I also explore the limitations of traditional methods of music theory highlighted by these analogies, and I recommend corpus studies, that is, computer-assisted statistical analyses of large bodies of music, as a means to progress beyond those limitations.

In the second part, I offer a deeper justification for my chosen methodology, which is a combination of traditional methods of music theory and corpus studies. I discuss the advantages of corpus studies over traditional methods of music theory, arguing that the latter is insufficient without the former. In addition, I briefly survey the ideas and legacy of logical positivism in musicology, confronting unclear, overly broad, and errant definitions; and in so doing, I distinguish positivism from corpus studies while briefly addressing philosophical issues of bias, objectivity and subjectivity, and the vagaries of facts and fact-finding endeavours, especially in humanities research.

In the final section of this introductory chapter, I provide an outline for the rest of the thesis.

# Insights from Linguistics

## Fluency, Appreciation, and Synchronic Studies

My primary aim in this thesis and in music theory in general is to cultivate fluency in a given musical language. Although my thesis does contain some diachronic content, that is, material concerning changes over longer time spans, my overall purpose is synchronic: pertaining to how things were at a single point of time (or, more loosely, during a constrained period of time). This is a distinction I borrow from linguistics. No infant acquires the history of a language when they acquire their language; they acquire the language spoken around them as it is at that time – as a full, complete system – and only that. Each language at each point in time (or more loosely, in each era) is beautiful and fully functional on its own. If it were not, we could not communicate with each other, almost effortlessly generate an infinite number of sentences, nor even think in language. Moreover, each language requires independent study for one to develop fluency and from there appreciation, and from there, potentially, enjoyment. The more distantly-related or dissimilar the new language is to the speaker's native language, the more study the speaker would require to develop fluency. This is not to say that tracing and understanding changes in a language are without merit. However, only learning fourteenth-century Middle English can make *Sir Gawain and the Green Knight* understandable to the modern listener or reader (understandable in at least the most basic sense of making the literal meanings of words and phrases understood), whereas learning how English has changed in the past seven centuries cannot create that understanding on its own and would instead leave the listener or reader of the same text lost and bored.

My position on studying musics is analogous. Gjerdingen has termed it "a 'historicist' orientation": "Other players may view various historical styles as worlds unto themselves, each a perfection in its own time and for its own purposes...."[27] Gjerdingen has referred to performers here, but as he has pointed out, it applies equally well to theorists.[28] To make possible a satisfying listening experience of any given musical language, we must first develop fluency in that musical language.

[27] Robert O. Gjerdingen, "'Historically Informed' Corpus Studies," *Music Perception: An Interdisciplinary Journal* 31:3 (2014): 192.
[28] Gjerdingen, "'Historically Informed' Corpus Studies," 192.

## Linguistic Intuition

Everyone who has acquired a language from infancy to childhood has an unconscious understanding of that language; they can recognize, interpret, and respond in that language, and they can recognize words, phrases, and sentences that are not constructed according to the underlying rules of that language. These recognitions are called *grammaticality judgements*; note that I am not writing about rules written in grammar books, but the unconscious rules that describe or perhaps define how the system of the given language works in the brains of those who use it.[29] Most children (without language delay) at least six or seven years old, with no concept of grammar from school still show this ability to distinguish phrases and sentences that make sense in their language and those that do not; the same is true for those who are *primarily oral* (a term rightfully replacing *illiterate*), including those speaking languages with no writing system at all.[30] This reflects *native speaker intuition*, also called *linguistic competence*, which is the strongest form of *linguistic intuition*.[31]

Linguists frequently consult native speakers for their intuitions. However, while native speakers can effortlessly and instantly make such judgments, the underlying structure of the language remains inaccessible to them through introspection alone; native speakers use their native language without being able to describe why the language works as it does.[32] If pressed, people might guess at reasons for their judgements of grammaticality, but they are likely either to be wrong or to quote rules from a prescriptive text, which is not an explanation.[33]

Note as well that non-native speakers of a language can, depending on the circumstances, reach native-fluency (the level of fluency of a native speaker), depending on the circumstances, but it is extremely hard to achieve; near-native fluency is achieved much more easily and much more frequently. Predictably, lower levels of fluency are easier still to achieve. The strength and reliability of a speaker's intuition depends on their level of fluency.

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[29] See William O'Grady, "Language: A Preview," in *Contemporary Linguistic Analysis: An Introduction 7th edition*, ed. William O'Grady and John Archibald (Toronto, ON: Pearson Canada, 2012), 10-11.
[30] The classic text on this subject is David T. Hakes, *The Development of Metalinguistic Abilities in Children* (New York: Springer-Verlag, 1980).
[31] The concept of linguistic intuition was first introduced in Noam Chomsky, *Aspects of the Theory of Syntax* (MIT press, 1965), 3. For a recent survey of research on the topic, see Jeffrey Maynes and Steven Gross, "Linguistic Intuitions", *Philosophy Compass* 8:8 (2013): 714–730.
[32] This is a point first made by Noam Chomsky in the 1960s and presented in the collection Noam Chomsky, *Language and Mind*, 3rd ed. (New York: Cambridge University Press, 2006), e.g. 22-23, 91.
[33] O'Grady, "Language: A Preview," 10-11.

Musical intuitions make for a mixed comparison. I would coin the term *native music-listener intuition* to refer to a person's musical intuitions developed from exposure to repertories since infancy, analogous to native speaker intuition. This should be contrasted to musical intuitions of repertories that become familiar to a listener far later in life or repertories that are still unfamiliar. As with language, the musical intuition (or *musical competence*) of a listener depends on their *musical fluency*.

Furthermore, as with language, we take for granted our strong musical intuitions; they underpin much of the work in cognition and perception research as well as music theory in general. Traditional music theoretical approaches to studying musical languages usually involve developing theories based on a combination of the theorist's musical intuitions and the theorist's observations in the repertory that confirm their intuitions, where study often ends. Theorists thus had relied heavily on their own musical intuition. By contrast, the music psychology/cognition-perception branch of music theory does pursue psychological experiments testing people's musical intuitions on many levels.[34] Moreover, historical theory is sometimes the study of the musical intuitions of past musicians.

On the other hand, music is much more flexible and consciously pliant than language is; it is far easier to consciously change musical structures than to change linguistic ones. Additionally, the structures of music are more accessible to introspection than those of language. However, we should note that this awareness of underlying musical structures is often limited. Furthermore, in some instances, those same intuitions are not so much limited as inaccurate, which I explore in the following section.

## First-Language Acquisition and Second-Language Learning

The process of learning a new musical language can be illuminated by a comparison to second-language learning.[35] As infants, we automatically acquire our first language (L1) through mere exposure to language, with or without instruction in it, hence the term *language acquisition* rather than *language learning*.[36] Likewise, mere exposure to any given type of music from infancy

[34] For example, see the discussion of a probe-tone study in Carol L. Krumhansl, *Cognitive Foundations of Musical Pitch*, Oxford Psychology Series no. 17 (Oxford University Press, 2001), 21-25. Other relevant studies are explored further in Chapter 3.

[35] For an early study in comparisons between language acquisition and music learning or acquisition, see Anthony K. Brandt, Robert Slevc, and Molly Gebrian, "Music and early language acquisition," *Frontiers in Psychology* 3 (2012): article 327: 1-17.

[36] Maria Teresa Guasti, *Language acquisition: The growth of grammar* (MIT press, 2017), 4.

leads to the development of musical intuitions regarding that specific type of music; this process is commonly referred to as *implicit learning* of music and sometimes as *music acquisition*, the latter of which I prefer.[37] However, contrasting phenomena occur with learning a second-language (L2); firstly, the process is not effortless and unconscious, unlike the acquisition of one's native language.[38] Moreover, a phenomenon known as *transfer* occurs: linguistic structures from the student's L1 influence their learning of L2. When the structures between the two languages are different, transfer is termed *negative*; negative transfer is also called *interference*. Transfer can occur on any level of structure: phonetic, phonological, syntactical, semantic, etc. An example of negative transfer is a foreign accent in a second language; that is the transfer of L1 phonetics and phonology to L2. Unusual word orders would be an example of the transfer of L1 syntax to L2. Transfer can be overcome – through persistence over time.[39] Unfortunately, however, there is a chance that the phenomenon of *fossilization* will occur: in the context of second-language use, this means that rather than the student shedding the features of their L1 that transferred to L2, certain L1 features would remain fixed in the student's production of L2.[40]

I would contend that when learning a new musical language, processes analogous to transfer, interference, and fossilization in second-language learning can occur. Music is much more flexible than language, however, and I would therefore expect music acquisition to be much more flexible than language acquisition. After all, we can recognize scales and harmonies that lie outside of our *native musical languages* (my term for the first types of music to which we were exposed), whereas by the age of twelve months, all infants regardless of their native language mostly lose the ability to discriminate between the majority of native and non-native speech

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[37] On language acquisition and music acquisition using associated neural structures, see Marc Ettlinger, Elizabeth Hellmuth Margulis, and Patrick Wong, "Implicit memory in music and language," *Frontiers in psychology* 2 (2011): article 211. On a developmental perspective of the learning and memory mechanisms shared between music and language, see Erin McMullen and Jenny R. Saffran, "Music and language: A developmental comparison," *Music Perception: An Interdisciplinary Journal* 21, no. 3 (2004): 289-311. On an example of music acquisition in infants, see for example, Saffran, Jenny R., Elizabeth K. Johnson, Richard N. Aslin, and Elissa L. Newport, "Statistical learning of tone sequences by human infants and adults," *Cognition* 70, no. 1 (1999): 27-52. For a general overview of topics in music acquisition, including rhythm, melody, and harmony, see Martin Rohrmeier and Patrick Rebuschat, "Implicit learning and acquisition of music," *Topics in cognitive science* 4, no. 4 (2012): 525-553.

[38] Even though the distinction between language acquisition and language learning being universally accepted by linguists, second-language learning is still frequently called *second-language acquisition*. The reason is beyond me.

[39] On second-language acquisition transfer, see Susan M. Gass and Larry Selinker, *Second language acquisition: An introductory course*, 3rd ed. (Routledge, 2008), 92-96.

[40] Larry Selinker, "Interlanguage," *IRAL-International Review of Applied Linguistics in Language Teaching* 10 (1972): 209-232; Susan M. Gass and Larry Selinker, *Second language acquisition: An introductory course*, 3rd ed. (Routledge, 2008), 14.

segments, especially if the sounds are similar in some way, e.g. in terms of the place and manner of articulation. For example, whereas adult native Italian speakers distinguish effortlessly between [ra] and [la], adult native Japanese speakers have difficulty hearing any difference between them; likewise, whereas adult native Hindi speakers distinguish effortlessly between [ʈa] and [ta], most adult native English speakers cannot distinguish them at all.[41] On the other hand, I am uncertain of the extent to which western classical musicians could differentiate quarter-tones or neutral thirds without special instruction, leading me to believe that there are probably some musical structures whose perception depends more rigidly on the listener's native musical language(s). Music acquisition could, in some respects, prove as rigid as speech sounds in language acquisition.

Under favourable circumstances, the differences between intermusical and interlinguistic perception might also extend beyond individual sounds to include more structural and syntactic judgements. For instance, Catherine Stevens et al. have shown that implicit learning can occur in adults exposed to culturally unfamiliar music and that the subjects in their experiment could make basic judgements about pitch-related closure, timbral consistency, and pitch-related coherence.[42] However, I would argue that a crucial limitation to their study was the commonalities of pitch-structure from the first music to the second, leading to *positive transfer* in their test subjects. Furthermore, Meagan Curtis and Jamshed Bharucha have shown that between two very different musics, negative transfer does indeed occur. They have explained that "when listening to music from an unfamiliar modal system, we may impose our own cultural expectancies on that musical system. Thus, our experiences with an unfamiliar modality may be drastically different than the experiences of one who is familiar with the modality."[43] I would likewise posit that our expectations for how music works become relatively fixed with our native musical languages, and that it takes conscious effort over time to develop musical intuitions appropriate for a new musical language that is substantially different from our first. I have experienced this many times: for example, with my first encounters with medieval music, Renaissance music, and various musics from other cultures. I have also heard others recount similar experiences, and I have observed it happening in others, especially new students of music history or ethnomusicology.

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[41] Guasti, *Language acquisition: The growth of grammar* (MIT press, 2017), 40-44.
[42] Catherine J. Stevens, Julien Tardieu, Peter Dunbar-Hall, Catherine T. Best, and Barbara Tillmann, "Expectations in culturally unfamiliar music: influences of proximal and distal cues and timbral characteristics," *Frontiers in psychology* 4 (2013): article 789.
[43] Meagan E. Curtis and Jamshed J. Bharucha, "Memory and musical expectation for tones in cultural context," *Music Perception: An Interdisciplinary Journal* 26, no. 4 (2009): 373.

The *native music-listener's intuitions* can be extremely stubborn. Even with extensive exposure to a new musical language, fossilization can remain.

Music theory, however, can be an extremely powerful tool for overcoming the limitations of our intuitions that were made from another musical language. The more distant the new repertory from what is familiar to us, that is, a repertory in which we have fluency, the more useful and maybe even essential music theory is for overcoming our limited and limiting musical intuitions.

## Linguistics Insights: Summary

To summarize so far: my aim in this thesis and in general as a music theorist is to use music theory to develop fluency in musical languages, because through the development of fluency, appreciation and then enjoyment can develop. Fluency precedes any satisfying listening experience. I position my work here within a broader "historicist" orientation, after Gjerdingen; each musical language is a world of its own, deserving specialized study.[44] In contrast to our experience with our native musical languages (i.e. our earliest musical languages), mere prolonged exposure is not enough for us to develop specialized musical intuitions for new musical languages, because our native music intuitions (i.e. the intuitions formed from exposure to our earliest musical languages) transfer to the learning of the new musical language, creating interference. Sometimes, the transference is so stubborn that fossilization occurs. However, the relative flexibility of our perception of music compared to our perception of language attenuates these effects. Music theory can be used to overcome negative transfer. Lastly, while our musical intuitions comprise an essential tool for our study of musical languages, limitations to our second-music intuitions prevent or distort further progress. To overcome these issues, an approach to studying music that can compensate or even bypass our intuitions should be used in conjunction with traditional approaches. In my view, this means using corpus studies and music psychology, as well as the musical intuitions of those who are fluent or preferably native listeners of the music of study, which, in the case of historical musics, involves historical theory.

In the following section, I will explore corpus studies more deeply, more specifically surveying its advantages and attending to pertinent philosophical issues.

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[44] Robert O. Gjerdingen, "'Historically Informed' Corpus Studies," *Music Perception: An Interdisciplinary Journal* 31:3 (2014): 192.

# Philosophical Justifications for my Methodology

## An Introduction to Corpus Studies

In my thesis, I have chosen to pursue historical theory combined with computer-assisted statistical analyses of large bodies of pieces. The latter methodology is a research method known as corpus studies. This procedure contrasts with traditional approaches, which usually involve the theorist's impressions developed after experience with many pieces but which do not formally involve focused, rigorous analysis of a systematically chosen and sufficiently large set of pieces.[45] In fact, I argue that while traditional methods of music theory are essential, they are incomplete on their own, and corpus studies go much further towards completing the process begun with traditional methods.

Corpus studies are often associated with perception and cognition studies specifically because of statistical learning in humans as well as machines; statistical learning is the process of unconsciously learning information about an object, such as music, based on its statistical properties.[46] The uses of corpus studies are hardly limited to perception and cognition studies, though. David Temperley and Leigh VanHandel, in *Music Perception*'s special issue on corpus studies,[47] have highlighted studies on style and historical practice, such as Jeppesen's study of Palestrina,[48] Gjerdingen's study of schemata in eighteenth-century music,[49] Tymoczko's study of tonal harmony,[50] and Ian Quinn's study of tonality in Bach chorales (which is also related to computer-learning and human cognition).[51] They have also highlighted studies on composition, improvisation, and the cognitive processes behind them,[52] as well as studies connecting music and

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[45] Please note that throughout this thesis, where I use the word *analysis*, I am referring to the formal study of music from a given music theory perspective, not to the creation of unity-narratives to explain or celebrate individual works of music. My sole concern is theory-proper: the study of whole musical languages, which is likely what is analyzed in all corpus studies.

[46] See, for example, Jenny R. Saffran, Richard N. Aslin, Elissa L. Newport, "Statistical Learning by 8-Month-Old Infants," *Science* 274:5294 (13 December 1996), 1926-1928.
I should also point out that statistical learning is only unconscious for humans. Since machines have no consciousness, there is no question of their learning being conscious or unconscious.

[47] David Temperley and Leigh VanHandel "Introduction to the Special Issues on Corpus Methods," *Music Perception* 31:1 (2013), 1.

[48] Knud Jeppesen, *The style of Palestrina and the dissonance* (Mineola, NY: Dover Publications, 2005).

[49] Robert O. Gjerdingen, *A classic turn of phrase: Music and the psychology of convention* (Philadelphia, PA: University of Pennsylvania Press, 1988).

[50] Dmitri Tymoczko, "Function Theories: A Statistical Approach," *Musurgia* 10:3-4 (2003): 35–64.

[51] Ian Quinn, "Are Pitch-Class Profiles Really Key for Key," *Zeitschrift der Gesellschaft der Musiktheorie* 7 (2010): 151-163.

[52] Panayotis Mavromatis, "Minimum description length modeling of musical structure," *Journal of Mathematics and Music* 3 (2009): 117-136; Marcus Pearce and Geraint Wiggins, "Improved methods for

language,[53] amongst others.[54] I use corpus studies here to develop theories of style and composition, informed by historical theory and music cognition and perception.

There are three main benefits to statistical analyses, especially when performed by a computer. Firstly, they overcome numerous cognitive biases, notably, fatigue from too much information, *framing* (i.e. how information is presented, including the special cases of *anchoring*: what comes first, what comes last), and *sample bias* (i.e. an unrepresentative sample, which leads to unrepresentative conclusions).[55] These biases affect not only formal studies of music but the impressions that we make unconsciously through exposure to music, i.e. implicit learning.

Secondly, related to the size of the sample, a computer can analyze vast amounts of music in an extremely short time – minutes rather than months. Analyzing great numbers of pieces is the norm with corpus studies; proper statistical analyses are performed on large samples, because doing so ensures that the sample analyzed is representative of the whole population of pieces in question.

Thirdly, a given statistical method with a given sample will always yield identical results.[56] In short, computer-assisted statistical analyses minimize bias and maximize accuracy and reliability of results and subsequent conclusions.

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statistical modelling of monophonic music," *Journal of New Music Research* 33:4 (2004): 367-385. Both as cited in Temperley and VanHandel "Introduction to the Special Issues on Corpus Methods," 1-2.

[53] Rens Bod, "A unified model of structural organization in language and music," *Journal of Artificial Intelligence Research* 17 (2002): 289-308; Aniruddh D. Patel and Joseph R. Daniele, "An empirical comparison of rhythm in language and music," *Cognition* 87:1 (2003): B35-B45; both as cited in Temperley and VanHandel "Introduction to the Special Issues on Corpus Methods," 2.

[54] See Temperley and VanHandel "Introduction to the Special Issues on Corpus Methods," 1.

[55] Sample bias is not new to all musicologists, of course. Fuller has criticized Lefferts, for example, for his sample not being representative; Sarah Fuller, "Exploring Tonal Structure in French Polyphonic Song of the Fourteenth Century," *Tonal Structures in Early Music* 1 (1998): 63-64. Sample bias, of course, is of central importance whether studying early music or the core of the common practice, for example, see Paul Wingfield, "Beyond 'Norms and Deformations': Towards a Theory of Sonata Form as Reception History," review of *Elements of Sonata Theory: Norms, Types, and Deformations in the Late-Eighteenth-Century Sonata* by James Hepokoski and Warren Darcy, *Music Analysis* 27:1 (2008): 141-145. For two essays involving carefully selecting a sample relevant to music and corpus studies, see David Huron, "On the Virtuous and the Vexatious in an Age of Big Data," *Music Perception: An Interdisciplinary Journal* 31:1 (2013), 4-9; and Justin London, "Building a Representative Corpus of Classical Music," *Music Perception: An Interdisciplinary Journal* 31:1 (2013), 68-90.

[56] My first and third reason are given as the only two advantages in Daniel Reisberg, ed., *The Oxford Handbook of Cognitive Psychology* (New York: Oxford University Press, 2013), 605.

## Positivism and Corpus Studies

The philosophically conscientious musicologist, however, might read such an introduction and recall recent arguments regarding positivism in historical musicology and music theory. After all, I am introducing a methodology involving mathematics and computers, I have cited and will continue to cite scientific studies, and I am already invoking concepts and terminology from the sciences. Furthermore, I have declared a benefit in minimizing bias, implying (intentionally) that I intend to increase the objectivity of my results through my approach. Why?

Decades have passed since these debates ended and publications on the issue ceased, but the field seems only to have partially moved on. In private conversations, paper presentations at conferences, and university classes, I have observed scholarship being inaccurately dismissed or criticized as positivist, especially work in music theory. Misconceptions regarding positivism have lingered, and the identification of corpus studies as positivist is not only too easy, it has already occurred, although only informally.

Unfortunately, no philosophical defense or justification of corpus studies has yet been offered, even with the publication of the book *Empirical Musicology* and a special issue of *Music Perception* dedicated to corpus methods.[57] I have endeavoured to provide a sufficient justification below, firstly giving an overview of the main points of the positivism dispute, secondly distinguishing the aims of corpus studies from the philosophy of positivism, and thirdly, briefly discussing the nature of facts and objectivity in musicological research. I argue that due to a culture of positivism that arose in music research, it was useful for previous scholars to identify a broad set of potential signs of positivism at work, but now that that culture of positivism in musicology seems to have dissolved, we should maintain a strict definition of positivism in order not to dismiss valuable work that might exhibit some but certainly not all of the identified indicators of positivism. Finally, having distinguished corpus studies from positivism, I argue that traditional music theory methods are incomplete and that they are completed by corpus studies.

[57] Eric F. Clarke and Nicholas Cook, eds., *Empirical musicology: Aims, methods, prospects* (Oxford: Oxford University Press, 2004); *Music Perception: An Interdisciplinary Journal* 31, no. 1 (2013), guest ed., David Temperley and Leigh VanHandel.

### Positivism in Musicology: Past Debate

The earliest prominent identification of positivism as a philosophy underlying musicological activity came from Joseph Kerman, in his 1985 book *Contemplating Music*.[58] Kerman has shown how a culture of positivism, a philosophy claiming value and meaning only in the objective to the exclusion of the subjective, limited the production of musicological scholarship engaged in criticism, which Kerman has defined as "…the study of the meaning and value of art works…."[59] Throughout the book, but especially in his chapter on historical musicology, he has focused on the creation of critical editions as an endeavour to establish facts and nothing more.[60]

There followed two direct responses to Kerman: one from Leo Treitler and one from Margaret Bent. Both Treitler and Bent have stressed the position best summarized by James Grier: "editing is an act of criticism."[61] Treitler and Bent have argued that interpretation was recognized as inherent to the production of critical editions. This point is well-taken. They have further argued that critical editions were therefore not meant to be neutral and objective.[62] However, both responses overlooked Kerman's identification of the production, style, and limited content of critical editions as socially acceptable activities within the then-dominant culture of positivism, focusing instead on their own individual understanding of editing as interpretative acts. Relatedly, their responses to Kerman's identification of the larger culture of positivism within musicology were mixed; Bent ignored it. Treitler conceded that musicology had been limited to facts alone, citing with disappointment his own PhD dissertation as an example,[63] although by highlighting the work of Nino Pirrotta, who embraced his subjectivity in his writing and apparently thus "exemplif[ied] Kerman's ideal," Treitler has also demonstrated that Kerman's assessment of the state of musicology was perhaps somewhat too severe.[64]

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[58] Joseph Kerman, *Contemplating Music: Challenges to Musicology* (Boston, MA: Harvard University Press, 1985). A much earlier but lesser-known study is Ivo Supičić, "Contemporary Aesthetics of Music and Musicology," *Acta Musicologica* 47, Fasc. 2 (1975): 193-207.
[59] Kerman, *Contemplating Music*, 16.
[60] See, for example, Kerman, *Contemplating Music*, 42-49.
[61] James Grier, *The critical editing of music: history, method, and practice* (Cambridge University Press, 1996), xiii.
[62] Margaret Bent, "Fact and Value in Contemporary Scholarship," *The Musical Times* 127, no. 1716 (1986): 87; Leo Treitler, "The Power of Positivist Thinking," *Journal of the American Musicological Society* 42, no. 2 (1990): 379, 394.
[63] Treitler, "The Power of Positivist Thinking," 382-383.
[64] Treitler, "The Power of Positivist Thinking," 387.

## Positivism in Musicology: Definitions

Many other points can be made, but the above will suffice for the present discussion, except for one crucial topic: the definitions of positivism offered within scholarship. Kerman's definition of positivism is broad, emphasizing not only the desire to eliminate subjectivity entirely but also an orientation towards minimizing subjectivity (in the making of critical editions specifically).[65] Treitler has sometimes shown deep insight into the relationship between positivism and history,[66] while at other times, his reasoning has been bizarre, such as his identification of the New Criticism as positivist.[67] Meanwhile, Bent's definition of positivism is simply incorrect; she has defined it as having two levels or stages, where empirically verifiable fact-finding forms the first level and criticism forms the second level,[68] but as I will show, this second level did not exist in positivism-proper.

Ten years after *Contemplating Music* was published, James Davis provided the best introduction to the philosophy of positivism in music, specifically with regard to music theory in the twentieth century.[69] In his 1995 article on "Philosophical positivism and American atonal music theory," Davis reviewed the history of logical positivism from Frege, Russell, and Wittgenstein, explaining that "Frege argued that all true knowledge was objective, and logic was the key by which such knowledge could be ascertained,"[70] while "Russell strove for scientific rigor," and sought to "remove any dependence on subjective interpretation."[71] However, the clearest, most definitive positivist stance was pronounced by Wittgenstein: to paraphrase, only logic and empirically verifiable statements have meaning, and everything else is meaningless.[72] Wittgenstein thus echoed Hume's famous statement that if any philosophy does not concern logic or experimental results, then we should "Commit it then to the flames: for it can contain nothing but sophistry and illusion."[73] Davis has further traced the connection between positivism and

[65] This position is emphasized in the chapter on music theory. Compare Kerman, *Contemplating Music*, 42, 90, and 75.
[66] Treitler, "The Power of Positivist Thinking," 392-395.
[67] Treitler, "The Power of Positivist Thinking," 385.
[68] Bent, "Fact and Value in Contemporary Scholarship," 87.
[69] James A. Davis, "Philosophical positivism and American atonal music theory," *Journal of the History of Ideas* 56, no. 3 (1995): 501-522.
[70] Davis, "Philosophical positivism and American atonal music theory," 503.
[71] Davis, "Philosophical positivism and American atonal music theory," 504.
[72] Davis, "Philosophical positivism and American atonal music theory," 505-506.
[73] David Hume, *An enquiry concerning human understanding: A critical edition* Vol. 3 (Oxford University Press, 2000), 120.

music theory with particular reference to the work of Mendel, Babbitt, Forte, and Schenker, showing the impact of a preoccupation with fact and a disdain for all subjectivity.[74]

Along with the history of logical positivism and its history in twentieth-century music theory, Davis has presented a notion of a broader "philosophical orientation" of "positivistic philosophy," which has five defining tendencies: "rigid empiricism"; "emulation of science in both methodology and terminology; a rejection or avoidance of metaphysics; the use of linguistic and logical analysis; and … the avoidance of subjective interpretation in the process of analysis."[75] This general philosophical orientation can serve as a collection of indications that a given writer might be a positivist, and I believe that some of these are what many scholars have in mind when criticizing scholarship as being positivistic. However, Davis' resulting category of positivistic philosophy is dangerously inclusive.

Some of the five tendencies must be understood only as possible symptoms of positivism; they can appear as consequences of the core principle of positivism, but they are not conclusive evidence of positivism. The dangerous consequence of labelling a work as positivistic because it might meet some of Davis' five defining tendencies is the dismissal of that work even if it is not truly positivist. For example, if only the emulation of science is enough to disqualify work, then a great deal of sound, productive musicological research would be disqualified, such as interdisciplinary work connected to music psychology or music education, corpus studies, instrument construction, and codicology. For another example, the avoidance of metaphysics could eliminate most of the field. Davis' category of *positivistic* is thus too vague, as is the persistent conception of positivism amongst some musicologists. Positivism should remain strictly defined so that its rigid value judgements can be dismissed while we retain an appreciation for empirical research's contributions. The strict definition of positivism is: only that which is logical and/or empirically verifiable (i.e. that which is objective) has meaning and value.

### Positivism in Musicology: Flaws

The flaws of the philosophy of logical positivism are too numerous to list here, but it is essential to summarize the two flaws most relevant to the humanities: firstly, positivism led to the exclusion and depreciation of subjectivity and consequently interpretation, imagination, meaning,

[74] Davis, "Philosophical positivism and American atonal music theory," 509-516.
[75] Davis, "Philosophical positivism and American atonal music theory," 508.

and thus criticism; and secondly, it led to the bolstering of unhealthy received dogmas and prejudices in musicology and music theory.

Regarding the first flaw, positivism demands the elimination of all subjectivity, which is impossible for humanities research. Subjectivity is inherent in the sciences as well, of course; it is present throughout the scientific method: observing, hypothesizing, designing experiments, and interpreting the results. However, I would argue that there is notably less subjectivity to begin with in certain fields than in the humanities (like mechanics, for example), and of course, the sciences actively seek to minimize subjectivity wherever possible. In the humanities, however, subjectivity is a research pillar. We rely on interpretation and imagination to make sense of the evidence we have and distill meaning from it; this reliance is especially apparent for those of us who are historians of distant pasts, because of the scant extant evidence.[76] In the humanities, many things can never be confirmed or falsified. For example, to study the history of the fall of the Western Roman Empire, we cannot recreate the empire to test whether the primary reason for the fall was outside invasions, disease, overexpansion, hyperinflation, political corruption, or other reasons,[77] nor would it be possible to manipulate current governments to test our historical theories under controlled conditions – and even if it were possible, it would be grossly unethical. Yet studies in political corruption, hyperinflation, the rise and fall of empires, etc., undeniably have value to the modern world.

The second flaw listed above is that positivism bolsters received dogmas and prejudices. Both in the sciences and the humanities, positivism does not erase but rather hides the subjective conceptual frameworks in which we pursue our work. It is easy to see this in the writings and

[76] Note that there is at least one area of the sciences that is most obviously like the study of history in this way: paleontology.

[77] On the fall of the Western Roman Empire and outside invasions, see, e.g., Peter Heather, *The Fall of the Roman Empire*: *A New History* (London: Macmillan, 2005), and Chris Wickham, *The Inheritance of Rome: Illuminating the Dark Ages 400-1000* (New York: Penguin, 2010), 76-108; on the fall and disease, see, e.g., Arthur E. R. Boak, *Manpower Shortage and the Fall of the Roman Empire in the West*, Jerome Lectures, 3 (Ann Arbor: Michigan University Press, 1955), and William Hardy McNeill, *Plagues and Peoples* (Garden City, NY: Anchor, 1976), 69-131; on the fall and hyperinflation, see, e.g., Liping He, *Hyperinflation: A World History*, (London: Routledge, 2017), 19-22, and Kevin Butcher, "Debasement and the Decline of Rome," in *Studies in Ancient Coinage in Honor of Andrew Burnett*, ed. Roger Bland and Dario Calomino (London: Spink, 2015), 181-205; on the fall and political corruption, see, e.g., Ramsay MacMullen, *Corruption and the Decline of Rome* (New Haven, CT: Yale University Press, 1988).

pedagogy of Forte and Babbitt, for example,[78] as well as in the construction of the classical musical canon.[79]

I contend that the root problem of positivism is that it is a kind of philosophical fundamentalism; it claims only one way, and it denies all else. However, if we remove the word *only*, then we are left with a statement that it is not only uncontroversial but self-evident: that which is logical and/or empirically verifiable has meaning and value.

### Facts, Relative Objectivity and Subjectivity, and the Humanities

As subjective as the humanities are, they also rely on facts and logic. I would argue that it is the humanities' specific relationship with facts – whether the facts are historical, literary, musical, codicological, or otherwise – that distinguishes the humanities from fiction. We do not accept arguments that contradict facts or arguments that are fantasies with no basis in fact, nor do we fabricate evidence, nor lie about historical facts. Facts form one of the bases of humanities research. Another basis of the humanities is logic. We do not, for example, create narratives that are inherently contradictory or self-refuting, nor ones that rest on circular reasoning. We also do not include narratives that depend on magic, aliens, or time-travel.

A third basis is interpretation, which is inherently subjective. In Wegman's words, "Without interpretation, we are not engaged in history, but in collecting and storing raw data."[80] Interpreting individual facts is one level of interpretation. A second level exists in the selection of facts, which itself is also subjective.[81]

Subjectivity is present in everything, including every step of the scientific process, as noted earlier. That which we might consider as purely objective rarely (or perhaps never) is. Fact, as I understand it, is objective at its core; we could use as a starting definition of a fact as "something true with complete objectivity." But if there is no complete objectivity, then there is

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[78] See for example, Kerman's summary: Kerman, *Contemplating Music: Challenges to Musicology* (Boston, MA: Harvard University Press, 2009), 60-112; and Lydia Goehr, *The Imaginary Museum of Musical Works: An Essay in the Philosophy of Music*, (Oxford University Press, 1992), 70-72.

[79] The canon has been thoroughly treated in musicology, so I will not elaborate further here. For a brief introduction, see William Weber, "The History of Musical Canon," in *Rethinking Music*, ed. Nicholas Cook and Mark Everist (Oxford University Press, 1999), 349-355.

[80] Rob C. Wegman, "Historical Musicology: Is It Still Possible?," in *The Cultural Study of Music: A Critical Introduction*, edited by Martin Clayton, Trevor Herbert, and Richard Middleton (Psychology Press, 2003), 137.

[81] See Wegman, "Historical Musicology: Is It Still Possible?" 136.

no true fact – at least according to this definition.[82] If we think of the only true objectivity as absolute objectivity, as part of an objective-subjective dichotomy, then everything should be considered subjective because it contains some subjective aspect. However, I see this perspective as facile.

I would suggest that even if there are no absolute facts (i.e. things that are true with absolute objectivity), we need not dispose of the notion of facts altogether. Instead of considering only absolute objectivity, we can productively consider a multidimensional spectrum of relative objectivity and subjectivity.[83] In the realm of fact, there are those things of which we are almost 100% certain, or, put differently, the probability of those things being true is nearly 100%. Examples include the speed of light in a vacuum, Mozart's birthdate, etc. Although there is some degree of uncertainty to such examples, the degree is so slight that it is negligible (unless some future evidence increases their uncertainty). For other facts, the uncertainty is greater but still very small, and we would and should continue to consider them facts. For other items, such as whether or not there ever existed a *Magnus Liber Organi*,[84] there is great uncertainty, and we have very reasonably learnt to distinguish them from high-probability facts. Please note that by *uncertainty*, I do not refer to the epistemological topic of belief or a person's sense of knowing something, but to the scientific concept related to likelihood of something being true, also called *firmness*.[85]

One way to increase the probability of arriving at a fact that is true (a fact whose probability of being true is extremely high), is through probability and statistics. Appropriately

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[82] For an overview of the philosophy of facts, see Kevin Mulligan and Fabrice Correia, "Facts," *The Stanford Encyclopedia of Philosophy*, Winter 2017 Edition, ed. Edward N. Zalta, last accessed 2018 February 17. <https://plato.stanford.edu/archives/win2017/entries/facts/>.

[83] The topic of scientific objectivity is rich, with various perspectives. I subscribe to probabilistic perspectives. For an overview of the philosophy of scientific objectivity, see Julian Reiss and Jan Sprenger "Scientific Objectivity," *The Stanford Encyclopedia of Philosophy*, Winter 2016 Edition, ed. Edward N. Zalta, last accessed 2019 May 7. <https://plato.stanford.edu/entries/scientific-objectivity/>.

[84] Edward H. Roesner, "Who 'Made' the *Magnus Liber*?," *Early Music History* 20 (2001): 227-266.

[85] See Vincenzo Crupi, "Confirmation: 3. Bayesian confirmation theories," *The Stanford Encyclopedia of Philosophy*, Winter 2016 Edition, ed. Edward N. Zalta, last accessed 2018 February 17. <https://plato.stanford.edu/archives/win2016/entries/confirmation/>; and Jan-Willem Romeijn, "Philosophy of Statistics," *The Stanford Encyclopedia of Philosophy*, Spring 2017 Edition, ed. Edward N. Zalta, last accessed 2018 February 17. <https://plato.stanford.edu/archives/spr2017/entries/statistics/>.
My focus on objectivity here might seem to be in conflict with Wegman, who dismisses the pursuit of "objectivity in historical knowledge", but my reading of Wegman is that his concept of historical knowledge exists at a higher level than historical facts, requiring layers of interpretation in order to be created, whereas historical facts are the locus of objectivity in my argument (Wegman, "Historical Musicology: Is It Still Possible?" 140). Consider that he writes that there are things we would consider "objective and incontrovertible" (Wegman, "Historical Musicology: Is It Still Possible?" 136).

collected data can be studied statistically to arrive at reliable results.[86] Note that, according to the proposed probabilistic definition of objectivity, increasing the truth-probability of our fact-finding means increasing the objectivity of our fact-finding.

Of course, subjectivity is present in statistical analyses too. Within studies based on statistics, subjectivity is a part of the researchers' choices with regard to sampling (what to measure), which statistical analyses to use, and the interpretation of statistical results. Even with computers, which do a great deal to bypass our cognitive biases, the same sources of subjectivity remain in the choice of methods. Subjectivity is perhaps most evident in that a computer only does what the programmer instructs it to do. This is not a problem I seek to resolve, because I do not see it as a problem. Subjectivity is inherent in the process. The purpose of statistical methods is not to hide or neglect subjectivity where it must exist, nor to erase or hide it from higher-level interpretation, i.e. criticism, but to minimize it specifically when establishing facts.

## Conclusion

My general position is simple and, I expect, uncontroversial: anything that can be tested (confirmed or falsified) should be tested, and as rigorously and precisely as possible. It is specifically with the establishment of facts that we should maximize objectivity and minimize subjectivity. This absolutely does not mean hiding or eliminating the role of subjectivity in establishing those facts nor the process of higher-level interpretation built on facts. I do not consider this to be a novel position, but simply an articulation of the implicit position most musicologists already hold.

Furthermore, I must stress that the refinement of fact-finding is insufficient to define any research as positivist, and we should be careful not to label as positivist work that simply focuses on fact-finding in the most accurate ways possible. Truly positivist research is defined by the denial of subjectivity and the pursuit of complete objectivity on all levels as the only source of value and meaning.

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[86] Note that the philosophies of statistics and probability are complex and controversial; my account is an extremely simple, introductory one, but I hope a useful one as well. On the philosophies of statistical and probabilistic evidence, see Jan-Willem Romeijn, "Philosophy of Statistics," *The Stanford Encyclopedia of Philosophy*, Spring 2017 Edition, ed. Edward N. Zalta, last accessed 2018 February 17, <https://plato.stanford.edu/archives/spr2017/entries/statistics/>; and Crupi, "Confirmation: 3. Bayesian confirmation theories." I should note as well the recently published Alan Hájek and Christopher Hitchcock, eds., *The Oxford Handbook of Probability and Philosophy* (Oxford University Press, 2016), especially "Part IV: Interpretations and Interpretive Issues," 315-476, and "Part VII: Applications of Probability: Philosophy," 625-832.

A softer but still tenable definition of positivism in musicology would be one like Kerman's, where *minimizing* subjectivity *of all kinds at every level* of research and the resulting absence of criticism is included. This is an important recognition, because it is sometimes how positivism is realized in real life, but it must not be confused with research that simply focuses on or specializes in systematic fact-finding but which does not deny higher-level subjectivity, i.e. criticism. In *Contemplating Music*, Kerman has identified not only a subtle trend in musicological publications but also an ideology in the culture of musicology, yet he and the movement of New Musicology have ensured that that ideology has largely crumbled. Therefore, if we abide by a stricter, more restrictive definition of positivist scholarship, we run little risk of missing work that is truly positivist in spirit or aim since there is so little left, and we gain the benefit of allowing specialized work that can contribute greatly to the field to flourish without condemnation. In this context, I believe Bent's words are appropriate: "Let us consolidate our common ground without forfeiting the rigour of our various specialities. Who wants interdisciplinary contact based on diluted disciplines?"[87]

## Outline

The following thesis is in five chapters. The first three chapters are concerned with historical theory, and the last two chapters are concerned primarily with music analysis. In Chapter 1, I examine the excerpts of Notre Dame treatises that connect, ignore, or disconnect Notre Dame Polyphony and melodic mode or, more broadly, plainchant, modal theory's originating repertory.

In Chapter 2, I perform a close reading of medieval modal treatises from the lens of music perception. Based on the treatises' discussions of modal determination, the *parapteres* and irregular recitation tones, and music psychology, I show that mode was perceived by theorists and singers, and that it was perceived throughout a given chant, not only at the ends or beginnings or both, contrary to what the explicit instructions for modal determination from the treatises suggest. Modal treatises also included implicit recognition of modulation in chants, further supporting the argument of a continuous, responsive, dynamic perception of mode.

If mode was perceived throughout a given chant, though, the question arises: what determines modal classification? Chapter 3 seeks to provide a partial answer. I survey the main

[87] Bent, "Fact and Value in Contemporary Scholarship," 89.

modal treatises, focusing on abstract structures and their implications for music perception, evaluating whether or not the texts imply the presence of a mode-dependent pitch class hierarchy, and if so, its form. I argue that a pitch class hierarchy is suggested, but that affinities and what I term *interval string qualities* suggest the presence of a mode-independent structure as well, which leads me to the hypothesis of a blend between mode-dependent and mode-independent pitch structures. From these observations and the structures surveyed, I derive the methodology of three statistical analyses for analyzing mode in chant and in organum: Mode Profiles (pitch class frequency distributions), Tendency (conditional probabilities of successive pitch class pairs), and Leaps and Melodic Outlines (conditional probabilities of leaps and melodic outlines in a modal context based on their bounding notes).

Chapters 4 and 5 contain the thesis' analyses. Because of the novelty of the methodology proposed in Chapter 3, the form of what modal results would be is yet unknown, and so it is necessary firstly to develop a modal reference point by analyzing a repertory that is modal by definition: plainchant. Chapter 4 therefore applies the analytical methodology to two chant repertories: responsorial chants that were used as the basis for making organum at Notre Dame Cathedral, and twelfth-century Parisian sequences.

The results from Chapter 4 seem to confirm the hypothesis presented in Chapter 3 that the music was organized according to a blend of mode-dependent and mode-independent pitch class structures.

Finally, Chapter 5 adapts and applies the methodology to Notre Dame *organum duplum*. Based on the traditional determination of a given piece's primary modal category by reference only to the last note of a chant, I propose one sampling method where all the organa are grouped according to the final of their chants, and those of each group are analyzed together. I propose a second sampling method as well, based on the principle of a continuous hearing of mode. I argue that the sustained tenor notes could be heard as drones and therefore invoke the concept of *dronality*: the pitch class of a low, sustained note is perceived as the tonal centre. Hence, the second sampling method proposed is that organum phrases be grouped by tenor pitch class, and those of each group be analyzed together as though belonging to one mode. I pursue both sampling methods, and both sets of results are compared to the chant results of Chapter 4 and to each other.

# Chapter 1 Notre Dame Theorists, Organum, and Melodic Mode

The melodic modal system was developed between the eighth and eleventh centuries for use with plainchant. Why then might we suspect that organum parts are organized according to the modes? Duplum parts of *organum purum* are not chant melodies, nor are they composed of parts of chant melodies. None of the major treatises that discuss organum explicitly instruct the reader to abide by the modes in making organum. Organum was a form of *musica mensurabilis*: measured music, which was always polyphonic; mode belonged to the domain of *musica plana*: plainchant. We should not arbitrarily assume that the two categories worked the same way. Nevertheless, in some of the treatises that discuss organum, there are clues that suggest that the melodic modes might have played a role in shaping the duplum parts.

In this chapter, I explore the historical support for suspecting that modal theory could be relevant to Notre Dame *organum duplum* and perhaps to all polyphonic genres of the Notre Dame school. The first half of the chapter is a survey of the presence or absence of modal theory in each of the principal Notre Dame Polyphony treatises. I explore each theorist's apparent outlook on plainchant, mode, and plainchant and mode's relevance to polyphonic genres. As I will show, each treatise treats the subjects differently, though we can also broadly group the treatises according to general perspectives. Pseudo-Garlandia and the Anonymous of St. Emmeram did not indicate in any way that they considered chant important to polyphony, however, the former did write an entire chant treatise to be paired with his measured music treatise, while the latter omitted chant and mode from discussion altogether. By contrast, both Lambertus and Anonymous IV claimed that plainchant was the foundation for understanding measured music, while Anonymous IV pointed specifically to the modal system as forming that foundation.

In the second half of this chapter, I consider the nature of the relationship between the categories of *musica plana* and *musica mensurabilis*. It has not yet been established whether thirteenth-century theorists considered *musica mensurabilis* to be subordinate to the much older *musica plana* or whether they considered the two categories to be related not hierarchically, but as sister branches of music. Both positions have been argued in earlier scholarship. Studying the contemporaneous viewpoints on the relationship between the two categories could elucidate the extent to which the melodic organization of plainchant would also have organized melodies in polyphonic genres.

In the dispute over which type of relationship existed between the two categories, I argue that none of the scholarly positions advanced so far are correct, because of the diverse positions

taken by the main Notre Dame theorists; here as well, there was no thirteenth-century consensus. I further argue that this multiplicity of positions reflects a transition that took place during the thirteenth century, in which the understanding of the relationship between the two categories of music shifted from a hierarchical or vertical one to a non-hierarchical or horizontal one.

## 1.1 On the Writings of Individual Theorists

### 1.1.1 *Discantus positio vulgaris*

The earliest minor treatise of the thirteenth century concerning polyphonic genres is the *Discantus positio vulgaris*. It dates from between 1230 and 1240, but the only surviving copy is the later edition found in Hieronymus de Moravia's famous compilation of treatises, made in the late thirteenth century, possibly c. 1285.[88] The *Discantus positio vulgaris* is very brief; it swiftly covers the basic rules for making discant, consonance and dissonance, the definitions of a few genres (*organum purum*, conductus, and motet), and the rhythmic modes. It does not mention melodic mode. Plainchant is discussed in the context of producing discant, since discant was made by adding a new part to a plainchant melody. The implication of the role of plainchant in polyphony will be discussed in the second half of this chapter.

### 1.1.2 Pseudo-Garlandia

The earliest major treatise on Notre Dame Polyphony is *De mensurabili musica*, written between c. 1240 and c. 1260. For many years, it had been attributed to Johannes de Garlandia, but the story of its attribution is complicated. The treatise was originally written by an anonymous Parisian author who was probably associated with the university.[89] I therefore refer to the original author as Pseudo-Garlandia.

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[88] Baltzer, "Johannes de Garlandia," 2001, *Grove Music Online*, last accessed 2019 May 22. <https://doi.org/10.1093/gmo/9781561592630.article.14358>. Note that Hieronymus de Moravia is often anglicized as Jerome of Moravia.

[89] Rebecca A. Baltzer, "Johannes de Garlandia," 2001, *Grove Music Online*, last accessed 2019 May 22. <https://doi.org/10.1093/gmo/9781561592630.article.14358>. The attribution to Johannes de Garlandia does not appear in the earliest manuscript sources of the treatise, but first appears in Hieronymus de Moravia's work. (Ibid.) Pamela Whitcomb has convincingly made that the case that Johannes de Garlandia was Jehan de Garlandia, a Parisian bookseller active in the late thirteenth century. In addition, he might have been Hieronymus' source for Pseudo-Garlandia's treatise, although Hieronymus received a significantly revised version, made c. 1270-1300. Pamela Whitcomb, "Teachers, booksellers and taxes: reinvestigating the life and activities of Johannes de Garlandia," *Plainsong & Medieval Music* 8, no. 1 (1999): 1-13. Thankfully, the differences between the earlier and later "editions" are not germane to the present discussion.

Pseudo-Garlandia authored a pair of treatises, *De plana musica*, on plainchant, and the more famous *De mensurabili musica*, on measured music. I will explore both.[90]

#### 1.1.2.1 *De mensurabili musica*

Pseudo-Garlandia's *De mensurabili musica* makes no mention of plainchant or the melodic modes, except in its opening sentence, which shows that his *De plana musica* was intended to precede his treatise on polyphony:

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|---|---|
| "Habito de ipsa plana musica, quae immensurabilis dicitur, nunc est praesens intentio de ipsa mensurabili, quae organum quantum ad nos appellatur, prout organum generaliter dicitur ad omnem mensurabilem musicam." | "Having considered that plain type of music [*plana musica*] which is called unmeasurable, it is now the present purpose [to consider] that measurable [music] which we call organum, inasmuch as organum is the word generally applied to all measurable music."[91] |

Beyond the implicit recognition of the preceding treatise *De plana musica*, how should we understand the opening phrase? My initial interpretation was that the phrase implies that Pseudo-Garlandia considered discussing chant as prerequisite to discussing polyphony. After all, he apparently felt that to write a treatise on measured music, it was necessary not merely to begin it with a few lines about chant, but to precede it with an entire treatise on chant. Perhaps, therefore, he believed that understanding chant and thus mode was necessary for understanding polyphonic genres.

However, I now believe that Pseudo-Garlandia was simply noting that his first task was complete, and so it was time to undertake his second task. As Baltzer has suggested, perhaps he

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For a detailed review of the debates over authorship before Whitcomb's brief overview, see Nigel Gwee, "*De plana musica* and *Introductio musice*: A Critical Edition and Translation with Commentary, of Two Treatises Attributed to Johannes de Garlandia" (PhD. diss., Louisiana State University, Baton Rouge, LA, 1996), 11-25.

[90] Nigel Gwee summarizes the four main arguments for the far less famous *De plana musica* being authored by Pseudo-Garlandia: namely, the opening lines of *De mensurabili musica* (which I discuss below), the joint transmission of *De plana musica* and *De mensurabili musica* in two of three surviving manuscripts, textual correspondances between the two treatises, and concepts in *De plana musica* that later theorists linked with (Pseudo-)Garlandia based on *De mensurabili musica.* See Gwee, "*De plana musica* and *Introductio musice*," 6-10.

[91] Johannes de Garlandia, *De Mensurabili Musica: Concerning Measurable Music*, trans. Rob Wegman, *Academia.edu*, last accessed 2018 January 27, since taken down. Page 1. <https://princeton.academia.edu/RobCWegman/Translations>.

sought to provide two texts to cover all that a student of music at the university in Paris would have needed (beyond Boethius' treatise),[92] but without considering the topics of the treatises to be related. Plainchant might have been considered necessary on its own, but not for understanding *musica mensurabilis*. This view is supported by the fact that *De plana musica* contains no reference (that I have found), whether subtle or direct, connecting its topic to any other, including polyphony. I return to this matter shortly.

In the second half of this chapter on the nature of the relationship between *musica plana* and *musica mensurabilis*, I will explore another layer of meaning to Pseudo-Garlandia's opening phrase that I believe supports my second interpretation.

#### 1.1.2.2 *De plana musica*

Turning to the specific contents of *De plana musica,* the extant copies strangely contain no reference to the melodic modes. The treatise includes sections on, amongst others: consonances and dissonances (*concordantia* and *dissonantia*); three genera of ancient Greek music (diatonic, chromatic, enharmonic); intervals; the gamut, complete with registers defined by tetrachords; the *synemmenon*, which is "defined as a sharping or flatting of a pitch";[93] notation; solmization; and hexachord mutation. However, there is no mention of mode nor any of its components, such as finals, ambitus, the eight modes, etc.[94]

The absence of modal parameters or features with the exception of the hexachord might seem to suggest that Pseudo-Garlandia gave no thought to understanding or regulating polyphony through modal theory, since mode was not even included in its traditional context,

[92] Baltzer, "Johannes de Garlandia," 2001, *Grove Music Online*, last accessed 2019 May 22. <https://doi.org/10.1093/gmo/9781561592630.article.14358>.
[93] Gwee, "*De plana musica* and *Introductio musice*," 28.
[94] Gwee, "*De plana musica* and *Introductio musice*," 26-29.

where it was considered essential.[95] However, there is good reason to think that an earlier-now lost version of *De plana musica* contained a discussion of the modes.[96]

Lastly, Pseudo-Garlandia's *De plana musica*, written in an extremely straightforward and even stark style, is a rudiments text, and I have found no comment therein on aesthetics, only the slightest comment related to music perception (in the chapter on consonances and dissonances), and, most pertinent to the current discussion, nothing connecting *musica plana* either to *musica mensurabilis* or to all music (as a foundation, for example). The treatise does not make explicit the nature of the relationship between the two treatises or the relationship between their subjects, and thus it gives no clues to the author's view on whether or not mode might have played a part in polyphony.

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[95] Gwee has written that it is possible that the speculative nature of the *De plana musica* precluded discussion of practicalities like finals and ambitus (Gwee, "*De plana musica* and *Introductio musice*," 42-43) but while approximately the first half of the treatise is indeed fully speculative, the second (and admittedly smaller) part is more practical, being concerned mostly with the gamut, intervals, hexachords, solmization, hexachord mutation, Bs and B-flats. I am therefore not convinced of Gwee's suggestion. (Compare Gwee, "*De plana musica* and *Introductio musice,*" 138-188 and 189-234.) One might suppose, then, that Pseudo-Garlandia saw the hexachords as the most important part of modal theory, to the degree that they became the only essential part of the theory. This view would accord with Mengozzi's, who has shown that certain thirteenth-century theorists overemphasized hexachords, in some cases even providing illogical descriptions of the hexachords' supposed primacy over the gamut, the diatonic background scale. Stefano Mengozzi, "Virtual Segments: The Hexachordal System in the Late Middle Ages," *The Journal of Musicology* 23, no. 3 (2006): 426-467; and Stefano Mengozzi, "The heptachordal basis of hexachordal theory: on the semiotics of musical notation in the Middle Ages," *Plainsong & Medieval Music* 22, no. 2 (2013): 169-194. As I explain below (n. 96), though, there is reason to support a contrary view: that Pseudo Garlandia's original text did include material on mode.

[96] This position is first argued by Erich Reimer, who pointed out the following quotation from Hieronymus of Moravia (c. 1270-1300): "Tropus autem secundum Johannem de garlandia est regula que de omni cantu in fine dijudicat [Trope according to Johannes de Garlandia is the rule that determines all song at its end]." Erich Reimer, ed., *Johannes de Garlandia: De mensurabili musica. Kritische Edition mit Kommentar und Interpretation der Notationslehre*, 2 volumes, Beihefte zum Archiv für Musikwissenschaft, vols. 10-11 (Wiesbaden: Steiner, 1972), 1:9, and n. 64, as cited in Gwee, "*De plana musica* and *Introductio musice*," 42. (Gwee has provided the English translation). Gwee has suggested that this citation of Garlandia might have been a case of *causa auctoritatis* (falsely citing an author to invoke that author's authority), but Gwee himself has pointed out that Hieronymus' other citations of Garlandia are found in *De plana musica* or *De musica mensurabilis*, which, in my mind, weakens the possibility that this single citation would be false. (Gwee, "*De plana musica* and *Introductio musice*," 42.) Furthermore, Baltzer has written that "According to the secondary evidence of the treatise of Lambertus [whose plainchant treatise was modelled after Pseudo-Garlandia's], the *Introductio musicae planae secundum magistrum Johannem de Garlandia*, and Guy de Saint-Denis, the teaching of *De plana musica* must have concluded with a discussion of the church modes, but this is not found in the extant *reportationes*." Baltzer, "Johannes de Garlandia," 2001, *Grove Music Online*, last accessed 2019 May 22. <https://doi.org/10.1093/gmo/9781561592630.article.14358>. I therefore believe that although hexachordal theory is the only part of modal theory that survives in the extant copies of *De plana musica*, an earlier version did also include material on the other parts of modal theory.

#### 1.1.2.3 *Introductio musice*

Before proceeding further, it should be noted that there is another plainchant treatise that is attributed to (Pseudo-)Garlandia, the *Introductio musice,* but Gwee has provided a thorough review of the arguments against attributing the *Introductio musice* to (Pseudo-)Garlandia, which I find compelling.[97] They are extensive and dependent on details, though, and thus lie beyond the scope of this chapter. Given the significant uncertainty of the *Introductio musice*'s authorship and dating, I have chosen to exclude it from consideration.[98]

### 1.1.3 Lambertus

As with many medieval treatises, questions of authorship surround the *Ars musica* generally attributed to Lambertus, also known as the *Tractatus de musica*, written c.1270-1279. It is composed of two parts or even two independent treatises, *Musica plana* and *Musica mensurabilis*. The music theorist Jacobus in his *Speculum musicae* (c.1330) credited "editus ab Aristotele" ("a certain Aristoteles")[99] as the author of the *Musica mensurabilis*, but this remains controversial.[100] Johannes de Grocheio (c.1300) and, crucially, the Anonymous of St. Emmeram

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[97] Gwee, "*De plana musica* and *Introductio musice*," 10-47. On the uncertain dating of the text, see Gwee, "*De plana musica* and *Introductio musice*," 52-55, 66-67.

[98] Conflating the author of *De plana musica* with the author of the *Introductio musice* can and has resulted in problematic interpretations. Mengozzi notes that the *Introductio musice* "may have been penned by a student of Garlandia" in Mengozzi, "The heptachordal basis of hexachordal theory," 181; but in a footnote, Mengozzi states that "here and in the remainder of this article I will refer to Garlandia as the *bona fide* author of these texts"; Mengozzi, "The heptachordal basis of hexachordal theory," 181, n.17. This is the approach he also takes throughout two other related studies: Mengozzi, "Virtual Segments: The Hexachordal System in the Late Middle Ages," *The Journal of Musicology*, 23 (2006), 426–67; Mengozzi, *The Renaissance Reform of Medieval Music Theory* (Cambridge: Cambridge University Press, 2010), 82-109. Additionally, in the latter study, he also includes a date of c.1270 for the *Introductio*, but the source or reasoning for the date is not specified. Mengozzi's approach of taking for granted Garlandia's authorship potentially misrepresents Pseudo-Garlandia and more generally thirteenth-century music theory, leading the reader to some conclusions that I find dubious.

[99] Christian Meyer, ed., and Karen Desmond, trans., *The 'Ars musica' Attributed to Magister Lambertus/Aristoteles*, Royal Musical Association Monographs Vol. 27 (Surrey, UK: Ashgate Publishing Ltd., 2015), 6-7.

[100] For an overview, see Christian Meyer, "Introduction" in Meyer, ed., and Desmond, trans., *The 'Ars musica' Attributed to Magister Lambertus/Aristoteles*, x. Gordon A. Anderson submitted arguments for Aristoteles being a misattribution (Gordon A. Anderson, "Magister Lambertus and Nine Rhythmic Modes," *Acta musicologica* 45, no. Fasc. 1 (1973): 57-58), however, Bent has shown that his arguments are not conclusive and that they are perhaps overly simplistic. (Margaret Bent, *Magister Jacobus de Ispania, author of the Speculum musicae,* Royal Musical Association Monographs Vol. 28 (Surrey, UK: Ashgate, 2016), 19.) Jacques Handschin identified a scribe "Aristotele" working in Paris in 1282, which is about the right time, though a bit late. (Jacques Handschin, "The Summer Canon and Its Background: II," *Musica disciplina* 5 (1951): 83, 107, as cited in Christian Meyer, "Introduction" in Meyer, ed., and Desmond, trans., *The 'Ars musica' Attributed to Magister Lambertus/Aristoteles*, x.) Christian Meyer and Karen Desmond have refrained from taking a definitive position in their recent monograph, thus presenting both possible

(1279) both cited a Magister Lambertus and attributed distinctive theories from the *Ars musica* to him, and they are closer to the time of the original author than later theorists like Jacobus.[101] Jeremy Yudkin has found that there was a mid-late thirteenth-century "Parisian magister Lambertus who was dean of the cathedral at Soignies," about 200 km from Paris.[102] He would have been a contemporary of both Pseudo-Garlandia and the St. Emmeram Anonymous.[103] The latest possible date of composition of the treatise would be determined as well, since this magister died in 1270.[104]

Meyer has also reviewed questions regarding the authorship of the *Musica plana* section specifically, because the known attributions to the overarching treatise apply only to the *Musica mensurabilis* section. However, the prologue of the *Musica mensurabilis*, like the prologue to Pseudo-Garlandia's *De mensurabili musica*, refers to a preceding section on *musica plana*, and this reference is found in all four complete sources, and in three of those sources, this reference immediately follows all or part of the *Musica plana* section.[105] In addition, Meyer has written that the *Musica plana* "has all of the characteristics of a skillful compilation", but even if it is a compilation, then the *Musica plana* could have been compiled by Lambertus himself or perhaps one of his students, and thus, the two treatises would always have been a pair. Finally, Meyer has concluded that, in the absence of further historical evidence, Lambertus and perhaps a scribe or student of his would have written both the *Musica plana* and *Musica mensurabilis*.[106]

Because of the St. Emmeram Anonymous and Grocheio's citations and the resulting timeline, the consistent references to the *Musica plana* and pairing of the two sections in the manuscript sources, Yudkin's discovery of a Magister Lambertus from the right time and place (approximately), as well as a lack of historical evidence to the contrary, I remain content to credit both parts of the *Ars musica* to Lambertus himself (or to a student of his).

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authors' names, Lambertus and Aristoteles, in the title. (Meyer and Desmond, *The 'Ars musica' Attributed to Magister Lambertus/Aristoteles*. See also Meyer, "Introduction," in *The Ars musica Attributed to Magister Lambertus/Aristoteles*, x.)

[101] Meyer, "Introduction," x. See also Bent, *Magister Jacobus de Ispania, author of the Speculum musicae*, 19.

[102] Jeremy Yudkin, trans. and ed., *De musica mensurata: The Anonymous of St Emmeram* (Bloomington and Indianapolis, 1990), 36.

[103] Yudkin, "The Anonymous Music Treatise of 1279: Why St. Emmeram?" 182-183.

[104] Yudkin, trans. and ed., *De musica mensurata: The Anonymous of St Emmeram*, 36.

[105] Meyer, "Introduction," xi-xvi.

[106] Meyer, "Introduction," x-xi.

#### 1.1.3.1 *Musica plana*

Like Pseudo-Garlandia, Lambertus wrote in depth on both plainchant and polyphonic genres, dedicating about equal space to the *Musica plana* and the *Musica mensurabilis* sections of his treatise. Unlike Pseudo-Garlandia, however, Lambertus' discussion of chant is more practical and less focused on speculative theory. Meyer has explained that the *Musica plana* has four sections: "the musical vocabulary (*de signis et nominibus vocum*), the construction of the scale of sounds following the diastematic model of musical notation (*de lineis et spatiis*), the hexachordal structure of the scale (*de proprietate*), and finally the principles of solmization (*de mutationibus*)", thus following the scheme in the *De plana musica* of Pseudo-Garlandia.[107] Pseudo-Garlandia's influence is also present in other ways that need not be detailed here.[108] In contrast to the surviving copies of *De plana musica*, however, Lambertus' treatise ends with a section on modal theory and a short tonary. The content on mode is, for the most part, traditional; Lambertus listed the eight modes, the four finals, transposed finals, and authentic and plagal ambituses, and the subsequent tonary includes brief discussions of *differentiae*.[109] However, his subtle extensions of modal theory, specifically regarding ambitus and chants with especially large ranges, was novel.[110]

Besides the broad topics of the treatise, I wish to highlight the emphasis on the universality of plainchant in the opening of *Musica plana*:

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|---|---|
| "Quoniam circa artem musicam necessaria quedam ad utilitatem constantium tractatim proponimus, necesse est, quod secundum auctoris intencionem subtilissimas regulas summopere subiectas intelligere studeamus." | "Since we are setting forth, at length, some essential elements of the musical art for the benefit of singers, it is necessary that we strive to understand the most subtle rules laid before us with the utmost diligence, according to the author's purpose."[111] |

[107] Meyer, "Introduction," xviii. Note that Meyer sees the four sources of Pseudo-Garlandia's *De plana musica* as four *reportationes* of (Pseudo-)Garlandia's teachings, whereas Gwee sees the three sources he uses, which overlap with Meyer's sources, as three versions of a single treatise. A comparison of their positions lies beyond the scope of this study.
[108] See Meyer, "Introduction," xviii-xxi.
[109] Meyer, ed., and Desmond, trans., *The 'Ars musica' Attributed to Magister Lambertus/Aristoteles*, 38-45; 45-59. Lambertus also shows an influence from Hermannus Contractus; see Meyer, "Introduction," xviii.
[110] Meyer, ed., and Desmond, trans., *The 'Ars musica' Attributed to Magister Lambertus/Aristoteles*, 40-45.
[111] Meyer, ed., and Desmond, trans., *The 'Ars musica' Attributed to Magister Lambertus/Aristoteles*, 6, 7.

Lambertus thus began the treatise by claiming that what followed was the "essential elements", not just for plainchant nor even for singing, but for "the musical art", implying *all music*.[112] This treatise is to be seen not as separate from or irrelevant to the polyphonic genres considered in his *Musica mensurabilis*, but as essential to understanding them. I reserve some skepticism about how well one can apply all of the statements of the *Musica plana* to contemporaneous polyphonic genres, but Lambertus' position is clear here – certainly clear enough to invite further study.

#### 1.1.3.2 *Musica mensurabilis*

Lambertus began his *Musica mensurabilis* section with references to Boethius, leading into the following passage:

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|---|---|
| "…sicut enim in effectibus nature cause sunt priores, sic in actibus rationis illa priora sunt et prius sciri desiderant, que posterioribus et ipsa consequentibus cognitionis principum amministrant." | "…for just as in effects of nature, there are prior causes, so in acts of reason those things are prior and wish to be known first that themselves supply the beginning of knowledge to the later things that follow from them.[113] |

Here, a sense of history between *musica plana* and *musica mensurabilis* is developed; the newer art not only follows the older art in sequence, but is caused by the older art. The knowledge of the older art, according to Lambertus, forms the foundation for the knowledge of the new art.

[112] I would add that Lambertus' added phrase of "the author's purpose" contributes further weight of will and intent to his general point here.
[113] Meyer, ed., and Desmond, trans., *The 'Ars musica' Attributed to Magister Lambertus/Aristoteles*, 60, 61.

Lambertus continued:

"Cum igitur in cognoscendo musicam mensurabilem sit ipsa plana musica fundamentum, et de ipsa in precedentibus convenienter existimamus esse tractatum, consequenter causa salvandi ordinis artem mensurabilis musice postponamus in qua tam theorice quam pratice quis possit in summa comprehendere cognitionem specierum, armoniarum qualitates et quantitates, similitudines et dissimilitudines proportionum, sonorum et vocum, necnon figuras longas et breves, tempora et mensuram, ac etiam orthographiam cognoscere et conservare et regulariter eam describere, ita quod omnis cantus qualitercunque fuerit diversificatus ad extremitatem, etiam in modum vielle congrue per illam possit declarari."

"Therefore, since *musica plana* is the basis for knowing measurable music, and we reckon that we have suitably covered this in the preceding, for the sake of preserving order let us place the art of measurable music afterwards, so that in both theoretical and practical terms, anyone may in sum grasp knowledge of the harmonic species, grasp the qualities and quantities, similarities and dissimilarities of proportions, sounds, and pitches, as well as longs and breves, tempora and measure, and also know and preserve and write down according to rule music's orthography, so that every piece of vocal music, however varied it may be, may be known right to the end, even in the instrumental style, and may be revealed through it."[114]

The statement "*musica plana* is the basis for knowing measurable music" can be interpreted in multiple ways. One might think that it merely refers to rudimentary knowledge and skills developed in learning monophony. Following the previously quoted passage, however, it seems that Lambertus understood the recognized structures of *musica plana* to be fundamental to *musica mensurabilis* as well. Moreover, there is an emphasis not only on singing, but on intellectually knowing and understanding; in this passage, Lambertus used the words *cognosco* and *cognitio*. In the prologue of the *Musica plana* section, he declared that "it is necessary that we strive to understand [*intelligere*] the most subtle rules laid before us…."

Therefore, Lambertus' account should lead the reader to expect modal theory to apply to *organum purum* as well as to other genres. This expectation is reinforced by the closing phrases

[114] Meyer, ed., and Desmond, trans., *The 'Ars musica' Attributed to Magister Lambertus/Aristoteles*, 60, 61.

of the above quoted passage: "…so that every piece of vocal music, however varied it may be, may be known right to the end, even in the instrumental style, and may be revealed through it."

I should point out that in the musical structures listed above (harmonic species, qualities and quantities, etc.), Lambertus did not explicitly mention mode or its main signifiers, such as final and ambitus. We could interpret them as being included in "qualities and quantities … of …. sounds and pitches", which is vague enough to include all sorts of things. One might argue that by this list alone, it is not clear that modal theory was included in the basis of measured music to which he was referring. On the other hand, in the larger context of the *Ars musica*, we should view this list differently. Lambertus discussed more topics in the *Musica plana* section than included in this list, and ample time was dedicated to modal theory. I therefore interpret Lambertus as implying mode in the quoted passage.[115]

### 1.1.4 The Anonymous of St. Emmeram

In chronological order, the next Notre Dame treatise is the *De musica mensurata* of the Anonymous of St. Emmeram. Although the author's modern designation would seem to indicate German origins – the Benedictine Abbey of St. Emmeram is found in Regensburg – the name comes from the library that held the single manuscript source of the treatise.[116] The treatise was written "in Paris in 1279 by an author who was linked directly to scholarly and artistic circles in that city, and whose work falls squarely into line with that of the other important theorists of the Notre Dame school."[117] The treatise's primary purposes were firstly, to condemn the novel theories of Lambertus, and secondly, to defend and uphold the older, established theory of

[115] Franz Wiering claims that Lambertus wrote that the modes were to be used only for plainchant, but he ignores the larger context of the treatise, including the passages I have quoted; moreover, he misinterprets Lambertus' introduction to mode due to an ambiguity in his (Wiering's) translation: "Sequitur videre de modis, qualiter omnis cantus ecclesiasticus se habeat et in quo differat": "What comes next is to consider the modes; that is, the way in which every ecclesiastical song behaves, and in which way it is different [from others]." In Franz Wiering, *The Language of the Modes: Studies in the History of Polyphonic Modality* (New York, NY: Routledge, 2001), 51; the Latin is taken from Meyer and Desmond, *The 'Ars musica' Attributed to Magister Lambertus/Aristoteles*, 38. However, Desmond's much stronger translation of the same passage reads "It follows to look into the modes, how each ecclesiastical chant possesses them, and into which modes the chant is separated", which eliminates the confusion. In Meyer and Desmond, *The 'Ars musica' Attributed to Magister Lambertus/Aristoteles*, 39.

[116] The library acquired the manuscript some time before c. 1350. See Yudkin, "The Anonymous Music Treatise of 1279: Why St. Emmeram?" 190.

[117] Yudkin, "The Anonymous Music Treatise of 1279: Why St. Emmeram?" 190.

Pseudo-Garlandia, which it does at great length.[118] However, the Anonymous of St. Emmeram offered no words on chant whatsoever.[119] He did not remind the reader of plainchant's pre-eminence over nor its antecedence to measured music, and he certainly did not tell us whether modal theory had any relevance to measured music. One possible reason for the absence of plainchant in his *De musica mensurata* is that he did not see any relevance of plainsong or modal theory to understanding measured music. On the other hand, perhaps he saw the connection as implicitly understood and already sufficiently discussed.

I will return to this treatise in the latter section of this chapter on the relationship between plainchant and measured music.

### 1.1.5 Anonymous IV

The next treatise is that of Anonymous IV, so named because his treatise was the fourth of seven anonymous treatises published by Coussemaker in the late nineteenth century.[120] His work was written after 1272, probably c. 1285.[121] Anonymous IV was English, but spent time in Paris and later wrote about his knowledge of Notre Dame Polyphony in his treatise. The unique and invaluable insights offered by Anonymous IV inform us of composers, pieces, and theorists, amongst many other topics. In Rob Wegman's words, "Without Anonymous IV, … we could not have begun to guess at the history of Notre Dame polyphony before the 1230s or 1240s, which is when our earliest musical sources turn up."[122] Like the work of other theorists of thirteenth-century Paris, his treatise was heavily based on Pseudo-Garlandia's.

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[118] By contemporaneous standards, the St. Emmeram Anonymous' treatise is extremely long, more than double the next-longest Notre Dame treatise (Anonymous IV). Yudkin, "The Anonymous Music Treatise of 1279: Why St. Emmeram?" 178.

[119] The Anonymous of St. Emmeram writes that he does not discuss *musica immensurabilis* (unmeasured music) in his treatise, which is understood implicitly as including plainchant. See Yudkin, trans. and ed., *De musica mensurata: The Anonymous of St Emmeram*, 71. See also the discussion in the second part of this chapter.

[120] Charles E. H. de Coussemaker, *Scriptorum de musica medii aevi nova series*, 4 vols. (Paris: Durand, 1864-76), 1:327-65.

[121] Mark Everist, ed., *Les Organa à deux voix pour l'office du manuscrit de Florence, Biblioteca Medicea-Laurenziana, Plut. 29.1,* Vol. 2 of *Le Magnus liber organi de Notre Dame de Paris* (Monaco: Éditions de l'Oiseau-Lyre, 2003), lv, lxviii.

[122] Rob C. Wegman, "The World according to Anonymous IV", in *Qui musicam in se habet: Studies in Honor of Alejandro E. Planchart*, ed. Anna Zayaruznaya, Bonnie J. Blackburn, and Stanley Boorman (American Institute of Musicology, Verlag Corpusmusicae GmbH, 2015), 693-730.

Anonymous IV began his treatise with the following passage:

"Cognita modulatione melorum secundum viam octo troporum et secundum usum et consuetudinem fidei catholicae nunc habendum est de mensuris eorundem secundum longitudinem et brevitatem, prout antiqui tractaverunt, ut magister Leo et alii plurimi plenius iuxta ordines et colores eorundem ordinaverunt sic procedendo…."[123]

"Having understood the formation of melodies according to the system of eight modes and according to the use and custom of the Catholic faith, we must now consider the measuring of them according to length and shortness, as the *antiqui* dealt with them, and as Master Leo and very many others arranged them more fully according to their *ordines* and *colores.*"[124]

Anonymous IV's treatise is the first to indicate explicitly that melodies not only in *musica plana* but also in *musica mensurabilis* are formed according to the melodic modes. In Anonymous IV's view, *organum purum* as well as the conductus and the motet were all modal.

### 1.1.6 Franco of Cologne

The final major treatise of the Notre Dame school is Franco of Cologne's *Ars cantus mensurabilis*, written some time after 1279.[125] As his name implies, he was likely German, from Cologne, and he might have been at the University of Paris for some time, where he attained the title of *magister*, before returning to Cologne.[126] He is most famous for setting forth a revolutionary system of rhythmic notation called *mensural notation* or *Franconian notation*. Franco's system is one of the most significant developments in the history of rhythmic notation, because its basis is the same as that of modern rhythmic notation: each duration is represented by a different note-shape.[127] (In earlier Notre Dame polyphony written in modal notation, i.e.

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[123] Reckow, ed., *Der Musiktraktat des Anonymus 4, Teil II: Interpretation der Organum purum-Lehre*, 22.
[124] Jeremy Yudkin, ed., *The Music Treatise of Anonymous IV: A New Translation*, vol. XLI of *Musicological Studies and Documents* (Middleton, WI: American Institute of Musicology, 1985), 13.
[125] Dolores Pesce, "Theory and notation," in *The Cambridge Companion to Medieval Music*, ed. Mark Everist (Cambridge, UK: Cambridge University Press, 2011), 282.
[126] Andrew Hughes, "Franco of Cologne," 2001, *Grove Music Online*, last accessed 2019 May 22. <https://doi.org/10.1093/gmo/9781561592630.article.10138> .
[127] In Franconian notation, each note duration and rest duration was represented by its own distinct note shape, except for longs, which retained multiple note symbols, but still, those were distinct from the symbols for other note values. In addition, short ligatures were standardized and classified to represent various durational patterns. See Pesce, "Theory and notation," 283.

according to the rhythmic modes, rhythmic patterns were denoted by patterns of series of various ligatures.) Franco was a distinctly progressive theorist.

Franco's treatise begins like Pseudo-Garlandia's, Lambertus', and Anonymous IV's, with an acknowledgement of plainsong:

"Cum de plana musica quidam philosophi sufficienter tractaverint, ipsamque nobis tam theorice quam practice efficaciter illucidaverint, theorice praecipue Boetius, practice vero Guido monachus, et maxime de tropis ecclesiasticis beatus Gregorius, idcirco nos de mensurabili musica – quam ipsa plana praecedit tanquam principalis subalternam – ad preces quorundam magnatum tractare proponentes, non pervertendo ordinem ipsam planam perfectissime a praedictis philosophis supponimus propalatam."

"Since certain philosophers have already sufficiently treated plain music, and have effectively elucidated the same for us with respect to both theory and practice… therefore we, who … intend to treat measurable music – which that plain music precedes just as the principal does the subordinate – [and who intend to treat it] without overturning this order, understand the same plain music to have been most perfectly covered by the aforesaid philosophers."[128]

Franco repeated themes in his prologue that we have seen in some of his predecessors' works. After his opening deference to plainsong, he explicitly established a hierarchy wherein *musica plana* was the principal and *musica mensurabilis* was the subordinate, which suggests that those things fundamental to plainchant would have been fundamental to measured music as well. I return to this point when discussing the relationship between plainchant and measured music. This explicitly hierarchical perspective also prompts me to read his acknowledgement of plainsong as implying that measured music could be covered only after plainchant was covered.

Similarly to Pseudo-Garlandia, Franco never mentioned melodic mode, but unlike Pseudo-Garlandia, he also did not write a treatise on chant to be paired with his *Ars cantus mensurabilis*. The only hint from Franco regarding mode is the aforementioned point in his prologue.

[128] Franco of Cologne, *Ars Cantus Mensurabilis: The Art of Measurable Song (c.1280)*, trans. Rob Wegman, *Academia.edu*, 1. Last accessed 2018 January 27. <https://www.academia.edu/2080505/Franco_of_Cologne_The_Art_of_Measurable_Song_c.1280_>.

### 1.1.7 Anonymous VII

The final treatise I wish to discuss is one of the minor treatises of the era: the *De musica libellus* by Anonymous VII, dated to approximately 1240-1260, the same period when Pseudo-Garlandia's treatise was originally written.[129] Most of Anonymous VII's treatise covers the standard basic subjects of contemporaneous treatises on measured music: the rhythmic modes, the notation of note values, ligatures, melodic and harmonic intervals, along with some references to the motet and one fleeting reference to discant, but none to organum. The final section is on melodic mode. Anonymous VII discussed the four main finals as well as "auxiliary finals" (related to cofinals; see Chapter 3 of this thesis). The only genres referred to in this final section are plainchant genres, specifically antiphons and responsories along with the lesser doxology (also called the *seculorum*).[130] The transition to this section is abrupt, making it seem somewhat out of place, perhaps even raising the suspicion that it was simply affixed to the rest of the treatise, yet it is hardly a footnote; it makes up almost a sixth of the whole treatise. For comparison, the section on intervals is only about 1.5 times the length, and the section on "the properties of figures" is about half as long. Additionally, I would suggest that the fact that Anonymous VII did not demarcate the sections by noting the shift in repertory could indicate that he did not see a hard division between *musica plana* and *musica mensurabilis*; I explore this notion further in the next section.[131]

Moreover, although passages on the modes are unusual in contemporaneous treatises dealing purely with *musica mensurabilis*, from a broader perspective, Anonymous VII's discussion of mode is not entirely out of place. As we have seen, Pseudo-Garlandia and Lambertus each composed an entire plainchant treatise to be paired with their measured music treatises, and many theorists began their *musica mensurabilis* treatises with an acknowledgement of plainchant, sometimes by proclaiming plainchant outright as the basis for understanding polyphony, as Lambertus, Anonymous IV, and Franco of Cologne did. From this perspective, Anonymous VII's brief treatise is like a miniature in multiple ways, covering the major topics for any major treatise

[129] Janet Knapp, "Two xiii Century Treatises on Modal Rhythm and the Discant: *Discantus positio vulgaris, De musica libellus* (Anonymous VII)," *Journal of Music Theory* 6, no. 2 (1962): 202.
[130] The antiphon and the seculorum are the objects of the discussed permutations, for example "If the antiphon ends on f and the seculorum begins…." See Janet Knapp, "Two xiii Century Treatises on Modal Rhythm and the Discant," 213.
[131] It might also be noteworthy that the treatise ends with chant and mode rather than beginning with them. It strikes me as highly unusual, but its significance (if any) is unclear to me.

on polyphonic genres as well as the topics on plainchant that might have been, in his view, essential for a reader of polyphonic theory.

## 1.2 The Relationship between *Musica Plana* and *Musica Mensurabilis*

In the previous section, I alluded to the Notre Dame theorists' understandings of the nature of the relationship between *musica plana* and *musica mensurabilis*. Exploring their perspectives on the relationship between the two could shed light on whether the language of plainchant, mode, would have pertained to that of polyphonic genres. That exploration is the subject of this section. I will begin with two arguments, and in their unfolding and comparison, I will examine new passages and revisit some passages from the first section.

Lawrence Gushee explained that in the thirteenth century, treatises elaborated new distinctions grounded in Aristotelian hierarchical distinctions, such as "*genus* and *species, natura* and *materia, essentia* and *accidentia*."[132] He argued that in thirteenth-century music treatises, *musica mensurabilis* was presented and understood as a species subordinate to *musica plana*.[133] David Cohen has explained the position thus: "The development of rhythmic notation in the late twelfth and thirteenth centuries led to a new categorical distinction in music theory and pedagogy: *Musica mensurabilis* (or *mensurata*) dealt with the advanced and specialized knowledge involved in written, mensural polyphony (*cantus mensurabilis*), especially the notation of rhythm (note shapes, ligatures, the rhythmic modes, etc.). It was 'subaltern' to *musica plana,* which comprised the fundamental and general principles of all music, both mensural polyphony and plainchant (*cantus planus*)."[134]

Meanwhile, Ernest Sanders contended that the perspective on the relationship between the two categories (plainchant and measured music) transformed from the twelfth to the thirteenth centuries. He argued firstly that prior to the mid-thirteenth century, a polyphonic performance of a chant was understood as "an elaborated version" of the chant; the principal difference between monophonic and polyphonic performances of the same chants was one of

[132] Lawrence Gushee, "Questions of Genre in Medieval Treatises on Music," in *Gattungen der Musik in Einzeldarstellungen: Gedenkschrift Leo Schrade* ed. Wulf Arlt, E. Lichtenhahn, H. Oesch, Vol. 1, 365-433 (Bern and München: Franke, 1973), 425.
[133] Gushee, "Questions of Genre in Medieval Treatises on Music," 425-428.
[134] David E. Cohen, "Notes, Scales and Modes in the Earlier Middle Ages," in *The Cambridge History of Western Music Theory,* ed. Tomas Christensen (Cambridge: Cambridge University Press, 2002), 355.

"[mode] of rendition," not genus.[135] He further argued that in the mid-thirteenth century, this perspective shifted to one where instead of plainchant and measured music being related hierarchically, with measured music being subordinate to plainchant, the two bodies of music had become two equal genera, i.e. two sister branches of the same tree of music. Note that Sanders' position concurred with Gushee's only for treatises from before the mid-thirteenth century.

Susan Fast has argued for the second part of Sanders' argument: that in the mid-thirteenth century, measured music and plainchant were understood by theorists to be sister genera, not species and genus, respectively.

I believe that the reality is more complex than any of the above positions, as I hope to show by surveying the sources on which earlier arguments depended as well as the other Notre Dame sources. Gushee's article largely focuses on earlier theorists, but for writers on *musica mensurabilis*, he adduced only Franco of Cologne.[136] Sanders adduced Pseudo-Garlandia's *De mensurabili musica,* the *Discantus positio vulgaris*, and the de La Fage Anonymous, the last of which he had, at the time, believed to be written in the twelfth century. Fast adduced mainly the Anonymous of St. Emmeram. In short, all three scholars drew conclusions based on samples that were too small.

I will address these scholars and theorists one by one.

### 1.2.1 Sanders on the de La Fage Anonymous and the *Discantus positio vulgaris*

On the de La Fage Anonymous, I should begin by pointing out that the treatise is not in fact from the twelfth century; Sarah Fuller has shown that it is a Cistercian treatise written some time after 1200; it is "not demonstrably prior to the earliest stages of Notre-Dame Polyphony," as some thought before her study.[137] As a result, it should not be used to represent attitudes from long before Notre Dame Polyphony.

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[135] Ernest H. Sanders, "Consonance and Rhythm in the Organum of the 12th and 13th Centuries," *Journal of the American Musicological Society* 33, no. 2 (Summer 1980): 264.
[136] Gushee, "Questions of Genre in Medieval Treatises on Music," 426-427.
[137] Sarah Fuller, "An Anonymous Treatise 'Dictus de Sancto Martiale': A New Source for Cistercian Music Theory," *Musica* Disciplina 31 (1977), 22.

The treatise's provenance is probably French, but still uncertain.[138] In terms of contents, it is primarily a rudiments text and a chant treatise. It is terse and focused almost exclusively on the practical essentials for beginners. The first thirteen chapters cover basics such as how to read music, intervals and their importance for sight-singing, and the modes.[139] Only in two later chapters, the author covers polyphony, specifically discantus and organum, their definitions, and how they should be made.[140]

Sanders argued that the treatise's author viewed polyphonic settings of plainchant simply as plainchant with a polyphonic mode of rendition rather than a monophonic one. In other words, according to Sanders, the process of building polyphony on plainchant was seen more as a plainchant performance practice, not as the creation of members of a new, separate genre. This view was apparently demonstrated by the treatise's terminology:[141] the vocal part singing the plainchant melody is always referred to as the plainchant: "cantus".[142]

Sanders also quoted the *Discantus positio vulgaris* to demonstrate similar wording, which he took to demonstrate the same principle: that when the treatise was composed, polyphony built on chant was seen as a type of chant performance.[143]

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[138] Fuller, "An Anonymous Treatise 'Dictus de Sancto Martiale,'" 25. Roesner also criticized Sanders for using the de La Fage Anonymous based on its uncertain provenance and unlikely connection to Paris, though he does presume a twelfth-century dating of the text. Edward H. Roesner, "Johannes de Garlandia on *organum in speciali*," *Early Music History* 2 (1982), 137.

[139] The content of the treatise is of interest to me for matters relating to Chapters 2 and 3 of this thesis, but because it belongs to the tradition of Cistercian theory, which I do not broach here, as well as its curt, perhaps even oversimplified content, I have not included it in further discussions of mode, chant, or polyphony in my thesis.

[140] Albert Seay, "An Anonymous Treatise from St. Martial," *Annales musicologiques* 5 (1957): 10-12.

[141] I write "apparently", because Sanders was not explicit about this terminology being the basis of his argument.

[142] For the relevant passages, see Sanders, "Consonance and Rhythm in the Organum of the 12th and 13th Centuries," 264-265; for the original Latin text, see Albert Seay, "An Anonymous Treatise from St. Martial," *Annales musicologiques* 5 (1957): 33, 35.

[143] Sanders, "Consonance and Rhythm in the Organum of the 12th and 13th Centuries," 266. The translation seems to be Sanders'. The full translated treatise is available in Knapp, "Two xiii Century Treatises on Modal Rhythm and the Discant: *Discantus positio vulgaris, De musica libellus* (Anonymous VII)," 203-207.

I believe that Sanders was correct that polyphony-as-performance-practice was the older view; it certainly corresponds with early discussions of organum, for example. I require more evidence, though, that this terminology distinguishes earlier discussions of polyphony from those of the mid-thirteenth century onwards, and that that distinction corresponds to a change in how the relationship between plainchant and polyphony was understood – as parallel or hierarchical. On its own, the fact that treatises refer to the plainchant part in discant as "cantus" does not necessarily signify that discant was understood as a mode of performance of plainchant, nor that the categories of plainchant and discant were related hierarchically. To establish that this specific wording differentiates pre-mid-thirteenth-century and post-mid-thirteenth-century polyphonic theory, a thorough investigation of the terms by which twelfth- and thirteenth-century theorists referred to the chant part in polyphony should be performed. Moreover, to establish that earlier treatises exhibited an understanding of polyphony as plainchant performance practice and later treatises did not, another study focused on how treatises did or did not exhibit these understandings should be performed.

Lastly, Sanders made a separate point regarding where in a treatise a section on polyphony is placed, writing that "…at least to the mid-thirteenth century, those writers who described polyphonic techniques dealt with them at the end of their treatises as an aspect of the main topic, which was chant, together with all its appropriate subtopics such as intervals, modes, and so on." He does not substantiate this claim, but all of the early texts that describe organum end with polyphony sections: *Musica enchiriadis*, *Scolica enchiriadis*, Hucbald's *De Musica*, Guido's *Micrologus*, etc. Besides the de La Fage Anonymous, though, the only late example I know is the relatively obscure *Summa musice*, c. 1200. On the other hand, a famous counterexample is *Ad organum faciendum*, a treatise from the early twelfth century entirely on polyphony. Without further research into Sanders' proposed trend, I would not rely on it too heavily.

In short, Sanders' points about terminology and treatise-organization are interesting for future research projects, but I find them too weak to be relied upon for the conclusions he drew.

### 1.2.2 Sanders on Pseudo-Garlandia

Sanders also quotes the first sentence of Pseudo-Garlandia's *De mensurabili musica* (quoted above in section 1.1.2.1): "Having considered that plain type of music [*plana musica*] which is called unmeasurable, it is now the present purpose [to consider] that measurable [music]

which we call organum, inasmuch as organum is the word generally applied to all measurable music."

According to Sanders, Pseudo-Garlandia set up three equivalencies:

1. Plainchant (*plana musica*) is equivalent to unmeasured music;
2. Measured music is equivalent to organum (as a genus);[144]
3. Organum (as a genus) is equivalent to polyphony.[145]

Therefore, according to Sanders, Pseudo-Garlandia described two sister genera, which could be described in any of the following ways: plainchant and measurable music; plainchant and organum; plainchant and polyphony; unmeasured and measured music.[146]

While some questions might arise from Sanders' interpretation, I do not believe that they undermine it.[147] I believe that his reading is sound. As we will see, though, his observation does not generalize to all theorists of the time.

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[144] In the sentences that follow the passage quoted above, Pseudo-Garlandia distinguished two classes of organum: one that was a genus, which was equivalent to polyphony, and one that was a species, i.e. the genre of *organum purum*. He referred to these two classes as "*generaliter et specialiter*" ("general and particular"). Johannes de Garlandia, *De Mensurabili Musica: Concerning Measurable Music*, trans. Rob Wegman, *Academia.edu*, last accessed 2018 January 27, since taken down. Page 29. <https://princeton.academia.edu/RobCWegman/Translations>.

[145] Of course, if organum is equivalent to measured music and to polyphony, then measured music is equivalent to polyphony. Whether Pseudo-Garlandia invented this equivalence of polyphony and measured music or simply documented it is unknown.

[146] Sanders, "Consonance and Rhythm in the Organum of the 12th and 13th Centuries," 267.

[147] Only a few questions come to mind when considering Sanders' reading. Firstly, is it accurate to consider organum (the genus) as equivalent to all polyphony? Pseudo-Garlandia did directly write that *organum* is the term used for all measurable music, but then, in the sentences that follow the passage quoted above, he did not list the other main polyphonic genres of the time (i.e. conductus and motet) as species of organum, rather, he listed textures (i.e. discant, copula, and organum). What does it mean that Pseudo-Garlandia was concerned with texture rather than genre? I find this fact odd, but, for the present discussion, inconsequential, because polyphonic textures still distinguish polyphony from monophony and support the same juxtaposition. (Indeed, the polyphonic textures listed characterize conductus and motet as well, except maybe for the *cum littera* sections of conductus, whose rhythms were likely determined by their lyrics (accentual poetry). Nevertheless, the rules of discant probably still applied, only without the strict proportions of modal rhythm that defined measured music (other than *organum purum*). On the rhythm of *cum littera* sections, see Ernest H. Sanders, "Conductus and Modal Rhythm," *Journal of the American Musicology Society* 38, no. 3 (Autumn 1985), 439-469; Margot E. Fassler, "Accent, Meter, and Rhythm in Medieval Treatises 'De rithmis'," *The Journal of Musicology* 5, no. 2 (Spring 1987), 164-190.)

Secondly, is it fair to equate plainchant to unmeasurable music, since Pseudo-Garlandia did not equate these two as directly as he equated all measurable music to organum? He wrote that plainchant was simply *called* unmeasurable; other music might have belonged to the same category of unmeasured music. I believe that this question has an answer, though: even if, for Pseudo-Garlandia, not all unmeasurable music was plainchant, he still juxtaposed unmeasured music with polyphony, making the former seem to be equivalent at least to monophony.

Relatedly, Sanders himself also posed the important question: given that the rhythm of *organum purum* is not measured, why did Pseudo-Garlandia categorize it as measured? (Sanders, "Consonance and

### 1.2.3 The Anonymous of St. Emmeram

Susan Fast has argued that the St. Emmeram Anonymous viewed *musica plana* and *musica mensurabilis* as two sister genera, citing as evidence a passage from his prologue that is similar to Pseudo-Garlandia's introductory statement:[148]

"…ista musica in duas partes dividitur principales, scilicet in immensurabilem et mensurabilem. Et nota, quod immensurabilis est ilia, ubi non sunt longae vel breves vel aliqua quantitas temporum sub certo numero distributa. Mensurabilis est ilia, in qua sua quantitas temporum reperitur."

"…music is divided into two principal parts, that is to say into unmeasurable and measurable. And note that unmeasurable music is that in which there are no longs or breves or any quantity of units of time distributed in a fixed number. Measurable music is that in which a quantity of units of time is found."[149]

Here, the division of music into two sister genera is unmistakable, but unlike with Pseudo-Garlandia's account, the two genera are not *musica mensurabilis* and *musica plana*, but *musica mensurabilis* (measured music) and *musica immensurabilis* (unmeasured music). The St. Emmeram Anonymous thus departed from Pseudo-Garlandia by dividing music solely by rhythmic structure.[150]

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Rhythm in the Organum of the 12th and 13th Centuries," 274.) As an answer, Sanders offered the idea that Pseudo-Garlandia wanted to categorize all polyphony as *mensurabilis musica*, because he wanted to interpret as measured organum's long notes at phrase-endings and cadences (which were previously described by the de La Fage Anonymous), and that he was thus forced to introduce the oxymoron *mensura non recta* (literally [the] *not-right measure* or [the] *not-right mode*) to describe *organum purum* in general. (For the translation of terms, see Johannes de Garlandia, *De Mensurabili Musica: Concerning Measurable Music*, trans. Rob Wegman, *Academia.edu*, last accessed 2018 January 27, since taken down. Page 29. <https://princeton.academia.edu/RobCWegman/Translations>. For Sanders' theory, see Sanders, "Consonance and Rhythm in the Organum of the 12th and 13th Centuries," 285.) I prefer the explanation that Pseudo-Garlandia wanted to categorize all polyphony as *mensurabilis musica*, and was thus forced to include organum, which led to the oxymoron *mensura non recta*. I wonder if perhaps organum was classified as measured music because it is within the genre of organum that discant, which is obviously measured, was found. Or maybe it was even simpler: maybe because the only measured music was polyphony, the two became associated, and they became inextricable in common use, thus leading to the conflation by Pseudo-Garlandia.

[148] Susan Fast, "Bakhtin and the discourse of late medieval music theory," *Plainsong & Medieval Music* 5, no. 2 (1996): 186-187.

[149] Yudkin, trans. and ed., *De musica mensurata: The Anonymous of St Emmeram*, 70, 71. See also Fast, "Bakhtin and the discourse of late medieval music theory," 186, 187.

[150] The St. Emmeram Anonymous' departure from Pseudo-Garlandia is made absolutely clear by the second sentence in the above quote, which discusses only durations, both specific (longs, breves) and general ("quantities of units of time distributed in a fixed number").

Shortly afterwards (not quoted above), the St. Emmeram Anonymous specified the three textures of *musica mensurabilis*: discant, copula, and organum, thus emulating Pseudo-Garlandia and also including organum in the category of measured music.[151] Therefore, the St. Emmeram Anonymous' *musica mensurabilis* category, like Pseudo-Garlandia's, is effectively more a category of polyphonic genres than of rhythmic structure. Also like Pseudo-Garlandia, the St. Emmeram Anonymous further explained that organum was also [the name of] a superordinate genus *equivalent* to *musica mensurabilis*. As a result, the St. Emmeram Anonymous' category of *musica mensurabilis* is equivalent to Pseudo-Garlandia's.

On the other hand, the St. Emmeram Anonymous did not define *musica immensurabilis* here except in rhythmic terms. He did not specify *musica plana* or plainchant or anything else. The most he wrote was: "it is not of concern now."[152] Therefore, the juxtaposition of superordinate genera is, strictly speaking, not the same as Pseudo-Garlandia's.

Nevertheless, even though the St. Emmeram Anonymous did not explicitly identify an equivalency between unmeasured music and plainchant, his equation of measured music with organum (as a genus, i.e. polyphony), implies that the category of *musica immensurabilis* is equivalent to monophony, if not plainchant.[153] Given the copious parallels between this treatise and the opening of Pseudo-Garlandia's treatise, I think it is reasonable to interpret *musica immensurabilis* as implying plainchant itself. As a result, I would contend that the implication regarding the relationship between plainchant and organum is the same as that of Pseudo-Garlandia's opening: the author considered the two to be sister genera, related non-hierarchically.[154]

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[151] Yudkin, trans. and ed., *De musica mensurata: The Anonymous of St Emmeram*, 71.
[152] "Est sine mensura, de qua non sit modo cura." Trans: "There is one without measure, and it is not of concern now." Yudkin, trans. and ed., *De musica mensurata: The Anonymous of St Emmeram*, 70, 71.
[153] The category of monophony could include both plainchant and solo secular song.
[154] Although my conclusion for this treatise and Pseudo-Garlandia's is the same as Fast's, her discussion of both treatises is problematic. Firstly, her coverage of Pseudo-Garlandia consists only of quoting part of his first sentence (quoted above) without the full context and without discussion. Her discussion of the St. Emmeram Anonymous is similar, but thankfully, she includes the whole of the relevant passage, not just part of it. Most importantly, she has treated the quoted passage from Pseudo-Garlandia and the quoted passage from the St. Emmeram Anonymous as though they are identical without justification. One might argue that the two theorists' descriptions amount to the same thing, as I have, but their sameness is neither self-evident nor established in earlier literature. Susan Fast, "Bakhtin and the discourse of late medieval music theory," *Plainsong & Medieval Music* 5, no. 2 (1996): 186-187.

### 1.2.4 Lambertus

As we have seen, Lambertus wrote that plainchant's essential elements applied to all music, which, of course, included measured music. In introducing measured music, he wrote that the knowledge of the old art formed the foundation of the knowledge of the new art, and he touched on how the new art followed from the old. He wrote that "*musica plana* is the basis for knowing measurable music," with an emphasis on intellectual knowing. I should note that he did not explicitly write that all of the theory for plainchant applied to all measured music or, less importantly for the purposes of this thesis, that polyphonic pieces are types of plainchant whose specific manner of performance is polyphonic. Nevertheless, in my view, all of the above points outline a perspective where *musica plana* and *musica mensurabilis* are related hierarchically, and *musica mensurabilis* is a daughter branch of *musica plana*.[155]

### 1.2.5 Anonymous IV

As highlighted earlier, Anonymous IV wrote that the melodic modes applied to polyphony, but I have not found any clues in his text regarding what he might have understood the relationship between plainchant and measured music or polyphony to be.

### 1.2.6 Franco of Cologne

As discussed earlier, Franco of Cologne explicitly established a hierarchy between the two categories, where *musica mensurabilis* was subordinate to *musica plana*, as a species is to a genus.[156]

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[155] Another issue with Fast's article is that although she has briefly discussed Lambertus in other contexts in her article, she has neglected to include his statements that suggest a hierarchical relationship between *musica plana* and *musica mensurabilis*. Susan Fast, "Bakhtin and the discourse of late medieval music theory," *Plainsong & Medieval Music* 5, no. 2 (1996): 186-187.

[156] Gushee quoted this passage to make his point on thirteenth-century theorists, and though his interpretation of Franco was correct, his observation does not generalize to all theorists of the century. Gushee, "Questions of Genre in Medieval Treatises on Music," 426-427. Fast has cited this part of Gushee's study, but her discussion is badly flawed: while dismissing Gushee's position that *musica plana* and *musica mensurabilis* were related hierarchically, she has misrepresented his conclusion as his personal interpretation of Franco rather than the result of understanding Franco's unambiguous words, and moreover, while disputing Gushee's position, she has dismissed Franco's position without justification. Susan Fast, "Bakhtin and the discourse of late medieval music theory," *Plainsong & Medieval Music* 5, no. 2 (1996): 186-187.

### 1.2.7 Anonymous VII

In the first half of this chapter, I discussed Anonymous VII's apparently abrupt transition from polyphonic topics (the rhythmic modes, rhythmic notation, the motet) to melodic mode and plainchant. In returning to his brief treatise, I wish only to note that this transition might not have seemed as abrupt to an author for whom the categories of plainchant and polyphony or measured music were not as divided as sister branches. Some treatises, especially short ones, might generally be more bluntly segmented, which might suggest that this transition in Anonymous VII's treatise is simply not meaningful, but one can also read here a subtle implication that the author viewed the two categories of music as being related hierarchically and thus that they were deeply connected. This perspective should be viewed more as a possible supplement to the other evidence, however, not a strong case to use as a base.

### 1.2.8 The Period of Composition of Parisian Organum

Before drawing conclusions based on the above considerations, I would like to consider the timeline of the treatises in relation to the period of organum composition. The chronology of Notre Dame organum, however, is exceedingly problematic. A full summary of the arguments surrounding the possible beginnings and endings of the timeline lies far beyond the scope of this study. Nevertheless, there are a few known or confidently speculated dates that we can use to make a very general point related to the above discussion on the relationship between plainchant and polyphony.

In one of Anonymous IV's most famous passages, he named Leoninus and Perotinus as leading figures in the composition of polyphony at the Cathedral of Notre Dame; Leoninus led the creation of the (perhaps mythical) *Magnus Liber organi* ("great book of organum", i.e. polyphony), and Perotinus, his successor, revised it.[157] Magister Leoninus was born c. 1135 in Paris. At some point in the 1180s, Leoninus served as a canon at Notre Dame Cathedral, where he stayed to become one of the most senior canons, and he was active at the cathedral through the 1190s until his death in 1201.[158] Magister Perotinus' dates are far more speculative, but Sanders

[157] For a full quotation of the famous passage with a discussion of many of the questions that arise from it and an exploration of the issues regarding the *magnus liber*, see Roesner, "Who 'Made' the *Magnus Liber*?", 227-266. For a brief account of the impact of Anonymous IV on Leoninus' biography, see Craig Wright, "Leoninus, Poet and Musician," *Journal of the American Musicological Society* 39, no. 1 (Spring 1986), 5-6.
[158] Craig Wright, "Leoninus, Poet and Musician," *Journal of the American Musicological Society* 39, no. 1 (Spring 1986), 31-32.

estimated that he likely lived from c. 1165 to c. 1225.[159] In addition, the Bishop of Paris at the time, Odo of Sully, issued one edict in 1198 and another in 1199 that inform us of the years of Perotinus' two famous four-part organa, as well as the feasts for which they were sung.[160] However, as Mark Everist has explained, "While the documents provide a fixed chronological point, a blizzard of scholarly debate has interpreted and reinterpreted their implications: either the two organa quadrupla represented the final point of 'development' of the work of both Leoninus and Perotinus (in which case, the entire project of Parisian organum was complete before the end of the twelfth century), or there are identifiable aspects of the 'Perotinian' repertory that could not have preceded the composition of the two datable works. Arguments on both sides are fraught with teleological difficulties, and no clear answer can be given for the opening and closing dates for the composition of Parisian organum."[161] However, Rebecca Baltzer has contended that even while editing of the repertory continued through the thirteenth century, new composition of organum had declined and possibly ended by c. 1225.[162]

Although it is impossible to know exactly when Notre Dame polyphony began, perhaps we can estimate the 1180s – when Leoninus was promoted to canon at the Cathedral of Notre Dame – as a (somewhat arbitrary) point at which *organum duplum* composition might have been in full swing. In addition, let us rely on Baltzer's end-point, at least for the point when new organum composition would have declined. This leaves us with an approximate era of 1180-1230, during which time – we might conjecture – the majority of organum composition occurred. This is, as is well known, well before the theoretical literature on the repertory began; Pseudo-Garlandia wrote his treatise c. 1240 at the very earliest and just as likely two decades later, while all the later theorists wrote their treatises from c. 1270 onwards, at least forty years after our approximate end-point of the main period of composition. The earliest surviving manuscript recording Notre Dame polyphony dates to the 1230s at the earliest.[163]

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[159] Ernest Sanders, "The Question of Perotin's Oeuvre and Dates," in *Festschrift für Walter Wiora zum 30. Dezember 1966*, ed. Ludwig Finscher and Christoph-Hellmut Mahling, 241-249. Kassel: Bärenreiter Verlag, 1967.

[160] See the summary in Sanders, "The Question of Perotin's Oeuvre and Dates," 244. The original discussion of the two documents is found in Jacques Handschin, "Zur Geschichte von Notre Dame," *Acta Musicologica* 4 (1932): 5-8.

[161] Mark Everist, "The Thirteenth Century," in *The Cambridge Companion to Medieval Music*, ed. Mark Everist (Cambridge, UK: Cambridge University Press, 2011), 72-73.

[162] Rebecca A. Baltzer, "How Long Was Notre-Dame Organum Performed?" in *Beyond the Moon: Festschrift Luther Dittmer*, ed. Bryan Gillingham and Paul Merkley (Ottawa: The Institute of Mediaeval Music, 1990), 119.

[163] Everist, "The Thirteenth Century," 73.

If Sanders was correct in his assertion that before the mid-thirteenth century, polyphonic pieces built on chant (e.g. organa) were understood as polyphonic renderings of chant, then although there was variety of perspectives amongst theorists from the mid-to-late thirteenth century regarding the relationship between plainchant and polyphony, there might have been more unity amongst the singer-composers of Parisian organum of the late twelfth- and early thirteenth-centuries.[164] This possibility is supported by Sanders' notion that Pseudo-Garlandia's division of *musica plana* and *musica mensurabilis* into two sister genera was new (c. 1240 at the earliest) and possibly in contrast to *Discantus positio vulgaris* (c. 1230) – that is, if we believe Sanders' interpretation (discussed above), which I hesitate to support. If the originators of Parisian organum did hold an earlier, more uniform view of the relationship between plainchant and polyphony, then they would likely have understood that what was fundamental to the principal plainchant was also fundamental to the subordinate polyphony.

Of course, this point cannot be claimed with great confidence; I have shown my own reluctance to accept Sanders' much less controversial claims about twelfth-century treatises, and of course, we do not have a single text on Notre Dame organum from the twelfth century, nor even from before the short *Discantus positio vulgaris*. Moreover, equally viable counterarguments are available. For example, if Pseudo-Garlandia was a magister, intimately familiar with music studies at the university and music-making at the cathedral (as he certainly appears to have been); if he was writing as early as c. 1240; and if he was older at the time, perhaps in his sixties, meaning that at the age of twenty, he would have been contemporaneous with both Leoninus and Perotinus, and thus could have been present for the premieres of Perotinus' four-part organa, and would still have witnessed even twenty more years of new organum compositions – if all of the above guesses are accurate, then perhaps Pseudo-Garlandia was not innovating the division of plainchant and measured music as much as he was reporting it. If he was reporting more than innovating, then his perspective could be taken as more representative of the singer-composers from (who knows how many) generations earlier.[165]

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[164] To my knowledge, the term *singer-composer* originated with Fuller, "An Anonymous Treatise 'Dictus de Sancto Martiale,'" 5.

[165] One could also argue that Pseudo-Garlandia was not merely reporting, since manuscripts made before his treatise notate certain things one way, and manuscripts made after his treatise notate those same things the way he recommended rather than the old way. However, we do not know what role his treatise played in that change – whether it singlehandedly instigated the change, whether it catalyzed a change already taking place, or whether it was simply a witness to it. For two of many examples examining the notational changes related to Pseudo-Garlandia's treatise, see Sanders, "Consonance and Rhythm in the Organum of the 12th and 13th Centuries," 264-286; and Roesner, "Johannes de Garlandia on *organum in speciali*," 129-160.

Without new evidence to lead us in any direction, it is impossible to be definitive or even confident in these respects; there are simply too many unknowns, so all sorts of scenarios can be viably posited. Nevertheless, given the origins of organum and discant as species of chant performance, and given the late twelfth-century (or earlier) beginnings of Parisian organum, I am inclined to think that at least the first generation of Parisian organum singer-composers might have considered organum specifically to be a specialized type of chant performance, and thus to be organized according to the same founding principles.

### 1.2.9 The Relationship between *Musica Plana* and *Musica Mensurabilis*: Conclusion

Gushee, Sanders, and Fast all argued for positions that do not account for the diversity in the major thirteenth-century *musica mensurabilis* treatises. Perspectives on this subject from the second half of the thirteenth century were not uniform, and so no generalization should be made.

In addition, while I agree with Sanders' overall point that the earlier view of the relationship between the categories was probably hierarchical, I find his evidence insufficient, though interesting. A great deal more research is needed to investigate the twelfth-century view of polyphony and plainchant.

## 1.3 Conclusion

As we have seen, there was no consensus amongst thirteenth-century theorists regarding the nature of the relationship between *musica plana* and *musica mensurabilis*. Pseudo-Garlandia and the Anonymous of St. Emmeram's perspective on *musica plana* and *musica mensurabilis* was that they had a horizontal relationship; on the other hand, Franco of Cologne's view (and, implicitly, that of Lambertus as well) was that the two categories had a vertical relationship, with *musica mensurabilis* being subordinate to *musica plana*. Meanwhile, Anonymous IV offered no statements nor clues on the matter.

Something curious comes to the fore in the above survey of the main Notre Dame theorists. Franco was the most progressive and innovative as well as one of the latest of the Notre Dame theorists, and yet his comments concord with the older view that measured music was subordinate to plainchant. Meanwhile, Pseudo-Garlandia was the earliest of the major Notre Dame theorists, and he put forth the novel reclassification of the two categories as sister genera. Furthermore, the conservative St. Emmeram Anonymous, aiming to preserve Pseudo-Garlandia's

doctrines, basically followed him in this area as well, while Lambertus, who was heavily influenced by Pseudo-Garlandia but departed from his treatise in novel ways,[166] seemed to have leant more towards an old-fashioned hierarchical view, like Franco's.

I believe that this apparent mishmash of progressive and conservative views and, more generally, the fact that various positions persisted through the second half of the thirteenth century reflect a decades-long reorientation in the understanding of the relationship between plainchant and polyphony, from a vertical one to a horizontal one. Whether the transition was consciously initiated by Pseudo-Garlandia or already underway amongst Parisian musicians is unknown. In either case, the transition was apparently long.

Related to that change, I presented the highly speculative possibility, based on what I timidly propose might be the timing of the core period of Notre Dame organum composition, that at least the earliest generation of Parisian organum might have been shaped by the idea of polyphony as a manner of chant performance; the singer-composers of that time would have understood that what was fundamental to the principal plainchant was also fundamental to the subordinate polyphony.

Returning now to the material of the first half of this chapter, I will summarize while re-evaluating some of the features of the main Notre Dame treatises where necessary.

Numerous theorists introduced their works on *musica mensurabilis* with an acknowledgement of plainchant, however, the meaning of each acknowledgement is clarified by the author's treatment of the relationship between the two musical categories. Contrary to my first impression, I believe that Pseudo-Garlandia's opening was likely little more than his plainly noting of the completion of his first task before proceeding to his second. The fact that he wrote a whole treatise on plainchant can be explained in other ways, perhaps as part of a comprehensive music curriculum. It is, nevertheless, of note that he wrote a plainchant treatise, devoting ample time to the traditional topics, likely including the (melodic) modes.

The Anonymous of St. Emmeram, meanwhile, wrote nothing at all about chant or melodic mode. However, given his emulation of Pseudo-Garlandia in his division of *musica plana* and *musica mensurabilis*, I would expect him not to have considered the structures of the former to apply to the latter.

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[166] Lambertus' most famous departure from Pseudo-Garlandia is his system of nine rhythmic modes instead of the traditional six. See Meyer, "Introduction," x.

Like Pseudo-Garlandia, Lambertus also wrote a plainchant treatise (or section) to be paired with his *Musica mensurabilis*, but by contrast, his words on plainchant were more a veneration than a mere acknowledgement. He wrote of the universality of plainchant, describing the treatise as a discussion of "essential elements" that applied to all music. In his introduction to measured music, he wrote that the knowledge of the old art formed the foundation of the knowledge of the new art, and specifically that "*musica plana* [was] the basis for knowing measurable music." Moreover, the modes were a substantial part of his plainchant treatise.

Like Lambertus, Anonymous IV also wrote that plainchant was the basis for understanding measured music, but he was the only theorist to have specified that the melodic modes were what formed that basis.

Franco of Cologne explicitly claimed that *musica mensurabilis* was a subordinate category to the genus of *musica plana*, and though he wrote nothing more on the topic, the implication, as I read it, is that the principles of the principal apply to the subordinate.

Finally, Anonymous VII provided an interesting example of a condensed treatise whose structure implies little or no division between plainchant and polyphony. Moreover, he included a relatively substantial section on mode in his text, which might suggest that polyphony was informed by mode.

The remarks of Lambertus and Anonymous IV especially are suggestive enough to prompt a project like this thesis, and the treatises of Franco of Cologne and even Anonymous VII only add more weight to the underlying question. Of course, we should not simply take their position(s) as true, especially given the contradictory testimonies of Pseudo-Garlandia and the St. Emmeram Anonymous. What is needed is to see if their claims are borne out by the music, which I shall do my best to pursue in the coming pages.

# Chapter 2 Historical Theory and the Cognitive Foundations of Modal Theory

## 2.1 Introduction

To date, a great deal of research has been devoted to deciphering medieval modal treatises, and necessarily so. Translation of medieval music texts is not a simple task, and this is especially true of Carolingian texts, where written modal theory began. Carolingian texts on music are unruly and unyielding. Few distinct works have survived long enough to reach us; those that have survived are complicated not only by issues of authorship and transmission but by the language employed. The inconsistencies and the polyguity of particular terms are rampant, namely the all-important *tonus,* which could refer to mode, "the interval of a whole tone...," a note, "in grammar, a verbal accent", and "one of Boethius' terms for the ... *tonoi* of ancient Greek theory...."[167] Further complicating matters is the distance between us and the thought that originated the extant texts and the music they discuss. Before Hucbald and the *Enchiriadis* treatises, music was discussed in "qualitative, metaphorical language," which is often frustratingly vague to modern readers.[168] As David Cohen has explained, "Carolingian tonaries and modal treatises of the period before c.850-900 provide no criteria for the assignments of melodies to modal categories, which they take as a given. Indeed, they make no use of, and no reference to, the basic theoretical concepts and structures which are taught and applied in analytical discussions of mode from the later ninth century on and which to us seem required for any technical analysis of melodies in structural terms – the note, the interval, a background scale of some kind...."[169] This is a point to which I will return shortly.

Such translation difficulties are still quite prominent in later centuries as well. The terms *tonus, tropus,* and *modus* continued to be used multifariously, to the consternation of modern scholars.[170] For one example, *tropus* was used by some theorists as basically synonymous with mode from the Carolingians through to Southern German theorists of the eleventh century (for

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[167] David Cohen, "Notes, Scales and Modes in the Earlier Middle Ages," in *The Cambridge History of Western Music Theory,* ed. Tomas Christensen (Cambridge: Cambridge University Press, 2002), 312.
[168] Cohen, "Notes, Scales, and Modes," 312.
[169] Cohen, "Notes, Scales, and Modes," 313.
[170] Harold S. Powers, et al., "Mode," 2001, *Grove Music Online*, last accessed 2019 May 21. <http://www.oxfordmusiconline.com/subscriber/article/grove/music/43718pg2>.

example, Hermannus Contractus' *sedes troporum*, "the seats of the tropes"),[171] but at least one theorist, the anonymous author of the *Summa musice*, c.1200, used the term to refer to melodic modal formulas.[172] Guido d'Arezzo, in the early eleventh century, referred to the same (or related) modal formulas using the term *neuma*, which itself was commonly used to refer to an aspect of music notation.[173]

The work of translating and decoding the structures and principles in medieval modal theory has been essential to any work that hopes to develop their meaning. There remains, however, great work to be done in exploring the medieval modal theorists' presuppositions and implications as well as their internal contradictions. This is true specifically with regards to the cognition of mode, that is, how medieval theorists and those they knew *heard* mode.

In order to analyze music according to mode, we must first define mode. How has mode been defined historically? What structures were used to define mode? What purposes did mode serve? And crucially, did mode relate to music perception, and if so, how? And how did those perceptions relate to mode's definitions? This chapter addresses these questions.

The purpose of this chapter is to derive from the historical theories of mode a richer, more flexible, and more perceptually relevant theory of mode, especially but not exclusively as it pertained to later chant. Throughout this chapter, I refer not only to later modal theory, however, but to modal theory from the Carolingians through to the end of the eleventh century. Even though the larger purpose of the thesis is to analyze polyphony of the twelfth and thirteenth centuries, there are several reasons for presenting close studies of early modal theory here and for not presenting much beyond the eleventh-century syntheses.[174]

Firstly, modal theory crystallizes somewhat in the eleventh century with the Italian school led by Guido d'Arezzo and the Southern German school led by Bern of Reichenau.[175] The

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[171] See Powers et al., "Mode: II. Medieval Modal Theory: 3. 11th-century syntheses: (ii) Reichenau theory of modal species and locations," 2001, *Grove Music Online*, last accessed 2019 May 21. <http://www.oxfordmusiconline.com/subscriber/article/grove/music/43718pg2>.

[172] See, for example, Christopher Page, ed. and trans., *Summa musice: A Thirteenth-Century Manual for Singers* (Cambridge University Press, 1991), 20.

[173] Leo Treitler, "The Early History of Music Writing in the West," *Journal of the American Musicological Society* 35, no. 2 (1982): 244.

[174] The term "eleventh century synthesis" comes from Harold S. Powers, et al., "Mode," 2001, *Grove Music Online*, last accessed 2019 May 21. <http://www.oxfordmusiconline.com/subscriber/article/grove/music/43718pg2>. The same term is used by Cohen, "Notes, Scales, and Modes," 339.

[175] Cohen, "Notes, Scales, and Modes," 339.

eleventh-century syntheses saw clarification and development of crucial structures in modal theory that remained relatively fixed well into the Renaissance, such as the standardization of the gamut, affinities, the *modi vocum*, the hexachords, and modal species of consonances, amongst others.[176] Twelfth-century modal theory is mostly a repetition of that of the eleventh century. In addition, the "standard model" of medieval modal theory is almost entirely the product of the eleventh-century syntheses.[177]

Secondly, along with the eleventh-century syntheses, there is a decline in certain types of discourse, namely qualitative descriptions, appeals to the listening experience, and even complaints about mistakes, all of which give rich insights into medieval music perception. This decline is most clearly seen in the work of the Southern German school, especially that of Hermannus Contractus, whose work is almost entirely structural in its focus.

Thirdly and most importantly, I wish to demonstrate that there exists a continuity of concepts running throughout modal theory's medieval history. Together, these concepts answer the questions I posed above. Although many things changed in modal theory, certain features as well as certain types of commentary remain throughout the centuries, such as those involving the determination of the mode of a chant, modal "confusion" on the parts of singers, supposed modal ambiguity, modal unity, and legitimacy. By tracing these concepts from the beginnings of modal theory in Western Europe to the eleventh-century syntheses, I hope to demonstrate that my conclusions are fundamental to understanding modal theory, especially from a listening, i.e. cognitive, perspective. Furthermore, the conclusions I draw form the basis for the methodology that I develop in later chapters.

The first section of this chapter is a brief overview of the role of mode in psalmody, which is foundational for later material in the chapter. Relatedly, for those readers who are unfamiliar with medieval modal theory, Appendix A presents a brief introduction to what I term the "standard model" of modal theory. Even as a skeleton, the "standard model" is inadequate, primarily because it has perpetuated medieval confusions, as I demonstrate in this chapter. Nevertheless, it is essential material.

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[176] Cohen, "Notes, Scales, and Modes," 339.
[177] Charles Atkinson, "The *Parapteres*: *Nothi* or Not?" *The Musical Quarterly* 68 (January 1982): 32; Cohen, "Notes, Scales, and Modes," 339-354; Powers et al, "Mode: II. Medieval Modal Theory: 3. 11th-century syntheses," 2001, *Grove Music Online*, last accessed 2019 May 21. <http://www.oxfordmusiconline.com/subscriber/article/grove/music/43718pg2>.

Chapter 2: Historical Theory and the Cognitive Foundations of Modal Theory

In the next section, I begin with mode's function and meaning in modal theory from the late eighth to the late eleventh centuries, focusing on theorists' identification of distinct sonic qualities held by each mode, structural explanations for these tonal identities, and qualitative themes of coherence, order, regulation, and cohesion. Crucially, their descriptions also make it clear that the modal quality of a chant was heard as filling every moment of that chant.

From there, I move to a justification for joining early, purely qualitative and late, mixed qualitative and structural Carolingian modal theory. I make my argument in three areas: structural and qualitative discourse as potentially different dimensions of one larger discourse; issues regarding the changes of the background scale or gamut; and questions of which part of any given chant determined the mode: the beginning or the end. I demonstrate that early texts reveal a complementarity between beginnings and endings, and I explore the perceptual implications of their accounts, specifically that both beginnings and endings had a perceptual impact on modal determination for everyone at all times.

This leads to the fourth section, on a modulatory hearing of chant vs a saturated monomodal hearing. Theorists from the ninth century onwards classified each chant as belonging to a single mode, claiming that the final determines the entire classification as well as the entire sound of a chant, but their accounts suggest that everyone recognized various modal areas within single chants, i.e. the occurrence of modulation, but no theory to accommodate it was developed. It is here that I present a pervasive flaw in medieval modal theory: the conflation of two distinct purposes. The first purpose is the classification of chant, whereas the second is the description of the listening experience. This is followed by medieval accounts demonstrating a modulatory hearing as well as a discussion of the *parapteres*, modulating psalm tones invented to compensate for modulating antiphons.

The fifth section deals with issues of legitimacy surrounding chants that begin and end in different modes, relating back to theorists' observations of modulation, but exploring their denigration of such chants.

Finally, I briefly address problems summarized by Falconer regarding the validity of early modal theory because of its origination with the importation of the Byzantine *octoechos*: simplified and systematized classification, foreignness and importation as opposed to imposition and enforcement, adaptation of the *octoechos*, the gamut, the myth of modal ambiguity, and evidence of Western European plainchant classifications outside of the modal system.

## 2.2 Preliminaries: The Modes in Psalmody

Modes are tonal categories, and modal theory was a method of classifying melodies according to their sound, their structure, and/or both. They were intricately linked to the practice of psalmody. The two main rituals in the medieval liturgy were the Mass and the Divine Office, the latter of which occurred daily, consisting of eight hours of prayer, mostly in the form of chanting psalms so that all 150 psalms could be recited each week.[178]

The psalms were not sung to individual melodies, but to formulas called *psalm tones* or more generally *recitation formulas*, since there are other genres of chant that rely on such formulas. Each psalm verse (that is, each line) was sung to a melodic formula that was flexible enough to fit any number of syllables; each formula had an opening figure (the *initium*), a closing figure (the *differentia*), and a tone on which most syllables were sung (in between the opening and the closing), called the "reciting tone" or *tenor*. These melodic formulas could thus be adapted to any line of text, so that any and every formula could be used to sing any psalm.

Psalms were also recited with antiphons. Antiphons are short chants sung as part of the Divine Office before and after each Psalm; during the middle ages, antiphons were also sung after each verse of a psalm.[179] They were short and simple, "essentially, often completely syllabic and ranging in length from half a line to an average of two or three lines...."[180] The psalms of the day were prescribed, and singers would choose the antiphons based on which meanings in the psalm texts they wanted to highlight through the complementary text of the antiphon. Antiphons, unlike psalms, had fixed melodies. Because of the alternation of psalm verses and antiphons (or even just because of the antiphon bookending the psalm), the seams where a psalm and an antiphon would meet were given special attention; the two were made to match tonally. There are eight psalm tones, one for each of the eight modes.[181] Antiphons were thus categorized as belonging to one of the eight modes. Singers chose the psalm tone that corresponded to the

[178] Margot Fassler, *Music in the Medieval West* (New York, NY: W. W. Norton & Company, 2014), 16.
[179] Apel, *Gregorian Chant*, 392.
[180] Apel, *Gregorian Chant*, 392.
[181] It is very difficult to convey this relationship without improperly implying or outright declaring causality. The origin of the psalm tones, though, is lost in time. It is difficult to say what effects the psalm tones and modes (or *octoechos*) had on each other (when the *octoechos* made it to the West; see below). My own opinion is that the coordination of psalm tones and modes happened because of the perceptual relevance of the imported *octoechos* and *not* because of some arbitrary or fluke decision enforced by privilege or power, as I explain below.

antiphon's mode, which ensured smooth transitions between psalm and antiphon, since both belonged to the same broad tonal category.

## 2.3 The Significance of Mode: Meanings, Functions, Sound, and Structure

Earlier, I commented on the difficulties translating and interpreting Carolingian texts on music, quoting David Cohen's outline of some of the key issues, such as the total absence of structural specifics. As Cohen has pointed out, though, there are still many things one can observe about the Carolingian conception of pitch and mode.[182] I therefore begin with the early Carolingian significance of mode, that is, the meanings and functions of mode, and from there, I move to later theorists as well. What did mode signify for the Carolingians? What signifies mode in a given chant? Put another way, how did a given chant communicate its mode to a Carolingian listener?

Powers' Grove article introduces Carolingian modal theory with the idea that "a clear distinction can be made between the practical and theoretical aspects of the church modes. For the sake of theoretical consistency, virtually every item in the entire repertory of Gregorian plainchant was assigned to one of the eight modes in the closed system. But for certain kinds of items, the modal system was made to serve a practical end as well."[183] I do not find this explanation of the functions of the modes and even the function of classification compelling. The Carolingian campaign for consistency was broad, but contemporaneous music theory was rife with inconsistencies, probably most apparent in the division between the cantus and harmonics traditions, as well as in the content of treatises (especially but certainly not limited to composites), and more subtly in issues of psalmody and mode assignment, which I will explore at length. It is well-understood that modes served the utilitarian function of facilitating smooth transitions between psalms and antiphons, but even that purpose is a musical one: the smoothness is achieved by connecting phrases that share the same nature or are of the same musical type or *mode*. Therefore, the fact that almost every type of chant, including those not involved in psalmody, was modally catalogued even when there was no apparent use to doing so suggests that modes served a purpose beyond practicality and theoretical consistency: that of

[182] Cohen, "Notes, Scales, and Modes," 308-331.
[183] Harold S. Powers, et al., "Mode," 2001, *Grove Music Online*, last accessed 2019 May 21. <http://www.oxfordmusiconline.com/subscriber/article/grove/music/43718pg2>.

demonstrating the similar *sound* of various works.[184] This is one of many aspects of mode suggested by the primary sources.

The earliest extant document on mode, *De octo tonis,* from perhaps as early as the eighth century,[185] begins:

"Diximus etiam octo tonis consistere in musicam per quos omnis modulation quasi quodam glutino sibi adherere videtur. Est autem tonus minima pars musicae, regula tamen; sicut minima pars grammatice littera, minima pars arithmeticae unitas. Et quomodo litteris oratio, unitatibus catervus multiplicentus numerorum consurgit et regitur, eo modo et sonituum tonorumque linea omnis cantilena moderatur."[186]

"We have said that in music there are eight modes; and through these, every melody seems to hold together, as though with a kind of glue. A tone, although a rule (mode), is the smallest part of music, just as the smallest part of grammar is the letter, and the smallest part of arithmetic is the unit. Just as speech arises and is governed by letters, and the multiplied accumulation of numbers by units, so every melody is governed by the boundary line both of its sounds and of its modes."[187]

Although we are not given details of how the melodies hold together, the cohesion sensed by the author is made vivid by the glue analogy. The grammar analogy emphasizes meronymy: a part-to-whole relationship, where the parts form a systematic, ruled coherence. Moreover, the coherence that is mode orders every level of organization, just as the cohesion

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[184] Busse Berger has argued convincingly that pervasive modal classification was pursued in an effort to memorize the massive plainchant repertory. Busse Berger, *Medieval Music and the Art of Memory,* 67-77. I believe that our views are not contradictory, but harmonious, however. Memorizing chant through analysis is most efficient when the musical features that are catalogued are musically, i.e. perceptually, relevant. Arbitrary features, such as the tenth note of each chant, would likely make memorization more difficult. Therefore, the pervasivity of modal classification can be a sign of both memorization and the perceptual relevance of modal categories.

[185] On the dating, see Michel Huglo, *Les Tonaires: inventaire, analyse, comparaison* (Paris, France: Société Française de Musicologie, 1971), 47; and Lawrence Gushee, ed., *Aureliani Reomensis Musica disciplina,* (American Institute of Musicology, *Corpus Scriptorum de Musica* 21, 1975): 11-14. I use *De octo tonis* as it appears in Chapter VIII of Aurelian's *Musica disciplina*: Aurelian of Réome, *Musica disciplina, e*d. Lawrence Gushee, *Corpus Scriptorum de Musica* 21 (American Institute of Musicology, 1975), 78-83; Aurelian of Réome, *The Discipline of Music (Musica disciplina)*, trans. Joseph P. Ponte, Translations: No. 3 (Colorado Springs, CO: Colorado College Music Press, 1968), 20-24.

[186] Aurelian of Réome, *Musica disciplina,* ed. Gushee, 78.

[187] Aurelian of Réome, *The Discipline of Music*, trans. Ponte, 20.

that is mode fills every part of the chant.[188] The Tonary of Metz, c. 825-855, emphasizes cohesion and order using similar language, though not as inspiring to the imagination: "Every kind of melody is justly [said to be] regulated and bound together (*regulatur ac perstringitur*) by the eight *toni*...."[189]

Aurelian's *Musica disciplina*, from c.840-849,[190] incorporates not only *De octo tonis* but other passages emphasizing similar principles,[191] as in the following from Chapter 10, implying order and coherence once again:

"Per hos sicut supradictum est tonos omnis modulatio armoniaca vergit…."[192]

"Every melody turns *harmoniously* through these modes...."[193] [Emphasis mine.]

Indeed throughout *Musica disciplina*, the modes are treated implicitly and explicitly as having distinct tonal qualities and identities; each one has a *sound*.

Although markedly different from *De octo tonis* and *Musica disciplina* in their structural specificity, *Musica Enchiriadis* and *Scolica Enchiriadis* (hereafter *ME* and *SE*), written between 850

[188] Few discussions of grammar analogies would be complete without mentioning Calvin M. Bower, "The Grammatical Model of Musical Understanding in the Middle Ages," in *Hermeneutics and Medieval Culture*, ed. Patrick J. Gallacher and Helen Damico (Albany, NY: State University of New York Press, 1989), 133-145, but whereas Bower demonstrates the importance of text for determining structural importance of pitches in a chant, and whereas he uses grammar analogies to develop a theory of hierarchy of musical phrases and thus a hierarchy of small- or large-scale tonal areas, I use the grammar analogies to understand the qualities of mode expressed by the analogies themselves. See also the more detailed survey of analogies to grammar and rhetoric in Karen Desmond, "*Sicut in grammatica*: Analogical Discourse in Chapter 15 of Guido's *Micrologus*," *The Journal of Musicology* 16:4 (1998): 467-493 and in Dolores Pesce, "A historical context for Guido d'Arezzo's use of distinction," in *Music in Medieval Europe: Studies in Honour of Bryan Gillingham*, ed. by Terence Baily and Alma Santosuosso (Aldershot, UK: Ashgate, 2007), 146-162.

[189] Walther Lipphardt, ed., *Der karolingische Tonar von Metz* (Münster, Aschendorff, 1965), p. 63.8-10, as cited in Cohen, "Notes, Scales, and Modes," 312.

[190] Gushee, ed., *Aureliani Reomensis Musica disciplina,* 15-16.

[191] It must be understood that Aurelian's *Musica disciplina* is a total compilation. It is therefore best to view the various bits and pieces "as survivals of sources used by Aurelian"; *Musica disciplina* is our earliest Carolingian collection of source readings on modal theory. In Aurelian of Réome, *Musica disciplina,* ed. Gushee, 11-16. For more detail, see Lawrence Gushee, "The *Musica disciplina* of Aurelian of Réôme: A Critical Text and Commentary" (PhD dissertation, Yale University, 1962), 138-148.

[192] Aurelian of Réome, *Musica disciplina,* ed. Gushee, 86.

[193] Aurelian of Réome, *The Discipline of Music*, trans. Ponte, 26.

and 900, have a great deal to offer here.[194] Rebecca Maloy has written that "From the opening pages of both treatises, it is clear that modal quality is integral to pitch conception and pedagogy."[195] Specifically in dealing with the relationship between the final and the mode, *ME* tells us that each of the four main modes (protus, deuterus, etc.) is "ruled and ended by" (*regitur et finitur*) the final of each mode.[196] This presents another feature besides coherence, cohesion, and tonal identity that is also present in the *De octo tonis* passage: a hierarchy to the pitches of the modes. *ME* places the final at the hierarchical apex, joining the tonal identity of each mode to its last note, made clear by the following passages:

"Demonstrandum nunc, quomodo haec quattuor ptongorum vis modos…."[197]

"It must now be demonstrated how the nature of the four tones [i.e. finals] regulates the modes...."[198]

"Secundam cum cecineris, senties tonum deuterum a sono [signum] deutero gubernari. Tertiam assumens videbis similiter in sono [signum] trito triti toni consistere potestatem. Quartam cum fueris modulatus, intelleges toni tetrardi genus a sono tetrardo [signum] procedere."[199]

"When you sing the second [melody], you will perceive that the deuterus mode is governed by the deuterus tone [E]. Taking the third, you will see that the character (*potestas*) of the tritus mode similarly resides in the tritus tone [F]. When you have sung the fourth, you will understand that the category (*genus*) of the tetrardus mode proceeds from the tetrardus tone [G]."[200]

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[194] On the dating of *ME* and *SE*, see Cohen, "Notes, Scales, and Modes," 323; Atkinson, *The Critical Nexus*, 118.

[195] Rebecca Maloy, "*Scolica* Enchiriadis and the 'Non-Diatonic' Plainsong Tradition," *Early Music History* 28 (2009), 74.

[196] *Musica Enchiriadis and Scolica Enchiriadis*, trans. Raymond Erickson, ed. Claude V. Palisca (New Haven, CT: Yale University Press, 1995), 4; "Musica enchiriadis," Thesaurus musicarum Latinarum (TML), last accessed 2018 Feb 7, source: *Musica et scolica enchiriadis, una cum aliquibus tractatulis adjunctis: recensio nova post Gerbertinam altera ad fidem omnium codicum manuscriptorum*, ed. Hans Schmid, Veröffentlichungen der Musikhistorischen Kommission, Band 3 (München: Bayerische Akademie der Wissenschaften; C. H. Beck, 1981), 1-29, 31-59. <http://boethius.music.indiana.edu/tml/9th-11th/MUSENCI>.

[197] "Musica enchiriadis," Thesaurus musicarum Latinarum (TML). <http://boethius.music.indiana.edu/tml/9th-11th/MUSENCI>.

[198] *Musica Enchiriadis and Scolica Enchiriadis*, trans. Erickson, ed. Palisca, 7.

[199] "Musica enchiriadis," Thesaurus musicarum Latinarum (TML). <http://boethius.music.indiana.edu/tml/9th-11th/MUSENCI>.

[200] *Musica Enchiriadis and Scolica Enchiriadis*, trans. Erickson, ed. Palisca, 9. Note that here, "the four tones" refers to the finals of the modes. The deuterus tone is E, the tritus tone is F, and the tetrardus tone is G.

Here, the finals are given an almost generative capacity, where the entire hierarchy of pitches as well as the tonal quality of each mode "resides in" and "proceeds from" the final. There are many examples discussing the particular quality of notes.

Johannes of Afflighem (also Johannes Cotto), in his *De musica* (c.1100), further corroborates the idea that the modes regulate and order the melodies:

"Modi a moderando sive modulando vocati sunt, quia videlicet per eos cantus moderatur id est regitur, vel modulatur id est componitur."[201]

"They are called 'modes' from moderando [controlling] or modulando [measuring off], obviously because through them chant is 'moderated,' that is, controlled, or 'modulated,' that is composed."[202]

Returning to the *Enchiriadis* treatises, *SE*, which is in the form a dialogue between a master and a disciple, provides an analogy between tonal quality of notes and colours:

"Huc, inquam, ades, ac vide, quomodo in tetracordis vel pentacordis quaternae varietatis ordo disponitur, ut, quotus ab alio quilibet constet sonus, liquido contempleris. Nam sicut in coloribus, si sint quaterni et quaterni locati ex ordine in lineamque dispositi, verbi gratia rubeus, viridis, gilbus, niger, necesse est, ut quisque color tribus aliis interpositis per quintana loca reperiatur…."[203]

"Come here, I say, and see how the arrangement of four-fold variety is disposed in tetrachords and pentachords, so that you will note clearly how far any tone is from another. For just as in colors, if they are ordered in groups of four and put into a series, for example, red, green, yellow, and black, the same color will necessarily be found at every fifth position, with the three other colors in between…."[204]

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[201] Johannes Affligemensis, "De musica cum tonario," Thesaurus musicarum Latinarum (TML), last accessed 2018 Feb 10, source: Johannes Affligemensis, *De musica cum tonario*, ed. J. Smits van Waesberghe, Corpus scriptorum de musica, vol. 1 (Rome: American Institute of Musicology, 1950), 43–200. <http://boethius.music.indiana.edu/tml/9th-11th/JOHDEM>.

[202] Warren Babb, trans. and Claude V. Palisca, ed., *Hucbald, Guido, and John on Music: Three Medieval Treatises* (New Haven: Yale University Press, 1978), 115.

[203] "Scolica enchiriadis de arta musica," Thesaurus musicarum Latinarum (TML), last accessed 2018 Feb 7, source: *Musica et scolica enchiriadis, una cum aliquibus tractatulis adjunctis: recensio nova post Gerbertinam altera ad fidem omnium codicum manuscriptorum*, ed. Hans Schmid, Veröffentlichungen der Musikhistorischen Kommission, Band 3 (München: Bayerische Akademie der Wissenschaften; C. H. Beck, 1981), 60–156. <http://boethius.music.indiana.edu/tml/9th-11th/SCENCH>.

[204] *Musica Enchiriadis and Scolica Enchiriadis*, trans. Erickson, ed. Palisca, 42.

At one point, the disciple tells the master:

"Ad dinoscendum autem, quis sonus ille vel ille sit, velim cognoscere in singulis suae proprietatem qualitatis."[205]

"However, so that I might recognize any given tone, I would like to know the properties of its quality in detail."[206]

For the purpose of recognition, which is a perceptual matter, the student asks to know more about the properties of the quality of the tones, and the master responds by talking about structure. Knowing and understanding the qualities of the tones are treated as having implicit value. The preoccupation with perceiving tonal qualities and explaining them through structure I find opposite to the idea of justifying arbitrary structures through an appeal to qualities.

Guido d'Arezzo also wrote on the special character of each mode to be recognized upon hearing them. In general, he avoids expressive, qualitative descriptions, but they do appear in his writing from time to time, demonstrating that mode was part of his experience and the experience of those about whom he wrote. One colourful example comes from his treatise *Micrologus* (c. 1026-1028):

"Atque ita diversitas troporum diversitati mentium coaptatur ut unus autenti deuteri fractis saltibus delectetur, alius plagae triti eligat voluptatem, uni tetrardi autenti garrulitas magis placet, alter eiusdem plagae suavitatem probat; sic et de reliquis."[207]

"The diversity in the tropes [i.e. the modes] so fits in with the diversity in people's minds that one man is attracted by the intermittent leaps of the authentic deuterus, another chooses the delightfulness of the plagal of the tritus, one is more pleased by the volubility of the authentic tetrardus, another esteems the sweetness of the plagal tetrardus, and so forth."[208]

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[205] "Scolica enchiriadis de arta musica," Thesaurus musicarum Latinarum (TML). <http://boethius.music.indiana.edu/tml/9th-11th/SCENCH>.

[206] *Musica Enchiriadis and Scolica Enchiriaadis*, trans. Erickson, ed. Palisca, 43.

[207] Guido d'Arezzo, "Micrologus," Thesaurus musicarum Latinarum (TML), last accessed 2018 Feb 7, source: Smits van Waesberghe, Joseph, ed., *Guidonis Aretini Micrologus*, Corpus scriptorum de musica (CSM) 4 (Rome: American Institute of Musicology, 1955), 79-234. <http://boethius.music.indiana.edu/tml/9th-11th/GUIMICR>.

[208] Babb, trans. and Palisca, ed., *Hucbald, Guido, and John on Music*, 69.

Johannes of Afflighem also writes of the distinct sound of each mode. One clear example from Chapter 16 reads:

| | |
|---|---|
| "Habent autem modi speciales et inter se diversas sonorum proprietates…."[209] | "The modes have individual qualities of sound, differing from each other…."[210] |

In Guido's treatises and in Johannes' treatise, qualities are often though clearly not always linked to structures, as they were two centuries earlier in the *Enchiriadis* treatises and Hucbald.

These considerations should shift our understanding of mode's relevance to the repertory from mode being mostly a collection of "melodic conventions,"[211] which strikes me as a conception of mode-as-genre, to mode indeed being that but including structural features as well: mode-as-musical-system. Furthermore, stepping lightly, if we wish to follow *ME* for talking about the mode of earlier writers as well, which I do, then we would say that the music was heard as tonally centred, with the tonal identity of each mode being dependent on its tonal centre; in fact, I find it hard to believe that it would have been otherwise.[212]

## 2.4 Compatibility Between Early and Later Carolingian Texts

The question then arises: is *ME*'s conception of mode compatible with earlier sources? The answer is mixed for three reasons. The first reason is differences in the texts' relationships with structural and qualitative discussions of mode, the second is the question of potentially different background scales or gamuts, and the third is an apparent disagreement on which part of a chant defines the mode.

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[209] Johannes Affligemensis, "De musica cum tonario," Thesaurus musicarum Latinarum (TML). <http://boethius.music.indiana.edu/tml/9th-11th/JOHDEM>.
[210] Babb, trans. and Palisca, ed., *Hucbald, Guido, and John on Music*, 133.
[211] Peter Jeffery, "Part II: Mode and Melos," in *The Study of Medieval Chant: Paths and Bridges, East and West*, ed. Peter Jeffery (Cambridge: The Boydell Press, 2001), 130.
[212] Please note that my purpose here is not to point out similarities between medieval modality and common practice tonality, but to investigate the fundamentals of modal theory. Quite apart from that, a study investigating diachronic universals or at least continuities in the Western European musical tradition might prove fruitful, though I do not pursue that here.

### 2.4.1 Structural and Qualitative Discourses

The earlier and slightly later sources have compatible qualitative discussions of mode, but the earliest sources simply say nothing at all on structural aspects, so I cannot decisively claim agreement or disagreement. There are two reasons that I argue for agreement, though. Firstly, the qualitative and quantitative are not explicitly in conflict, nor are they so inherently; they are potentially different dimensions of one thing. Secondly, the fact that eighth-century theorists did not articulate any structurally-based theories does not mean that they did not have musical intuitions that corresponded to structures; in fact, it would be impossible to have musical intuitions on the level discussed here that do not have a structural basis. This is a point that dissolves Falconer's division of "the melodic and systematic."[213] One does not exist without the other, even if the systematic is unconscious, like our internal linguistic grammars are. Likewise, "theorists" before 850 were just barely developing the concept of a note, and therefore they did not have the abstract means to verbalize what their musical intuitions were telling them. So, seeing the possibility that the qualitative and the structural are different dimensions of one greater whole allows us to see that theorists from each generation might have been describing the same experience in different ways.

I wish to stress that focusing on structural aspects and focusing on qualitative impressions were not mutually exclusive. *ME* and *SE* contain numerous qualitative passages that are in many ways as rich as those from *De octo tonis* or Aurelian. Hucbald's treatise, written around the same time as the *Enchiriadis* treatises though slightly younger,[214] focuses heavily on structural matters, hardly leaving any words for colourful metaphors and the like, but it is somewhat unusual in that regard; it should not be taken as a dividing line between structural and qualitative writing. In addition, *Commemoratio Brevis* is a slightly later treatise that still retains both the qualitative and the structural. It is only with the Southern German theorists of the eleventh century that qualitative discussions seem to diminish greatly in modal discourse.[215]

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[213] Keith Falconer, "The Modes Before the Modes: Antiphon and Differentia in Western Chant," in *The Study of Medieval Chant: Paths and Bridges, East and West*, ed. Peter Jeffery (Cambridge: The Boydell Press, 2001), 131-145.
[214] On Hucbald's likely knowledge of *ME* and *SE*, see Atkinson, *The Critical Nexus*, 150.
[215] See Cohen, "Notes, scales, and modes," 351-354.

### 2.4.2 The Gamut: The Background Scale

The second issue in interpreting all of these texts as being largely compatible with each other is the background scale. The *Enchiriadis* treatises both present a radically different scale-system than the gamut apparently used by every other theorist. Nancy Phillips has argued that the daseian scale of the *Enchiriadis* treatises represents the gamut of chant at the time, but the idea has been rejected by most scholars.[216] There is insufficient space for a full overview of the controversy of Phillips' argument here, but my position, as well as that of many others, is that the gamut used in ninth-century Western Europe was one that was mostly diatonic, more complex than that propounded by Hucbald,[217] but close to the later diatonic gamut used by every theorist from the tenth century onwards.[218] As a result, the remarks made by all Carolingian music theorists can be understood as applying to a much more cohesive repertory than the daseian scale might lead us to believe.

### 2.4.3 Modal Determination: Beginnings and Endings

The third issue with joining together the ideas of mode from, on the one side, the early, primarily qualitatively focused sources, such as *De octo tonis*, Aurelian, Regino of Prüm, and early tonaries, and, on the other side, the structurally or both qualitatively and structurally focused *Enchiriadis* treatises, Hucbald, and *Commemoratio brevis*, is the fact that the latter group stresses the final pitch as the primary criteria for determining the mode of a chant, whereas the former group stresses beginnings or nothing at all (since they often do not mention pitches). However, the early sources that do specify something actually specify both the beginnings and the ends. Aurelian tells us in chapter 10 that the beginning is the modal determinant for antiphonal chants:

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[216] Nancy Phillips, "Musica and Scolica enchiriadis: The Literary, Theoretical, and Musical Sources" (PhD. diss., New York University, 1984), 173-174, 470-497.

[217] Hucbald was the earliest medieval theorist to describe and diagram the diatonic gamut, as inherited from ancient Greek music theory. Hucbald used ancient Greek note names as well as intervals, not letter names to describe the gamut. See Babb, trans. and Palisca, ed., *Hucbald, Guido, and John*, 28-35; Hucbald, "De harmonica institutione," Thesaurus musicarum Latinarum (TML), last accessed 2018 Feb 7, source: *Scriptores ecclesiastici de musica sacra potissimum*, 3 vols., ed. Martin Gerbert (St. Blaise: Typis San-Blasianis, 1784); reprint ed., (Hildesheim: Olms, 1963), 1:103–25. <http://boethius.music.indiana.edu/tml/9th-11th/HUCHAR>.

[218] The best treatment of this issue is found in Maloy, "*Scolica Enchiriadis* and the 'Non-Diatonic' Plainsong Tradition," 61-96. For a collection of some of the relevant literature on Phillips' argument regarding the daseian scale, see Atkinson, *The Critical Nexus*, 130-133 n.122. See also Barbara Hebborn, *Die Dasia-Notation,* Orpheus Schriftenreihe zu Grundfragen der Musik 79 (Bonn: Orpheus-Verlag, 1995), especially 47-49.

introits, antiphons, and communions; but then he explains that the end is the modal determinant for offertories, responsories, and invitatories:

"Notandum sane quia in offertoriis et responsoriis atque invitatoriis non aliubi requirendi sunt toni nisi ubi fines versuum intromittuntur, maximeque servandus est sensus litterature quam modulationis. In introitis vero, antiphonis necne communionibus semper in capite requirantur."[219]

"It should well be noticed that in the Offertories, Responsories [i.e., Responsories of Matins as well as Graduals] and Invitatories, the mode (*tonus*) should be sought only at the point where the verses are inserted [i.e., at the end of the Offertory, Gradual, etc.] and where the sense of the text rather than of the melody must especially be preserved. In the Introits, however, as well as in the antiphons and communions, the mode should always be looked for at the beginning."[220]

Regino of Prüm, in his *Epistola de harmonica* (c. 901) [221] writes the equivalent basic message:

"Illud autem summopere prudens cantor observare debet, ut semper magis principium antiphonae, introitus, vel communionis attendant in toni sonoritate, quam finem. Et e contrario in responsories magis considaret finem, et exitum in toni consonantia, quam initium."[222]

"But what the expert cantor ought mainly to observe is that he always attend more to the beginning of the antiphon, of the introit, or of the communion in the sounding of the mode than the end. And, on the contrary, in the responsories he should consider the end and the finishing on a consonance of mode more than the beginning."[223]

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[219] Aurelian of Réome, *Musica disciplina,* ed. Gushee, 89.
[220] The translation here is mostly from Apel, *Gregorian Chant*, 174, but Apel removes the phrase on the sense of the text. I have replaced it with Ponte's translation, Aurelian of Réome, *The Discipline of Music*, trans. Ponte, 28.
[221] Yves Chartier, "Regino of Prüm," 2001, *Grove Music Online*, last accessed 2019 May 27. <https://doi.org/10.1093/gmo/9781561592630.article.23070>.
[222] Edna Marie Le Roux, RSM, "The De harmonica and Tonarius of Regino of Prüm" (PhD diss., Catholic University of America, Washington, DC, 1965), 26-27.
[223] Le Roux, RSM, "The De harmonica and Tonarius of Regino of Prüm," 26-27.

It seems that the longer, more ornate chants did not have beginnings that could be counted on for matching the mode given by the end, and that even though the beginnings mattered enough to be the sole modal determinant for simpler chants, the perceptual weight of the end really did matter too. The shift is not from using beginnings to using endings, but from using either beginnings or endings depending on the context, to using only endings, all the while omitting anything else there is to say about the tonal substance of the music.[224]

I should note that the importance given to beginnings and endings as the main points that determine mode reflects two well-established effects from the study of cognitive psychology: the primacy effect and the recency effect. Both effects involve enhanced recall of items or events based on their position in a series; items at the beginning and at the end are recalled more than those in the middle.[225] Note that these are all short-term memory effects. In a musical context, these effects would relate to local events like beginnings and endings of a chant, and not to events occurring across pieces, for example. The medieval emphasis on beginning and endings can thus be understood as the result of our cognition

## 2.5 Modulatory Hearing vs. The Saturated Monomodal Hearing

The cited passages from the eighth to the eleventh century that highlight coherence, order, regulation, and cohesion tell us that every morsel of a chant was understood as belonging together within *one* mode. I label this the *saturated monomodal* hearing of a chant – *monomodal*

[224] Pesce has argued in an endnote that psalmody explains the emphasis on beginnings: "Both Aurelian's and Regino's remarks must be placed in their proper perspective. They were made in prefaces to tonaries in which chants were grouped according to psalm-tone endings, or *differentiae*. The theorist's task was to explain how to choose a *differentia* that would complement the opening of the antiphon or responsory – hence, the emphasis on chant beginnings. While Regino and Aurelian apparently made their initial modal designations based on the antiphon or responsory ending, it is evident from their tonaries that they sometimes relied on chant beginnings when chants lacked modal unity; in chants of this kind, the beginning suggests a different mode from the ending. Both Regino and Aurelian commented on such chants in their introductions and classified them according to the mode of their opening." In Dolores Pesce, *The Affinities and Medieval Transposition*, 145 n.3. However, if it were *only* the joint between psalm tone *differentiae* and antiphon beginnings that mattered to them, then why the fuss around modulating antiphons and irregular psalm tones (see below)? Why the descriptions of internal modulations within an overarching mode (a monomodal frame; see below)? Why would the complexity of the chant make a difference? Why did beginnings still matter so much to some later theorists, like Guido? I find the argument that psalmody is the only reason for stressing the beginnings of chants highly problematic.

[225] Both are represented as part of the *serial position curve*. Bennett L. Schwartz, *Memory: Foundations and applications* (Thousand Oaks, CA: Sage Publications 2011), 70-74. Therein, the primacy effect is shown as stronger than the recency effect. I have also seen the effect graphed with the highest point at the end, for example, in Ken Gilhooly, Fiona Lyddy, and Frank Pollick, *Cognitive Psychology* (Maidenhead, UK: McGraw-Hill Education, 2014), 120-121.

because there is only one mode, and *saturated* because each moment is filled by the mode. This concept defines how we commonly discuss chants and mode, and it is certainly in agreement with the way Aurelian, the *Enchiriadis* treatises, Hucbald, Guido, Johannes, and others discuss modal determination, as we have seen.

As I wrote earlier, beginning with Hucbald and the *Enchiriadis* treatises, only the final note of a chant was used to determine the mode. If we combine this interpretation with that of saturated monomodality, then we arrive at a listening experience where, upon hearing the final note of a chant for the first time, the listener would project the final sense of mode backwards, retrospectively reinterpreting the whole piece. This, however, is counterintuitive, and its perceptual plausibility is, frankly, dubious at best. If we combine the earlier method (where the beginning can matter) with that of saturated monomodality, then we arrive at a listening experience where, upon hearing an opening stock melodic phrase associated with a mode or more generally, music that is structurally modal, then the listener would project the sense of the mode forward throughout the chant. This seems far more plausible, although one's capacity to maintain a definitive sense of the mode would surely be stretched by a complicated chant, and such a reading neglects how we might intuitively weigh the importance of the end. Of course, the medieval perception of this stretch is supported by Aurelian and Regino not being able to choose fully between beginnings and endings, implicitly showing that neither could do fully.

### 2.5.1 Perceiving Mode at Beginnings, Endings, and Everywhere Else

There is a still larger principle implicit in the early theorists' directions, though: when Aurelian and Regino tell us to choose the mode based on the beginning of an antiphonal chant, it means that one would perceive the mode at the beginning, and this ability to hear the mode would not mysteriously disappear when hearing the beginning of what would *become* a longer, more complicated chant, regardless of Aurelian and Regino's instructions for figuring out the mode. If they heard mode at the beginning of all antiphonal chants, then they surely heard mode at the beginning of all other chants as well, regardless of what followed the beginnings.[226]

Furthermore, documentation of the ability to hear mode in music before the final note is not limited to the Carolingians. Guido d'Arezzo provides a few examples. In *Micrologus* (c. 1026-

[226] Distinguishing between the two purposes of discussions of mode also allows us to understand more easily why "Aurelian assigns *Nos qui vivimus* and the other antiphons of its type to the eleventh and last *differentia* of the seventh mode, though in his discussion, he clearly intends them to be sung with the *tonus peregrines.*" Falconer, "The Modes Before the Modes," 141.

1028), Chapter 11, he writes that the final is what determines the mode, and he rejects using beginnings:

"Praeterea cum aliquem cantare audimus, primam eius vocem cuius modi sit, ignoramus, quia utrum toni, semitonia reliquaeve species sequantur, nescimus. Finito vero cantu ultimae vocis modum ex praeteritis aperte cognoscimus."[227]

"Furthermore, when we hear someone sing, we do not know what mode his first note is in, since we do not know whether tones, semitones, or other intervals will follow. But when the chant has ended, we know clearly from the preceding notes the mode of the last one."[228]

Here, Guido dismisses the first note as having no relevance to the mode of a chant, since we do not know the mode of the first note, but this is not what was referred to by beginnings. Guido fails to consider or perhaps to include a chant's opening more generally, such as an opening melodic formula or even just a few notes. Furthermore, Guido implicitly contradicts himself two chapters later, writing about melodic formulas specific to the modes, for which he uses the word "neumes":

"Ad quos in cantibus discernendos etiam quaedam neumae inventae sunt, ex quarum aptitudine ita modum cantionis agnoscimus sicut saepe ex aptitudine corporis quae cuius sit tunica, reperimus, ut [ musical example] Mox enim ut cum fine alicuius antiphonae hanc neumam bene viderimus convenire, quod autenti proti sit non opus est dubitare; sic et de reliquis."[229]

"For ascertaining these modes in chants, certain *neumes* [i.e. melodic formulas] have been composed, so that we learn the mode of the chant from the way it fits these, just as we often discover from the way it fits the body which tunic is whose. For example, [musical example] as soon as we have seen that this neume accords with the end of an antiphon, there is no need to doubt that it is authentic protus; and similarly with the other modes."[230]

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[227] Guido d'Arezzo, "Micrologus," Thesaurus musicarum Latinarum (TML). <http://boethius.music.indiana.edu/tml/9th-11th/GUIMICR>.
[228] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 67.
[229] Guido d'Arezzo, "Micrologus," Thesaurus musicarum Latinarum (TML). <http://boethius.music.indiana.edu/tml/9th-11th/GUIMICR>.
[230] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 68.

If one can ascertain the mode from hearing a melodic formula, then one can ascertain the mode at the beginning if a melodic formula opens the chant, and more generally, one can recognize the mode from a passage of music without referring to a decisive final note. In addition, the phrase "as soon as we have seen that this neume accords with the end of an antiphon…" reveals Guido as knowing the mode of the formula but relying on the final to confirm that same mode for the whole antiphon; the confirmation from the final legitimated the first modal determination.

Additionally, at the outset of the following chapter, Guido writes:

| | |
|---|---|
| "Horum quidam troporum exercitati ita proprietates et discretas ut ita dicam, facies extemplo ut audierint, recognoscunt…."[231] | "Some men who are well trained in the particular characters and, so to say, the individual features of these tropes [modes] recognize them the instant they hear them…."[232] |

This is an unequivocal description of people identifying mode from the opening of a chant, and that quite quickly as well. This apparent contradiction between instructing the reader to rely solely on the final for determining the mode and recognizing the mode of melodies based on the presence of, or similarity to, melodic formulas is also present in the later *Regule rithmice*.[233]

Johannes of Afflighem also takes the familiar position that the final is what determines the mode, but in Chapter 11 of *De musica*, he takes the point even further, writing:

| | |
|---|---|
| "Sciendum autem quod tota vis cantus ad finales respicit."[234] | "Now it should be known that the *whole quality of chant* turns on the finals."[235] [Emphasis mine.] |

[231] Guido d'Arezzo, "Micrologus," Thesaurus musicarum Latinarum (TML). <http://boethius.music.indiana.edu/tml/9th-11th/GUIMICR>.
[232] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 69.
[233] Compare Dolores Pesce, *Guido d'Arezzo's* Regule rithmice, Prologus in antiphonarium, and Epistola ad michahelem*: a critical text and translation, with an introduction, annotations, indices, and new manuscript inventories*, Musicological Studies Vol. LXXIII (Ottawa, Canada: The Institute of Mediaeval Music, 1999), 366-367 on finals, and 380-381 on neumes.
[234] Johannes Affligemensis, "De musica cum tonario," Thesaurus musicarum Latinarum (TML). <http://boethius.music.indiana.edu/tml/9th-11th/JOHDEM>.
[235] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 118.

Yet Johannes, in Chapter 16 of *De musica*, corroborates in a more general sense (without reference to modal formulas) Guido's point of immediate recognition of the mode upon hearing a chant, thus imitating Guido's self-contradiction as well:

"Habent autem modi speciales et inter se diversas sonorum proprietates, adeo ut diligenti musico seu etiam exercitato cantori cognitionem sui ultro ingerant. …ita nimirum musicus, non autem solo nomine, audita qualibet harmonia statim cuius toni sit agnoscit; quamvis tamen hoc in aliquantis fallat."[236]

"The modes have individual qualities of sound, differing from each other, so that they prompt spontaneous recognition by an attentive musician or even by a practiced singer. …so it is no wonder that a musician, when he hears any music, recognizes at once what tone it is in – and not simply by label, though the sound may deceive in some cases."[237]

The *perceived* mode was not determined only by the final, nor did it need the final; rather, modal perception was inevitable throughout the music. I further contend that the monomodal prescription was artificial and purely theoretical.

I posit that for all medieval discussions of mode, there are at least two possible purposes. The first is to classify a chant. To be clear, this is the "bottom-line" classification: the answer to the question "what is the (overall) mode of this chant?", which is what theorists were after when cataloguing and organizing chants for their coordination with recitation formulas. The second purpose is to describe the aural or perceptual experience and musical intuitions associated with mode, usually in relation to parts of chants or melodic material in general.

Each of the two purposes is conceptually distinct, but they are often intertwined, or more accurately, confused and conflated in medieval discussions of mode. However, often enough, only one purpose is primary. By my reading, the confusion of these two purposes is the source of most medieval theorists' modal bewilderment and most of our confusion regarding their engagement with mode.

[236] Johannes Affligemensis, "De musica cum tonario," Thesaurus musicarum Latinarum (TML). <http://boethius.music.indiana.edu/tml/9th-11th/JOHDEM>.
[237] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 133.

There are two more groups of historical evidence for a modulatory understanding of medieval mode that I wish to present. The first is the anomaly that is the *parapteres*. The second is medieval modal treatises' implicit recognition of modulation.

### 2.5.2 The Parapteres

As the short *De modis musicis* from c. 850 explains, the *parapteres* are four extra modes created to accommodate chants that begin and end in different modes. Connected to them are irregular psalm tones, which reverse the tonal scheme of the *parapteres* in order to be matched with those irregular antiphons (see Figure 2.1, below).

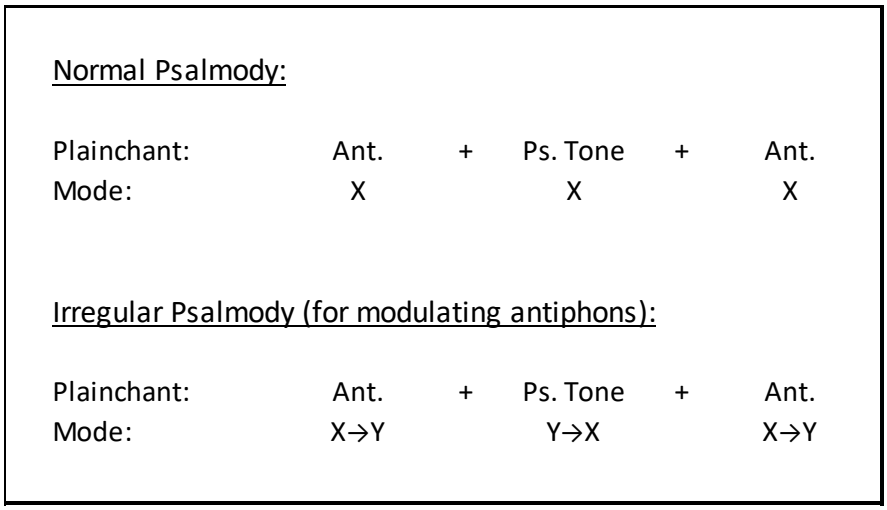


**Figure 2.1** Mode in Normal and Irregular Psalmody
"X" and "Y" represent different modes. "Ant." abbreviates *antiphon*; "Ps. Tone" abbreviates *psalm tone*.

The *tonus peregrinus* originated in this context; it was once one of many irregular tones in use.[238] The *parapteres* show us unambiguously that some chants were recognized as modulating, which contradicts the theorists' insistence that every chant be classified under a single mode. More interesting still is Aurelian's account of those irregular psalm tones in *Musica disciplina*:

[238] Terence Bailey, "*De Modis Musicis*: A New Edition and Explanation," *Kirchenmusikalisches Jahrbuch* 61-62 (1977-1978): 47-60.

"Licet negent quidam has toni huius habere consonantiam, sed tamen falluntur. .... Etenim quidam volunt earum versus cum ipsorum reciprocatione, nescio sub quo neophyto coniungere tono. Verumtamen mentiuntur, quia multo ante he inente sunt quam hi toni, et multa annorum precessere curricula quod in gremio sanctae canuntur ecclesiae."[239]

"Although some say that these antiphons do not have the sonority of this mode, they are nevertheless mistaken. .... Certain people wish to join the verses of these antiphons with their reciprocal portion by means of some new-fangled Tone, but they are mistaken, because these antiphons were devised long before such Tones were and many cycles of years preceded (such Tones), because these antlphons are sung in the lap of [the] Holy Church."[240]

In another section, Aurelian writes:

"Extitere etenim nonnulli canto res qui quasdam esse antiphonas quae nulle earum regulae possent aptari asserverunt."[241]

"There used to be some singers who complained that there were certain antiphons that could not be fitted to any of the rules."[242]

These passages refer to practices related only to modulating antiphons and irregular psalm tones. Regardless of the disapproval of some theorists, the new "modes" filled a need. Singers of the day apparently had particular difficulty with modulating antiphons, which is reflected by the fact that it is only in dealing with those modulating antiphons that those singers proposed new modes and irregular psalm tones, thus breaking with the prescribed set of modes. I should note that it is not clear from Aurelian's anecdote whether it was all modulations that so

[239] Aurelian of Réome, *Musica disciplina,* ed. Gushee, 110.
[240] Aurelian of Réome, *The Discipline of Music*, trans. Ponte, 41.
[241] Aurelian of Réome, *Musica disciplina,* ed. Gushee, 82.
[242] Aurelian of Réome, *The Discipline of Music*, trans. Ponte, 24. In Aurelian's treatise, the position on the *parapteres* and related tones is predictably inconsistent, and the extra modes and tones are treated in entirely separate sections without reference to each other. Compare Aurelian of Réome, *The Discipline of Music*, trans. Ponte, Chapter VIII, 24; Chapter XV, 38; Chapter XVI, 41. As I wrote above, Aurelian's treatise is a collection of sources, not a unified work written by a single theorist. Moreover, even with all the inconsistencies of prescriptions, we know from Atkinson's work on Regino and Aurelian that the antiphons listed in Aurelian's *Musica disciplina* are the modulating *nothae* antiphons listed by Regino (described below), which confirms the connection between Aurelian's modulating antiphons and the *parapteres.* See Atkinson, "The *Parapteres*: *Nothi* or Not?" *The Musical Quarterly* 68 (January 1982): 32-59.

confused the singers or just the sharp modulation that would occur at the end of one chant and the beginning of the next, such as with a modulating antiphon being joined with a psalm tone, but the context (of the first passage cited, at least) suggests that it was the latter: sharp modulations from the end of one chant to the beginning of the next. Singers devised these new modes and tones in order to accommodate their modal intuitions. Mode was not superficial, and apparently, neither was modulation.

In addition, Atkinson has shown that the *parapteres* do continue to appear in treatises and more so tonaries from the ninth century through to the thirteenth. Yet the *parapteres* are barely mentioned in most treatises if at all, and when they are discussed, they are dismissed in favour of the higher-prestige "traditional" eight modes. With theorists holding them in such low regard and giving them only slight attention in prose, I believe that their utility kept them in use against the weight of their low prestige. These extra modes and associated psalm tones could not have persisted had they not had a continued usefulness.

Note that although later theorists do not mention the *parapteres* themselves, some continued to wrestle with the modulating antiphons associated with them, namely Johannes of Afflighem and the *Summa musice* author, as we will see below.

### 2.5.3 Modulation in Medieval Modal Theory

This brings us to our second body of evidence. Revisiting medieval treatises with an eye for the authors recognizing different modal regions within a given chant, i.e., recognizing modulation, firstly reveals not only that a saturated monomodal interpretation is never explicitly given, but that a modulatory interpretation is, and secondly, that mode was indeed heard throughout chants, not only with the arrival of the final note.[243]

[243] I should mention that I am not the first to write on modulation in medieval music; Hans Tischler touched on the subject in a short article, but his treatment is exceedingly problematic. Firstly, it is extremely brief; his article contains only four pages of prose. Secondly, he makes no reference to medieval treatises nor to monophonic music upon which to base his claims. As a result, the few modal determinants he proposes are disconnected from the texts and the music. Finally, there is only one late polyphonic musical example to illustrate his point. Returning to the third point: Tischler claims that mode is signalled by three things: cadences, modal formulas, and "stress on certain intervals related to the modal 'tonic,'" and he gives rhythm as a fourth signifier for mensural music. In Hans Tischler, "Mode, modulation, and transposition in medieval songs." *The Journal of Musicology* 13, no. 2 (1995): 277. In the current and following chapter, I cover the accounts of medieval theorists and the modal structures they discuss, and I further include quantifiable measures that are derived from these discussions.

Tischler's position on mode in polyphony is also highly problematic; I will return to it in Chapter 5, when analyzing mode in organum. (See n. 551.)

Take, for example, a (somewhat perplexing) passage from Aurelian, Chapter 12, from which we can glean that there is a variety of modes being observed in a single antiphon:

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|---|---|
| "Antiphona autem quae inicium habuerit authenti deuteri et finis eius desierit de plagis triti, non finietur de plagis triti sed de autentu tetrardi, quia insemet retinent quandam conexionem autentus deuterus et autentus tetrardus in sui fine…."[244] | "An antiphon that begins in the second authentic and ends in the third plagal will not be terminated (at its last occurrence) in the third plagal, but in the fourth authentic, because the second authentic and the fourth authentic retain a certain connection at their end…."[245] |

Modulation is also implied in the following rule given by Hucbald:

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|---|---|
| "…ita ut ad aliquam ipsarum quatuor quantavis ultra citraque variabiliter circumacta, necessario omnis, quaecumque fuerit, redigatur cantilena."[246] | "...any melody whatsoever is perforce classified under some one of these four pairs of modes, however variously it ranges about, whether far afield or close to the final."[247] |

Regino writes in his *Epistola de harmonica institutione* (c. 900) about antiphons that move through three modes:

| | |
|---|---|
| "Sunt namque quaedam antiphonae, quas nothas, id est degeneres et non legitimas, appellamus, quae ab uno tono incipiunt, alterius sunt in medio, et in tertio finiuntur."[248] | "There are certain antiphons that we call *nothae* – that is, degenerate and illegitimate – that begin in one tone, are yet another in the middle, and end in a third."[249] |

[244] Aurelian of Réome, *Musica disciplina,* ed. Gushee, 95.
[245] Aurelian of Réome, *The Discipline of Music*, trans. Ponte, 32.
[246] Hucbald, "De harmonica institutione," Thesaurus musicarum Latinarum (TML), last accessed 2018 Feb 7, source: *Scriptores ecclesiastici de musica sacra potissimum*, 3 vols., ed. Martin Gerbert (St. Blaise: Typis San-Blasianis, 1784); reprint ed., (Hildesheim: Olms, 1963), 1:103–25. <http://boethius.music.indiana.edu/tml/9th-11th/HUCHAR>.
[247] Babb, trans. and Palisca, ed., *Hucbald, Guido, and John*, 39.
[248] *Scriptores ecclesiastici de musica sacra potissimum*, 3 vols., ed. Martin Gerbert (St. Blasien, Typis S. Blasiensis, 1784; repr., Milan: Bollettino bibliografico musicale, 1931), 1: 231a; Bernhard, *Clavis Gerberti*, 40) as cited in Atkinson, *Critical Nexus*, 168 n.54.
[249] Atkinson, "The *Parapteres*: *Nothi* or Not?," 46.

Such an awareness is also apparent in the *Commemoratio*:

"Hoc uero admonendum quia quaedam non eiusdem toni antiphonae indiscretam iniciorum similitudinem habent, ut in sequentiis cui melo quaeque aptanda sit uideatur, et maxime cuiusque cantus attendatur finis in quo cuiusque toni proprietas euidentius claret…."[250]

"A word of caution: certain antiphons not belonging to the same mode have such similar beginnings that to continue one with the melody of the other would seem quite natural; special attention must be paid to the ending of each chant, where the indication of its mode appears most clearly…."[251]

The *Commemoratio* makes it clear that the recommendation for using the end as the primary determinant of the mode is based on the end's *relative* strength, not on its absolute retrospective saturating power.

Such passages presupposing modulation are very much present in later treatises as well. Numerous examples are available in Johannes of Afflighem's *De musica*, especially ones following the form of the previous *Commemoratio* quotation, where the beginning and ending modes are specified, but the beginning mode is dismissed or corrected in favour of the ending mode. For example:

"Falluntur etiam persaepe indocti cantores in iudicandis tonis ex similibus cantuum principiis; verbi gratia multi hanc antiphonam Iste puer plagi deutero adiudicant, quia in inceptione convenit cum ista antiphona In odore; est autem Iste puer autenti proti, In odore plagis deuteri."[252]

"Uneducated singers very often go wrong in judging the tones [modes] from similar beginnings of chants. For example, many assign the antiphon *Iste puer* to the plagal deuterus, because at the beginning it agrees with the antiphon *In odore*. Yet *Iste puer* is in the authentic protus and *In odore* in the plagal deuterus."[253]

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[250] Terence Bailey, ed., *Commemoratio Brevis de Tonis et Psalmis Modulandis,* Introduction, Critical Edition, Translation (Ottawa, Ont: University of Ottawa Press, 1979), 98.
[251] Terence Bailey, ed., *Commemoratio Brevis de Tonis et Psalmis Modulandis*, 99.
[252] Johannes Affligemensis, "De musica cum tonario," Thesaurus musicarum Latinarum (TML. <http://boethius.music.indiana.edu/tml/9th-11th/JOHDEM>.
[253] Babb, trans. and Palisca, ed., *Hucbald, Guido, and John*, 131.

Also like the *Commemoratio*, Johannes mentions similar beginnings as the source of confusion. Since there is no other evidence to suggest that Johannes was aware of the *Commemoratio*, this coincidence of material is perhaps another example of continuity in medieval modal theory. Johannes writes in an earlier example, this time echoing Hucbald, again without any other evidence to suggest that he was aware of Hucbald's treatise:

"Nam ubicumque cantus incipiatur et quomodocumque varietur, semper ei modo adiudicandus est, in cuius finali cessaverit."[254]

"Wherever a chant begins and however it is diversified, it is always to be assigned to that mode on whose final it ends."[255]

Johannes gives us more than a dozen such passages on modally-mismatched beginnings and endings in both responsories and antiphons, but for brevity's sake, the above examples will suffice.[256]

The author of the *Summa musice* (c. 1200) writes similarly to Johannes and to Hucbald here:

"Dictum est quod cantus uniuscuiusque toni maxime penes finem attenditur et etiam iudicatur, et hoc est dicere quamvis cantus aliquis in principio toni specialis alicuius proprietates habeat, et in medio magis assimiletur adhuc eidem, in fine tamen ei precipue adaptatur."[257]

"It has been explained that a chant of any mode is chiefly considered and judged in the region of its close. This means that however much a chant may display the characteristics of a particular mode at its beginning and may yet move closer to that same mode in the middle, it is chiefly adapted to [its mode] at the end."[258]

Moreover, the *Summa musice*, after Johannes, contains similarly constructed passages for chants that seem to begin and end in different modes. The author mentions some of the same

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[254] Johannes Affligemensis, "De musica cum tonario," Thesaurus musicarum Latinarum (TML). <http://boethius.music.indiana.edu/tml/9th-11th/JOHDEM>.
[255] Babb, trans. and Palisca, ed., *Hucbald, Guido, and John*, 118.
[256] For more examples, see Babb, trans. and Palisca, ed., *Hucbald, Guido, and John*, 118, 131-133, 133-135. Note that Johannes' list includes some of the *nothae* antiphons, but many of his examples are not found in the comprehensive list in Atkinson, "The *Parapteres*: *Nothi* or Not?" 36-37. This warrants further research.
[257] Page, ed. and trans., *Summa musice*, 178.
[258] Page, ed. and trans., *Summa musice*, 98.

chants as Johannes did, although like Guido, the author refers to modal formulas, which he terms *tropus* (and which Christopher Page translates as "turn"), for example:

"Quandoque tropus oritur in cantus medio, quandoque ante finem non longe a fine, sicut patet in hoc responsorio *Preparate corda vestra domino* quod in principio videtur authenti proti, id est primi, in fine autem desinit in E la mi et proto deutero, id est tercio, deputatur; responsorium etiam *Gaude Maria*, quod in principio et in medio est deuteri authenti, id est tercii, in fine autem datur plagi tertio, id est sexto."[259]

"Sometimes, the 'turn' arises in the middle of a chant, sometimes before the end not far from the close as can be seen in the responsory *Preparate corda vestra domino* whose beginning is of the authentic Protus, that is to say of the first [mode], but which closes on E and therefore moves from the Protus to the Deuterus, the third mode. So too in the responsory *Gaude Maria,* because at the beginning and in the middle it is of the authentic Deuterus, the third mode, but it is assigned to the third plagal mode at the end, however, that is to say the sixth."[260]

The *Summa musice* goes on to provide examples of antiphons that are finished in different modes depending on the church in which they are sung, the modal regions of which he still assigns unambiguously.[261]

It would seem, therefore, that the question of whether beginnings or endings determined mode is *perceptually* irrelevant; rather, every moment signifies mode. Every little bit of chant can carry modal information, and it would seem that mode was very much part of the medieval listening and singing experience, enough so for singers to be confused by modal disjunctions. If mode was perceptually relevant, then so was modulation. It is therefore not only the *parapteres* antiphons that can be deemed modulating, but many other chants, especially the more ornate ones.

[259] Page, ed. and trans., *Summa musice*, 186.
[260] Page, ed. and trans., *Summa musice*, 107.
[261] Page, ed. and trans., *Summa musice*, 107-108.

## 2.6 Legitimacy and Framing Monomodality

There is yet another dimension to all of this, illuminated by another *Commemoratio* quotation:

"Sunt etiam, ad quas canendi sunt psalmi, iuxta principalis melodiam cum subiugalis habeant finem. Aut iuxta subiugalem modulentur et in principalem desinant. Sunt qui non in finalem sonum terminantur sed in grauiorem qui sub se est. Repetit autem neuma finalis illum in quo legitime cantus consistit et finit vt: [music example follows.]"

"Moreover, there are some antiphons, ones which require the singing of psalms, which combine an authentic melody with a plagal ending, or which close in the authentic, having been sung in the plagal. There are others which do not terminate with the *finalis,* but on a lower note. The concluding melisma, however, returns ultimately to the note on which the chant legitimately comes to a close: [music example follows]."[262]

Here, the *Commemoratio* first discusses extensions and changes to the ambitus in the course of a chant. Then we are told that there are phrases that end on notes other than the final. But crucially, we are told that all those considerations apply to *internal* phrases, and that the *legitimate* end concludes where expected. Modulation is an internal affair, but chants are legitimate when they end as they begin. In other words, there can be a diversity of modal regions within a monomodal frame, which I call *framing monomodality*, and legitimacy is in part determined by respecting that frame.[263]

The most obvious and the most severe identification and condemnation of illegitimacy is illustrated in Regino's *Epistola*, quoted earlier; Regino labelled antiphons beginning and ending in different modes, that is those associated with the *parapteres*, "*nothae* antiphons," and as Atkinson explains, "the term *nothae* is derived from the Greek ... [nothos], meaning 'illegitimate,

[262] Bailey, *Commemoratio brevis*, 100-101.

[263] Note that monomodal frames are not the only basis for judging legitimacy, however. Falconer writes: "A famous series of examples in the *Scolica Enchiriadis* … confirms the existence of awkward semitones, here named *absoni* ('defective') or *uitia* ('defects'), in chants 'just as barbarisms and solecisms are frequently intermixed figuratively into metric verse, so too are semitones *(limmata)* inserted into chants as a result of conscientiousness.' Unfortunately, since the only examples the treatise offers are diagrammatic, there is no reason to suppose that the chants in question belonged to the Gregorian repertory." Falconer, "The Modes Before the Modes", 133 n.7.

born out of wedlock.'"[264] However, these antiphons were so-called not only because they modulated, which many chants did, but because they did not maintain a monomodal frame.

Why is it that internal modulations were not condemned in the way that a polymodal frame was? I would speculate that there would have to be an orthodoxy about the unwritten rule that every chant belonged to a single mode, which itself likely originated from an observation of short, simple chants, i.e. antiphons. A theorist fervently dedicated to this concept could deceive himself into thinking that internal modulations were perhaps not travels to other modal regions at all (even though this would contradict the medieval theorists' own accounts, as demonstrated above); however, contrasting beginnings and ends demand recognition. Internal modulations would not disturb the classification of a chant, since the two most important points for modal determination, the beginning and the end, would still be in agreement. Nevertheless, as we have seen, some theorists, like Johannes of Afflighem went as far as denying the initial mode altogether in favour of an overarching mode that matched the final.

To summarize so far, after a close reading of major medieval modal treatises, I have come to two major conclusions: firstly, every bit of chant and certainly every phrase carries modal signification; and secondly, legitimacy was dependent on a specific notion of modal unity, namely chants having a monomodal frame.

## 2.7 Falconer and the Importation of the Eight-Mode System

So far, however, I have omitted discussion of the fact that the modes were imported from Byzantium as the *octoechos*, likely in the eighth century.[265] I have also ignored matters involving the *differentiae*, the cadential formulas associated with reciting tones, as well as early tonaries and methods of classification predating the existence of writings about classification. All of these factors are brilliantly brought together by Keith Falconer's essay "The Modes Before the Modes," and so before closing, I will address his points in particular.[266]

[264] Atkinson, "The *Parapteres*: *Nothi* or Not?" 46.
[265] Falconer, "The Modes Before the Modes," 143.
[266] Falconer, "The Modes Before the Modes," 131-145.

### 2.7.1 Simplification and Systematization of Musical Classification

Falconer has explained that the *differentiae* might have predated the acceptance of the *octoechos* in the West.[267] In the earliest sources, antiphons were grouped by families of opening melodic formulas[268] and then associated with *differentiae*, but classification was informal and inconsistent, and the number and form of *differentiae* vary greatly across sources.[269] In many tonaries after the eighth century, *differentiae* are used as a subcategory of mode, but again without any consistency across sources.[270] As Falconer has put it, "With the acceptance of the *octoechos*..., a smaller number of larger categories (the eight modes) absorbed the larger number of smaller categories (the *differentiae*) that had previously governed Western chant."[271] Mode simplified and, to some extent, systematized classification.

I take this assertion not just to be correct, but also to be a partial explanation for why the modes were such a successful import, especially since Falconer's exploration of mode is primarily negative. He has emphasized the foreignness of mode: it was not the theory that originated with the core repertory and thus not the most appropriate for reflecting the earliest intuitions behind the pre-mode organization of antiphons that was just starting to develop when mode arrived. Falconer is not alone here: David Hiley has written "that the eight-mode system was imposed in

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[267] Falconer, "The Modes Before the Modes", 138. Falconer has connected the issue of dating the origins of the modes and the *differentiae* in the West to modulating antiphons and so-called modally ambiguous antiphons. In a passage immediately preceding the discussion of dating, Falconer has raised the following questions: "…should we consider every antiphon belonging to this *differentia* as potentially ambiguous just because some of them are? Or do strictly *modal* ambiguities make little difference to *differentia* assignments? Perhaps we may assume, in the absence of any other information, that each antiphon in the tonary was at least typical of something - but what?" I believe the perspective I have offered responds in large part to these questions, but I acknowledge that they are not comprehensive answers. Moreover, they do not take away from Falconer's point that "Contrasting the modes and the *differentiae* as categories for antiphon classification raises all sorts of questions - questions of date, of provenance, of precedence." Falconer, "The Modes Before the Modes," 138.

[268] Gevaert famously created the first catalogue of these opening melodies, which he called "themes," and which Falconer refers to frequently. See François Auguste Gevaert, *La mélopée antique dans le chant de l'église latine* (Ghent, 1895). Other groupings exist, however; for a brief overview of these, see David Hiley, *Western Plainchant: A Handbook*, 89-90.

[269] Falconer, "The Modes Before the Modes," 143. He has written "depend[ing] on melodic as opposed to systematic criteria…." This division is valuable, but it ignores the fact that when mode was first accepted into the West, it did not explicitly have systematic criteria, at least not in the extant documentation. As noted earlier, *De octo tonis* has no structural content whatsoever. See also Peter Jeffery, "The earliest oktoechoi: the role of Jerusalem and Palestine in the beginnings of modal ordering," in *The Study of Medieval Chant: Paths and Bridges, East and West*, ed. Peter Jeffery (Cambridge: The Boydell Press, 2001), 161-177.

[270] Falconer, "The Modes Before the Modes," 136.

[271] Falconer, "The Modes Before the Modes," 142.

the West on a chant repertory not originally so conceived."[272] Falconer has therefore stressed the ways in which mode did *not* fit the music. Take, for example, antiphon classification by mode: as we have seen, many chants begin similarly though ending differently, and when they are organized by final (as by later modal theory), what results is a number of antiphons *divided* by mode even though they would have been grouped together under the same *differentia(e)* before modal theory existed. Later modal theory thus created unnatural divisions.

While true, this view prompts me to question whether simpler classification would be enough of an explanation for mode's appeal when it would create significant classification problems along the way. Why solve one problem by creating a similar problem?

### 2.7.2 Recognition and Musical Relevance

Before offering my answer, we should recall the division of purposes I posited in the preliminary part of my chapter. To be absolutely clear, I completely concur with Falconer's more negative position on mode with regards to mode-as-classification-measure, but when I take the perspective of mode-as-theory-reflecting-musical-intuition, I find his arguments incomplete.

Earlier, I mentioned the idea of many chants being modally classified only for the supposed sake of consistency, since no plain practical purpose presents itself. Falconer has mentioned a similar situation, specifically with the St. Riquier tonary.[273] He has proposed that the practical value of such assignments may have been pedagogical instead of performative, but I have a more innocent or – dare I say – fun idea: the writers at this turning point were just *happy* to be able to assign mode because they finally had a theory that could capture crucial musical intuitions that had hitherto gone without the means to be articulated.

My view is that even though it was imported, mode corresponded to certain deep musical intuitions held in Western Europe. Rather than seeing the *octoechos* as a foreign construct arbitrarily applied to chant, I see its reception as much like the experience of recognition, like when a friend finds the exact word for which I have been searching. The foreignness cannot be taken for granted, but neither can the possibility that mode worked on a fundamental, intuitive

[272] David Hiley, *Western Plainchant: A Handbook*, 454. As evidence, however, Hiley has only offered the shift from using beginnings to using finals to determine the mode of the chant, which I have addressed.
[273] Falconer has explained that the St. Riquier tonary from the late 700s assigns modes to graduals, alleluias, and offertories, "which require neither psalm tones nor *differentiae*, and [the tonary] omits *differentiae* for the chants that do require them." Falconer, "The Modes Before the Modes," 140.

level. Without perceptual relevance to those importing the *octoechos*, I see no reason why they would import it at all.

We should also observe that there was no person or institution in a position of power that imposed the *octoechos* on chant repertories and then enforced that imposition. I use the word "enforce," because when something is not native and it is perceptually irrelevant or significantly different structurally, there must either be some internal appeal or some external enforcement, the latter of which is provided by prescriptive institutions. However, there is no sign of enforcement, nor is there evidence that the *octoechos* were originally associated with prestige; there are no extant documents that promote, promulgate, or show off the *octoechos*, nor documents that belittle those who would not adopt them.[274] Note as well that the importation of the o*ctoechos* predates Charlemagne's rise to power and the Carolingian educational and liturgical reforms.[275]

### 2.7.3 Mode's Limitations in Accommodating Western Chant

In support of his view, though, Falconer has demonstrated the limitations of modal theory for accommodating the repertory. He writes "…even the most comprehensive attempts to classify [Gregorian chant] reveal numerous chants that fall both within and without the modes to which they are assigned."[276] Some antiphons modulate or resist categorization because of two things: firstly, the introduction of a new pitch that sounded foreign to the mode, and secondly, what Falconer has deemed *confusion* due to similar antiphon melodies with different modal assignments.[277]

#### 2.7.3.1 Pitches Beyond the Gamut

Pitches foreign to the modes were dealt with in two ways: firstly, *transpositions* down a fifth of whole chants or problematic phrases thereof, and secondly, *transformation*: the alteration of problematic pitches or phrases.[278] These modally foreign pitches survived in transposed chants as B-flats and B-naturals, which would originally have been F-naturals and F-sharps. F-sharp was not properly theorized in the middle ages; it had no place in the diatonic gamut, described in

[274] Peter Jeffery, "The earliest oktoechoi," 161-177.
[275] Jeffery, "The earliest oktoechoi," 147, 163.
[276] Falconer, "The Modes Before the Modes," 131.
[277] Falconer, "The Modes Before the Modes," 134-135.
[278] Falconer, "The Modes Before the Modes," 132.

modal theory from Hucbald onwards,[279] and therefore, they were not easily conceptualized and there was no way to notate them (at least outside of the daseian scale).[280] There is no denying that the eight modes had no place for these notes. This absence, however, leaves room for modern music theory.

#### 2.7.3.2 Supposed Modal Ambiguity

As for the so-called confusing or ambiguous antiphons, though, Falconer's examples are antiphons that open with the same melody but close on different finals and thus in different modes.[281] The medieval writers clearly and easily marked the mode of each section of chant, though. The classification was difficult only because of medieval theorists' need to assign one mode to each chant, even to chants that modulate, but the theorists always knew the various modes involved in the modulations.

Aurelian, for example, unambiguously described the antiphon *Malos male perdet* as beginning in mode 3, moving through mode 6, and ending in mode 7. Falconer has proposed that this might be the result of Aurelian having confused two antiphons with similar beginnings, but even if this is true, the more important point to me is that Aurelian did not seem at all confused by the presence of modulations or their end-points or beginning-points.[282]

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[279] The main theorists responsible for establishing the form of the diatonic gamut in the middle ages were Hucbald, Pseudo-Odo, and finally Guido d'Arezzo. However, Hucbald's gamut was inherited from ancient Greek music theory, and while Guido's *Micrologus* set forth what would become the gamut's standard form and notation, including letter names for notes, its construction was almost exactly the same as Hucbald's gamut. On the development of the gamut, see Cohen, "Notes, Scales, and Modes," 340-341.

[280] Although the daseian scale of the *Enchiriadis* treatises includes notes outside of the diatonic gamut, it also excludes notes that are in the gamut, which is one of the main reasons for doubting the scale's suitability for generally modelling plainchant. See Maloy, "*Scolica Enchiriadis* and the 'Non-Diatonic' Plainsong Tradition," 61-96.

[281] Falconer, "The Modes Before the Modes," 134-136. Notable chants include the antiphons *Nos qui vivimus*, *Malos male perdet*, *Magnum hereditatis mysterium*, *Urbs fortitudinis*, and the communion *Beatus seruus*; also noteworthy are Gevaert's themes 3, 6, 29, 35, and 36; Gevaert, *La mélopée antique dans le chant de l'église latine*.

[282] Falconer, "The Modes Before the Modes," 134-135. See, for example, the passage quoted earlier: "An antiphon that begins in the second authentic and ends in the third plagal will not be terminated (at its last occurrence) in the third plagal, but in the fourth authentic, because the second authentic and the fourth authentic retain a certain connection at their end." Aurelian of Réome, *The Discipline of Music*, trans. Ponte, 32. Remarkably, Aurelian did not seem even bothered at this one point by not having a monomodal frame. This is a relatively rare example in Aurelian of what I consider a description of mode for the sake of representing more the author's perception than anything else. It is not dismissed or degraded for its lack of a monomodal frame, nor is it forced into a single mode with the reminder that chants always fit into one of the eight modes. He identifies the modes as he hears them without reference to legitimacy or broader categorization. This inconsistency is almost certainly due to the fact that Aurelian's treatise is a composite.

For Aurelian, Regino, the *Commemoratio*, Johannes, and the *Summa musice*, no phrase of chant is modally vague. When Aurelian writes that "An antiphon that begins in the second authentic... [will be terminated] in the fourth authentic....",[283] he is clearly writing that the final mode will not be the same as the starting mode, and he is unambiguously labelling the mode of each part. This similarly applies to all of the excerpts on modulatory chants quoted above.

The *Commemoratio brevis* author does not advise using beginnings for modal determination, but he implicitly recognizes their perceptual impact: "certain antiphons not belonging to the same mode have such similar beginnings that to continue one with the melody of the other would seem quite natural...."[284] What this translates to is the idea that we do not know where modally we will wind up based on where we begin. However, that is not modal ambiguity. It is, rather, an implicit recognition of a polymodal frame. Moreover, the *Commemoratio* seems to suggest that we not even recognize mode at the beginning because we do not yet know the mode at the end, but we cannot suspend our sense of mode until we find out where we have arrived.

Medieval theorists trying to convince their readers that there is some ambiguity because of modulation is nothing more than their confusion resulting from their need to restrict pieces to a monomodal frame because of a concept of legitimacy. In the same *Commemoratio* passage just cited, we are told "that to continue one [antiphon] with the melody of the other would seem quite *natural*...."[285] [Emphasis mine.] If the beginnings are modally unambiguous, then whether the antiphons the *Commemoratio* refers to here ends in the same mode or in a different mode, the tonal path would be normal and unsurprising. But for the sake of simplicity in classifying the chant, he instructs us to look only at the endings. When tonaries and theorists decided on differing modal classifications based solely on the opening theme or solely on the final, this reflected only their "compulsive need for uniformity,"[286] not their perception of mode, and their own intuitions and perceptions of mode can still be seen peeking through the inconsistencies of their writings.

[283] Aurelian of Réome, *The Discipline of Music*, trans. Ponte, 32.
[284] Bailey, *Commemoratio brevis*, 99, line 99.
[285] Bailey, *Commemoratio brevis*, 99, line 99.
[286] Falconer, "The Modes Before the Modes," 142.

### 2.7.4 Early Tonaries, Melodic Formulas

Falconer has written that "The earliest tonaries seem to classify antiphons according to several criteria at once, including melody types, opening notes, opening formulas, historical and liturgical considerations" but not the other determinants of mode, namely finals.[287] Nevertheless, none of these are necessarily at odds with the components of earlier modal theory, i.e. final, ambitus, reciting tone, and background scale structure, from the lens of modal perception. In addition, formulas are part of modal theory's earliest form; there is already an overlap in these lists. There is no conflict whatsoever using modal theory's musical value, only when we use mode as a strict classification measure involving rigid monomodal frames. All that changes is how each tool is prioritized depending on how we wield the theory, and that is up to us as modern researchers.

### 2.7.5 Old Roman and Ambrosian (Old Milanese) Classification Methods

Lastly, Falconer has pointed out that "neither the Ambrosian nor the Old Roman rites seem to have adopted the *octoechos* at any point in their history, yet both have systems of cadences that closely resemble the *differentiae*. More remarkable still, the Ambrosian rite seems to have classified these cadences according to a system of melody types."[288] In addition, "the Ambrosian rite classifies antiphons according to melodic criteria for every aspect of psalmody."[289] Why do we not explore Ambrosian classification with an eye for tools that can advance mode-as-musical-theory? Sadly, I neither have the time here nor the expertise to exposit the Ambrosian rite, but it should still be noted that there remains great room for the development of modal theory just based on the "toolkit" of medieval Milan, where the Ambrosian rite originated.[290]

Medieval theorists limited the potential of mode to act as a theoretical construct for communicating intuitions about musical structure by being more concerned with its ability to

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[287] Falconer, "The Modes Before the Modes," 141.
[288] Falconer, "The Modes Before the Modes," 143.
[289] Falconer, "The Modes Before the Modes," 143.
[290] On psalmody in the Ambrosian rite, see Terence Bailey, "Ambrosian Psalmody: An Introduction," *Studies in Music from the University of Western Ontario* 2 (1977): 65-78; Terence Bailey, "Ambrosian Psalmody: The Formulae." *Studies in Music from the University of Western Ontario* 3 (1978): 72-96. On Ambrosian antiphons, see Terence Bailey and Paul Merkley, *The Antiphons of the Ambrosian Office* (Ottawa, ON: Institute of Medieval Music, 1989). On Old Roman psalmody, see Joseph Dyer, "The Singing of Psalms in the Early-Medieval Office," *Speculum* 64, no. 3 (1989): 535-578. On Old Roman antiphons, see Edward Nowacki, "Studies on the Office Antiphons of the Old Roman Manuscripts" (PhD diss., Brandeis University, 1980).

force any chant as a whole into a single category. We do not need to do the same thing, however. Unless I am mistaken, it is too easy to conclude that mode was simply an imported theory without direct relevance to the musical practice it was imported for. Because of what mode signified and because of the potential underlying compatibility of the qualitative and the quantitative, I believe that thinking strictly about formulas or *differentiae* or openings or finals misses the crucial point that mode was a part of the Carolingian listening and singing experience, and we have an opportunity not just to study mode as a historical classification measure but to use mode as the start of (part of) a modern theory of medieval music.

## 2.8 Conclusion

Let us review the observations and arguments made in this chapter.

Firstly, mode was not solely an idea divorced from practice, nor merely a means to achieve smooth coordination of psalms with antiphons. Medieval writers appealed to hearing to justify and confirm modal structures. In the earliest texts on mode, the perception of mode is the sole subject, and the language is entirely qualitative and metaphorical. In later Carolingian texts, metaphorical observations are coupled with specified structures, and while the proportions of qualitative and structural writing changes with the centuries, there are themes in the description of the experience or cognition of mode and the functions of mode that persist: cohesion, coherence, order, and regulation. Each mode is described as having its own particular sound, its own quality, and that sense of mode pervaded each portion of music in question, usually a whole piece. I have used the word *saturation* and related forms (*saturated*, etc) to refer to this phenomenon.

However, I argue that there are at least two distinct purposes that pervade medieval writings on mode: the first purpose is the classification of chants; the second purpose is the description of the listening experience. I further argue that these two purposes were sadly conflated by medieval writers.

Because of classification, theorists stipulated that each chant must belong to only one mode; I term this requirement or description *monomodality*. At the same time, almost all theorists prescribed the final note as the primary determinant of the mode, to the point of excluding the discussion of the perceptual impact of any other part of the chant in modal determination.

Combined with saturated monomodality, the reign of the final over the mode of entire pieces leads to an implausible listening experience where, upon hearing the final note of a chant for the first time, the listener would project the final sense of mode backwards, retrospectively reinterpreting the whole piece.

What's more, Aurelian and Regino both discussed beginnings as modal determinants for some chant genres, which means that they must have heard the mode at the beginning of any chant, which would be much more plausible cognitively. Moreover, some theorists, like Guido d'Arezzo and the author of the *Summa musice*, continued to recognize modal formulas as signifying mode, regardless of their place in a chant – beginning, middle, or towards the end. Others, like Johannes of Afflighem, even mentioned that many people knew the modes so well that they could recognize the mode of a chant from its opening. Furthermore, theorists from the ninth to the eleventh centuries described or presupposed modulation and distinctive, unambiguous modal regions in numerous chants. The *parapteres*, i.e. additional modulating "modes", along with modulating psalm tones, were added in the ninth century to cope with modulating antiphons, and although they always received scorn from theorists, they remained in use into the thirteenth century, in my view demonstrating their persistent utility.

Unfortunately, because of the confusion between perceiving mode and classifying whole chants combined with the stipulation that all chants must belong only to one mode, modulation remained mostly a presupposition and was never formally recognized and incorporated into modal theory. In addition, if chants were recognized as beginning and ending in different modes, in other words, not having a monomodal frame, then they were denigrated. Regino offers the most severe example of this, dismissing modulating antiphons as *nothae*, "illegitimate, born out of wedlock." Strangely, however, the dismissal, condemnation, or denial of modulation did not occur with modulations internal to a monomodal frame, but with chants with polymodal frames, which I suggest was caused by a dogmatic adherence to the arbitrary rule that every chant must belong only to one mode, which would have been in conflict with the intuitive recognition of mode at the two most important parts of any chant: the beginning and the end.

Through these observations, it has been possible to disentangle the medieval accounts of modal perception from medieval rules of modal classification. Furthermore, it is possible to develop a much more flexible, sensitive, and frankly *musical* theory of mode – one that truly appeals to and develops our perception of music – than what is suggested by medieval theorists' explicit instructions.

Chapter 2: Historical Theory and the Cognitive Foundations of Modal Theory

In the following chapter, I will move to structures of mode, but with a connection to music cognition, which will lead to developing a methodology for the analyses that culminate the thesis.

# Chapter 3 Fundamental Structures of Mode

In the previous chapter, I presented a close reading of modal theory treatises to observe continuities in the described perceptions of mode and to begin to reframe modal theory in terms of medieval perceptual accounts rather than in terms of official rules prescribed by the theorists. My aim in the current chapter is to use historical theory to develop a more robust methodology for analyzing mode in chant.

As I showed in the previous chapter, formal modal theory, with its absolute dependence on the final, implied a suspension of modal perceptions until the last note, at which point, a large-scale retrospective reinterpretation of the entire chant would occur. If the listener depended on melodic formulas, there was an implication in traditional modal theory that only when formulas were present was mode defined, and any music that was novel, that is, not containing familiar formulas, left the listener without a sense of mode until the final. In order to develop a theory of medieval mode that applies to music before the last note – music that may or may not contain melodic formulas – we must examine other structures: ones that are specific, abstract, and pervasive. Of course, the present discussion would be incomplete without finals, but I do not include them for their supposed supremacy in determining mode.

Beyond the final, there is a short list of standard structures associated with mode. Melodic modal formulas existed from before the first treatises. Ambitus is one of the first two described structures (the other is the final). From the ninth century onwards, modal treatises featured discussions of the qualities of each note based on or derived from its surrounding intervallic context. These qualities led to the concepts of affinities and *modi vocum*. From these, Guido d'Arezzo, in the early eleventh century, developed the hexachords. Later in the same century, a school of Southern German theorists led by Bern of Reichenau and influenced by Guido fully developed the theory of the species of consonances. Much later, in the early fourteenth century, Marchetto da Padova added to modal theory the concept of leaps and melodic outlines characteristic of each mode.[291]

While all of these concepts and structures have been studied in depth, their implications for medieval music cognition have not yet been examined. In this chapter, I pursue a deeper

[291] Harold S. Powers, et al., "Mode," 2001, *Grove Music Online*, last accessed 2019 May 21. <http://www.oxfordmusiconline.com/subscriber/article/grove/music/43718pg2>.

understanding of the cognitive principles underlying medieval modal theorists' observations and proposed structures. By building on the implications for medieval music perception, I develop analytical approaches for mode beyond finals, ambitus, and melodic formulas. Please note that I omit further discussion of modal melodic formulas, because they originate in the Carolingian period and do not persist beyond the eleventh century, let alone into Notre Dame Polyphony.

I begin the chapter with a discussion of the likelihood of a hierarchy of pitches relative to the final. Because pitch class hierarchies in tonal music are reflected in the existence of scale degrees, I develop the analogous concept of mode degrees relative to a final. I propose four potential indications that mode degrees were part of the medieval perception of the modes: medieval treatises demonstrating a recognition of mode degree qualities; medieval treatises ascribing relative importance to certain degrees; particular mode degrees holding particular positions within phrases and pieces; and lastly, mode-dependent pitch class behaviour. I examine medieval modal treatises' discussions of each of the above features; their discussions lend support to the idea of a pitch hierarchy and the presence of certain mode degrees, though not all.

I then consider the cognitive implications of another frequent subject of discussion in modal treatises, which I have termed *interval string qualities*: a separate set of note qualities that relate to intervallic structures. Through an analysis of their relationship to the gamut and to the modes, I explain how these qualities offer the strongest challenge to mode degrees, which leads to a consideration of contradictions or perhaps cognitive competition or compromise between mode degree qualities and interval string qualities. As a result, I argue that medieval modal treatises lend weight to the idea of a pitch class hierarchy, but that they also leave room for a less well-defined, more vague hierarchy with fewer strata due to interval string qualities also playing an important role in shaping melodies.

In addition, I show how some traditional structures are fit to be used as analytical tools, while others are not. I use this distinction to further develop and refine the set of analyses available. Hexachords and leaps and melodic outlines are evaluated here.

Finally, I establish the basic methodology for the thesis. I outline three analyses: Mode Profiles (pitch class frequency distributions), Tendency (pitch class pair probabilities), and Leaps and Melodic Outlines. All three analyses relate to the earlier discussions of the pitch class hierarchies.

## 3.1 Pitch Class Hierarchies and Mode Degrees

Let us take a brief departure from medieval music theory to examine an aspect of modern tonal theory that might illuminate a new feature of the modes. In a common practice tonal context, pitch classes are, for most listeners, perceived as scale degrees. Each pitch class in a key is assigned a number according to its ordinal position in a scale counting from the tonic, which is, by definition, scale degree 1.

Those enculturated in tonality almost always perceive each scale degree as having an aural identity; each has an indescribable quality, which I term *scale degree quality* to distinguish it from *interval string quality*, which we will explore shortly. Scale degrees seem to be intuitive for almost everyone,[292] and a core part of ear-training curricula is the refinement of that intuition through scale-degree-recognition training (or its equivalent: solfege syllables in a moveable-do system). The qualities of scale degrees have been most richly explored in *Sweet Anticipation* by David Huron, who surveyed "Western-enculturated musicians" for metaphors that they used to describe scale degree qualities.[293] Huron has proposed seven categories for the descriptors reported in the survey results: "certainty/uncertainty, tendency, completion, mobility, stability, power, and emotion."[294] Most of these categories can be related to musical functions or pitch class "behaviours", which can be studied through probability and statistics.[295] This is an idea to which we will return when developing the methodology.

Furthermore, five of these seven categories (i.e. certainty/uncertainty, tendency, completion, mobility, stability) almost certainly reflect the fact that we perceive scale degrees hierarchically. Carol Krumhansl, in her pioneering work on music cognition and perception, has also drawn connections between abstract tonal hierarchies and music theory terminology that is related to "stability", "relative structural significance, priority, resolution (versus tension), and rest

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[292] An interesting exception is the listener who does not hear tonal melodic or harmonic functions, whether in scale-degrees or in tonal harmony. This type of listener relates to Tymoczko's "harmonic nihilist", in Dmitri Tymoczko, *A Geometry of Music: Harmony and Counterpoint in the Extended Common Practice* (New York, NY: Oxford University Press, 2010), 261.

[293] I assume that the musicians were trained in western classical music, but Huron does not specify. David Huron, *Sweet Anticipation: Music and the Psychology of Expectation* (Cambridge, MA: MIT Press, 2006), 144. Note that this was an informal survey of only ten musicians; it was used as a starting point for his discussion and perhaps research, not as a principal study, although such a study would likely yield interesting results.

[294] Huron, *Sweet Anticipation*, 146; 144-147.

[295] Note that I use the word *behaviours* metaphorically, as though pitches go somewhere. A more literal description of music might be that various pitches are sounded in patterned ways according to music psychological phenomena.

(versus activity)".[296] Most of these themes identified by Krumahnsl correspond to categories of terms highlighted by Huron.[297]

One of the main ways this hierarchical perception of pitch classes in a tonal context has been established has been through music cognition experiments involving participants enculturated in Western musics.[298] Pitch hierarchies are, of course, not limited to common practice tonal music, nor to Western musics; they have been studied in numerous musics throughout the world, including Arab, Turkish, Iranian, Chinese, Japanese, Vietnamese, Myanma, Balinese and Javenese, and Indian musics, amongst others.[299] However, due to insufficient studies, it is not yet clear whether a hierarchical perception of pitch classes relative to a tonal centre is part of the dominant experience in *every* musical culture, though some form of hierarchical pitch class cognition has been posited as a likely universal due to principles of acoustics and the physiology of hearing (e.g. octave equivalence, the harmonic series above a fundamental, cognitive reference points).[300]

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[296] Krumhansl, *Cognitive Foundations of Musical Pitch*, 19.

[297] Huron is very much aware of Krumhansl's work; he cites her numerous times in *Sweet Anticipation*, and he has reviewed her *Cognitive Foundations of Musical Pitch* as well. See, e.g. Huron, *Sweet Anticipation*, 149; David Huron, Review of *Cognitive Foundations of Musical Pitch*, by Carol L. Krumhansl, *Psychology of Music* 20, no. 2 (1992): 180-185. However, I do not believe that this overlap in categories of Krumhansl's themes of music theory terms and Huron's survey response descriptions is intentional. Huron does not cite Krumhansl in this part of his book.

[298] For an overview of tonal hierarchy theory, see Bret J. Aarden, "Dynamic melodic expectancy" (PhD diss., The Ohio State University, 2003), 11-26. For a summary of the first probe-tone studies establishing major and minor key tonal hierarchies in the minds of listeners across various levels of musical training, as well as geometric modelling of the hierarchies and tone-relationships, see Krumhansl, *Cognitive Foundations of Musical Pitch*, 21-49, based on based on Carol L. Krumhansl and Edward J. Kessler, "Tracing the dynamic changes in perceived tonal organization in a spatial representation of musical keys," *Psychological review* 89, no. 4 (1982): 334-368. See also Carol L. Krumhansl and Roger N. Shepard, "Quantification of the hierarchy of tonal functions within a diatonic context," *Journal of experimental psychology: Human Perception and Performance* 5, no. 4 (1979): 579-594; Carol L. Krumhansl and Edward J. Kessler, "Tracing the dynamic changes in perceived tonal organization in a spatial representation of musical keys," *Psychological review* 89, no. 4 (1982): 334-368. These studies were significantly improved upon by Aarden's reaction-time study, in Aarden, "Dynamic melodic expectancy". See also Huron, *Sweet anticipation*, 150-158.

[299] See for example, Harold S. Powers, et al, "Mode: V. Middle East and Asia," 2001, *Grove Music Online*, last accessed 2019 May 21. <http://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000043718>.

[300] W. Jay Dowling and Dane L. Harwood, *Music Cognition* (Orlando, FL: Academic Press, 1986); Eleanor Rosch, "Cognitive reference points", *Cognitive psychology* 7, no. 4 (1975): 532-547. See also Timothy C. Justus and Jamshed J. Bharucha, "Music perception and cognition", in *Stevens' Handbook of Experimental Psychology*, 3rd ed., ed. Hal Pashler, Vol. 1, *Sensation and Perception*, ed. Steven Yantis (New York, NY: John Wiley & Sons, 2004), 479.

Lastly, each scale degree reflects the pitch-hierarchy in a few ways. For one, each scale degree has a distinct behaviour, such as its tendency and flexibility: it tends to move towards other scale degrees with greater or lesser strictness.[301] This particular behaviour will be discussed further below. For another, only certain scale degrees tend to be used in particular positions in a piece of music (e.g. phrase endings, piece endings), specifically because those scale degrees hold high positions in the scale degree hierarchy.[302]

Let us return now to medieval modal theory. We can imagine one feature of the modes to be *mode degrees*, which would be analogous to scale degrees: each pitch class in a mode would be assigned a number according to its ordinal position in that mode counting from the final, which, by definition, would be mode degree 1. If mode degrees existed and shared the above basic properties of scale degrees, then:

1. Mode degrees would have had their own perceived qualities;
2. Pitch classes would have been considered more or less important depending on each one's relationship to the final of the given mode;
3. Particular positions in phrases and pieces would have been held only by certain mode degrees, not pitch classes;
4. Each pitch class would have exhibited a behaviour distinct to each mode, while each mode degree would have exhibited consistent behaviour across the modes.

These four points can be divided into two pairs: one pair dealing with music perception, and one dealing with music composition, which followed in large part from music perception. Enquiries into medieval mode degree perception must be pursued through readings of medieval modal treatises, while enquiries into mode-specific pitch class behaviours can be pursued both through reading medieval treatises and, especially, through analyzing music.

In this section, I explore these four features to assess whether or not medieval modal theorists described the presence of mode degrees in chant, the repertory for which modal theory was developed. I demonstrate that the latter three of the four properties are present in modal treatises, either implicitly or explicitly. However, I do not take this as conclusive confirmation of mode degrees because of the topic covered in the section that follows: interval string qualities.

[301] On *tendency* and *flexibility*, see Huron, *Sweet Anticipation*, 158-163.
[302] See Huron, *Sweet Anticipation*, 153-158.

### 3.1.1 Mode Degree Qualities in Medieval Treatises

In medieval treatises, there is not a single explicit discussion of mode degrees. However, out of all of the medieval modal texts of which I am aware, there are two passages that suggest a reading of mode degrees. Both come from Guido. The first, from his second treatise *Regule rithmice* (written between 1026-1032), defines mode as the specific relationship between pitches:

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|---|---|
| "Est modus ad reliquos ptongi collatio ptongos. Dant collate modum sibimet discrimina vocum." | "A mode is the relation of a sound to the rest of the sounds. The various pitches brought into relation with each other yield a mode."[303] |

Guido followed this passage by noting that each of the four finals is defined by the pattern of intervals surrounding them, which might suggest that the relation between pitches to which Guido referred was not defined by individual qualities and behaviours but was rather their configuration in the gamut, which is defined by a fixed pattern of intervals. This relation between various pitches, however, would be common to all the modes, since the intervallic structure of the gamut remains the same regardless of the final. If any *individual* mode is to be yielded, there must be something more to the relation between pitches than their intervallic distance to each other, and that must be a hierarchy of pitches. Given Guido's continuation, it unfortunately seems unlikely that he realized that intervals do not explain the modes as he defined them above. I return to this idea below.

The second passage that mentions special qualities that pitch classes have from their relationship to a final or more generally to a mode, i.e. mode degree qualities, comes from Chapter 13 of *Micrologus*:

[303] Dolores Pesce, *Guido d'Arezzo's* Regule rithmice, Prologus in antiphonarium, *and* Epistola ad michahelem, 398-399.

"Praeterea et in ignotorum cantuum inquisitione praedictarum neumarum et subiunctionum appositione plurimum adiuvamur, cum talium aptitudine soni cuiusque proprietatem per vim tropicam intuemur. Est autem tropus species cantionis qui et modus dictus est, et adhuc de eo dicendum est."[304]

"Furthermore, in studying chants new to us, we are helped chiefly by juxtaposing the aforesaid neumes [melodic formulas] and appendages [*subiunctiones*], since from the way these fit we come to see the particular character of each note through the effect of the 'tropes.' 'Trope' is the aspect of chant which is also called 'mode,' and we shall now discuss it."[305]

To paraphrase, from the melodic formulas of each mode and other passages, we come to recognize the particular modally-specific quality or character of each note: the qualities relative to the modes. Unfortunately, Guido did not expand upon this point to discuss the individual qualities of each note. The passage is followed by a new chapter that begins by describing men who can recognize the tropes and distinctive qualities of each mode. This might suggest that there was, at most, a faint awareness of mode degree qualities, but generally, the conscious awareness of mode degrees seems to be absent from modal texts.

### 3.1.2 Relative Importance Ascribed to Pitch Classes

Modal treatises do provide other reasons to surmise that mode degrees were a part of the medieval modal listening experience, however. Below, I briefly summarize the treatises' emphasis on certain notes relative to the final of a given mode.

#### 3.1.2.1 Final

As we have already seen, every treatise from the ninth century onwards emphasizes the final as the most important pitch in a mode. The final is the tonal centre and the primary determinant of the mode. This alone is enough to show that there is a hierarchy of pitches,

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[304] Guido d'Arezzo, "Micrologus," Thesaurus musicarum Latinarum (TML), last accessed 2018 Feb 7, source: Smits van Waesberghe, Joseph, ed., *Guidonis Aretini Micrologus*, Corpus scriptorum de musica (CSM) 4 (Rome: American Institute of Musicology, 1955), 79-234. <http://boethius.music.indiana.edu/tml/9th-11th/GUIMICR>.

[305] Warren Babb, trans., and Claude V. Palisca, ed., *Hucbald, Guido, and John on Music: Three Medieval Treatises* (New Haven: Yale University Press, 1978), 69.

otherwise there would be no pitch class that would be considered most important for a given mode. However, this does not reveal the full form of the hierarchy.

#### 3.1.2.2 Upper-Fifth

There is one more note that is repeatedly given second-greatest importance: the fifth above the final, which I refer to as the *upper-fifth*. The origin of the upper-fifth is almost certainly psalmody, where it was initially the reciting note for all of the authentic modes (and later, for most of the authentic modes); the authentic modes, moreover, were originally considered superordinate to the plagal modes.[306] However, as noted in the previous chapter, it was not until the *De musica* of Johannes of Afflighem, c. 1100, that the *tenor*, i.e. the upper-fifth, was added to a collection of officially recognized notes in a pitch hierarchy relative to the final.[307]

Strangely, the importance of the upper-fifth is only sometimes brought forth by medieval theorists as part of a discussion of relatively important notes in a mode. More frequently, it was discussed in the context of interval string qualities and affinities, which are the subject of the following section. *Musica* and *Scolica Enchiriadis*, Hucbald, Pseudo-Odo, and Guido all gave special status to the upper-fifth as a substitute final (hence the term *cofinal*), apparently justified

[306] See, for example, Aurelian of Réome, *The Discipline of Music (Musica disciplina)*, trans. Joseph P. Ponte, Translations: No. 3 (Colorado Springs, CO: Colorado College Music Press, 1968), 8-9; and

[307] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 97; Harold S. Powers, et al., "Mode: 3. 11th-century syntheses. (i) Italian theory of modal functions. (d) Tenor," 2001, *Grove Music Online*, last accessed 2019 May 21. <http://www.oxfordmusiconline.com/subscriber/article/grove/music/43718pg2>; Christopher Page, ed. and trans., *Summa musice: A Thirteenth-Century Manual for Singers* (Cambridge University Press, 1991), 22.

The minor anonymous treatise *Summa musice*, c. 1200, following Johannes of Afflighem, also includes the upper-fifth in its modal hierarchies. Page, ed. and trans., *Summa musice*, 109.

by or derived from identical intervallic contexts, a crucial idea to which we will return shortly.[308] Nevertheless, almost no other notes could be used for this purpose; the position of substitute-final could usually only be filled by the upper-fifth, which itself reflects the upper-fifth's importance.

Other functions served by the upper-fifth are discussed below.

#### 3.1.2.3 Johannes of Afflighem's Hierarchy: Finals, Tenors, Glorias

Johannes of Afflighem proposed three explicit levels of a pitch hierarchy.[309] Firstly, he held that the finals were the most important notes for determining the mode.[310] Second-most important were the *tenors*, which were the reciting notes of each mode: the upper-fifths in the authentic modes and the upper-thirds for the plagal modes, except when Cs replace Bs. Regarding tenors, he wrote:

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|---|---|
| "Quasi enim claves modulationes tenent, et ad cantum cognoscendum nobis aditum dant."[311] | "…like the keys to locks, they [the tenors] control melodies, and they give us a way to identify chant."[312] |

In the previous chapter, I cited passages that wrote of mode regulating melody. In this passage, Johannes ascribes a similar function to the tenors. Additionally, it is clear that to Johannes, the tenors give us a way to understand chant more deeply; in the statement's context of discussing mode and modal determinants (the finals are discussed immediately afterwards), the tenors would also seem to give us a way to understand mode more deeply.

What's more, although Johannes was not specific on this point, for the tenor to function distinctly as an identifier of a chant, the tenor must behave distinctly – differently from the other

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[308] The relevant passages are summarized in Dolores Pesce, *The Affinities and Medieval Transposition* (Bloomington, IN: Indiana University Press, 1987), 6-13, 18-22.
[309] It should be mentioned that although Johannes' treatise was not nearly as popular as Guido's treatises or those of the eleventh-century Southern German theorists, Johannes' work was popular enough in mid-thirteenth century Paris that Hieronymus of Moravia cited him extensively. See Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 95.
[310] See, for example, Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 118.
[311] Johannes Affligemensis, "De musica cum tonario," Thesaurus musicarum Latinarum (TML), last accessed 2019 May 30, source: Johannes Affligemensis, *De musica cum tonario*, ed. J. Smits van Waesberghe, Corpus scriptorum de musica, vol. 1 ([Rome]: American Institute of Musicology, 1950), 43–200. <http://boethius.music.indiana.edu/tml/9th-11th/JOHDEM>.
[312] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 117-118.

notes in the mode. As a result, the same pitch class would behave differently depending on whether or not it is the tenor of the given mode. This connects to the idea of specific mode degree behaviour, which is explored more below. Unfortunately, Johannes did not elaborate further.

For Johannes, the third-most important note in a mode after the tenor is the *gloria*. Each gloria of a mode is the first note of that mode's reciting formula for the Lesser Doxology ("Gloria patri et filio et spiritu sancto…"). Glorias as a class of modally important notes seems to be an invention by Johannes and unique to his treatise except for one later source, and in addition, their selection seems to be without reason. It is worth observing, however, that while the glorias are irregular, there are basically two trends. For half of the modes (E-plagal, F-authentic, F-plagal, G-plagal), the gloria is the final itself. Note that three of these four modes are plagal. Meanwhile, for D-authentic and E-authentic, the gloria is the third above the final, and for G-authentic, it is the fourth above the final, C;[313] all of these are the reciting notes of their final's respective plagal mode (C had long-since substituted B as reciting note by the time of Johannes). The D-plagal mode's gloria is exceptional, being C as well.

Johannes' derivation of these notes seems random and musically and cognitively irrelevant. Moreover, the finals are, of course, already covered by the category of final, making their categorization as glorias useless. The plagal reciting notes, however, are interesting here, because they are given a place of importance in the authentic modes. In Johannes' category of *tenor*, plagal reciting notes are reserved for plagal modes, just as authentic reciting notes are reserved for authentic modes. I believe that upper-fifths, however, were generally given higher status, even without the formal title of *tenor* that they would acquire in an authentic mode, which would mean that in plagal modes, the upper-fifths might still have been in the pitch-hierarchy, but perhaps switched in position with the plagal reciting note. In the authentic modes, though, plagal reciting notes did not have any formal recognition or inclusion in the modal framework before Johannes' glorias.

As a result, although I generally believe that the category of glorias is exceedingly problematic and thus should be discarded altogether, it does lead me to believe that plagal reciting notes might have been next in the pitch hierarchy for authentic modes, at least for Johannes and one more author.

[313] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 119.

To my knowledge, Johannes' tenors and glorias were copied in only one treatise: *Summa musice*. *Summa musice* was a relatively uninfluential, anonymous German treatise from c. 1200. It was heavily influenced by Johannes' treatise.[314] The only change in the glorias in *Summa musice* compared to Johannes' *De musice* is that the G-authentic mode's gloria was B instead of C.[315] Even the derivations of the tenors and glorias are replicated, though they are paraphrased. This corroboration might add slightly more weight to my conclusions about the potential merit of glorias, but I should note that while *Summa musice* is a treatise with much to offer, it should be understood in its historical place: it did not carry the breadth of influence that, for example, Guido or the *Enchiriadis* treatises did.

#### 3.1.2.4 Upper-Third (and Substitute Upper-Fourth)

Lastly, we should note that apart from Johannes' tenor category, medieval treatises do not specify the upper-third as a structurally important note for plagal modes, and apart from my specific reading of Johannes' tenor and gloria categories, medieval treatises do not treat the upper-third as structurally important for any mode. Nevertheless, because of its role as the reciting note of most plagal modes, I would expect the upper-third (and its substitute upper-fourth in G-modes) to prove important.

#### 3.1.2.5 Summary: Relative Importance Ascribed to Pitch Classes

As we have seen, there are notes in a given mode that were considered to be more important than others based on their relationship to the final. The first was the final itself, which was well-established as the most important pitch of a mode. From the final's importance alone, we know that there was a pitch hierarchy.

The second-most important note in a mode was the upper-fifth, but its treatment in modal treatises is not as straightforward. It was frequently discussed, but usually not simply for the sake of celebrating its significance. Instead, it featured in discussions of other parts of modal theory, one of which was the cofinal or substitute-final, where the upper-fifth almost exclusively filled the role. That exclusivity of the upper-fifth to function as the cofinal demonstrates the upper-fifth's special importance.

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[314] Page, ed. and trans., *Summa musice*, 5.
[315] Page, ed. and trans., *Summa musice*, 111-113.

In Johannes' treatise, upper-thirds and plagal reciting notes are the next category that receive special consideration. However, Johannes' categories are nearly unique to him, and his influence was relatively limited.

Based only on the above overview of medieval texts giving importance to some pitches over others depending on the mode, we can say that there was a pitch hierarchy, with the final at the apex, possibly followed by the upper-fifth, and, with far greater uncertainty, the upper-third or plagal reciting notes might have held third place.

### 3.1.3 Positions Within Phrases and Pieces

The third indication of mode degrees I proposed above is that pitch classes would fill particular positions in phrases and pieces based on the pitch classes' interval to the final. There are two positions considered here: last notes and first notes.

#### 3.1.3.1 Finals

As is well-understood, theorists considered the final note of a phrase or piece to be the most important note. Theorists thus used the term *final* to refer both to the note's position in a phrase or in a whole chant and to the tonal centre of the given passage of music.

#### 3.1.3.2 Initials

An *initial* is the first note of a phrase or chant.[316] Hucbald, Pseudo-Odo, Guido, Bern of Reichenau, Johannes, and the author of *Summa Musice* all refer to initials, but each of their accounts differs significantly from the others, and many of them are internally problematic. My position is that initials are relatively unimportant to modal theory, as evidenced by the basic problem articulated by Fuller: "in themselves, isolated initial notes are not modal identifiers, for unlike finals they are shared across modal categories."[317] As a result, I will not provide a comprehensive account of medieval discussions of initials here, but rather, a brief overview.

Hucbald's first account of initials was short, incomplete, and subordinate to another topic. He wrote only that lower-fourths and sometimes lower-fifths were used for beginnings (and not endings). He did not mention these intervals as part of a list of all initials or even all important

[316] I am using the term *initials* after Powers, et al., "Mode," 2001, *Grove Music Online*, 2019 May 21. <http://www.oxfordmusiconline.com/subscriber/article/grove/music/43718pg2>.
[317] Sarah Fuller, "Interpreting Hucbald on Mode," *Journal of Music Theory* 52, no. 1 (2008): 18.

initials, though, but as part of the discussion of affinities, which I examine below.[318] Hucbald's second account was much more thorough: for each of the four principal modes, he provided a list of opening phrases – one for each initial.[319] For each mode, many initial pitch classes are given at least one example each – one that begins on D, one that begins on E, etc. Note that some of these initials are so rare in certain modes that Hucbald could only provide weak examples from internal phrases of chants,[320] however, the remaining options are so numerous that they are not worth exploring.

Lastly, Fuller has made a strong case that, for one, the contents of Hucbald's section on mode is fraught with problems (e.g. his exploration of initials and boundaries of initials, inconsistency in his discussion of *socialitas*),[321] and, for another, the section on modes is deficient compared to contemporaneous treatises (e.g. the *Enchiriadis* treatises, *De octo tonis*, and the Metz tonary treatises).[322] Fuller has further observed that Hucbald's language seems to assume that his audience was already familiar with modal theory and the chant repertory.[323] This is bolstered by Gushee's suggestion that the surviving form of Hucbald's treatise might be incomplete.[324] Gushee furthermore observed that Hucbald's treatise often appeared in manuscripts alongside *Musica* and *Scolica enchiriadis*, *Alia musica*, and *Commemoratio brevis*, all of which together might have comprised a core curriculum of medieval music readings;[325] on its own, however, it is inadequate and problematic. As a result, here and elsewhere, we should be cautious when reading Hucbald on mode.

Pseudo-Odo, in his *Dialogus de musica*, also listed chants as examples for each modal initial. While his list remained influential through the fourteenth century, for our purpose, it suffers from the same problem as Hucbald's list: the options are too many to be useful in establishing any hierarchy or even a solid connection between modes and initials.[326]

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[318] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 39. See also Pesce, *The Affinities and Medieval Transposition*, 8, 147 n.9.
[319] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 40-42. See also Fuller, "Interpreting Hucbald on Mode," 16-20.
[320] Fuller, "Interpreting Hucbald on Mode," 19.
[321] Fuller, "Interpreting Hucbald on Mode," 15-20.
[322] Fuller, "Interpreting Hucbald on Mode," 16.
[323] Fuller, "Interpreting Hucbald on Mode," 23-26.
[324] Gushee, "Questions of Genre in Medieval Treatises on Music," 397-398.
[325] Gushee, "Questions of Genre in Medieval Treatises on Music," 397-398. See also Fuller, "Interpreting Hucbald on Mode," 13 n.2.
[326] Powers, et al., "Mode," 2001, *Grove Music Online*, last accessed 2019 May 21. <http://www.oxfordmusiconline.com/subscriber/article/grove/music/43718pg2>. Fuller has also pointed out that the primary importance of his list is to add to the distinctions between authentic and plagal modes, not to cover initials. Fuller, "Interpreting Hucbald on Mode," 18 n.17.

Guido, in Chapter 13 of his treatise *Micrologus*, wrote:

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|---|---|
| "Ibi enim praevidetur quibus in vocibus singulorum modorum cantus rarius saepiusve incipiant et in quibus minime id fiat…."[327] | "For there one can foresee on what notes of the particular modes chants less often or more often begin, and on what notes they do so least…."[328] |

However, Guido wrote almost only of what was least permissible, the options of which were few.[329] The permissible options are too many to be worth listing here, and, like with Hucbald and Pseudo-Odo, they were therefore too many to be relevant to the current discussion.

Johannes was more specific. He wrote that the possible starting notes for authentic modes, relative to the final, were: the lower-second, final, upper-third, upper-fourth, and upper-fifth, making five out of seven possible notes. The E-authentic mode was exceptional, in that it had a sixth option of the upper-sixth. For plagal modes, Johannes listed two options: upper-fourths and lower fifths.[330] Given the lists provided by his predecessors, however, it is obvious that his list is incomplete. Moreover, as always, the overlap in initial pitch classes across modes is enormous and thus not useful.[331]

#### 3.1.3.3 Summary: Finals and initials

To summarize thus far, numerous theorists, including Hucbald, Pseudo-Odo, Guido, Bern, and Johannes reviewed initials, but across theorists and within each treatise, there is no discernible pattern nor even a consistent account of initials as they relate to mode. Therefore, only the finals (and cofinals) of phrases or whole chants should be considered as important temporal positions for reflecting a pitch-hierarchy.

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[327] Guido d'Arezzo, "Micrologus," Thesaurus musicarum Latinarum (TML), last accessed 2018 Feb 7, source: Smits van Waesberghe, Joseph, ed., *Guidonis Aretini Micrologus*, Corpus scriptorum de musica (CSM) 4 (Rome: American Institute of Musicology, 1955), 79-234. <http://boethius.music.indiana.edu/tml/9th-11th/GUIMICR>.

[328] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 68.

[329] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 68-69. See also Guido's comments at the outset of Chapter 11, though they do not add significantly to the discussion: Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 66.

[330] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 124.

[331] The *Summa musice* also devotes time to initials, but there is no discernible pattern, nor, curiously, is there a correspondence with any earlier theorist, not even with Johannes, who, as noted, influenced the *Summa musice* greatly. Page, ed. and trans., *Summa musice*, 98-101.

#### 3.1.3.4 Boundary Notes

The previous two positions we have considered, finals and initials, are examples of temporal positions. We should also consider range-based positions. Upper and lower boundaries of melodies and their interactions with openings, closings, and peaks of melodies form a subject of research that must await further study elsewhere. Each medieval theorist seems to have given his own unique account in slightly or moderately different contexts. This section will also serve as a very brief overview of only a few treatises: *Musica* and *Scolica Enchiriadis*, Hucbald's *Musica*, Guido's *Micrologus*, and Hermannus of Reichenau's *Musica*.

*Musica* and *Scolica Enchiriadis* give the lower-fifth as the lower boundary for both authentic and plagal modes, but for the upper limit, they give the upper-ninth for authentic modes and the upper-fifth for the plagal modes, I would guess probably due to the construction of the daseian scale.[332]

Hucbald gave the upper-fifth as the upper boundary for openings of chants, but he gave the lower-fifth as the lower boundary for the openings of all chants.[333] He does not offer general boundaries of melodies.

Guido offered rules for the boundaries of opening and closing phrases as well as for entire chants.[334] The rules cannot be summarized by a single pattern, as far as I can tell. In the context of opening and closing phrases, Guido did not mention lower limits. For the upper boundaries of opening and closing phrases in authentic modes, he gave the upper-fifth as the boundary.[335] For the upper boundaries of opening and closing phrases in plagal modes, he gave the upper-thirds for the D- and F-modes and the upper-fourths for the E- and G-modes.[336] These boundary notes correspond to the reciting notes of their respective modes, although he did not specify this. This could lend further support to the idea that the plagal reciting note of a mode did have an important place in the hierarchy of pitches relative to the final.

In the context of whole chants, Guido gave the following boundaries. For authentic modes, the lower limit was the lower-second, and the upper limit was the upper-twelfth,

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[332] *Musica Enchiriadis and Scolica Enchiriadis*, trans. Erickson, ed. Palisca, xxxiii.
[333] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 39.
[334] Guido's boundary rules are specifically for antiphons and responsories. See Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 69.
[335] Without explanation, Guido gives the exception of E-authentic, presumably because the upper-sixth is the reciting note and is very common. Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 69.
[336] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 68-69.

although Guido first emphasized the upper-octave. For plagal modes, the lower limit was the lower-fifth, and the upper limit was the upper-sixth, although Guido first emphasized the upper-fifth.[337] I would suggest that Guido might have wished to emphasize boundaries of upper-fifths and upper-octaves perhaps as the general or underlying rule while also providing intervals based on actual practice.

Finally, Hermannus of Reichenau, representing the eleventh-century Southern German school, gave far simpler, far less varied rules for boundary notes across the modes: for authentic modes, he always gave the upper-octave as the upper boundary and the final as the lower boundary; for plagal modes, he always gave the upper-fifth as the upper boundary and the lower-fourth as the lower boundary, except for E-plagal, where the C substituting the B reciting tone stretches the boundary, though even there, Hermannus first proclaimed the B as the upper limit, only then immediately to compromise it. The need for consistency and generalization that makes Hermannus' treatise unusually elegant thus compromises the degree to which his theory reflected practice.[338]

To summarize, firstly, there is a broad range of reported upper and especially lower boundary notes from medieval modal theorists. However, each theorist privileged the upper-fifth, even while the lower boundary notes changed frequently. Lastly, we should note Guido's more acceptable upper boundary notes for plagal modes, which were the plagal reciting notes, which I interpret as suggesting once more that the plagal reciting note might be relatively high in the hierarchy of pitches for a given mode.

### 3.1.4 Mode-Dependent Pitch Class Behaviour

Earlier, I noted that Johannes of Afflighem implied that in a given mode, the pitch class he categorized as the mode's tenor functioned and thus must have behaved differently from other notes in the mode. As noted, though, Johannes gave no details regarding the tenor's specific behaviour.

I believe that one can similarly infer the idea of specific pitch-class behaviour from discussions of finals and, to a lesser extent, upper-fifths; in being distinguished from other notes, it would seem highly likely that they would behave distinctly as well. Unfortunately, like with

[337] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 69.
[338] Hermannus Contractus, *Musica*, ed. and trans. Leonard Ellinwood ([Rochester, NY]: Eastman School of Music, University of Rochester, 1936), 32-34.

Johannes and his tenor category, there are few hints from medieval theorists regarding how the behaviour might differ. In the methodology section that closes this chapter, I will outline two statistical measures that can be used to investigate mode-specific pitch class behaviour, especially at the level of individual notes. For the remainder of this section, however, I will discuss one medieval theory that explores mode-specific behaviour on the level of groups of notes: Marchetto's theory of modal implication by leaps and melodic outlines.

#### 3.1.4.1 Marchetto's Proper and Commixed Leaps and Melodic Outlines

Marchetto da Padova, in his *Lucidarium* (1317-1318), famously articulated the concept of modal implication within the larger, overarching mode of a specific chant or passage. He introduced the idea (concordant with Chapter 2 of this thesis) that within a chant, various modes could be implied by the melody. Although he lived in the late twelfth and early thirteenth century, his research area was plainchant, the style of which had not changed significantly since the early twelfth century. His work relied heavily on that of the eleventh-century Southern German school, therefore, I will briefly summarize the relevant parts of the most famous form of their theory of species of consonances. I will then return to Marchetto's work, from which I will derive an analytical approach for this thesis' methodology.

##### 3.1.4.1.1 The Species of Consonances

The eleventh-century Southern German school of music theory is famous for the use of the theory of *species of consonance*s.[339] I briefly summarize here the second stage of the theory's development in the eleventh century, represented by Bern of Reichenau, because it was the theory of this stage that was most influential.[340]

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[339] The eleventh-century Southern German school's great innovation in species theory was to define each mode's octave species in terms of a concatenation of a species of fifth and a species of fourth. However, species of consonances actually originate in Ancient Greece and were transmitted to the middle ages by Boethius. They are first introduced to ecclesiastical modal theory by the treatise *Alia musica*. As Cohen has explained, "This 'treatise' comprises at least three textual layers, the number and relations of which remain a matter of dispute, as do their individual dates, relative chronology, and the date of the compilation as a whole – although it is generally accepted that they probably fall within the later ninth and/or earlier tenth centuries." Cohen, "Notes, Scales and Modes in the Earlier Middle Ages," 331. On the contents, innovations, and errors in *Alia musica*, see Cohen, "Notes, Scales and Modes in the Earlier Middle Ages," 331-338 and Atkinson, *The Critical Nexus*, 171-201. In general, although it is one of the core medieval modal theory treatises, it is not critical for either the previous or the current chapter, and as a result, I do not explore it and its many complications in this thesis. I should note, though, that it also does not contradict the main points made in these two chapters.

[340] The eleventh-century theory of species of consonances developed in three stages. The first stage, represented by Pseudo-Bernelius is summarized in Atkinson, *The Critical Nexus*, 202-211. The third stage is

The term *species* is used here as a term of classification, as in *genus* and *species*. The consonances (i.e. the genera) are the (perfect) fourth and the (perfect) fifth. Their species are the various configurations of tones and semitones that constitute fourths and fifths, respectively. For example, the fifth from D up to A can be described in terms of tones (T) and semitones (S) as follows: T-S-T-T. According to this theory, this ordering of tones and semitones is classified as the first species of fifth.

First species of fourth and first species of fifth are associated with the first pair of modes, i.e. D-final modes. Second species of fourth and fifth are associated with the second pair of modes, i.e. E-final modes. Likewise, the third species are associated with the third pair of modes (F-final modes), and the fourth species are associated with the fourth pair (G-final modes).

In addition, each mode was defined by a succession of a species of fourth and a species of fifth of the same ordinal number as the mode's final, with the exception of the G-final modes. For example, the D-authentic mode was defined as a first species of fifth followed by a first species of fourth (ascending), and the D-plagal mode was defined as a first species of fourth followed by a first species of fifth (ascending). G-modes are exceptional because there is no fourth species of fourth, and so it is composed of a first species of fourth (D-E-F-G; T-S-T) and a fourth species of fifth. All of the modes and their component species of fourth and fifth are shown in Figure 3.1 below.[341]

represented principally by Hermannus of Reichenau, whose work was not very influential. See Cohen, "Notes, Scales and Modes in the Earlier Middle Ages," 351 n.101.

[341] Figure 3.1 is greatly inspired by Figure 11.9 from Cohen, "Notes, Scales and Modes in the Earlier Middle Ages," 354.

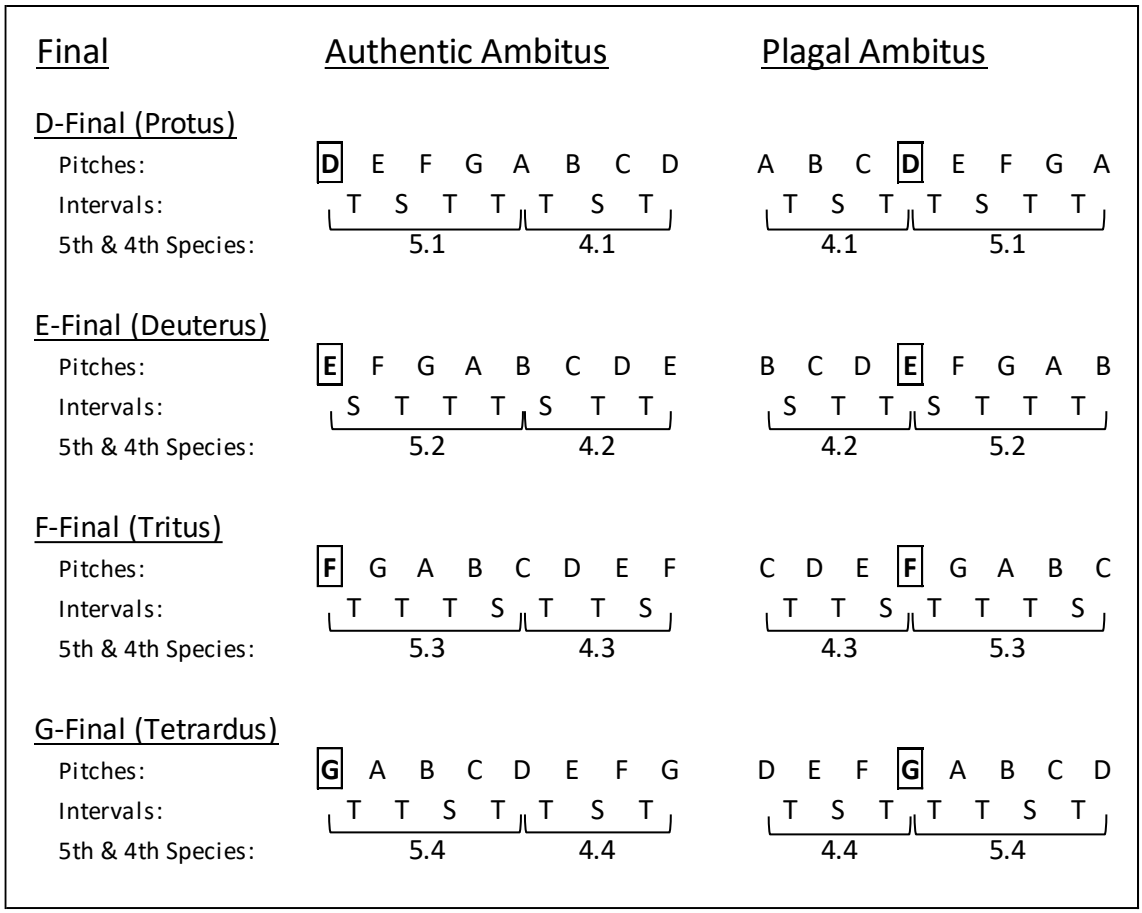


**Figure 3.1** The Modes and Their Component Species of Fourth and Fifth
"5.1" denotes the first species of fifth; likewise, "4.1" denotes the first species of fourth. Finals are shown in **bold** typeface and in boxes.

One of the consequences of defining the modes as shown above is the invention of the concept of the *modal octave*; each mode is demarcated by an octave, either from final to the upper-octave (as in authentic modes) or from the lower-fourth to the upper-fifth (as in the plagal modes). These octaves are theoretical constructs and do not represent the bounds of the music, as shown in the boundaries section above.[342] Another feature of this theory is that the notes at the boundaries of the octave that delimit a given mode and the notes at the boundaries of the fourth and the fifth that together form the mode are the pitch classes of the final and the upper-fifth. Jennifer Bain refers to these pitches as "modal nodes".[343]

[342] Cohen, "Notes, Scales and Modes in the Earlier Middle Ages," 354.
[343] Jennifer Bain, "Hildegard, Hermannus, and Late Chant Style," *Journal of Music Theory* 52, no. 1 (2008): 123.

Defining the structure of the modes in terms of the species of fourth and fifth led to a change in chant style characterized by an emphasis of the modal nodes of the final and upper-fifth as well as the upper-octave. This emphasis was achieved through leaps between and melodic outlines of the modal nodes. Bain, for example, has discussed this feature in compositions by Hermannus of Reichenau (Bern's student) and Hildegard von Bingen.[344]

#### 3.1.4.1.2 Marchetto's Theory of Commixture

The Reichenau theorists' species of consonances were developed to analyze the structure of the modes. Their analysis gave prominence to the modal nodes, which influenced an important shift in the style of chant composition. The Reichenau theorists, however, did not propose a method for analyzing music using the species of fourth and fifth.[345] Marchetto, two and a half centuries later, was the first to present a theory regarding how the modal nodes were made prominent in composition and relatedly, how various modes were implied by the use of leaps and melodic outlines. Firstly, the very notion that specific melodic figures emphasizing the modal nodes of a given mode would imply that specific mode supports the idea of mode degrees. Secondly, it is his theory that forms the basis of the last analysis in my methodology.

The basic idea towards the end of Chapter 11 of Marchetto's *Lucidarium* is that there are certain series of notes that, when heard, imply certain modes, regardless of the overall mode of the passage in which that series is found.[346] These series include leaps and melodic outlines, the latter of which can be defined as any sequence of consecutive notes moving in only one direction (either ascending or descending) that is bounded on both sides by changes of direction or rests. When the implied mode matches the general mode, the series of notes is deemed *proper*, and when it does not match, it is deemed *commixed*.[347]

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[344] Bain, "Hildegard, Hermannus, and Late Chant Style," 123-149. As Bain has pointed out, melodic emphasis on the final, upper-fifth, and upper-octave had already been recognized as a stylistic trait of Hildegard's, but it had not previously been connected to the Reichenau theorists and the general stylistic shift in chant composition that followed them. See ibid., 123-125.

[345] *Alia musica* was the first treatise with analyses of fourths and fifths species in plainchant melodies, making it a critical predecessor of Marchetto of Padova; see Atkinson, *The Critical Nexus*, 199-201.

[346] See Jan W. Herlinger, ed. and trans., *The Lucidarium of Marchetto of Padua: A Critical Edition, Translation, and Commentary* (University of Chicago Press, 1985), 370-519.

[347] Rahn explains Marchetto's original terminology, where propriety is determined by a match between the overarching mode and the mode implied by a given passage: "To convey the notion of a proper appearance, Marchetto generally uses the adverb *proprie* (properly). To indicate an "improper" appearance, he generally uses the adjective *commixta* (commixed)." Jay Rahn, "Marchetto's Theory of Commixture and Interruptions," *Music Theory Spectrum* 9 (1987): 124.
On a separate note, it is possible to observe the seeds of proper or characteristic outlines not only before the Reichenau theorists, but even two centuries earlier in *Scolica Enchiriadis*, but a full exposition of these

In the final section of the chapter, Marchetto presented a collection of examples of mostly melodic outlines, which he described in terms of species of consonances, as well as a list of the modes implied by each example. In fact, in this section of the treatise, all of the examples consist of an outline from D up to A (in one case by direct leap), and depending on the configuration of steps and leaps internal to the outline, he listed the implied modes. Between zero and three notes are removed from between D-A in the examples.[348] Note that, according to Marchetto, each example implied multiple modes. Furthermore, he explicitly noted the degree to which a mode was implied in a given example, from "weakly" to "definitely", in Jay Rahn's interpretation.[349]

Absent from this section, however, is an explanation for how Marchetto determined the implied modes.[350] Rahn has proposed a method for explaining Marchetto's choices of implied modes. Firstly, he established two categories of notes: *special notes* and *orienting notes*. Special notes are those that bound melodic outlines and leaps. Orienting notes are the upper-fourth and upper-fifth of the mode, as well as the upper-octave for authentic modes and the lower fourth for plagal modes; in other words, orienting notes are the modal nodes plus the upper-fourth. Secondly, relying heavily on the two categories of notes, Rahn proposed a set of nine criteria to explain Marchetto's implied modes.[351]

I will not pursue a full discussion of Rahn's nine criteria here. They include factors such as special notes being orienting notes, the range of the outline, the time between special notes, the time between repetitions of a note, whether the special notes are a fifth or a fourth apart, and more. While most of his criteria are intuitive, some require further interpretation. Moreover, while Rahn's study is compelling, before developing his criteria into a systematic program of analysis of leaps and melodic outlines, I would want to test them using a computer to ensure that they give the desired results, however, I am uncertain about the design of such a program.

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traces must await a separate study. For the most suggestive passage, see *Musica Enchiriadis and Scolica Enchiriadis*, trans. Erickson, ed. Palisca, 48-49. Of course, this was not directly followed by the stylistic change in chant composition of the eleventh century, although the implications for early chant are worth exploring.

[348] Rahn, "Marchetto's Theory of Commixture and Interruptions," 123.

[349] Marchetto actually used words denoting relative frequency of occurrence, not relative perceptual strength, but Rahn has shown that in their context, a literal reading would have yielded obviously false statements that also would have contradicted the purpose of the musical examples and their descriptions. He has therefore convincingly contended that Marchetto used frequency words in this context to denote degree of modal implication. Rahn, "Marchetto's Theory of Commixture and Interruptions," 124.

[350] Herlinger, ed. and trans., *The Lucidarium of Marchetto of Padua*, 508-519.

[351] Rahn, "Marchetto's Theory of Commixture and Interruptions," 117-135.

Nevertheless, as complex as the array of implied modes and outline configurations is, I must emphasize that the fact that changing the internal configurations of a melodic outline changed the implied modes demonstrates that specific pitch behaviour reflected mode, which suggests a pitch hierarchy.

In addition, due to the complexity of Marchetto's examples and Rahn's criteria, it is not possible for me to use an analysis of leaps and melodic outlines that counts and classifies every possible configuration of consecutive notes within an outline according to what Marchetto considered the implied modes. Such a study could be a thesis of its own. This does not mean that I have abandoned leaps and melodic outlines altogether, though. Rather than counting every possible set of notes between D and A moving one direction, I count only leaps directly between D and A and melodic outlines containing all of the notes between D and A (D-E-F-G-A and A-G-F-E-D). I explain the analysis in more detail in the methodology section below.

### 3.1.5 Summary: Mode Degrees and Pitch Hierarchy

Firstly, there are no reliable descriptions of perceived qualities of mode degree in medieval treatises.

Secondly, from the ninth century onwards, there was a heavy emphasis on the final as the most important note of a mode, which alone indicates that a pitch hierarchy existed. The upper-fifth was also emphasized, and there might be some (admittedly weak) reason to expect the plagal reciting notes (the upper-third or upper-fourth for E and G modes) to hold some importance as well. Other notes are not specified as important.

Thirdly, the treatises do emphasize that only certain notes held certain positions in phrases and pieces. Most important was the last note, the final. Initials were repeatedly reviewed by theorists, but with no consistency. Boundaries, (highest and lowest notes) were emphasized as well, with great variety across accounts. However, for the upper-boundary, the upper-fifth was privileged. There is no such forerunner for the lower-boundary. Lastly, I would again call attention to the fact that Guido preferred the plagal upper-boundary to be the plagal reciting notes, which might again suggest their importance in pitch hierarchies.

Fourthly, Marchetto's theory of modal implication buttresses the idea of a pitch hierarchy through mode-dependent pitch behaviour. In Marchetto's theory, leaps and melodic outlines defined by the modal nodes of a given mode imply that mode. Though as we have seen, the details are quite complex, since various configurations within the same bounding notes (special

notes) would imply various modes. Nevertheless, the fact that changing the insides of a melodic outline changed the implied modes demonstrates that each mode was reflected by specific pitch behaviour, which suggests a pitch hierarchy.

Although three of the four signs of mode degrees proposed above have been found, before we can conclude that there were pervasive mode degrees and a thorough pitch hierarchy, we must address the many problems that arise through consideration of a potential cognitive competitor to mode degree qualities: interval string qualities.

## 3.2 Interval String Qualities

So far, I have discussed one type of quality perceived in a pitch class: mode degree quality, which is dependent on a sense of a tonal centre, the final. The second type of quality is what I term *interval string quality*, which is independent of any final. Interval string qualities, though not by that name, have been extensively explored by Dolores Pesce,[352] so I will keep my comments brief, reviewing the most important information and highlighting features that have so far remained understudied.

The interval string quality of any pitch is dependent only on the pattern of intervals surrounding that pitch in the gamut, which I refer to as its *interval string*.[353] For example, a D has a tone below it (to C), a tone above it (to E), a semitone above that (to F), and so on. In other words, where *t* refers to a tone, *s* to a semitone, and *D* to the pitch class, the interval string around D can be written as follows: t-**D**-t-s-t-t…. The interval string of a pitch is determined only by the position of the pitch in the gamut (and by the presence or absence of a Bb), since the surrounding intervallic structure is the intervallic structure of the gamut itself.[354]

### 3.2.1 An Overview of Medieval Accounts of Interval String Qualities

Various theorists from the late ninth century through the eleventh century defined interval strings and matching interval string qualities, each in their own way. The authors of the

[352] Dolores Pesce, *The Affinities and Medieval Transposition* (Bloomington, IN: Indiana University Press, 1987); Dolores Pesce, "B-flat: Transposition or Transformation?" *The Journal of Musicology* 4, no. 3 (1985): 330-349.
[353] I use *interval string* as a general term not limited to any specific theorist's definition and the context thus invoked.
[354] Pesce, *The Affinities and Medieval Transposition*, 6-22.

*Enchiriadis* treatises, for example, used tetrachords (four-note segments).[355] Guido's term for his version of interval strings was *modi vocum* (*modus vocum*, sing.), and its form was a six-note segment (which I will discuss shortly). Hermannus of Reichenau termed his version *sedes troporum*. Some earlier theorists gave the interval string no name at all.[356]

Interval strings repeat at the octave, but Guido d'Arezzo as well as his predecessor Pseudo-Odo determined that a series of only five intervals would recur starting before the octave: at the fifth above the finals.[357] For example, the interval string around D (defined using six notes as Guido did), t-**D**-t-s-t-t, is the same as that around A, t-**A**-t-s-t-t. These repetitions of interval strings were used by various theorists to explain the observed shared (intervallic) quality between pairs of notes a fifth apart. The shared interval string quality is called *affinity*.

Interval string qualities and affinities were most famously discussed by Guido in his texts *Micrologus* (1026-1028) and *Epistola Guidonis Michaeli Monacho de Ignoto Cantu* (c. 1032),[358] through which, he developed a system of transposition as well as the hexachords, to which I will return shortly.[359] However, the interval string qualities, affinities, and related transpositions were first recognized in the ninth century, and they continued to be transmitted by numerous theorists through to the eleventh century.

*Musica Enchiriadis* (c. 900) described notes having distinct qualities (*propriam*) defined by the pattern of surrounding intervals,[360] as well as notes at various intervals (other than the octave) sharing the same quality (*suaemet qualitatis*) due to sharing the same interval string.[361] *Scolica Enchiriadis* (c.900) used the term *socialitas* ("natural kinship") for the affinity between notes of like interval string quality, which were termed *compare* ("compeer" or "peer") or *sociales* ("related sounds").[362]

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[355] Pesce, *The Affinities and Medieval Transposition*, 9-11.
[356] See David Cohen, "Notes, Scales and Modes in the Earlier Middle Ages," in *The Cambridge History of Western Music Theory,* ed. Tomas Christensen (Cambridge: Cambridge University Press, 2002), 351-354; and Pesce, *The Affinities and Medieval Transposition*, 9-11.
[357] On Pseudo-Odo's recognition of affinities, see Pesce, *The Affinities and Medieval Transposition*, 12-13.
[358] Pesce, *The Affinities and Medieval Transposition*, 19. The dates are given by Claude Palisca in Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 68.
[359] Pesce, *The Affinities and Medieval Transposition*, 18-22.
[360] Erickson, trans., and Palisca, ed., *Musica Enchiriadis and Scolica Enchiriadis*, 2.
[361] Erickson, trans., and Palisca, ed., *Musica Enchiriadis and Scolica Enchiriadis*, 5; see also 42 n.16. Note that because the treatise uses the daseian scale, the intervals do not correspond to that of the diatonic gamut.
[362] Erickson, trans., and Palisca, ed., *Musica Enchiriadis and Scolica Enchiriadis*, 42-44, 48-49; see also 42 n.16. The author followed the identification of *socialitas* (or affinity) with a discussion of how after a phrase ends on a given note, a "concordant" continuation, i.e. one that preserves the mode, would only be

Hucbald, also writing c. 900, used the term s*ocialitas* for the affinity between the four finals and their upper-fifths, justified again by their identical interval strings.[363] He also suggested that upper-fifths could serve as alternate finals due to this affinity.[364]

Pseudo-Odo, c. 1000, wrote of s*imilitudines vocum*, "likenesses of sounds", and he also emphasized only the relationship between the final and the upper-fifth.[365] Most famously, Guido used the word a*ffinitas* (1026-1028), which was later copied by numerous theorists, including Johannes of Afflighem, who used a*ffines* and *affinitas*.[366]

Throughout their history, affinities were used to explain why the upper-fifth could function as a substitute final. The concept of substitute finals was needed for two circumstances: firstly, as an explanation for a widespread practice that did not correspond to the rule of ending with finals, and secondly, as the key idea required to justify transposing parts of chants or entire chants to avoid notes that were not available in the gamut, such as E-flat.[367] I will return to the reasoning behind justifying the upper-fifth as the cofinal through the invocation of affinities shortly.

Lastly, I should note that the centuries-long history of medieval descriptions of interval string qualities, in my view, emphasizes their likely importance to medieval singers.

### 3.2.2 Mode Degree Qualities vs. Interval String Qualities

To reiterate, the interval string quality of a note is dependent only on the surrounding pattern of intervals, i.e. its interval string, which is determined by the gamut. Therefore, interval string qualities are defined independently of the final, making them fundamentally different from mode degree qualities, which would be defined entirely by each mode degree's relationship to the final, as a scale degree acquires its quality from its relationship to the tonic.[368]

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possible if the proceeding melody begins at the same pitch or at an upper or lower *compar* (the context makes it clear that this is only the upper- or lower-fifth here).

[363] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 39. See also Pesce, *The Affinities and Medieval Transposition*, 7, 147 n.7-8.

[364] Hucbald further extended the concept to the lower-fourths and sometimes the lower-fifths, but limited those notes to "beginnings, not endings". Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 39. See also Pesce, *The Affinities and Medieval Transposition*, 8, 147 n.9.

[365] Pesce, *The Affinities and Medieval Transposition*, 11-14.

[366] Pesce, *The Affinities and Medieval Transposition*, 44.

[367] Pesce, "B-flat: Transposition or Transformation?" 336.

[368] It is worth observing that common practice tonality does not use affinities. I suspect that most people who are trained only in common practice tonality would have difficulty perceiving or accessing a sense of

There is, to some degree, an opposition between the two qualities. If one hears a pitch class in a given mode primarily as a mode degree, then when the mode changes, one will hear the pitch class differently. In addition, if mode degrees existed, then those pitches should behave differently in different modes, as discussed earlier. On the other hand, if one hears a pitch class as defined primarily by its interval string, then the same pitch class would sound the same regardless of the mode, since its interval string would always remain the same. In addition, if affinities defined the hearing of pitch classes, then those pitch classes should not behave differently in different modes. I believe that this opposition reveals a cognitive competition or compromise between mode degrees and affinities. One of the two would have to have been higher than the other in the hierarchy of musical structures that existed unconsciously in medieval listeners' minds.

An affinities-based hearing would contradict the notion of modal saturation posited in the previous chapter. It would also contradict the observations made in the first section of this chapter on the four proposed traits of mode degrees. Even so, the enduring and widespread popularity of affinities should convince us not to dismiss them. How can we reconcile the two competing structures?

Firstly, I believe that we need study the music in order to find answers, which I pursue in Chapter 4.

Secondly, I would like to briefly speculate about the possible properties of a musical system where both affinities and mode degrees might coexist. Let us begin, once again, with tonality, only because its familiarity makes it a useful reference point. The major scale is a seven-level hierarchy. Each pitch class has its own sound (i.e. scale degree quality), behaviour, and functions. With the modes, however, very little is specified beyond the final and upper-fifth. Even the third-highest place in the pitch hierarchy is a guess. Perhaps the notes of the modes were organized in a hierarchy with fewer levels or divisions. In a two-level hierarchy, there would be the final in the top level and then everything else together in the lower level. In a three-level hierarchy, the final would be in the top level, followed perhaps by the upper fifth or by the reciting note in the next level, followed by everything else. In the *everything else* level, I would expect the interval string qualities to take over from well-defined mode degrees, and so the interval string qualities would determine the behaviour of the pitches. If the analyses do not

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interval string qualities. I must admit that although I can conceive of interval string qualities and recognize them as a distinct category, I am not sure that I hear them at all.

reveal a full, robust hierarchy, interval string qualities could be the explanation. If the analyses reveal very little mode-dependent pitch class behaviour, then interval string qualities could be a leading explanation.

It could also be that certain parts of chants, namely openings and closings of phrases and pieces, would be organized in a final-dependent way, i.e. modally, but other parts of the same chant might not be. Investigating whether modal melodies, specifically in plainchant, are modal throughout or only in specific sections lies beyond the scope of this thesis, but it is an important question to answer to understand plainchant modality.[369]

### 3.2.3 A Final-Dependent Function of Interval String Qualities?

There is one final point to make regarding interval string qualities. Although interval string qualities are not inherently related to finals, their described function in the treatises was tightly tied to the final and a pitch relative to it: the upper-fifth. Interval string qualities were used to explain the special status that was given to the upper-fifth as the second-most important note of the mode and as the only note that could substitute the final. On the one hand, I can imagine how this might make sense to a medieval listener: the interval string qualities of the upper-fifth and the final being the same would have meant that the two notes shared some perceived similarity in their sounds, which could have justified the substitution. On the other hand, this justification involves using a final-independent observation to explain a final-dependent phenomenon, which would seem to be contradictory.

I would like to offer two possible explanations for medieval theorists using the identical interval string qualities between the final and the upper-fifth to justify using the latter as a cofinal. The first is that the apparent contradiction depends on thinking of final-dependent phenomena

[369] To pursue the question of whether plainchant melodies are modal throughout or only in specific sections, we might first have to parse beginnings, middles, and ends so that we can extract middles for separate analyses. To do so, we would need to start by systematically creating as comprehensive a catalogue or lexicon of opening and closing formulas in Frankish-Roman chant as possible. Some of this work has already been done; see, for example, Terence Bailey, *The Intonation Formulas of Western Chant* (Toronto, ON: Pontifical Institute of Mediaeval Studies, 1974). In addition, my understanding is that phrase openings and especially closings tend to be highly conventional and formulaic, which might make them exemplars of the modes, but their shortness could interfere with statistical analyses. As a result, it would likely not be possible to use them as modal reference points, i.e. samples from which to derive results that would be modal by definition as in Chapter 4 of this thesis, at least not in statistical analyses such as those pursued here (see the methodology section of this chapter, below). Nevertheless, mode-dependent and mode-independent pitch class behaviour might still be distinguishable through various means, such as those employed in Chapter 4 of this thesis.

(such as mode degrees) and interval string qualities as dichotomous. In fact, if interval string qualities were perceived, and they seem to have been, then they would have existed alongside finals, which are obviously final-dependent. If, as proposed in the preceding section, there existed some hybrid of mode degree qualities and interval string qualities through a special pitch class hierarchy (i.e. one with fewer levels including an *everything-else* level), then perhaps the cofinal rationale would make sense.

The second explanation is that that justification was a post hoc explanation for a pre-existent practice. There are clues in early treatises that this might have been the case. I will offer only three examples, though more might exist.

Firstly, *Scolica Enchiriadis* used the term *compares* to refer to a similar or identical interval string quality shared both by the final and the upper-fifth *and* by the final and the upper fourth.[370] However, the interval strings of the upper-fifth and the upper-fourth are not the same, and therefore, the interval string qualities should differ.

Secondly, Hucbald also identified the lower-fourth (relative to the final) as having affinity with the final. However, Hucbald described that affinity as weaker than the one between the final and the upper-fifth. This is striking, since this relative weakness is not explained by the interval strings: after all, the upper-fifth and lower-fourth belong to the same pitch class and therefore have identical interval strings. This would seem to suggest that not only did the upper-fifth pitch class have a privileged position in the pitch class hierarchy, but that the upper-fifth pitch itself was of unique importance and perhaps had a distinct function as well.

Thirdly, Hucbald included lower-fifths "in certain cases" as having the same affinity to finals as lower fourths did,[371] which further breaks down the justification of affinity through identical interval strings, since the interval strings of the lower-fifth and the lower-fourth are not the same in any of the modes of Western plainchant.[372] Note as well the similarity of this example to the *Scolica* example; I do not have an explanation for that similarity.

The above three cases cannot be explained through the concept of matching interval strings, even though their rely on affinities as justifications.

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[370] Erickson, trans., and Palisca, ed., *Musica Enchiriadis and Scolica Enchiriadis*, 42-44, 48-49, 42 n.16.
[371] Babb, trans., and Palisca, ed., *Hucbald, Guido, and John on Music*, 39.
[372] In fact, there is no diatonic mode with only two semitones where the two semitones are non-adjacent (e.g. all of the medieval modes and the two tonal modes (major and minor)) in which lower fourths and lower fifths can ever have identical interval strings, let alone in which all three of the final, lower-fourth, and lower-fifth can all share identical interval strings.

I would argue that although there might be some merit to the first of the two explanations I proposed in this section, i.e. that the intervallic-quality justification of cofinals might form more evidence of a hybrid system of final-dependent and final-independent pitch class behaviour, the above three examples of inconsistent intervallic-quality-reasoning lead me to believe that the second explanation, i.e. that the justification is post hoc, is the more apt one.

As a final note to this section, I should add that there is great room for further research into the details of how various theorists used or misused interval string qualities in their treatises and potential commonalities across treatises.

### 3.2.4 Hexachords

One of the most famous structures associated with modal theory, and one of the most popular, at least from the thirteenth century until the seventeenth century, was the hexachord.[373] A hexachord is a series of six consecutive notes with the intervallic pattern T-T-S-T-T (where *T* is tone and *S* is semitone). In the gamut, the pattern recurs beginning on the pitch classes C, G, and, when B-flat is used, F. It originated in Guido's definitions of affinities; he defined the interval string of the four finals as a six-note series: C up through A.

However, Guido did not identify the hexachord as a structural unit. It served two functions. The first was pedagogical: Guido used it to teach students how to sight-sing, which it facilitated by emphasizing memorization of the intervallic structure of the gamut. The interval string of each pitch class was emphasized through the assignment of what are now known as hexachord syllables to the six notes of the hexachord: *ut, re, mi, fa, sol,* and *la*.[374] The hexachord's second function was to connect notes that shared affinity: finals and their upper-fifths, the latter of which could function as cofinals. This was important for transposing chants or portions thereof.

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[373] Jehoash Hirshberg, "Hexachord," 2001, *Grove Music Online*, last accessed 2019 May 31. <https://doi.org/10.1093/gmo/9781561592630.article.12963>.

Note as well that "The word *hexachord* was not used until the sixteenth century. Medieval theorists referred to the unit as *cantio, deductio,* and *voces muiscales*." Pesce, *The Affinities and Medieval Transposition*, 174. However, according to modern convention, I identify them by the term *hexachords*.

[374] Wilhelm of Hirsau, of the Southern German school, observed the recurrence of the hexachord starting on F when Bb was used, which planted the seed of the generalization of the hexachord. Finally, by Pseudo-Garlandia in the mid-thirteenth century, the hexachord had become a major part of modal theory. Pesce, *The Affinities and Medieval Transposition*, 51-53.

A hexachord is the longest series of notes within an octave whose intervallic pattern starts to repeat within the octave; a series of six intervals (seven pitch classes) would define an individual mode.[375] Furthermore, the hexachordal pattern begins to repeat after at most three notes, resulting in two or three hexachord syllables being possible for most pitches of the gamut.

Although hexachords are usually associated with modal theory, I would argue that hexachords are not, in fact, modal. The recurring pattern of five consecutive intervals is inherent to the intervallic structure of the gamut, and the pattern-placement does not change depending on the mode. In a mode, it is through relationships to a tonal centre that qualities and functions arise, e.g. final, reciting note, tenor, mode degrees (potentially), etc., whereas with hexachords, syllable-assignment does not depend on the final.

To demonstrate this difference, we can take any pitch, for example, D, and then consider what determines its hexachord syllable. The assignment of the hexachord syllable *re, sol,* or *la* to that D depends not at all on the mode, but rather only on two aspects: primarily, the intervallic pattern surrounding the note (including whether there is a B-natural or a B-flat) and, secondarily, the range of the melody at that moment. The D can be assigned any of the three above hexachord syllables in any of the four principal modes.

Given that affinities and thus hexachords both arose from the structure of the gamut, which is identical across all the modes, hexachords cannot be used to differentiate modes. Therefore, hexachords are not useful for investigating what differentiates one mode from the others. As a result, I do not use hexachords in any way in my methodology for analyzing mode.

Nevertheless, the eventual popularity of hexachords in the middle ages might suggest that they served some function beyond their original uses of transposing melodies and teaching sight-singing. I would suggest that this function was to highlight interval string qualities. Hexachord syllables emphasized interval string qualities and de-emphasized mode degrees, which would have been represented by the letter note-names (D, E, F, etc.). However, there was a huge time gap between the documentation of interval string qualities in the ninth century, the spread of hexachords across Europe in the twelfth century, and hexachords' pronounced rise in popularity in thirteenth century.[376] This time gap between their origins and their popularity might

[375] Cohen, "Notes, Scales and Modes in the Earlier Middle Ages," 350.
[376] See Pesce, *The Affinities and Medieval Transposition*, 51-53. On the sudden rise in popularity of hexachords in the thirteenth century, see also Pesce, "B-flat: Transposition or Transformation?" 346; and Stefano Mengozzi, "The heptachordal basis of hexachordal theory: on the semiotics of musical notation in the Middle Ages." *Plainsong & Medieval Music* 22, no. 2 (2013): 174-188. Mengozzi's larger argument

weaken the reasoning that interval string qualities caused hexachords' ubiquity. Nevertheless, the emphasis on interval string qualities might explain part of the appeal of hexachords if not their surge in the 1200s.

One might also suggest that one of the original uses of the hexachord, the highlighting of the relationship between the final and the upper-fifth, would minimize the perception of interval string qualities in favour of mode degree qualities. However, the effect of connecting all the notes sharing affinity by assigning hexachord syllables to all the notes would have been the de-emphasis of the relationship between the final and the fifth relative to the other affinities.

To summarize, hexachords are not modal; the assignment of hexachord syllables does not depend on and is not affected by the mode. As a result, they do not feature in my methodology. Furthermore, hexachords inherently stress interval string qualities over mode degree qualities. Lastly, the popularity of hexachords might imply that interval string qualities were of great importance to medieval listeners.

### 3.2.5 Summary: Interval String Qualities

In this section, I have discussed the concept of *interval string quality*, which captures the medieval concept of a perceived quality of a pitch class based on its surrounding intervallic pattern, which I call its *interval string*. The concept seems to be present in nearly every modal treatise of the middle ages, though it is given a different name by almost every theorist until the twelfth century. The history of the concept is very long; it is present in treatises from the end of the ninth century onwards: *ME* and *SE*, and treatises by Hucbald, Pseudo-Odo, Guido d'Arezzo, and Hermannus of Reichenau, amongst others not included in my brief overview.

However, whereas mode degrees and their qualities depend on the identity of a pitch class as the final, interval string qualities are fixed according to the intervallic structure of the gamut. Interval string qualities are final-independent; they are the same irrespective of the mode. They are therefore not modal.

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regarding the hexachordal dominance of music theory discourse in the later middle ages and the hexachordal syllables and letter-note-names being considered equal is thought-provoking, but I hesitate to support it, in part due to a lack of sufficient historical sources to support his claims, as well as certain assumptions in his work that are not carefully treated. See ibid., 169-194.

Hexachords, Guido's famous and popular theoretical construct built around a recurring intervallic pattern found in the gamut, are similarly not modal; they are a product of the structure of the gamut that does not change with any mode.

One of the most important observations about interval string qualities is that they must be, at least to some extent, cognitively at odds with mode degree qualities. The contradiction between them is that mode degrees are defined by a final whereas interval string qualities are defined by the gamut; a pitch class would be heard as a specific mode degree depending on which pitch class is the final, but interval string qualities never change with the modes, since they are defined by the intervallic structure of the gamut, whatever the pitch class that happens to be the final. I believe that it is possible, though, for both mode degree qualities and interval string qualities to coexist in some blend. I have proposed that mode degrees might exist in a pitch class hierarchy that has fewer than seven levels (one for each pitch class); instead, there might be a category for the final, a category for the upper-fifth, perhaps a category for the reciting note, and maybe categories for other mode degrees as well, but then also an *everything else* category that would hold the remaining pitch classes, all of which would operate according to something to do with the gamut, independent of the mode, rather than each of the everything-else pitch classes having a distinct function relative to a final.

Finally, interval string qualities were used by medieval theorists to explain why the upper-fifth of a mode could function as a cofinal: two different pitch classes with matching interval strings (in this case the final and the upper-fifth) were identified as having matching interval string qualities and thus a similar enough sound that the upper-fifth could sometimes substitute the final. However, I believe that this reasoning was a post hoc explanation for a pre-existent practice that had originated in some other principle now unknown to us. I doubt the legitimacy of the medieval justification of the cofinal in large part because of the inconsistencies in the way matching interval string qualities were identified, ranked, and used in medieval modal treatises.

## 3.3 Methodology

My methodology contains three different analyses:

1. Mode Profiles: Pitch Class Frequencies;
2. Tendency;
3. Leaps and Melodic Outlines of (Perfect) Fifths and Fourths.

### 3.3.1 Analysis 1: Mode Profiles: Pitch Class Frequency Distributions

The first analysis to be performed is a study of distributions of pitch class frequencies for music of a given mode. The relative frequency of pitch classes in a given context (how often each pitch class occurs) might seem to a traditional theorist to be an arbitrary thing to measure. However, the distributions of pitch class frequencies in a given key have become a mainstay in studies of cognition and perception as well as mathematically inclined music theory research, the latter of which does not enter into the present discussion.[377] When pitch class distributions in tonal music are derived through music psychology experiments, they are called *key profiles*. Generally, pitch class distributions derived from statistical analyses of scores have not been given a distinct term, however, they are generally referred to as *key profiles* as well, for reasons that will become clear shortly, although *corpus-derived key profiles* would be more apt.

Key profiles were first introduced by Carol Krumhansl and Edward Kessler's foundational 1982 probe-tone study.[378] Their work has since been improved upon greatly by Bret Aarden in 2003, who used a more reliable reaction-time study, which yielded much better results. This improvement of results is judged very simply: the pitch class distributions resulting from Aarden's music psychology experiment matched more closely the pitch class distributions in the music collection used as a reference point, the Essen Folksong Collection.[379] Aarden thus further confirmed Krumhansl's hypothesis that listeners would unconsciously internalize pitch class distributions,[380] which is an example of the more general phenomenon of implicit learning, which I discussed in the Introduction, in the context of language and music acquisition.[381] Key profiles, both derived through music cognition experiments and through corpus studies, reflect the hierarchy of pitches in each given key.[382]

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[377] Key profiles have been used extensively in key-finding algorithms, such as those developed by David Temperley. See for example, David Temperley, *Music and Probability* (Cambridge, MA: MIT Press, 2007), 89-98.

[378] Krumhansl and Kessler, "Tracing the dynamic changes in perceived tonal organization in a spatial representation of musical keys," 334-368; this study is refined in Krumhansl, *Cognitive Foundations of Musical Pitch*, 21-49.

[379] Aarden, "Dynamic Melodic Expectancy,"42-68; "The Essen Folksong Collection contains over 6000 traditional European folksongs, primarily of German origin." Ibid., 43.

[380] Krumhansl, *Cognitive Foundations of Musical Pitch*, 18-21, 286.

[381] A study that provides an overview of various studies of implicit learning and music is Martin Rohrmeier and Patrick Rebuschat, "Implicit learning and acquisition of music," *Topics in cognitive science* 4, no. 4 (2012): 525-553.

[382] Krumhansl, *Cognitive Foundations of Musical Pitch*, 21-49; Aarden, "Dynamic melodic expectancy," 11-26, 42-68; Huron, *Sweet Anticipation*, 144-147.

Complicating matters, however, is an assumption that underlies the research relying on key profiles that was not checked until very recently: that, omitting modulatory passages, scale degree distributions would be consistent for each of the two modes of tonality (major and minor) regardless of the key, i.e. regardless of the tonic pitch class. In other words, it was assumed that all major pieces had one scale degree distribution and that all minor pieces had another; this consistency of scale degree distributions across keys of the same mode is termed *transpositional equivalence*.[383] However, Ian Quinn and Christopher William White showed in a 2017 study that scale degree distributions across openings of 995 major-mode pieces and 596 minor-mode pieces from the Yale-Classical Archives Corpus differed significantly depending on the tonic pitch class, with chromaticism increasing with increasing accidentals in the home-key key-signature. Their results remained consistent even when modulatory passages were excluded from the analysis.[384]

Luckily, the problem of chromaticism is not one with which I must contend when studying Notre Dame organum, whose accidentals are few: B-flat, E-flat, and F-sharp. I would expect that songs from the Essen folk song collection, which Aarden and Huron used for their key profiles, would not show such differences or at least not significant differences in their scale degree distributions, although this expectation should also be verified.[385] Nevertheless, the basic lesson from Quinn and White stands: we should not assume that pieces of the same key or mode have the same distribution of pitch classes or mode degrees.[386]

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[383] See Aarden, "Dynamic melodic expectancy," 11-26, 42-68; Huron, *Sweet Anticipation*, 144-147. Such stable distributions across keys seem to be corroborated by David Temperley's Kostka-Payne corpus: 46 excerpts from the workbook for Kostka and Payne's *Tonal Harmony* textbook; Temperley, *Music and Probability*, 84-86; Stefan Kostka and Dorothy Payne, *Workbook for Tonal Harmony* (New York: McGraw-Hill, 1995).

[384] Ian Quinn and Christopher Wm. White, "Corpus-Derived Key Profiles are Not Transpositionally Equivalent," *Music Perception: An Interdisciplinary Journal* 34, no. 5 (2017): 531-540.

[385] On Huron's use of key profiles, see Huron, *Sweet Anticipation*, 150-153, 394 n.14.

[386] The correspondence between the Essen folk song collection's scale degree distributions and the music cognition experiments of Krumhansl and especial Aarden raise the question: how would listeners develop such uniform intuitions without uniformity in the repertories to which they are exposed? It is possible that pitch class distributions in pop music (for which we do not have key profiles) and folk songs are more consistent than the selections from the Yale-Classical Archives Corpus, which would explain the shaping of modern tonal expectations. It might also be that there are more classical pieces written in keys with fewer sharps and flats, or that we are simply more familiar with such pieces due to radio play or music history course selections or a number of other factors, all of which form open avenues for further research to answer the question of where our musical intuitions for classical music originate.

Separately, future studies investigating how key profiles have changed over time starting with the mid- or late-seventeenth century continuing through the nineteenth century would be of great personal interest as well.

The study of mode-profiles has only been pursued in one study by David Huron and Joshua Veltman, but it is highly problematic.[387] Firstly, it builds on the faulty assumption discussed above that all pieces of a single mode have the same distribution of pitch class frequencies. Secondly, a consideration of modulation is absent from their study. This is understandable, since modulation in chant is not yet a part of "mainstream" modal theory. Nevertheless, the result of the assumption that all plainchants are monomodal is that modulatory passages are not excluded from their samples, and thus each sample represents any number of secondary modal passages combined with the primary ones, making each mode's sample far less likely to represent the given mode. Another problem with the sample is that all of the pieces are taken from the *Liber Usualis*, which is not considered a reliable source for any chant research, since the sources of the *Liber* are numerous and unknown; it was first compiled in the nineteenth century by the monks of Solesmes, who did not keep track of the source for each chant.[388] It might be, however, that the differences between the sources used by the *Liber* might prove minor or insignificant in a large enough corpus study; the same patterns probably underlie all variants of each chant. Lastly, Huron and Veltman's sample includes chants of random genres across chronologically diverse layers of chant. Different chant layers could yield different results, and though the results might not be drastically different, their similarity should first be established rather than assumed. Therefore, while their study is interesting, I do not consider the results reliable.

The question of whether or not there are repeating distributions in the samples in this study must be addressed in each analysis. To do so, I use a dendrogram cluster analysis in conjunction with the probability calculations of each analysis. I will describe this procedure in greater detail after outlining the remaining two analyses.

To summarize, in the first analysis, I examine the relative frequency distributions of each pitch class. Consistent distributions within or across modes could correspond to mode profiles.

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[387] David Huron and Joshua Veltman, "A Cognitive Approach to Medieval Mode: Evidence for an Historical Antecedent to the Major/Minor System," *Empirical Musicology Review* 1, no. 1 (2006): 33-55.
[388] Hiley, *Western Plainchant: A Handbook*, 2, 624-627; "Liber usualis," 2001, *Grove Music Online*, last accessed 2020 January 7. <https://doi.org/10.1093/gmo/9781561592630.article.16573>; Joseph Dyer, Kenneth Levy, and Dimitri Conomos, "Liturgy and liturgical books: III. Reformation and post-Reformation liturgical books," 2018, *Grove Music Online,* last accessed 2020 January 7. <https://doi.org/10.1093/gmo/9781561592630.article.40071>.

### 3.3.2 Analysis 2: Tendency: PC-Pair Analysis

Towards the beginning of this chapter, I suggested that a pitch class hierarchy would be reflected by mode-specific pitch class behaviour. One such behaviour could be *tendency*. Tendency is the likelihood that a given pitch class will proceed to any specific pitch class(es) in a given mode. Flexibility is its inverse: how unlikely a given pitch class is to move somewhere else. For example, in common practice tonality, the probability of the leading tone going to the tonic is high. The probability of raised scale degree 1 going to scale degree 2 is extremely high. By contrast, the probability that the tonic will go to any one harmony is relatively low; the tonic could go to many different harmonies, and thus, it is very flexible.

Tendency is a concept taught with part-writing for tonal harmony courses, but to my knowledge, only Huron has done what at first glance appears to be a systematic study of it in a tonal context. As invaluable as Huron's reporting on his results is, it is incomplete. Huron presents tendency schematics for only three scale degrees, and his schematic of all tendencies in a major key omits certain tendencies, such as those between scale degrees 7 and 6 or between scale degrees 6 and 1. In addition, he only shares data for the major mode. I hope that he eventually publishes the complete results.[389]

In this analysis, I use conditional probabilities to determine the tendency (or tendencies) of each pitch class. The result is a distribution of tendency probabilities.

### 3.3.3 Analysis 3: Leaps and Melodic Outlines

The third analysis calculates the conditional probability of various leaps and melodic outlines. As alluded to earlier, it is derived from Marchetto's work; the leaps and melodic outlines have the span of perfect fourths and perfect fifths, and they are categorized according to their bounding notes, or what Rahn calls *special notes* (see section 3.1.4.1.2 above). Outlines of fifths are counted separately from outlines of fourths.

The analysis of leaps of a fifth answers the following question for a given musical context (e.g. a piece in a certain mode): given that some leap or melodic outline of a fifth will occur, how likely is the occurrence of each specific leap or melodic outline of a fifth (e.g. a leap between D and A)? The analysis of leaps and melodic outlines of a fourth answers the analogous question.

[389] Huron, *Sweet Anticipation*, 158-163.

In designing this analysis, I originally considered analyzing the probabilities of leaps separately from the probabilities of melodic outlines. Because leaps occur so infrequently in the music, though, measuring them alone makes the dendrogram cluster analyses crash (on the dendrogram cluster analysis, see below). As a result, leaps of a fifth (or L5) have been combined with melodic outlines of a fifth (or M5), and leaps of a fourth (or L4) have been combined with melodic outlines of a fourth (or M4). In terms of probability, the calculation is expressed as the probability of a specific L5 or M5 given the probability of any L5 or M5.[390]

This analysis only counts melodic outlines that contain all of the notes between their bounding notes; no melodic outlines with internal leaps are counted. Their exclusion ensures that every melodic outline between two given pitch classes has the same modal implication. Including all varieties of outlines within a single pitch-class-pair category would subsume too many objects of different modal implications under a single heading, rendering the category ambiguous or confused. On the other hand, creating separate categories for every possible melodic outline configuration would yield an unwieldy number of categories.

To demonstrate another limitation of this analysis, consider the following two series of notes, which we can imagine in a D-final mode piece:

1. A-G-F-E-F-E-D
2. A-G-F-E-F-E-D-C-D

In both examples, we might draw a melodic outline of a fifth from the A down to a D, but the outlines would be indirect. In the first example, there is an outline of a fourth from A to E followed by a step up and then an outline of a third down to D. In the second example, the A-E outline of a fourth is followed by another fourth-outline from F to C before cadencing on D. These outlines of fourths would be counted in this thesis, whereas the overarching outline from A down to D would not be counted. The reasons are as follows. Firstly, it is not a given that the two outlines of a fourth (A-E, F-C) should be subsumed under the A-D outline. It might not have been that a sense of the modal nodes was so strong that the medial outlines would have been ignored and that an outline of a fifth would have been recognized. Secondly, the larger context would do a great deal to lead the listener in other directions. For example, if just before this cadence, the mode was F-plagal, then the F-C outline might obscure the A-D outline. Lastly, designing a code that can recognize such overarching outlines is complex, and, I suspect, it would rely firstly, on

[390] This is written using the probability function of *union*, represented by the symbol U, and used thus: L5UM5. It represents an "either/or" situation, as in "either an L5 or an M5 would satisfy the requirement."

reference to modal nodes, which relates to the same assumptions addressed in the first point, and secondly, on larger modal regions, which we do not yet understand well enough for such a project. The analysis of leaps and melodic outlines of fifths and especially fourths should therefore be understood as not capturing all of the larger, more complex and more subtle outlines in the music.

In addition, even if we ignore the issue of picking the right overarching indirect outline, the above examples demonstrate how melodic outlines of fourths can be and often are used as building blocks within melodies. In such cases, the overarching outline would be more modally significant than the component fourths-outlines out of which it is constructed. Since I am excluding from the analysis all indirect and therefore all overarching outlines, what remains are only the modally-less-important constituent fourths-outlines, which might mean missing the forest for the trees.

Berger has made a related point while criticizing Wulf Arlt's motivic analysis of a conductus possibly composed by Perotin.[391] According to Berger, Arlt has overemphasized the importance of a descending tetrachord in his analytical narrative.[392] She notes, "…a descending tetrachord is a rather basic melodic figure, which can be found throughout the Western repertory."[393] She further points out that Immel and Roesner have both demonstrated that the descending tetrachord is an ornamental melodic formula found throughout the organa of Notre Dame, implying that the figure is so elementary and so common that it would not have the significance that Arlt's analysis ascribes to it and depends on it having, perhaps like if one were to weave a grand analytical narrative based on typical, conventional authentic cadences in tonal music.[394] One might suspect, therefore, that the analysis of fourths-outlines in general might also reveal nothing of value for both mode-dependent and mode-independent pitch class behaviour.

However, while fourths-outlines might not have been meaningful for the level of music and meaning in Arlt's narrative nor in most traditional modes of music analysis, they might prove meaningful in a statistical analysis. The most common and most basic components of melody,

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[391] Wulf Arlt, "Denken in Tönen und Strukturen: Komponieren im Kontext Perotins," in Perotinus Magnus, ed. Jürg Stenzl, Music-Konzepte, no. 107 (Munich: Edition Text + Kritik, 2000), 53-100.
[392] As Berger points out, Arlt has also cherrypicked the data; he has ignored similar melodic outlines of a fourth when they did not serve his analytical narrative. Berger, *Medieval Music and the Art of Memory*, 43; Arlt, "Denken in Tönen und Strukturen," 53-100.
[393] Berger, *Medieval Music and the Art of Memory*, 43.
[394] Berger, *Medieval Music and the Art of Memory*, 43; Immel, "The Vatican Organum Treatise Re-examined," 127-134; Roesner, "Who 'Made' the *Magnus Liber*?", 259-261. Berger explores the same figure later in her book: Berger, *Medieval Music and the Art of Memory*, 169-174.

that is pitch classes, out of whose combinations all building blocks of all (Western classical) melodies are made, and to any isolated one of which we give almost no importance in analysis, have been shown to be rich in meaning when analyzed statistically, as we have seen in the context of key profiles. Therefore, I believe that the analysis of leaps and melodic outlines of a fourth is still worth pursuing, because distributions of "direct" outlines could still reflect whether a certain level of structure is mode-dependent or mode-independent or perhaps some combination of both.

### 3.3.4 Octave Equivalence

All of the analyses count only pitch classes, not individual pitches, thus assuming octave equivalence. I believe that historical accounts are generally clear that octave equivalence existed.[395] In addition, octave equivalence is widely recognized in the field of music cognition and perception as a human universal.[396]

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[395] Examples from medieval modal treatises demonstrating the recognition of octave equivalence are too many to list comprehensively, though I will note a few early ones to establish the solidity of the idea even in the early middle ages, as well as one of the most important Notre Dame sources. Around the year 500, Boethius reported that Ptolemy had written of octaves being *aequisonus*: "Equison pitches are those which, struck at the same time, yield one and an apparently simple sound from two – for example, the diapason [the octave] and its double, the bisdiapason [the double octave]." Anicius Manlius Severinus Boethius, *Fundamentals of Music*, trans. Calvin M. Bower, ed. Claude V. Palisca (New Haven, CT: Yale University Press, 1989), 171; see also 170, n. 33.

Just before citing Boethius in his treatise, Hucbald described octave equivalence; Babb, trans. and Palisca, ed., *Hucbald, Guido, and John*, 25, paragraph 111a/7.

The late ninth-century treatise *Alia musica* is known for using octave species to describe the modes, following Boethius (though it also included errors unrelated to octaves); Powers et al., "Mode: II. Medieval Modal Theory: 2. Carolingian synthesis, 9th–10th centuries: (ii) Octave species and the Hellenistic names," 2001, *Grove Music Online*, last accessed 2020 January 21. <http://www.oxfordmusiconline.com/subscriber/article/grove/music/43718pg2>.

As I noted in Chapter 2, *ME* and *SE* are exceptional in that the daseian scale that they promulgated is not octave-based, but the daseian scale is not regarded by most scholars (including myself) as representing the contemporaneous repertory. Moreover, *ME*'s description of organum doubled at the octave famously acknowledges octave equivalence, even as it contradicted the structure of the daseian scale. *Musica Enchiriadis and Scolica Enchiriadis*, trans. Erickson, ed. Palisca, 19.

Of course, the use of only the first seven letters to classify all notes within seven pitch classes is based on octave equivalence, which, to my knowledge, first appeared in Guido's *Micrologus*. See Atkinson, *The Critical Nexus*, 220.

Finally, Pseudo-Garlandia classified both unisons and octaves together as complete concords with the following explanation: "We speak of complete [concords] when two pitches are joined in the same time unit in such a way that the sense of hearing cannot distinguish one pitch from the other, on account of the concord, and these are called one-sounding, or same-sounding, as in the unison and octave." Johannes de Garlandia, *De Mensurabili Musica*, trans. Rob Wegman, *Academia.edu*, last accessed 2018 January 27, since taken down. Page 14. <https://princeton.academia.edu/RobCWegman/Translations>.

[396] For example, see Daniel J. Levitin, and Susan E. Rogers, "Absolute pitch: perception, coding, and controversies," *Trends in Cognitive Sciences* 9, no. 1 (2005): 27. Laurent and Armand have shown that infants perceive octave equivalency, suggesting that octave equivalency is biological; Laurent Demany, and

On the other hand, there are clues that in plainchant, pitches of a single pitch class above and below the final might not have been treated the same way; for example, in a D-plagal chant, the lower-A and upper-A might have behaved differently. I have referred to two such clues in section 3.2.3 above, namely the example from *Scolica Enchiriadis* and the first example from *Hucbald*. The reasons for these discrepancies are not clear, but due to the strength of the claim of music perception universality, I am comfortable leaving those questions for later studies.

Indeed, if only for reasons of data analysis, octave equivalence is a necessity for this thesis; distinguishing pitches of each pitch class would probably spread results out across too many pitch categories, possibly to the point of obscuring reasonable conclusions.

### 3.3.5 Two Units: Pitch Classes and Mode Degrees

Throughout, the results for each analysis are given twice: once in terms of pitch classes and once in terms of mode degrees. Having the data presented in both terms enables the analyst to observe which terms reveal the stronger patterns.

### 3.3.6 Pearson-Dendrogram Cluster Analysis

In the discussion of mode profiles, I pointed out that we should not assume that pieces of the same mode have the same distribution of pitch classes or scale/mode degrees. This generalizes to all of the analyses: we must not assume that there is a single distribution across the set of the given unit of music (e.g. pieces, phrases). If we were to incorrectly assume that there is a single pitch class distribution that more or less fits each piece, we would incorrectly take the average distribution, more formally called the *arithmetic mean* distribution, to accurately represent the sample of pieces, which would render our results extremely misleading. In Figure 3.2 below, for example, the arithmetic mean of the two disparate distributions F1 and F2 is a flat series of equally tall bars.

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Françoise Armand, "The Perceptual reality of tone chroma in early infancy," *The Journal of the Acoustical Society of America* 76, no. 1 (1984): 57-66. On the other hand, I should note that Jacoby et al. have complicated the picture of universal octave equivalence in their 2019 study involving a remote Amazonian tribe, the Tsimane', who, according to the authors, appear not to reflect octave equivalence. The study's implications on the universality of octave equivalence are not as plain as they might seem to be, but a detailed discussion of this study lies far beyond the scope of this thesis. Jacoby, Nori, et al., "Universal and non-universal features of musical pitch perception revealed by singing," *Current Biology* 29, no. 19 (2019): 3229-3243.

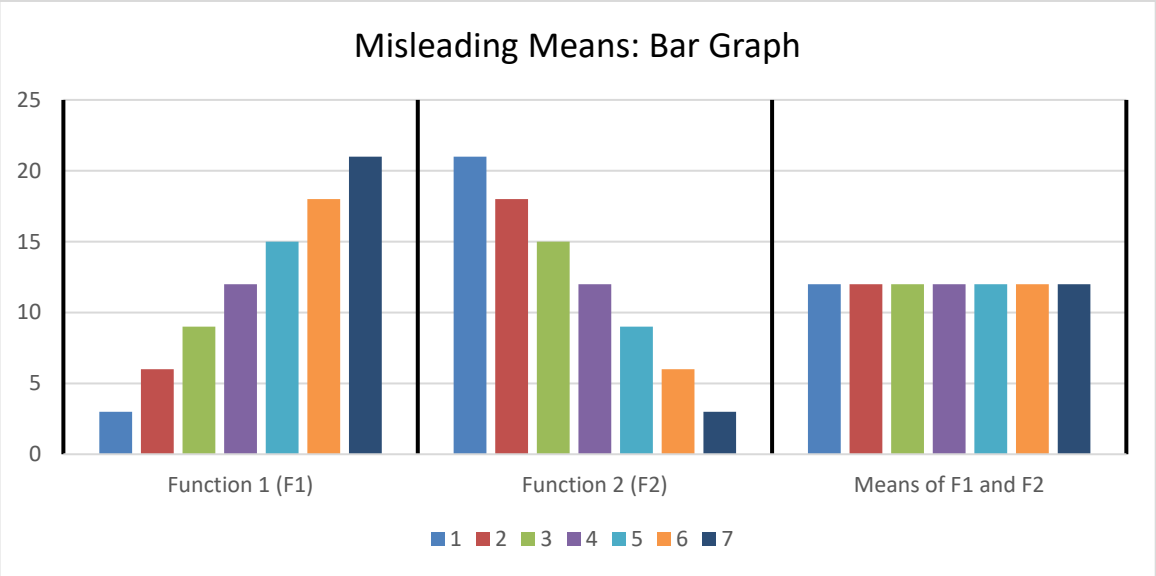


**Figure 3.2** Misleading Means: Bar Graph: The Mean of F1 and F2: Equally Tall Bars

Figure 3.3 presents the same data underlying Figure 3.2 as three stacked bar graphs:[397]

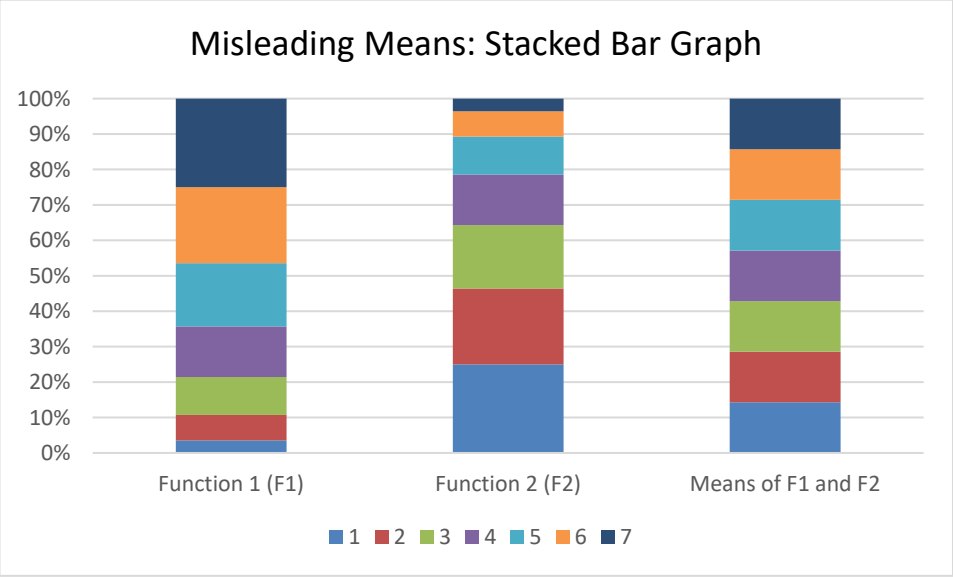


**Figure 3.3** Misleading Means: Stacked Bar Graph: The Mean of F1 and F2: Equally Tall Bars in a Stack

[397] Presenting the same data with a line graph would yield one line going up for F1, one going down for F2, and a flat line for the means. For discrete data, such as all of the results herein, bar graphs and stacked bar graphs are much more appropriate.

Instead of errantly assuming that means are representative of the data, we must determine the grouping of data, which is the job of a clustering analysis.

Martin Lysy, a professor of statistics at the University of Waterloo, and I developed a clustering analysis to handle my data. All distributions from the analyzed unit of music (e.g. phrases, sections, pieces) are depicted in a dendrogram as the *leaves* of the tree; they are the data points to be clustered. The clusters are technically called *nodes* or *clades*; the first level of clades shows the clustering of leaves, and higher-level clades show clustering of higher branches, meaning clusters of clusters. The tree is hierarchical. At the top of the dendrogram, or the root, all branches join.[398] Between the root and the leaves, the analyst must choose where to "cut" the branches, or in other words, which level of clustering to emphasize.

The clustering process begins with the Pearson Chi Square test, which can be used as a test of homogeneity: a test of whether two or more distributions are the same, and if not, how close they are. The test's result is a p-value that acts as a measure of dissimilarity between the two distributions.[399] The computer performs the Pearson Chi Square test for each pair of distributions, and then the distributions are clustered using a dendrogram analysis, where the values for similarity are "translated" into relative distance between each distribution in the tree.

The computer then runs a Pearson Chi Square test on each cluster, i.e. all the members of a clade, which gives a p-value that is a measure of homogeneity for that clade. Unless distributions are startlingly similar, p-values are expected to increase quickly as they are assigned to increasingly large clusters, i.e. clusters higher up the tree. When the p-value goes beyond a cut-off value, then the members of the cluster are considered too dissimilar to belong to the same distribution, and the branches are "cut", thus determining the final clusters.

[398] The tree grows upside down.
[399] This is technically a p-value, but in its use, it is not the same as a normal p-value. It is better described, especially in the present context, as a measure of dissimilarity.

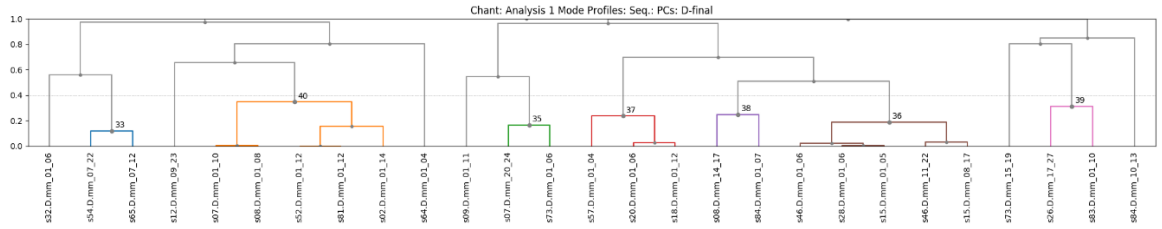


**Figure 3.4** An Example of a Dendrogram

Finally, the computer calculates an arithmetic mean distribution (informally, an average distribution) for each cluster as well as the number of members (e.g. pieces, phrases) in each cluster. These mean distributions are presented alongside all distributions that do not belong to a cluster, all of which together form the results presented in each section.

There is one final note on this cluster analysis to be made: the standard cut-off value is 0.05 or 5%, which I initially had as my cut-off value. However, many distributions that appear to me and to my programmer Maximilian Albert to be substantially similar only clustered far up the tree, well beyond the cut-off value. There are a few possible reasons for this. First of all, the Pearson Chi Square test counts differences at the extremes more than differences in the middle, for example, the difference between 0 and 2 would be counted differently from the difference between 49 and 51. It is possible that differences at the extremes, such as pitch classes appearing in some distributions and not others within the same analysis, would increase the Pearson Chi Square test's evaluation of their dissimilarity. Secondly, drastic differences in the smaller values of a distribution could lead to higher dissimilarity values than one might expect from the similarities of larger values. For example, in some set of results, if the frequencies of As, Bs, Cs, and Ds are all small and all vary widely, but Es, Fs, and Gs have relatively stable, large frequencies, then I believe that the dissimilarity values would still be large.

I have decided, therefore, to use a cut-off value of 0.4, which is highly unusual, but the results are more intuitive. I have also elected to include all the un-clustered distributions, which are many.

### 3.3.7 Subsamples

It is convention within corpus studies that the entire body of pieces of interest not be analyzed, because doing so would leave nothing left for testing hypotheses after the first analyses. Furthermore, each study is considered as "using up" the sample. The computer has,

therefore performed all of the analyses on a randomly selected 70% subsample of the relevant chunks of music, whether phrases or pieces or otherwise.

### 3.3.8 Software Development: Coders' Credit

The software that I have used for all of the methods and analyses in this chapter is original. I designed the statistical analyses to be run and the type of graphs needed, and I hired Maximilian Albert to design the software. He wrote it using Python and Music21, the latter of which was developed by Michael Cuthbert. Martin Lysy helped us with the design and programming of the Pearson-Dendrogram Cluster Analysis, using R. Finally, long after Maximilian Albert had completed the software according to my specifications, I needed the means across the modes for Analyses 1 and 3, at which point Srinivasan Guruswami appended code to the software to retrieve the data. The graphs for the means across modes were produced using Microsoft Excel, which is why the formatting and colour-coding differs from the rest of the thesis.

### 3.3.9 The Methodology and Positions within Phrases and Pieces

Although I have given a great deal of attention to notes at specific temporal and range-based positions within phrases and pieces, the analyses in my methodology investigate other structures. Of the four important positions (i.e. finals, initials, upper and lower boundary notes), I use only finals, and not as the subject of any of the analyses, but as a tool to construct samples by mode; exactly how will be detailed in Chapters 4 and 5, where I adapt the general methodology presented here to each repertory analyzed. This is not a shift in focus, however. I discussed finals and initials in the previous chapter within an exploration of modal perception occurring throughout pieces, not only at their beginnings and ends, and in this chapter, I discussed notes at specific positions within the larger consideration of final-dependent pitch class hierarchies. Relatedly, the analyses in my methodology are all focused not only on events at specific positions, but on pervasive structures that define mode throughout, namely the existence and possible form of mode-dependent and mode-independent pitch class structures.[400] This focus is especially

[400] A study on patterns at specific phrase- and piece-positions would be valuable in its own right, but I would expect its purpose and methods to be different. Such a study might shed light on important modal structures occurring at those four positions (final, initial, upper and lower boundaries (or max and min)), but, most obviously, those structures that would be studied would mostly be specific to those positions, not all modal material. Moreover, such a study would be less likely applicable to other repertories. In addition, perhaps such a study could reveal idiomatic mode-specific material that occurs at those positions, but to do that, the study would need to use different analyses.

important for studying mode in organum, where phrase limits are hardly clear and many older formulas and conventions are never found.

Even if the results of any of this thesis' analyses for these four positions were to differ from the broader results, the contribution of these four points amounts only to a few data points amongst scores or even hundreds; their differences would not disturb the larger findings.

### 3.3.10 Liquescents and Plicas

In the following two chapters, the general methodology presented here will be adapted to various repertories, partly by omitting certain segments of music, however, individual pitches, including liquescents and plicas, are never omitted. While the argument can be made that they are less important or less structural because they are ornamental, and should therefore be omitted, I take a different view. In chant, whether a note was a liquescent or not was inconsistent across manuscripts, suggesting that it was a performance choice, not a structural difference.[401] In fact, in twelfth-century Parisian sequences, I have observed at least one iteration of a melody without a liquescent followed by the repetition of the melody with a liquescent introduced, also demonstrating that the difference is performative but not structural.

In Notre Dame organum, there is at least one sign that plicas should be counted as normal notes. Everist, while writing on the type A medial articulation in *organum duplum*, which I will not touch on again in this thesis and thus will not explain further, writes "…the type A medial articulation divides the section of *organum* [*purum*] into two equal halves … of 63 pitches each (*including both plica notes and plica tones*)" [emphasis mine].[402] Although a small indication, it is nonetheless an indication that plicas contributed to the design of melodies, including note count.

Lastly, I should note that such notes are relatively uncommon; they occur frequently enough, but I suspect that even if they were omitted, there might not be a terribly large effect on the results, though there might be.

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[401] Hiley, *Western Plainchant: A Handbook,* 357.
[402] Mark Everist, ed., *Les Organa à deux voix pour l'office du manuscrit de Florence, Biblioteca Medicea-Laurenziana, Plut. 29.1,* Vol. 2 of *Le Magnus liber organi de Notre Dame de Paris* (Monaco: Éditions de l'Oiseau-Lyre, 2003), lxxxii.

### 3.3.11 Weighting Notes

Because there is no specified rhythm for any of the music analyzed in this thesis, i.e. plainchant and organum, all notes have been counted equally rather than weighted according to their duration or accent in a metrical grid.

## 3.4 Conclusion

The principal purpose of this chapter has been to develop a methodology to analyze mode throughout a chant, not only at the final note of a phrase or piece. In order to develop such a methodology, those structures that pervade modal music and define each mode needed to be determined, to which end, I returned in this chapter to historical theory.

I began with a proposition that if a pitch class hierarchy existed in medieval modal music, then one manifestation of that hierarchy could have been mode degrees, analogously to how the pitch class hierarchy in tonal music manifests in one way as scale degrees. To investigate the possible presence of mode degrees, I proposed four potential signs of medieval listeners having perceived mode degrees: treatises would have described various mode degrees as having distinct qualities; treatises would have described a hierarchy of important degrees relative to a final; only certain mode degrees would have occupied certain positions in phrases and pieces, such as the final and initial; and each pitch class would have exhibited a behaviour distinct to each mode, while each mode degree would have exhibited consistent behaviour across the modes. I established that the latter three features are found in modal treatises, though only certain mode degrees seem to have been significant: finals, upper-fifths, and possibly reciting notes.

Complicating matters is what I have chosen to call *interval string qualities*, that is, qualities of notes based on the pattern of intervals surrounding them, that is, their interval strings. I believe that interval string qualities were probably given high importance by medieval singers, since the qualities are discussed in perhaps every modal treatise from the end of the ninth century onwards, eventually as Guido's popular construct of the hexachord. As I have shown, though, interval string qualities have somewhat of a contradictory relationship with mode degrees. Mode degrees and mode degree qualities would be defined according to each degree's relationship to the given final (i.e. the tonal centre), but interval string qualities are defined by the unchanging intervallic structure of the gamut, making them fixed and independent of finals and thus modes. As a result, interval string qualities themselves are not modal, nor are structures

built out of patterns of interval strings, including hexachords. Therefore, for analyzing mode and for distinguishing modes from each other, I do not expect hexachords to be useful.

Because mode degree qualities and interval string qualities seem to be fundamentally incompatible but somehow both a part of the medieval experience of the modes, I have proposed that the two qualities might have coexisted in a special kind of pitch class hierarchy. It would be defined by two features not found in tonal pitch class hierarchies: firstly, there would be fewer levels than one for each pitch class; and secondly, there would be an everything-else level, that is, a single level populated by all of the pitch classes that did not have their own individual levels in the hierarchy. Within the everything-else level, interval string qualities and mode-independent structures would drive pitch class behaviour, but within the levels specific to various mode degrees, mode degrees and mode-dependent structures would drive pitch-class behaviour.

I also have argued that when medieval theorists used the identical interval string qualities between the final and the upper-fifth to justify using the latter as a cofinal, their justification was a post hoc explanation for a pre-existent practice. I have argued thus due largely to a few odd examples of inconsistencies in how interval string qualities were applied in the context of that justification.

In the final section of this chapter, I outlined my methodology, which focuses on structures that should reflect whether or not a pitch class hierarchy exists and if so, what kind. The methodology contains three analyses: Mode Profiles, which measures the simple probabilities of each pitch class given each mode; Tendency, which calculates the probabilities of each pitch class going to each other pitch class; and Leaps and Melodic Outlines, which exists in two forms, the first of which calculates the probability that a leap or melodic outline of a fifth of a given pitch class will occur given that a leap or melodic outline of a fifth will occur, and the second of which calculates the same probabilities for intervals of a fourth. Each of the main analyses will use a dendrogram cluster analysis to determine whether or not there are consistent distributions within the analyzed samples. The results for each analysis will be graphed in terms of pitch classes and in terms of mode degrees to highlight patterns or consistencies in terms of final-independent or final-dependent organization.

# Chapter 4 Analyzing Mode in Plainchant

## 4.1 The Need for Modal Points of Comparison

In the previous chapter, I discussed the main structures of medieval modal theory to determine what features or determinants of the modes might be measurable. Beyond final and ambitus, however, few such features are listed, and as I established in Chapter 2, the final has limited usefulness for describing the mode at the beginning of a chant and during the middle of longer, more complex chants or *organum purum* passages. I therefore considered the modal structures in terms of music perception and developed a methodology for analyzing mode, which consisted of three analyses: Mode Profiles, Tendency, and Leaps and Melodic Outlines.

I derived a methodology that could investigate the factors that are implicit in modal theories, such as a mode degree hierarchy. If we were to apply the methodology to organum straightaway, though, how would we interpret the results? We do not yet know what modal results might look like. We could distinguish between random and non-random results, but not modal and non-modal results; any number of types of results of these analyses would be ambiguous. For example, if we discover that there are pitch-class distributions in *organum purum*, we would have no way of knowing whether those distributions are, in fact, related to mode, because we would have nothing to which to compare it. Therefore, before analyzing mode in organum, we must develop points of comparison. To do this, we must apply the methodology to the repertory that is modal by definition: plainchant.

In this chapter, I will apply the three analyses outlined in the previous chapter to plainchant in order to form a point of comparison that can be used to evaluate the results of the application of the same three analyses to organum, which is the subject of the following chapter.

Plainchant is vast and diverse, though, comprising thousands of pieces from at least eighteen main genres that developed in layers across several centuries, from the eighth century (at the latest) to the fifteenth century and possibly later, although most of the repertory was developed by the thirteenth century. There are also multiple chant repertories: Frankish-Roman chant (popularly known as Gregorian chant), Old Roman chant, Milanese (or Ambrosian) chant, Beneventan chant, Gallican chant, Old Spanish chant (also called Mozarabic chant), and probably others of which I am unaware. I must therefore be more specific about my samples.

An ideal reference point would be a chant genre contemporaneous with Notre Dame organum, whose melodies have a style extremely close to that of the duplum parts of Parisian organum. Such a reference point does not exist. What's more, the style of *organum purum* melodies is stylistically distinct from any earlier chant genre. Perhaps we can be comforted, though, by the fact that three of the main Notre Dame theorists, Lambertus, Anonymous IV, and Franco of Cologne, wrote in some way that understanding plainchant is the basis for understanding polyphony, as discussed in Chapter 1. Their testimony bolsters the idea that, even if not ideal points of comparison, existing plainchant genres could serve our purpose.

I have chosen two repertories of Frankish-Roman chant to be my points of comparison for organum: firstly, the set of responsorial chants from which Parisian organa were made, specifically responsories, graduals, and alleluias; and secondly, twelfth-century Parisian sequences, which were composed and used at the Cathedral of Notre Dame and which might have shaped the development of Notre Dame Polyphony. Neither is a perfect point of comparison, but I believe that they are the best reference points available for the purposes of this study.

I begin this chapter with a brief discussion of the manuscript sources used for the pieces analyzed in this chapter. I then discuss each of the two chant repertories, their relevance to Notre Dame organum, and their strengths and weaknesses as points of comparison. This opens a brief exploration of the peculiar relationship between old and new discernable in the style of *organum purum*. Following this, I outline the adaptations of the general methodology to the two chant repertories. Finally, I present the results of the four analyses of both plainchant samples.

## 4.2 The Sources

### 4.2.1 The Responsorial Chants

The responsorial chants analyzed in this chapter are those found in volumes 2-4 of the 2001 *Magnus Liber Organi* edition, edited by Everist. Those volumes contain an edition of the chants for the Mass, i.e. graduals and alleluias, made from Paris, B.N. lat. 1112.[403] According to Margot Fassler and Robert Branner, it is "a notated missal and sequentiary" from c. 1220 that was

[403] Mark Everist, ed., *Les Organa à deux voix pour l'office du manuscrit de Florence, Biblioteca Medicea-Laurenziana, Plut. 29.1*, Vol. 2 of *Le Magnus liber organi de Notre Dame de Paris* (Monaco: Éditions de l'Oiseau-Lyre, 2003), lxxxiii.

used at the Cathedral of Notre Dame.[404] Everist made the edition of the chants for the Office, i.e. responsories, from Paris, B.N. lat. 15181-2,[405] which is a noted breviary from c. 1300 that was also used at the Cathedral of Notre Dame.[406] He very helpfully shared with me digital copies of his transcriptions, which I converted to Sibelius format and reformatted them for ease of computer analysis.[407]

These two manuscripts are suitable sources of Mass and Office chants for this thesis because they were used during the period of Notre Dame Polyphony at the cathedral and thus likely represent the form of these plainchants that would have been used by those who made organum. In addition, I have used only those responsorial chants with which organa were made, because those chants have the most relevance to organum.

### 4.2.2 The Sequences

I have prepared an edition of the sequences analyzed in this chapter from the manuscript Paris, B.N. lat. 1112. As above, the manuscript is suitable for this study because of its use at Notre Dame c. 1220. Conveniently, as Fassler has explained, "Although the manuscript is late, copied almost a century after Adam and his school flourished, the works contained in it do not pose notational problems. In addition, although the sequence repertory at the cathedral expanded during the course of the thirteenth century, there were no major stylistic changes within it."[408] Therefore, the results of this chapter's analyses of sequences should generalize to the sequences as they were composed by Adam Precentor and his "school" in the early twelfth century.

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[404] Margot E. Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," *Speculum* 62, no. 2 (April 1987), 348, n.16; the dating was given by Robert Branner, *Manuscript Painting in Paris during the Reign of Saint Louis: a Study in Styles* (Berkeley, CA: University of California Press, 1977), 206, as cited in Margot E. Fassler, *Gothic Song: Victorine sequences and Augustinian reform in twelfth-century Paris*, 2nd ed (Notre Dame, IN: University of Notre Dame Press, 2011), 149.

[405] Everist, ed., *Les Organa à deux voix pour l'office du manuscrit de Florence,* Vol. 2, lxxxiii.

[406] Susan Kidwell, Inventory of "Paris, Bibliothèque nationale de France - Département des Manuscrits, latin 15181," ed. Debra Lacoste, additional fields added or edited by Charles Downey, in: *Cantus: A Database for Latin Ecclesiastical Chant -- Inventories of Chant Sources* (Directed by Debra Lacoste (2011-), Terence Bailey (1997-2010), and Ruth Steiner (1987-1996); web developer, Jan Koláček (2011-)). Available from <http://cantus.uwaterloo.ca/source/123631/>. Last accessed 2019 May 19.

[407] These files are available upon request.

[408] Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," 348, n.16.

## 4.3 Introducing and Comparing Repertories

### 4.3.1 Notre Dame *Organum Purum*

Of course, I have already introduced and discussed *organum purum* at length. For the purposes of this section, I wish to highlight only some general facts and features of the style of the duplum part in *organum purum* sections (not in discant sections, which do not concern us here):

1. Duplum melodies are very ornate.
2. They have very large ranges, usually spanning at least an octave and frequently between a tenth and a twelfth.
3. They also frequently employ what I would deem modulation; throughout a single organum, the duplum does not seem to emphasize only one mode. This will be studied in more depth in the next chapter.
4. The duplum is texted, but it is so extraordinarily melismatic that many syllables can cease to sound like constituent parts of words, instead seeming to become independent, wordless syllables.
5. The length of passages defined by single tenor notes, which I refer to as *organum phrases* (see Chapter 5), varies widely, as does the length of passages defined by single syllables.[409] Many times, consecutive phrases are almost equal in length, but in my opinion, it is hardly the majority of cases, and I believe that many more times, the phrases are too variable to be considered even roughly periodic.[410]
6. Organa are relatively long, spanning between about six and thirteen minutes in length.[411] The plainchants upon which the organa are built take about half the time to be sung.

[409] I refer to the span of organum defined by a single syllable an *organum syllable*. However, the term is not used in this study. I include it here because in the process of studying organum, I have found that there is a lack of basic taxonomy that could serve other scholars interested in studying the repertory analytically.
[410] Note that this is not a statement based on a quantitative analysis of the subject of phrase-lengths or consecutive phrase-lengths, and therefore that there is a need for verification here. I believe that further studies into the lengths of series of organum phrases could provide fascinating insights into how large-scale organum sections are shaped.
[411] These numbers are based on the following two recordings: Red Byrd, *Magister Leoninus* (Hyperion 66944, 1997); Red Byrd, *Magister Leoninus* (Hyperion 67289, 2001).

7. The organum repertory contains numerous formulas, which are unique to this repertory, not taken from earlier chant genres.[412] The duplum part does not employ musical turns of phrase or musical gestures that signaled the mode in early chant genres.[413]
8. Lastly, there is the rhythm of *organum purum*. This has been the subject of extensive scholarly debate and controversy, however, much of the dust has settled, and a consensus has more or less been reached.[414] Firstly, based on Pseudo-Garlandia's measured music treatise, it is clear that in *organum purum* passages, the duplum was not performed according to the rhythmic modes, where the lengths of long and short notes were defined by the ratio 2:1 or, in the case of mode 3, 3:1:2.[415] Secondly, it is not entirely clear exactly what kinds of rhythm were used for the duplum,[416] but singers would have been free to choose whether or not to let the context determine their rhythmic choices.[417] Pseudo-Garlandia also makes a set of recommendations (known as his *rules of consonance*) for lengthening certain notes at structural points, namely cadences.[418] "Freely-rhapsodic interpretations", in Everist's words, have become the norm in modern performances.

### 4.3.2 Responsorial Chants and *Organum Purum*

I have chosen responsories, graduals, and alleluias to be a reference point for analyzing mode in *organum purum* specifically because Parisian organa were made using these chants as

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[412] See Hans Tischler, *The Parisian Two-Part Organa: The Complete Comparative Edition*, vol. 1, *Style and Evolution – Catalogue Raisonné – Office Organa* (Hillsdale, NY: Pendragon Press, 1988), lviii-lxviii.
[413] This is a widely recognized feature of plainsong, yet it is not frequently the subject of close analysis. See Powers et al., "Mode," 2001, *Grove Music Online*, last accessed 2019 May 21. <http://www.oxfordmusiconline.com/subscriber/article/grove/music/43718pg2>.
[414] Past positions are summarized in Jeremy Yudkin, "The Rhythm of Organum Purum," *Journal of Musicology* 2, no. 4 (Autumn 1983), 355-359. For a cogent overview of the main perspectives as well as a discussion of the gap between identifying the old errors in rhythmic interpretation of the duplum and making rhythmic recommendations, see Everist, ed., *Les Organa à deux voix pour l'office du manuscrit de Florence*, vol. 2 of *Le Magnus liber organi de Notre Dame de Paris*, lxxi-lxxiii.
[415] See Everist, ed. lxxi-lxxiii, especially the comments on Johannes de Garlandia's *mensura non recta*, lxxii. Note as well that mode 4's note durations can be described by the ratio 1:2:3, however, it is perhaps universally accepted that mode 4 only existed in theory treatises, never in practice.
[416] Roesner has offered an overview of the various proposed explanations that are not entailed or explicitly demanded by *mensura non recta* in Edward H. Roesner, "Johannes de Garlandia on o*rganum in speciali*," *Early Music History* 2 (1982), 145.
[417] On the option of the singer to follow context, see the discussion of *ex contingenti* in Yudkin, "The Rhythm of Organum Purum," 360-361.
[418] This is the interpretation that was contended by Sanders and has been endorsed by Roesner, in Ernest H. Sanders, "Consonance and Rhythm in the Organum of the 12th and 13th Centuries," *Journal of the American Musicological Society* 33 (1980), 269-271; Roesner, "Johannes de Garlandia on o*rganum in speciali*," 137.

their base; in each organum, a chant melody was sung by the tenor, around which, the duplum sang a newly composed part. However, although the tenor part held a plainchant melody, the notes of that chant were lengthened considerably, thus drastically changing the melody's sound, perhaps even making it unrecognizable to those not trained in organum performance-composition. The parts of the chant that were set polyphonically, though, were only those parts that were originally sung by one or more soloists; the sections of the chant sung by the choir continued to be performed thus. Liturgically, an organum functioned as the plainchant that it set polyphonically, with the difference being that the organum was reserved for higher feast days; it was for special occasions. I am confident that the intimate familiarity that the singer-composers who made organum must have had with these chants, regardless of the alterations of the chant line, would have influenced their composing of organum.

Let us explore the stylistic similarities and differences between responsorial chants and duplum parts in *organum purum* sections, leaving aside the obvious, and in this context, irrelevant difference of monophony vs. polyphony. Because each of these three responsorial chant genres is stylistically distinct, I will make note of each one individually where needed.[419]

1. The three genres are all ornate; graduals are the most so. I should note, however, that the ways in which graduals are ornate contrast organum; I will comment on this more below.
2. Of the three genres, graduals seem to have the largest range, sometimes reaching a tenth or more, but often staying around an octave. Responsories tend to have a range of about an octave. Alleluias are variable, often staying within a sixth or seventh, and sometimes extending to an eleventh. All three genres generally tend to have more conservative ranges than organum.
3. Many responsorial chant melodies modulate. Within a single chant, the phrases and large-scale sections (e.g. respond, verse, etc.) frequently cadence on a variety of pitch classes. This is another parallel to organum. On the other hand, many other melodies do not modulate; they are modally uniform, with every cadence arriving on the same pitch class.

   I should note, however, that the extent to which their modulations can be traced from the note on which a phrase or section cadences back into the preceding phrase itself remains a question for me. This trace would define modal regions, not just pauses on

[419] For a general overview of responsories, graduals, and alleluias, see Hiley, *Western Plainchant: A Handbook*, 69-76, 76-81, and 130-136 respectively. Most of this section refers back to these chapters.

non-final notes that might or might not be modulatory. I return to this question in the section below on adapting the methodology.

4. Responsorial chants are generally considered melismatic, though I must specify that in fact, in a given chant, much of the text is set syllabically or neumatically. At the same time, they are known for having substantial melismas. Graduals and alleluias are considered extremely melismatic, though in different ways (more on this shortly). Responsories are considered melismatic, but less so. It should be noted that the melismas of all three genres are not as extensive or numerous as those of organum, but organum is extreme in this respect.
5. In all three genres, phrases are long. Phrase lengths are generally irregular, though there are exceptional cases.
6. As noted, these plainchants are about half the length of their respective organa. Relative to many other chants from other genres, however, they are amongst the longest chants.
7. Formularity is very much an aspect of responsories and graduals, though in different ways. Like organa, graduals contain a number of melodic formulas unique to that genre, even though their formulas are vastly different. Responsories, on the other hand, are based on recitation formulas, like psalm tones. Alleluias, meanwhile, do not, to my knowledge, contain pre-existing formulas.
8. Lastly, the rhythm of chant, while not decided, would seem to me to be aptly characterized as "freely rhapsodic".[420]

There are still other important differences to note, some of which are less easily defined than the above. Firstly, there is a huge time gap between the composition of these chants and Parisian organa. Many responsories were composed between the eighth and the tenth century, and most were written by the eleventh.[421] The core repertory of 105 graduals were already in existence in the late eighth century.[422] The alleluia repertory is mostly composed of an early layer

[420] For two overviews of chant performance practice, see Lance Brunner, "The Performance of Plainchant: Some Preliminary Observations of the New Era" *Early Music* 10, no. 3 (July 1982): 316-328; ibid. also recently printed in *Medieval Music*, ed. Honey Meconi, The Library of Essays on Music Performance Practice, series ed. Mary Cyr (Burlington, VT: Ashgate, 2011), 3-15; and Katarina Livljanic "Giving Voice to Gregorian Chant or: Coping with Modern Orthodoxies", in *Medieval Music*, ed. Honey Meconi, The Library of Essays on Music Performance Practice, series ed. Mary Cyr (Burlington, VT: Ashgate, 2011), 15-26.
[421] Hiley, *Western Plainchant: A Handbook*, 70, 75.
[422] James W. McKinnon, "Gradual [Responsorium graduale](i)," 2001, *Grove Music Online*, last accessed 2019 May 22. <https://doi.org/10.1093/gmo/9781561592630.article.11576>.

composed by the ninth century and a later layer composed by the end of the eleventh century.[423] By contrast, as discussed in the Introduction and in Chapter 1, the Parisian organum repertory was composed in the late twelfth through early thirteenth centuries. There was between half a century and as many as five centuries between the composition of the Parisian organum repertory and the responsorial chant repertories.

Even in the case of only fifty to seventy-five years between a late alleluia and an early organum from Notre Dame, the style of chant composition changed markedly through the eleventh and twelfth centuries, as demonstrated by, on the one hand, the works of Hermannus of Reichenau and Hildegard von Bingen,[424] and, on the other, the twelfth-century Parisian sequence (see below). The style of each of the three genres of responsorial chants discussed here is markedly earlier than that of Notre Dame organum. Responsories, as noted in point 7 in the list of stylistic features above, seem to originate as embellished recitation, like psalm tones, but much more complex. This is apparent in the formulaic openings and closings of phrases and in the ornamented repetition of reciting notes. Organum does not use these formulas, nor recitation. Graduals are highly stylized, often including features such as repercussive figures (i.e. strings of repeated notes reminiscent of recitation, but without changing syllables), embellished repetition of a single note, and oscillation between two pitches a third apart, amongst others; most of these do not appear frequently in organum if at all. The only exception is the embellished repetition of a note, which usually occurs in short phrases over a tenor E or, especially, B.[425] They do, however, contain the highest number of melismas of the three genres.

Alleluias, while still contrastive to duplum melodies, are not as stylistically-distant from them as responsories and graduals. A detailed exploration and comparison of the subtler aspects of the two melodic styles must await a future study, but I believe it is worth noting one issue in particular: motivic repetition and development.

Earlier alleluias, those from the ninth century, contain no motivic repetition within the *jubilus*, which is the long melisma on the syllable *-ia* from *alleluia*, nor within the verse. Later

[423] Hiley, *Western Plainchant: A Handbook*, 133-134. There was apparently another surge of alleluia composition in fifteenth-century South Germany and Bohemia; see Hiley, *Western Plainchant: A Handbook*, 131.
[424] See Jennifer Bain, "Hildegard, Hermannus, and Late Chant Style," *Journal of Music Theory* 52, no. 1 (2008): 123-149.
[425] The first organum in F, *Iudea et Iherusalem*, has a string of repeated notes in its first syllable. However, my impression is that such repercussive figures are rare. A study of the presence and function of such passages in the organa in F remains to be performed, however.

alleluias, those from the tenth century, are rife with motivic repetition within both the jubilus and the verse. Motives are not only repeated exactly but varied as well. Their number is not fixed, and their lengths are diverse, but they can be substantial.[426] Both styles of alleluia appear in the organa.[427]

Organa do not have the same motivic structures as later alleluias, but there are numerous instances of varied repetition of motives, related to what Fassler refers to as the "working out of a melodic idea" (more on this in the following section).[428] It is a somewhat subtle similarity between the repertories, but I consider it noteworthy.

### 4.3.3 The Twelfth-Century Parisian Sequence and *Organum Purum*

The sequence has a long history, beginning in the Carolingian period and going through various phases of composition at least through the twelfth century. The Parisian sequence repertory of the twelfth century was the foremost genre of chant composition in its time, and its leading, most prolific composer was Adam Precentor, a poet and precentor (cantor) at the Cathedral of Notre Dame during the early eleventh century; he spent most of his adult life at the cathedral.[429] This generation of sequence composition flourished in Paris and at the cathedral, where it became a part of the liturgy.[430]

Sequences of this time use *paired versicle form*: the pieces are (usually) composed of pairs of melodies that are often identical and often repeated with minor variations. These sequences are thus also called *rhymed sequences*. They have relatively short phrases with clear textual and musical cadences.

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[426] For a more detailed discussion as well as examples, see Hiley, *Western Plainchant: A Handbook*, 132-136.
[427] An example of an organum on an earlier alleluia is Alleluia V. Dies sanctificatus, no. 2 in Mark Everist, ed., *Les Organa à deux voix pour la messe (de Noël à la Fête de Saint-Pierre et Saint-Paul) du manuscrit de Florence, Biblioteca Medicea-Laurenziana, Plut. 29.1*, Le Magnus liber organi de Notre Dame de Paris, series editor Edward H. Roesner, vol. 3 (Monaco: Éditions de l'Oiseau-Lyre, 2001), 205. An example of an organum on a later alleluia is Alleluia V. Pascha nostrum, no. 14 in ibid., 217.
[428] Margot E. Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," *Speculum* 62, no. 2 (April 1987), 371; Fassler, *Gothic Song*, 341.
[429] Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," 349. Adam Precentor is also known as Adam of St. Victor for his involvement with the Abbey of St. Victor. For his biography, see Margot E. Fassler, "Who Was Adam of St. Victor? The Evidence of the Sequence Manuscripts," *Journal of the American Musicological Society* 37, no. 2 (1984): 233-69. On the interconnectedness of the Cathedral of Notre Dame and the Abbey of St. Victor, see ibid., 250.
[430] On the late sequence in Paris and specifically at the cathedral of Notre Dame, illuminated through the manuscripts and the composers of the repertory, see Fassler, *Gothic Song*, 137-160.

The process of composing organum did not directly involve the sequence repertory as it did responsorial chants, but Fassler has argued that sequences were influential and even crucial for the development of Notre Dame Polyphony and organum specifically. As a result, I will begin this section with a summary of her arguments, followed by my assessment of them, and lastly, a summary of broad stylistic similarities and dissimilarities based on the numbered list used in the previous two sections.

Fassler offers numerous reasons to consider a connection between the two repertories. Firstly, she points out three leading figures from three consecutive generations at Notre Dame in the twelfth century: Adam Precentor, Magister Albertus, and Magister Leoninus. Adam's relationship with the sequence has been noted. Albertus was the successor to Adam as cantor of Notre Dame; he was a possible composer of conductus and owner of multiple books of what might also be conductus collections.[431] The connection between the sequence and the conductus, another principal genre of Notre Dame Polyphony, will be broached shortly. And as discussed in Chapter 1, according to Anonymous IV, Leoninus was an excellent composer of organum at Notre Dame; indeed, he was famously one of only two composers named by the theorist. Moreover, because Leoninus was the earliest composer and figure that Anonymous IV listed, and because Anonymous IV lists various figures from multiple successive generations who were involved with Notre Dame Polyphony, this passage suggests, by my reading, a sense of a rough timeline or musical family tree, with Leoninus at the head; he might have been one of the earliest Notre Dame organum composers.[432] Thus, the first composers of Notre Dame Polyphony would have inherited the eminent legacy of sequence composition and performance at the cathedral. Fassler further contends that Adam, Albertus, and Leoninus shared a "common goal … of transforming the liturgy of the Cathedral of Notre Dame into one of the most splendid in all of Europe."[433]

Secondly, Fassler identifies motivic development across successive sequence phrases as well as within the duplum part of *organum duplum*. I should add that in an organum, this "working out of a melodic idea" happens within a relatively short timeframe compared to motives that continue to develop across a whole sequence, although a full study of motivic development in two-part organa remains to be done.[434]

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[431] Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," 349.
[432] For the passage, see Roesner, "Who 'Made' the *Magnus Liber*?" 227-228. My reading concords with Fassler's apparent opinion that Leoninus was "the first great creator of Notre Dame polyphony…." Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," 349.
[433] Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," 349.
[434] Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," 371.

Another point relates to phrase length. Sequence phrases are well defined and short, often between fourteen and twenty-one notes long; their component "subphrases", either half or a third of the length of the full phrase, are also well defined and of course even shorter.[435] Fassler later provides an example of *organum purum* that shows "many short, well defined phrases in the duplum" ostensibly like those in sequences.[436]

Fassler also highlights an emphasis on cadences, though not in the same way as in sequences, which rely on various cadential formulas not found in organum.[437]

With regard to discant, there are frequently well-defined phrases that are often four beats long, like the Parisian accentual poetry of the time. It is also easy to see how a consistent beat and a rhythmic grid created by regular repetitions of rhythmic patterns (called *ordines*) relates to sequences, where the only difference is that sequences use accentual patterns instead of durational ones. Furthermore, Fassler brilliantly analyzes the role of the two voices in different rhythmic patterns as taking over two distinct functions served by an accentual text in a sequence: the plain rhythm of the tenor sounds the ictus, while the duplum works out motives.[438]

Finally, Fassler connects organum to the rise and "increasing dominance" of *accentual poetry*, also called *rhythmic poetry*, which she identifies as one of the central features of new composition in the late eleventh and twelfth centuries, which forms the crux of her last point.[439] Accentual verse was defined by four features:

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[435] Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," 358 n. 35. Note that what I have labeled a *subphrase* Fassler terms a *phrase*; what I label a *phrase*, she would label *half a strophe*, which is also called a *versicle*.
[436] Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," 371.
[437] Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," 358, 371.
[438] Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," 371.
[439] Accentual verse was not new, dating to at least the fourth century, but it was only in the eleventh century that its prestige rose, and it began to appear "in all types of sacred poetry", both liturgical and paraliturgical. Margot E. Fassler, "Accent, Meter, and Rhythm in Medieval Treatises 'De rithmis'," *The Journal of Musicology* 5, no. 2 (Spring 1987), 170.

1. A constant number of syllables per line and thus uniform line length;
2. Consistent patterns of word accent, which usually aligned with the beat or *ictus*;
3. A resulting continuous "rhythmic grid or framework";[440]
4. End-rhyme (rhymed cadences).[441]

Note as well that accentual verse was isosyllabic: the syllables were of equal duration.[442]

Accentual verse stood in sharp contrast to *durational poetry*, also called *metrical poetry*, which was much older; durational poetry is defined by patterns of syllable length, not syllable stress. The most popular metre was dactylic hexameter, used by Homer, Virgil, and Ovid in Ancient Greek and Classical Latin. It was "the most popular meter for medieval poets who had cultivated an understanding of Latin metrical versification,"[443] and thus it continued to be written through the twelfth and thirteenth centuries. It is highly varied; multiple metrical feet (patterns of successive long and/or short syllables) would be used, but with only a few rules limiting the possible combinations, line length could range from thirteen to seventeen syllables.[444]

Accentual verse from the twelfth century was used for the texts of many musical genres: "sequences, planctus, conductus, liturgical dramas, versus, secular songs," and others.[445] The late sequence influenced the conductus primarily through its use of accentual verse; the grid of accentual patterns in their texts defined the rhythm for both the sequences and the syllabically texted (*cum littera*) sections of conductus.[446]

Fassler has argued that, in Notre Dame organum, the rhythms of discant (and *organum purum*) originated with accentual verse.[447] She has speculated that strong and weak accents in verse were transformed into long and short durations in the duplum, which led to a consistent

[440] Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," 358.
[441] Note that accentual verse originally had only two features: a repeating number of syllables per line, and the judgement of the ear. The other features appeared during the twelfth century. Full a full overview of the development of accentual verse across the twelfth and thirteenth centuries, see Fassler, "Accent, Meter, and Rhythm in Medieval Treatises 'De rithmis'," 164-190.
[442] Fassler, "Accent, Meter, and Rhythm in Medieval Treatises 'De rithmis'," 178.
[443] Fassler, "Accent, Meter, and Rhythm in Medieval Treatises 'De rithmis'," 177 n. 55.
[444] Fassler, "Accent, Meter, and Rhythm in Medieval Treatises 'De rithmis'," 177 n. 55.
[445] Fassler, "Accent, Meter, and Rhythm in Medieval Treatises 'De rithmis'," 179.
[446] See Sanders, "Conductus and Modal Rhythm," 439-469.
[447] Fassler's theory suggests to me to that, according to the same thinking, not only the rhythm of discant but the rhythm of Pseudo-Garlandia's rules of consonance would have originated with accentual verse. To be clear, this is not my position, but I believe that it is the implication of hers.

beat and a rhythmic framework similar to that found in accentual poetry, but durational instead of accentual.[448]

However, the same rhythmic transformation did not happen with sequences. Polyphony could not have been the cause of these durational patterns, since they do not seem to have occurred in the conductus repertory. Why then would the development of a durational framework have developed in organum and not other polyphonic genres? If accentual verse had influenced the invention of something in organum, why would it not have been duplum notes having varied accent, i.e. loudness, as in all other musical settings of accentual verse, rather than having varied length?[449]

Fassler has proposed the following explanation: accentual poetry had alternating stressed and unstressed syllables, which created a strong stress-based rhythmic pulse. This was retained in the musical settings of accentual poetry, which were syllabic. To create a similar effect in melismatic *organum purum* and syllabic/neumatic discant (which was not texted with accentual poetry, setting much earlier plainchant texts), composers alternated consonances and dissonances; consonances were lengthened, and dissonances were shortened, which created what Fassler has referred to as "harmonic accent" as opposed to stress accent.[450] If the consonances were the "on beat", then the result would have been the first rhythmic mode, whose base rhythmic pattern was long-short. Thus, according to Fassler, the rhythmic modes were born.[451]

However, on this last point alone, I would ask: If this transformation of syllable-accent to note-duration occurred in organum melismas due to the lack of text, then why did it not change organal rhythm (*modus non recta*) to modal rhythm? In fact, why would it have influenced discant sections? Perhaps they were thought to originate with this change. But then why would discant not have been performed accentually rather than modally, since modal rhythm mimics more the behavior of durational verse? In addition, why would the same change not have occurred in the conductus, since it is not composed solely out of consonances? Relatedly, why

[448] Fassler, "Accent, Meter, and Rhythm in Medieval Treatises 'De rithmis'," 188-189.
[449] Fassler has written that "the primacy of stress accent in Parisian monophony does not suggest that stress accent itself was important in a similar way for Parisian polyphony. Instead, late twelfth-century Parisian composers brought accentual patterns into their compositions by new means." Fassler, "Accent, Meter, and Rhythm in Medieval Treatises 'De rithmis'," 190. However, stress accent was important for the versus and the conductus.
[450] Fassler, "Accent, Meter, and Rhythm in Medieval Treatises 'De rithmis'," 189.
[451] Fassler, "Accent, Meter, and Rhythm in Medieval Treatises 'De rithmis'," 188-190.

would the originators of organum at Notre Dame have invented a genre whose predominant texture is melismatic and even chant-like rather than a new syllabic, accentual one, like the conductus? I believe that the above questions reveal the major flaws in Fassler's proposed narrative. I do not believe that composers of organum were aiming to create "harmonic accent" and thus created modal rhythms, nor that this theory concords with certain other stylistic traits of *organum purum*, which I will discuss in the following section.

While there are other points that seem inaccurate to me, many of Fassler's points are correct. Firstly, I believe that her observation on the institutional legacy and presence of sequences at the cathedral is undeniable. The compositional school of Adam Precentor was centered at Notre Dame, and the sequence became a lasting part of the liturgy there well beyond the thirteenth century, including the period of Notre Dame organum composition.

Secondly, I do see motivic development in organum, although the manner in which motives are varied might differ between organum and the Parisian sequence. It is a subject deserving further exploration, which is sadly beyond the scope of this thesis.

Thirdly, most of the points about discant are true as well. The presence of the following are staples of the style: a regular beat; well-defined, short phrases; regular phrase length; and a rhythmic grid created by repeated modal rhythms. Her observation of the roles of ictus and motivic development played by the tenor and duplum, respectively, I find compelling as well.

On the other hand, I disagree with her generalization of the point about short, well-defined, periodic phrases in *organum purum*. Such passages do occur and frequently at that (at least in F), but as I wrote earlier, I believe that at least as often, *organum purum* phrases are long, ill-defined, and/or irregular.

Lastly, as I have noted, I disagree with her theory of the sequence's role in the development of modal rhythm in organum.

Let us return now to the numbered list to summarize how the sequences of Adam Precentor et al. compare to Notre Dame *organum purum*.

1. Sequence melodies, unlike those of *organum purum*, are not ornate; they proclaim, not decorate.[452]
2. Both sequences and organa have quite large ranges.

[452] Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," 357.

3. Sequences modulate, as do organa, in my view. Furthermore, their modal regions both occur in segmented blocks. How this might be the case in organa will be detailed in the following chapter. In sequences, each phrase's mode is well-defined, and there are few modally ambiguous phrases or phrases that might serve as transitions between modal regions. There is much room for further study in this respect, though.
4. Sequences, unlike organa, are syllabic.
5. Sequences have short, well-defined phrases, which themselves are composed of shorter, well-defined units. Sequence phrases are very regular in length, especially comparing each versicle of a pair, but also across consecutive phrases. The same points can be said of discant. The *organum purum* passages, as I contend, are very irregular, with many extremely long phrases whose boundaries are unclear, although they also include short phrases and nearly periodic phrases.
6. Sequences and organa are both long.
7. The sequence repertory contains many formulas, as does the organum repertory, but as with responsorial chants, I do not believe that there is overlap between the formulas used in the two repertories.

The above features show that while there are significant similarities between the two repertories, there are many significant dissimilarities as well.

### 4.3.4 Excursus: Old and New in the Style of Notre Dame Organum

As we have seen, Notre Dame *organum duplum* shares many stylistic features with the responsorial chants studied here: both repertories have long, ornate, melismatic, and modulating melodies, composed of long phrases of various, irregular lengths. Dissimilarities include the range size, the piece length, and the extent to which melodies were derived from recitation formulas and older melodic gestures. When Notre Dame organum is compared to the twelfth-century Parisian sequence, however, the proportion of similarities to dissimilarities is inverted: sequences are syllabic; they are not ornate but proclamatory; they are composed of short, well-defined, isoperiodic phrases; and their rhythm derives from their accentual texts. The similarities include predominantly large ranges, overall piece-length, and the ways that I believe modulation occurs. The similarities are important, but the reason for the inverted proportion of similarities to dissimilarities is an open question. To address this question, I will begin by once more considering poetry.

Fassler has recommended that poetry be studied with music, due to their intertwined nature in twelfth-century Paris, but while we have discussed Adam Precentor's poetry, we have not discussed Leoninus'.[453] In contrast to Adam, Leoninus wrote only durational poetry, specifically dactylic hexameter, the verse used by learned poets of the time, which hearkened back to Classical Latin poetry. Leoninus' main poetic work was his *Hystorie sacre gestas ab origine mundi*, an enormous versification of the narrative of the first eight books of the Old Testament.[454] Furthermore, by my reading of Anonymous IV, Leoninus might have been one of the earliest Notre Dame organum composers and one of the leading figures of the compositional movement.

There arises from these observations and speculations a historical narrative regarding something of the impetus for the creation of Parisian organum. I posit that while Leoninus did share the common goal of Adam and Albertus to transform the liturgy at Notre Dame, he strove to add to the liturgy in a radically different way from his two predecessors. He was focused on the old and the ancient. His poetry was Classical, his subject was the Old Testament, and his music had defining characteristics mostly from older chant repertories.[455] The polyphonic genre that he might have spearheaded was built on an existing part of the liturgy, substituting the original performance of those responsorial chants by transforming them into something that, while new, still conspicuously retained many of their stylistic features.

In addition, it is surprising not only that organa were *not* developed from sequences, but also that they *were* built on alleluias. Early sequences were, until recently, thought to have originated as newly texted alleluia jubili; the melody setting the single syllable *-ia* was then set syllabically to a new text. This seems only to have been the case for some of the earliest

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[453] Fassler, "The Role of the Parisian Sequence in the Evolution of Notre-Dame Polyphony," 347.

[454] Craig Wright, "Leoninus, Poet and Musician," *Journal of the American Musicological Society* 39, no. 1 (Spring 1986): 16-21. I wish to add a small but curious note: there is a poetic metre called *leonine verse*, which "consist[s] of hexameters, or alternate hexameters and pentameters", where each line has an internal rhyme, usually in the middle. [Margaret Drabble, ed., *The Oxford Companion to English Literature*, 6th ed., s.v. "leonine verse" (New York: Oxford University Press, 2009). 587.] It is named after Leoninus, but the name is badly-chosen, since leonine verse is actually very rare in Leoninus' writings. See Wright, "Leoninus, Poet and Musician," 17 n. 45. Nevertheless, it is ironic that Leoninus should have a verse with internal rhyme named after him when he never wrote in the extremely popular accentual verse of his day, which had rhyme as one of its defining features!

[455] In fact, although I do not discuss the chant genre here, the offertory strikes me as another interesting point of comparison. Much of Hiley's description of the offertory reads like a possible description of florid organum: the verses were "long, melismatic outpourings as impressive as anything in the Gregorian repertory", with "wide range[s] and frequent change[s] of register or even of tonality…." Hiley, *Western Plainchant: A Handbook*, 121. I also find it curious timing that the offertory verses should have disappeared from use in Paris in the twelfth century (Hiley, *Western Plainchant: A Handbook*, 121), so close to the birth of *organum duplum*.

sequences, though; many if not most others from the same period were entirely new compositions.[456] However, Fassler has shown that "Even when [the Franks] did not model a sequence upon a particular alleluia, they at least wanted to create the impression that they had done so."[457] The medieval *perception* from the ninth through to at least the eleventh century was that the origin of the sequence lay in re-texting the alleluia's jubilus. The alleluia was one of the three main genres of Parisian organum. The fact that organum was built not just on older chant genres but specifically on the genre thought to have been the ancestor of the sequence I believe adds more weight to the narrative that one idea behind the creation of organum was to make something new that celebrated and perhaps even reinvigorated the old.

However, I should also point out that because of the alleluia's late addition to the Proper of the Mass, its position in the liturgy within and across churches was divergent. Various manuscripts of Notre Dame organum preserve different numbers of alleluias; the earliest, W1, preserves far fewer than does F.[458] We should therefore not think that organum arose specifically as a new means to celebrate the alleluia over the sequence, but rather that the involvement of the alleluia in organum-making might reflect the above-posited impetus.

Of course, there are many important unknowns here. We do not know whether or not Leoninus was even in the earliest generation of organum composers, let alone the leader or originator of the project. Indeed, listing unknowns of the twelfth century would be endless. Nevertheless, I believe that Leoninus and his peers passed over many of the characteristics of contemporaneous compositions to develop a new polyphonic genre built on older chants and using older stylistic traits.

Conveniently, if this narrative is correct, then it would only add support to this study.

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[456] The debate is reviewed in Hiley, *Western Plainchant: A Handbook*, 186-189.
[457] Fassler, *Gothic Song*, 40.
[458] Craig Wright, *Music and Ceremony at Notre Dame of Paris 500-1550* (Cambridge: Cambridge University Press, 1989), 270.

## 4.4 Adapting the Methodology to the Chosen Plainchant Repertories

### 4.4.1 Responsorial Chants

Responsories, graduals, and alleluias are composed of multiple large-scale formal sections: *responds* and *verses*, which are always present, and *glorias* (statements of the lesser doxology) and *prosae*, which are not. I use the general term *stanzas* for all of the above formal sections.[459]

In responds and in verses, line-length varies. Longer lines contain internal cadences, but not all cadences are equal. The hierarchical relationship between musical phrases mirrors the hierarchical relationship between linguistic phrases. The strength and importance of musical cadences correspond to grammatical cadences, i.e. ends of text phrases of different hierarchical levels. A chant text's punctuation marks can therefore be used in combination with the music to define the boundaries and the hierarchical levels of musical phrases.

Periods, question marks, and semicolons in the reference texts I have used denote the highest-level division: the ends of lines and the ends of stanzas, which are predictably the locations of the strongest musical cadences.[460] The next level of division is marked by colons; the musical cadences found here are also relatively strong. The lowest-level division of phrases is marked by commas; the structural distinctions at these points are much less pronounced, and therefore I hesitate to label them as cadences. I label these phrases of different hierarchical levels *period-phrases*, *colon-phrases*, and *comma-phrases*, after the punctuation (or level of punctuation) that delimits each of them. The class of *period-phrases* includes phrases ended by question marks and semicolons as well.

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[459] *Stanza* might seem to be a misnomer here, since in poetry, a stanza is a group of multiple text-lines that function as a unit (e.g. couplet, tercet, quatrain), whereas responds sometimes consist of multiple lines and other times, only single lines (or in the case of alleluias, one word: *alleluia*), and verses are single lines; the lesser doxology is always only the same one line. However, the term *stanza* nicely distinguishes each of the single-line responds, verses, and glorias as its own functional unit, so I propose that we think of these occurrences as single-line stanzas.

[460] For responsories, I have consulted Renato-Joanne [René Jean] Hesbert ed., *Corpus antiphonalium officii*, vol. 4, *Responsoria, versus, hymni et varia* (Roma: Casa Editrice Herder, 1970). Based on what I have seen in some of the manuscripts that Hesbert used as the basis of his edition, it seems that other than periods (and rarely colons), his punctuation is based on the structure of the Latin texts and is thus editorial. For mass chants (graduals and alleluia verses), I have consulted Inga Behrendt, *Gregorien.info* [Index of medieval liturgical chants], Hochschule für Kirchenmusik der Diözese Rottenburg-Stuttgart, Eberhard Karls Universität Tübingen Musikwissenschaftliches Institut, Diozese Rottenburg-Stuttgart. Last accessed 2019 May 21. <https://gregorien.info/en>.

This classification is derived from medieval theorists who, as early as the ninth century, described hierarchical musical units through analogies to grammatical and rhetorical units.[461] The basic idea is a staple of medieval music theory, and moreover, it is extremely well-suited to describing one type of structure in the repertory of responsorial chants: phrase boundaries.

Because I consider the ends of comma-phrases exceedingly weak, especially for having bearing on modal determination, I have chosen to exclude them from consideration; I do not count "comma-cadences" for the analyses. I do count cadences at the ends of period- and colon-phrases, but not for each phrase to be analyzed as its own unit. The reason is as follows: within a given stanza, for phrases that end on a note other than the final of the stanza, I am often left with the impression that the phrase's mode has not changed until its last note, which leads me to wonder if perhaps the phrase is truly in another mode, as would be suggested by the readings from Chapter 2; instead, I wonder if such cadences would be better understood as secondary points of arrival within the same mode, as Jennifer Bain once suggested to me.[462] Half-cadences in tonal music illustrate this idea; they are not authentic cadences, but they also do not mark modulations; rather, they sound very much in the key. Yet because of the strength of period-phrase cadences, and because these cadences often end on notes other than the final of the stanza, I do not wish to assume that there is modal unity within each stanza, especially when it would contradict the evidence from modal treatises. After all, I might not discern a difference because of a lack of fluency as a non-native listener of this musical language. To avoid distorting the data with such ambiguous samples, I have decided to count whole stanzas based on their finals, but to exclude from analysis period-phrases and colon-phrases that end on different pitch classes from the final of the stanza.

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[461] The first important work in this area is Bower, "The Grammatical Model of Musical Understanding in the Middle Ages," 133-145. Bower has provided here an overview of grammatical and rhetorical terminology applied to music by medieval theorists as well as the beginnings of a project of plainchant phrase structure analysis. Karen Desmond has deepened the overview of the medieval use of grammatical and rhetorical discourse in music writing, and she has examined Guido d'Arezzo's use of the same in the context of his treatise *Micrologus* and in his broader historical context to illuminate deeper layers of meaning in his text. Desmond, "*Sicut in grammatica*: Analogical Discourse in Chapter 15 of Guido's *Micrologus*," 467-493. Lastly, Dolores Pesce has added other theorists' works to the summary of the previous two writers and provided more subdivisions to the descriptions of medieval music theoretical uses of grammatical terminology. She has also connected Guido's use of these terms to his theory of affinities and the importance of the notes C, D, and E in his text. Pesce, "A historical context for Guido d'Arezzo's use of distinction," 146-162.

[462] Conversation at the Colloque 2011 – Halifax Colloquium of the Institut grégorien du Canada/Gregorian Institute of Canada, August 5, 2011.

I should add, however, that hearing a half cadence as staying in the same key, even when preceded by a secondary dominant, depends on a strong and constant sense of tonality and thus scale degrees. Likewise, hearing a cadence on a non-final note as remaining in the mode would depend on having a strong and constant sense of mode degrees. However, if the sense of mode and thus the sense of mode degrees, i.e. the sense of all notes being defined by their relationships to the final, are weaker or more ambiguous, perhaps each cadence to a non-final note would almost always sound like a cadence to a new final.

To determine whether or not the cadences of internal phrase-finals on notes other than the stanza-final are modulations, and if so, how strong or clear they are, we could begin by comparing analyses of those phrases whose finals match their stanza's final and analyses of those phrases whose finals do not match their stanza's final, but work in this area will have to wait for future research.

### 4.4.2 Sequences

Twelfth-century sequences are composed of many short, well-defined phrases, each with its own cadence. Sequences from this time frequently modulate, and many of them even begin and end in different modes, as defined by the finals of their phrases. Some of them modulate to one other mode, or *secondary mode*, while others modulate to numerous secondary modes. However, my impression is that the majority of individual phrases stay in a single mode, which makes them useful units for defining segments of music to be analyzed. As a result, I have grouped together phrases of the same mode to be analyzed as single sections. As I discussed in the previous chapter, however, it should not be assumed that all phrases of the same final or final and ambitus work the same way and thus that they would yield similar results. On the other hand, analyzing individual phrases is extremely problematic, because phrases are often too short to function as good samples.

Therefore, I have devised the unit *monomodal section*. A monomodal section is defined as any group of consecutive phrases (from one sequence) that have the same mode and contain at least eighty notes, to ensure that the sample size is sufficiently large; they must also be delimited at their start by the beginning of the piece or immediately preceding phrases of at least one different mode, and delimited at their end by the ending of the piece or immediately succeeding phrases of at least one different mode. For example, given a series of five consecutive phrases in the middle of a sequence, where the phrases' finals are (in order) D, F, F, F, E, the three phrases with an F-final form a monomodal section.

Only monomodal sections have been analyzed. All other phrases, i.e. those not part of any monomodal section, are "discarded" or excluded from analysis. Note that this method relies on my impression of monomodality within each phrase for justification. This is simultaneously a limitation and an opening; relying on my musical intuition here does not guarantee with 100% certainty that there are actually no modulations within a monomodal section, but in the absence of a mode-finding algorithm, which to my knowledge does not exist yet, it would be impossible to analyze modal patterns without some initial assumptions.

I have performed all of the analyses thrice. In the first set of analyses, I determine the mode of each phrase only by the final. In the next two sets of analyses, I determine the mode of each phrase both by the final and by the ambitus, with one set of analyses for each ambitus: authentic and plagal.

When categorizing the modes of phrases by both final and ambitus, monomodal sections exclude from analysis consecutive phrases that are of different ambituses, even when they have the same final. For example, when determining mode by both final and ambitus, three consecutive D-final authentic-ambitus phrases that are followed by a phrase of another final would be grouped together and analyzed as one monomodal section, but three consecutive D-final phrases with different ambituses (e.g. one authentic, the next plagal, etc.) would not be counted as a monomodal section, and they would therefore be omitted from analysis. By contrast, when determining mode by final alone, three consecutive D-final phrases that are followed by a phrase of another final would be grouped together and analyzed as one monomodal section regardless of the ambitus of the constituent phrases.

It is possible to conceive of analyzing phrases in various other ways. Originally, I planned on analyzing phrases based on the relationship between their mode and the mode of the piece in which they are found. For example, one option was to analyze only phrases of the same mode as the overall mode of the sequence. That meant defining a monomodal frame for the sequences. For pieces that began and ended in different modes, though, all of their phrases would be excluded from study, and that was the case with quite a few sequences. Some sequences stayed in one mode until the last phrase or two, or even just until the final five-note Amen. A method to include these needed to be developed as well. We could also look specifically at phrases of a different mode from the overall mode of the piece. We could also look at pieces including or excluding the phrases of secondary modes.

Such a system of results is extremely convoluted, though. Moreover, it would yield extremely small sample sizes: the repertory would be cut into many tiny pieces, leaving us with

unreliable results. Most importantly, the distinctions are just too fine, especially for a first study of this kind. I do not believe that F-final phrases in a D-mode sequence work differently from F-final phrases in an E-mode sequence, and therefore, I do not wish to exclude from analysis any secondary F-final phrases (belonging to a sequence with an overall mode that does not have an F-final). Indeed, sections of consecutive phrases of the same mode sound to me to be about the same, no matter what the framing mode of the sequence might be. If this is incorrect, it can be disproved by a later study. As a first step, it is preferable to study all of monomodal sections regardless of the framing mode or starting or ending mode of a chant.

#### 4.4.2.1 The Edition of Sequences: Appendix C

Because an edition of the sequences in Paris, B.N. lat. 1112 does not exist, I made one for the purpose of these analyses, which forms Appendix C of this thesis. It contains a full transcription of the sequences in Paris, B.N. lat. 1112 and editorial notes.

## 4.5 Results

For all of the graphs showing the results of the analyses performed in this chapter, see Appendix E: Chapter 4 Plainchant Results. For instructions on how to read the graphs therein, see Appendix D: Guide to Reading the Results.

This section and the graphs in Appendix E are both organized by analytical method first, then repertory (i.e. responsorial chants, sequences). In Appendix E, each repertory section is further subdivided into pitch classes and mode degrees. Each pitch class graph is also displayed as a mode degree graph, where the data is the same except for the labelling and the colour-coding. Both forms of each graph have been provided so that the reader can determine whether or not there are observable patterns in all of the results across modes when viewed in terms of either pitch classes or mode degrees.

The purposes of these analyses are:

1. To determine whether or not there is consistency within the results for each mode;
2. To determine whether patterns occurring consistently across the modes are defined more by pitch classes or by mode degrees.

If an analysis reveals consistency across the analyzed segments of music within each mode, then firstly, modality is reflected in the analyzed structure, and secondly, the results can be used to form modal points of comparison for organum analysis.

If an analysis reveals consistency across the modes, then multiple modes would share common features. If either pitch classes or mode degrees can be shown to define the modes more than the other, then this would indicate the cognitive and thus musical precedence of one over the other.

Lastly, I should point out that results for a B-final "mode" have been included where available. There are no B-final stanzas in the responsorial chants; these are the results for monomodal sections in sequences whose phrases end on B. The idea of a B-final mode without an F-sharp is dubious to say the least, and so although I have included them in the summary tables, their results are not counted in the tables summarizing patterns across modes and the interpretation of the results. Additionally, in the summary tables, B-final results are always shaded in grey and bracketed as a result.

### 4.5.1 Analysis 1: Mode Profiles

The cluster analysis graphs for each mode (by final and by final and ambitus) show that the results are not consistent. There is no single distribution of *all* the pitch classes that is seen in all or most clusters, nor are there a few distinct, *full* distributions. Different ambituses for one final are not the cause of the inconsistencies, which are also rife within the results for each final and ambitus. The proportions of pitch classes change drastically across the clusters and leaves. In addition, the ranking of pitch classes (e.g. from highest to lowest likelihood of occurrence) varies as well. For example, the most frequently occurring pitch class in one cluster might be the fifth-most frequent in another, and then the second-most in yet another. As a result, it is not possible to establish solid, constant, *full* mode profiles for any of the modes.

Nevertheless, each mode has pitch class distribution trends. Firstly, in each mode, there are certain pitch classes that usually occur in the top few ranks. Secondly, although the rank of each of those pitch classes sometimes varies within the range of the top few ranks, I believe that the consistency of the ranks is high enough to infer reliable trends. These trends have been interpreted using the cluster analysis graphs in conjunction with arithmetic means (or less formally, averages) of all of the individual distributions from each cluster analysis.[463] Because of the results' many inconsistencies, the mean distributions cannot be taken as fully representative of the data, even though it may be tempting to use them thus. Instead, the means can be used to

[463] The means tables and graphs are provided in Appendix E, following the graphs of the dendrogram cluster analyses.

systematically identify or corroborate the top-ranking pitch classes or mode degrees for each set of results. When taking the mean of a set of distributions where a few variables always occupy the highest ranks, those few variables become more prominent, and the other variables that are less consistently ordered "average out", meaning that their results should become more evenly distributed or spread out; variables that are consistently unlikely remain unlikely in the means. Other times, because the various distributions are not exact opposites of each other, lower-ranking pitch classes are not fully "averaged out", but the higher-ranking variables are still individuated. Thus, the means can be useful analytical tools, but they must be used alongside the cluster analysis graphs.

In order to filter the top ranking pitch classes and mode degrees from each set of means, I developed an algorithm with my wife, Divya Ravi, who has a scientific background with almost no knowledge of Western classical music theory and is thus not inclined to rank notes according to any theory, including those contained in my thesis. The algorithm entailed four steps:

1. All probabilities less than 10% were excluded. Events with such low probabilities were considered negligible, especially relative to the many more probable events.
2. All probabilities that were altogether within a 1% range were grouped together to share a single rank, e.g. 17.3%, 17.8%, 18.1%. This rule did not apply to values where consecutive pairs are separated by 1%, e.g. 17%, 18%, 19%.
3. If and only if the sum of ranked probabilities reached or crossed 75%, the ranking of events (notes or outlines) stopped.[464] A minimum threshold of 75% ensured that a healthy majority of the probabilities were represented in each summary.[465] Stopping after at least 75% filtered the least important events very effectively.
4. All probabilities above 14.01% had to be ranked, even if the sum of ranked probabilities had already crossed 75%. This "must include" function ensured that events with a sufficiently high probability were not omitted due to Step 3.[466] The

[464] If there were insufficient values greater than or equal to 10% that would have summed to 75%, then the ranking process stopped without the sum reaching 75%. This was extremely rare, however, occurring, I believe, only once in all of the analyses.
[465] The sum was often above 80% and even 90%; for example, if a sum of 73% were reached, and the next value were 10%, then to surpass 75%, the 10% would be added, yielding 83%.
[466] In all of the results for both Chapter 4 and Chapter 5, this "must include" step was used only twelve times: in this chapter, in: Analysis 3, Sub-Analysis 1, responsorial chants, C-final; Analysis 3, Sub-Analysis 2, responsorial chants, G-final; Analysis 3, Sub-Analysis 2, sequences, G-final and A-final; and in Chapter 5, in Analysis 1, Sub-Analysis 2, medium organum phrases, A-final; Analysis 3, Sub-Analysis 1, organa, G-final and A-final; Analysis 3, Sub-Analysis 1, long organum phrases, E-final; Analysis 3, Sub-Analysis 1, medium organum phrases, E-final; Analysis 3, Sub-Analysis 2, long organum phrases, A-final; Analysis 3, Sub-Analysis

justification for 14.01% was as follows. The probability of occurrence of each note in a mode if all seven notes are equally likely is 14.29%;[467] 14.01% is almost equal to 14.29% while introducing some slight flexibility. The 0.01% was included to eliminate any values rounded up to 14% (e.g. 13.8%).[468]

To ensure the accuracy of the interpretation of the means, they have been read alongside the dendrogram cluster analysis graphs; the means graphs often project rankings lower than the first few that are contradicted by the randomness across individual results in the respective cluster analysis. To preserve the consistency and transparency of the ranking process, the summary tables that follow (e.g. Table 4.1) include all of the notes or outlines ranked by the algorithm, but based on the cluster analysis, those tabulated events that should not be ranked are shaded in grey and bracketed. I subsequently ignore those events in interpreting the results.

Lastly, the ranking process sometimes results in five or more ranked notes in one mode, but even if they are not bracketed and ignored, I am skeptical of the reliability of the lowest ranking notes.

#### 4.5.1.1 Responsorial Chants: Results

Table 4.1 below represents the hierarchy of the most frequently occurring pitch classes in each mode in responsorial chants, which can be used as a modal reference point.

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2, medium organum phrases, D-final and A-final. In two of the above instances, the "must include" value was above 20%; without this step, they would have been omitted due to Step 3: stop after crossing the sum of 75%.

Separately, although this step ensures that sufficiently high probabilities relative to the whole of 100% are included, there is a related purpose not formally covered by the algorithm: ensuring that sufficiently high probabilities *relative to the highest probability in a mode* (*max P*) are included. For example, 20% should always be included (according to the reasoning behind Step 4 of the algorithm) because, relative to the aggregate, it is a hefty portion; but if the max P in a set is 22%, then the "absolutely" low probability of 12% could be considered relatively high, being greater than half of the max P. If similar algorithms should be generated for future analyses, it might be useful to consider this issue of half the max P.

[467] 100%/7 notes per mode = 14.29% per note per mode. B-flat and other accidentals are ignored in this calculation.

[468] Curiously, there is often a sharp decline in values below 14.29% in the results of Analysis 3, both in this chapter and in the next. In addition, even when the values with probabilities lower than 14% (and greater than or equal to 10%) have been included in the tables (usually to reach 75%), their stability or regularity of is so low that I have ignored them while interpreting the results; they are usually bracketed and shaded in grey in the summary tables (see the last paragraph before the next subsection).

**Table 4.1** Analysis 1: Mode Profiles: Responsorial Chants: Summary

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D | 1 |
| | | F | 3 |
| | 2 | E | 2 |
| | | G | 4 |
| | | | |

E-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G | 3 |
| | 2 | E | 1 |
| | | F | 2 |
| | 3 | D | 7 |
| | | A | 4 |

F-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | A | 3 |
| | | G | 2 |
| | | F | 1 |
| | 2 | C | 5 |
| | | | |

G-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | A | 2 |
| | | G | 1 |
| | 2 | C | 4 |
| | 3 | D | 5 |

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | A | 1 |
| | 2 | C | 3 |
| | 3 | G | 7 |
| | 4 | D | 4 |

C-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D | 2 |
| | 2 | E | 3 |
| | | F | 4 |
| | 3 | C | 1 |

The fact that each mode has well-defined higher ranks but ill-defined lower ranks supports the idea of a hybrid mode-dependent and mode-independent hierarchy, where the ill-defined lower ranks comprise an everything-else level.

Furthermore, in half of the above tables, first place is shared by two or three pitch classes, and in half of the tables, second place is also shared by two pitch classes. The fact that the top ranks are often shared by multiple pitch classes might be an important aspect of modal pitch class hierarchies. Besides an everything-else level, we might also find more than one pitch class occupying a single level. This might be a sign of the flexibility of the modal system.

The recurring highly ranked notes across modes are summarized below in Table 4.2. It displays (1) the pitch classes (PCs) and mode degrees (MDs) that appear in at least three modes in the previous table, (2) the total number of times each pitch class or mode degree appears, and (3) the number of times it appears in each rank. The results are organized by total frequency, then by rank.[469] For example, the first row of the left table should be read as "the pitch class G ranks highly in five modes: first place in three modes, second place in one mode, third place in one mode."

[469] Please note that *frequency* in the context of reading such summary tables refers to the number of times an outline is ranked highly across the modes, meaning the number of times it appears in the summary tables, not to an absolute or relative frequency from the cluster or means analyses.

**Table 4.2** Analysis 1: Mode Profiles: Responsorial Chants: Recurring PCs and MDs

| | | Total | Ranks | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| PCs Highly Ranked in ≥3 Modes | G | 5 | 3 | 1 | 1 | |
| | D | 5 | 2 | | 2 | 1 |
| | F | 4 | 2 | 2 | | |
| | C | 4 | | 3 | 1 | |
| | A | 3 | 3 | | | |
| | E | 3 | | 3 | | |

| | | Total | Ranks | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| MDs Highly Ranked in ≥3 Modes | 1 | 6 | 4 | 1 | 1 | |
| | 2 | 5 | 3 | 2 | | |
| | 3 | 5 | 3 | 2 | | |
| | 4 | 5 | | 3 | 1 | 1 |
| | | | | | | |
| | | | | | | |

The much higher frequency and consistently higher ranks of the recurring mode degrees show that the recurring pattern of mode degrees 1, 2, 3, and 4 across modes determines the results. Furthermore, the form of the top of each mode's hierarchy seems to be common to all or most of the modes.

If mode degrees determine the top-ranked notes, though, then why are there recurring pitch classes? They are likely coincidental. If we are convinced (as I am) that the recurring mode degrees form such a strong pattern that they are primary, then they explain the recurrence of their equivalent pitch classes. For example, in responsorial chants, if the mode degrees 1, 2, 3, and 4 define the top-ranking notes in almost every mode, F is bound to occur in C-final, D-final, E-final, and F-final, being mode degrees 4, 3, 2, and 1 respectively. A more refined approach is what I call *successive elimination*: firstly, the event we are certain has determinacy, i.e. that with the highest frequency and ranking, is eliminated from consideration; secondly, the remaining strongest pattern, which would be the next determinant, is eliminated from consideration. The process continues until no patterns remain.

In this case, we begin with mode degree 1, then in the remaining results, mode degrees 2 and 3 form the dominant pattern. After their elimination, mode degree 4 has the strongest pattern. Only those pitch class recurrences that are not explained by the stronger mode degree patterns should be considered; in this case, there are none. Therefore, the recurrence of pitch classes in this set of results is coincidental.

#### 4.5.1.2 Sequences: Results

Table 4.3 below represents the hierarchy of the most frequently occurring pitch classes in each mode in sequences, which can be used as a modal reference point.[470]

**Table 4.3** Analysis 1: Mode Profiles: Sequences: Summary

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D | 1 |
| | 2 | E | 2 |
| | | F | 3 |
| | 3 | A | 5 |
| | | G | 4 |

E-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D | 7 |
| | 2 | E | 1 |
| | 3 | C | 6 |
| | 4 | F | 2 |
| | | | |

F-Final Modes

| | Most Likely | |
|---|---|---|
| | PCs | MDs |
| Rank | No F-final monomodal sections | |

G-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G | 1 |
| | 2 | A | 2 |
| | 3 | D | 5 |
| | 4 | C | 4 |
| | 5 | B | 3 |

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | A | 1 |
| | 2 | G | 7 |
| | 3 | C | 3 |
| | | B | 2 |
| | | D | 4 |

B-flat-Final Modes

| | Most Likely | |
|---|---|---|
| | PCs | MDs |
| Rank | No B-flat-final monomodal sections | |

B-Final Modes*

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs? |
| Rank | 1 | B | 1 |
| | 2 | A | 7 |
| | 3 | D | 3 |
| | | | |
| | | | |

C-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C | 1 |
| | 2 | D | 2 |
| | 3 | E | 3 |
| | 4 | G | 5 |
| | 5 | F | 4 |

The recurring patterns in Table 4.3 above are summarized below in Table 4.4, which, like Table 4.2, displays the frequencies of recurring pitch classes and mode degrees across modes, and

[470] Strangely, in the cluster analysis graphs, there are no results for B-final, but there are results for B-authentic. This is an error made by the computer. As a result, the means graphs do not include results for B-final, but I included the data from the B-authentic cluster analysis graph in Table 4.3. The cause of the error is still unknown. For any future research using the same software, it should be investigated and corrected.

each note's frequency per rank. Mode degrees 4 and 5 are bracketed, because even though they each recur more than twice, they hold relatively low ranks.

**Table 4.4** Analysis 1: Mode Profiles: Sequences: Recurring PCs and MDs

| | | Total | Freq. per Rank | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| PCs Highly Ranked in ≥3 Modes | D | 5 | 2 | 1 | 2 | |
| | G | 4 | 1 | 1 | 1 | 1 |
| | A | 3 | 1 | 1 | 1 | 1 |
| | E | 3 | | 2 | 1 | |
| | | | | | | |

| | | Total | Freq. per Rank | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 |
| MDs Highly Ranked in ≥3 Modes | 1 | 5 | 4 | 1 | | | |
| | 2 | 4 | | 3 | 1 | | |
| | 3 | 3 | | 1 | 2 | | |
| | 4 | 4 | | | 2 | 1 | 1 |
| | 5 | 3 | | | 2 | 1 | |

Let us use the process of successive elimination to determine the determinative patterns. Mode degree 1 recurs more frequently and with much higher rankings, thus forming the most certain pattern. Since all the pitch classes that are mode degree 1 are present in Table 4.3 only because they are mode degree 1 in their given mode, we can eliminate them from consideration. What remains is pitch class D with a higher total and overall ranking than mode degree 2, suggesting its greater importance to mode degree 2. After eliminating D and its equivalent mode degrees, mode degree 2 is the remaining most frequent and most highly ranked note. After its elimination, mode degree 3 has the strongest pattern, after whose elimination, mode degree 4 does. This process of successive elimination thus confirms mode degrees as primary determinants of the results overall.

Surprisingly, pitch class D had unique importance in these results as the only pitch class ostensibly with determinacy. I suspect, however, that its apparent determinacy results from two factors: D's high rank in E-final and the absence of F-final results. Had results for F-final been similar to those of the other modes, as I would expect, then only mode degrees would have formed the prevailing pattern. This is only speculation, of course. Future studies can confirm or disconfirm my suspicion.

The concept of a pitch hierarchy is also well supported by these results, but we should recall that the results do not represent a full hierarchy – only the top few levels. Furthermore, in some modes, some ranks are once again occupied by multiple notes.

As a final note on mode profiles, I should add that the cluster analysis results for both responsorial chants and for sequences show that each mode's distributions are not consistent enough to be represented by a single arithmetic mean distribution, as in Huron and Veltman's study.[471] What's more, even the top-ranking mode degrees in my results do not match theirs. The results of Analysis 1 thus directly contradict the mode profiles presented by Huron and Veltman. Deeper research in this area is greatly desired.

### 4.5.2 Analysis 2: Tendency

#### 4.5.2.1 Repertory: Responsorial Chants and Sequences

The Analysis 2 results for the sequences are remarkably similar to those of the responsorial chants, so the below discussion applies equally to both repertories.

#### 4.5.2.2 The Results

As one can see in Appendix E, section E.2, only means graphs for the tendency distributions of each mode (defined only by final) have been provided, with the exception of D-final, for which graphs of forty of the clusters or leaves have been provided (see Appendix E, section E.2, subsection 1.1.1.5.1.2). Even small inconsistencies amongst graphs with so many variables lead to less clustering and thus many individual leaves in the dendrogram. Each graph shows only one dendrogram cluster or leaf, and the proliferation of leaves in the dendrogram analysis yield an extraordinary number of graphs; if all the graphs for only the tendency analysis of every mode were included, the resulting document would be over 500 pages long. Such a document would be unusable, and so the graphs have not been included.

Despite the inconsistencies, there are broad trends that can be observed. The most likely pitch classes in every stack in a given mode recur across most of the graphs for that mode, and although the proportions of probabilities often change, the ranking of the most likely pitch classes usually remains about the same; when the ranking changes, it is usually from the top two most likely pitches exchanging ranks. These results are more consistent than the Mode Profiles results.

To summarize the data, I have included one graph of the distribution of mean (average) probabilities for each mode (defined by final) in Appendix E, section E.2, subsections 1.1.1.5.1

[471] Huron and Veltman, "A Cognitive Approach to Medieval Mode: Evidence for an Historical Antecedent to the Major/Minor System," 42-43. See Chapter 3 of this thesis, section 3.3.1.

(PCs) and 1.1.1.6 (MDs). However, it is not possible to establish a single, steady tendency distribution for each mode in either of the two chant repertories. Therefore, as with the previous analysis, the graphs of means in this section must not be interpreted as perfectly representative. Despite the fact that the specific ranks and proportions displayed in the means graphs are approximate, the graphs do capture the most probable tendency outcomes for each mode.

Table 4.5 below summarizes the most likely second notes for each first note, *across the modes*. Note that the number of mode degrees and the number of pitch classes differ. For this analysis, in the pitch class results, B-flat and B-natural are differentiated, whereas in the mode degree results, the mode degree associated with B-flat changes with each mode, and its results are added to its non-flat counterpart. For example, in D-final, B-flat and B-natural are both counted as mode-degree 6.

**Table 4.5** Analysis 2 Tendency: Responsories: Most Likely Second Note, Across Modes

| | | Second Note Likelihood | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| First note (given note) | pcD | C | E | D |
| | pcE | D | F | E |
| | pcF | E | G | |
| | pcG | F | A | |
| | pcA | G | C | A |
| | pcB-flat | A | G | C |
| | pcB | A | C | D/G |
| | pcC | D | C | B |

| | | Second Note Likelihood | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| First note (given note) | MD1 | 2 | 1 | |
| | MD2 | 1 | 3 | |
| | MD3 | 2 | 4 | 5 |
| | MD4 | 3 | 5 | |
| | MD5 | 4 | 6 | |
| | MD6 | 5 | 7 | |
| | MD7 | 1 | 6 | 2 |

There is overwhelming consistency in terms of pitch classes, but there is also overwhelming consistency in terms of mode degrees. Each first-place rank usually occurs in five to seven of the eight modes for pitch classes and five to six of the seven modes for mode degrees. How can both be true?

All of the results for all pitch classes and mode degrees across all modes across both repertories can be summarized thus: any given note is most likely to go to a note a step away; if a possible second note is a semitone away, then it is the more likely option; most steps usually

descend, and a few usually ascend (pitch class C and mode degrees 1 and 7). Thus, whether in terms of mode degrees or pitch classes, the most likely outcome will be about the same.[472]

These results show a type of mode-independent pitch class behaviour, since it is not defined by any tonal centre. Tendency differs from other mode-independent pitch class behaviours investigated here, though; unlike patterns that underlie only mode-independent pitch class behaviour of some kind, these tendencies are so fundamental and so general that they underlie all mode-independent *and* mode-dependent pitch class behaviour. They do not distinguish one category from the other. As a result, the mean tendency distributions cannot be used as modal reference points.

The more general implication of these results for modal theory is that there are other parameters beyond mode degree and interval string qualities that can sometimes outweigh both of them.

### 4.5.3 Analysis 3: Leaps and Melodic Outline

The Analysis 3 results for each mode are also much more consistent than the results of Analysis 1, but it should also be noted that in the graphs for C-modes in particular (as well as E-plagal and G-plagal), there are very few stacks. The fewer clusters result from the fact that the sample sizes are smaller, because leaps and melodic outlines occur far less frequently than individual pitch classes, of course. The sample sizes are still ample, however.

Just as in Analysis 1, I have used the cluster analysis and arithmetic means with the same algorithm to interpret the data of Analysis 3. Because of the relative consistency of the results, especially for Sub-Analysis 1: L5UM5, the means graphs for each mode might actually be representative.

In Analysis 1, the number of well-defined ranks of pitch classes were taken to reflect the extent to which a mode's hierarchy of pitch classes was defined. Similarly, the fact that multiple notes often shared single ranks in various modes was also taken as reflecting the structure of modal pitch class hierarchies. In Analysis 3, however, the same inferences cannot be made. There is no evidence that a given mode's hierarchy of specific outlines has bearing on the

[472] I would be curious to see if a tendency analysis that ignores all stepwise motion would yield results specific to each mode, but such a study will have to wait.

structure of that mode's pitch class hierarchy. Instead, each mode's hierarchy of outlines is taken primarily as a pattern specific to each mode.

#### 4.5.3.1 Sub-Analysis 1: L5 U M5

##### 4.5.3.1.1 Responsorial Chants: Results

Table 4.6 below represents the top-ranking outlines of a fifth in responsorial chants. These results should be taken as representative and used to form a modal reference point.

**Table 4.6** Analysis 3: Sub-Analysis 1: L5 U M5: Responsorial Chants

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D-A | 1-5 |
| | 2 | C-G | 7-4 |

E-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D-A | 7-4 |
| | 2 | C-G | 6-3 |

F-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | F-C | 1-5 |
| | 2 | A-E | 3-7 |

G-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-D | 1-5 |
| | 2 | F-C | 7-4 |

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-D | 7-4 |
| | 2 | D-A | 4-1 |

B-flat-Final Modes

| | Most Likely | |
|---|---|---|
| | PCs | MDs |
| Rank | No B-flat-final stanzas | |

B-Final Modes

| | Most Likely | |
|---|---|---|
| | PCs | MDs |
| Rank | No B-final stanzas | |

C-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C-G | 1-5 |
| | | D-A | 2-6 |
| | | A-E | 6-3 |
| | 2 | F-C | 4-1 |

The recurring patterns in Table 4.6 are summarized below in Table 4.7, which displays the frequencies of recurring pitch class and mode degree outlines across modes, and each outline's frequency per rank.

**Table 4.7** Analysis 3: Sub-Analysis 1: L5 U M5: Responsorial Chants: Recurring PCs and MDs

| | | Total | Ranks | |
|---|---|---|---|---|
| | | | 1 | 2 |
| L5UM5 (PCs) Highly Ranked in ≥3 Modes | D-A | 4 | 3 | 1 |
| | C-G | 3 | 1 | 2 |
| | F-C | 3 | 1 | 2 |
| | | | | |

| | | Total | Ranks | |
|---|---|---|---|---|
| | | | 1 | 2 |
| L5UM5 (MDs) Highly Ranked in ≥3 Modes | 1-5 | 4 | 4 | |
| | 7-4 | 4 | 2 | 2 |
| | | | | |
| | | | | |

Mode degrees determine the above results, as shown by their greater frequency and higher ranking. Following the same logic as in Analysis 1, since 1-5 is the most frequent and most highly ranked outline, it is primary; eliminating 1-5 from the results leaves 7-4 as primary, after which, almost all the results are explained.[473]

#### 4.5.3.1.2 Sequences: Results

Table 4.8 below represents the top-ranking outlines of a fifth in sequences.[474] As with the previous sample, these results should be taken as representative.

[473] One of the modes where 1-5 seems to be absent is A-final, but we find instead D-A in second place; if the A-final material where D-A frequently occurs is actually in D-final but with A only as a last note as a cofinal a kind of half cadence, then D-A would be 1-5 here as well, and 1-5 would only be absent in E-final. I would be hesitant to draw such a conclusion without first establishing that those phrases are, in fact, in D-final somehow. Moreover, the data for A-final, while sometimes divergent from most other modes, is often convergent as well, which would imply that A-final was unofficially its own mode, not D-final in disguise.

[474] In Table 4.8, an asterisk appears next to the mode labels *G-Final* and *B-Final*, because both have small complications. Firstly, the results for G-final tabulated below deliberately contradict the order of the results in the means graph, because the cluster analysis graphs make it clear that the F-C/7-4 outline is far rarer than the others, except for one monomodal section where the outline accounts for 100% of all fifth-outlines, and another monomodal section where it accounts for one third. These outliers have distorted the means graph to make it less representative. As a result, I have ranked 7-4 in last place in Table 4.8. Secondly, in the cluster analysis graphs, there are no results for B-final, but there are results for B-authentic. This is an error made by the computer, the cause of which is unknown. As a result, the means graphs do not include B-final, but I included the data from the B-authentic cluster analysis graph in Table 4.8. Nevertheless, as B-final results, they are excluded from all subsequent tables and the interpretation of results.

**Table 4.8** Analysis 3: Sub-Analysis 1: L5 U M5: Sequences

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D-A | 1-5 |
| | 2 | C-G | 7-4 |

E-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D-A | 7-4 |
| | | C-G | 6-3 |

F-Final Modes

| | Most Likely | |
|---|---|---|
| | PCs | MDs |
| Rank | No F-final monomodal sections | |

G-Final Modes*

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-D | 1-5 |
| | 2 | A-E | 2-6 |
| | | D-A | 5-2 |
| | | C-G | 4-1 |
| | 3 | F-C | 7-4 |

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D-A | 4-1 |
| | 2 | G-D | 7-4 |
| | 3 | A-E | 1-5 |
| | | | |
| | | | |

B-flat-Final Modes

| | Most Likely | |
|---|---|---|
| | PCs | MDs |
| Rank | No B-flat-final monomodal sections | |

B-Final Modes*

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs? |
| Rank | (1 | A-E | 7-4) |
| | | | |

C-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C-G | 1-5 |
| | 2 | G-D | 5-2 |

The recurring patterns in Table 4.8 are summarized below in Table 4.9, which displays the frequencies of recurring pitch class and mode degree outlines across modes, and each outline's frequency per rank.

**Table 4.9** Analysis 3: Sub-Analysis 1: L5 U M5: Sequences: Recurring PCs and MDs

| | | Total | Ranks | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| L5UM5 (PCs) Highly Ranked in ≥3 Modes | D-A | 4 | 3 | 1 | |
| | C-G | 4 | 2 | 2 | |
| | G-D | 3 | 1 | 2 | |
| | | | | | |

| | | Total | Ranks | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| L5UM5 (MDs) Highly Ranked in ≥3 Modes | 1-5 | 4 | 3 | | 1 |
| | 7-4 | 4 | 1 | 2 | 1 |
| | | | | | |
| | | | | | |

The sequences results are apparently similar to the responsorial chants results, but the differences have significant implications. Due to D-A's slightly higher ranking than 1-5, with one occurrence in second place rather than third, we should assign it primacy. If we follow the same process of elimination as usual, then after eliminating D-A, C-G has predominance, after whose

elimination, G-D does. Finally, two A-Es remain. This process suggests that the results are almost fully determined by pitch classes. (See Table 4.10 below.)

**Table 4.10** Analysis 3: Sub-Analysis 1: L5 U M5: Sequences: Eliminating D-A, C-G, G-D

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D-A | 1-5 |
| | 2 | C-G | 7-4 |

E-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D-A | 7-4 |
| | | C-G | 6-3 |

F-Final Modes

| | Most Likely | |
|---|---|---|
| | PCs | MDs |
| Rank | No F-final monomodal sections | |

G-Final Modes*

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-D | 1-5 |
| | 2 | A-E | 2-6 |
| | | D-A | 5-2 |
| | | C-G | 4-1 |
| | 3 | F-C | 7-4 |

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D-A | 4-1 |
| | 2 | G-D | 7-4 |
| | 3 | A-E | 1-5 |
| | | | |
| | | | |

B-flat-Final Modes

| | Most Likely | |
|---|---|---|
| | PCs | MDs |
| Rank | No B-flat-final monomodal sections | |

B-Final Modes*

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs? |
| Rank | (1 | A-E | 7-4) |
| | | | |

C-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C-G | 1-5 |
| | 2 | G-D | 5-2 |

There are three reasons that I find this conclusion difficult to believe. Firstly, responsorial chant fifth-outlines are clearly defined by mode degrees, including 1-5, which is the most expectedly modal outline. Secondly, F-final yielded no results; its missing distributions might reveal similarity to D-, G-, and C-final, as they did in responsorial chants, in which case, 1-5 would be the strongest pattern. This is again purely speculative, but not without reason. Thirdly, successive elimination works best when the difference between the strongest pattern and every other at each step but especially the first step is clear, whereas here, it is very slight.

I am therefore tempted to discard D-A's slight outranking of 1-5 and explore the implications of prioritizing 1-5 over D-A as in the responsorial chants. Following the same process, 1-5 is eliminated first, leaving 7-4 with the strongest pattern, after whose elimination, a

smattering of outlines remains: two 5-2s and two 4-1s or two C-Gs and two D-As (see Table 4.11 below).[475]

**Table 4.11** Analysis 3: Sub-Analysis 1: L5 U M5: Sequences: Eliminating 1-5, 7-4.

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D-A | 1-5 |
| | 2 | C-G | 7-4 |

E-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D-A | 7-4 |
| | | C-G | 6-3 |

F-Final Modes

| | Most Likely | |
|---|---|---|
| | PCs | MDs |
| Rank | No F-final monomodal sections | |

G-Final Modes*

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-D | 1-5 |
| | 2 | A-E | 2-6 |
| | | D-A | 5-2 |
| | | C-G | 4-1 |
| | 3 | F-C | 7-4 |

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D-A | 4-1 |
| | 2 | G-D | 7-4 |
| | 3 | A-E | 1-5 |
| | | | |
| | | | |

B-flat-Final Modes

| | Most Likely | |
|---|---|---|
| | PCs | MDs |
| Rank | No B-flat-final monomodal sections | |

B-Final Modes*

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs? |
| Rank | (1 | A-E | 7-4 ) |
| | | | |

C-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C-G | 1-5 |
| | 2 | G-D | 5-2 |

To summarize, the results suggest that pitch classes have primacy, but only due to a small difference in the first step and absent F-final results. Moreover, the results are very similar to those for responsorial chants, yet there would be a stark contrast in underlying structure (pitch class vs mode degree primacy). I am therefore skeptical of the conclusion that pitch classes were primary determinants, and I strongly suspect that the results are distorted by the absence F-final results.

[475] Here as well, if the D-A outlines occurring within A-final phrases are actually occurring within D-mode phrases that end on A (as a cofinal or "half-cadence"), then the apparent 4-1s would in fact be 1-5s. This reinterpretation would strengthen the mode degree reading of the results, but it is, again, only speculative. Crucially, ascertaining which explanation is correct would depend on the modal determination of those segments of music, which could only be developed with future research.

Each mode's results can be used as modal reference points, but due to the above issues, I am wary of including the proposed underlying structure of the results as part of the reference point.

#### 4.5.3.2 Sub-Analysis 2: L4 U M4

The results of the following sub-analyses within each mode are notably less consistent than the L5UM5 results. I believe that the results' increased variety derives from the shorter outline length; as explored in the previous chapter, fourths can be used in a number of ways in melodies, sometimes appearing on their own and sometimes being constituents of larger indirect outlines.

##### 4.5.3.2.1 Responsorial Chants: Results

Table 4.12 below represents the top-ranking outlines of a fourth per mode in responsorial chants. Despite the greater variety in the cluster analysis compared to fifth-outlines. The table should be used to form a modal reference point.

**Table 4.12** Analysis 3: Sub-Analysis 2: L4 U M4: Responsorial Chants

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C-F | 7-3 |
| | 2 | D-G | 1-4 |
| | | | |
| | | | |

E-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | D-G | 7-3 |
| | 2 | E-A | 1-4 |
| | 3 | G-C | 3-6 |
| | | | |

F-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-C | 2-5 |
| | 2 | F-Bb | 1-4 |
| | 3 | C-F | 5-1 |
| | | A-D | 3-6 |

G-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-C | 1-4 |
| | 2 | A-D | 2-5 |
| | 3 | D-G | 5-1 |

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | A-D | 1-4 |
| | 2 | G-C | 7-3 |
| | 3 | D-G | 4-7 |

B-flat-Final Modes

| | Most Likely | |
|---|---|---|
| | PCs | MDs |
| Rank | No B-flat-final stanzas | |

B-Final Modes

| | Most Likely | |
|---|---|---|
| | PCs | MDs? |
| Rank | No B-final stanzas | |

C-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C-F | 1-4 |
| | 2 | D-G | 2-5 |
| | | G-C | 5-1 |

The recurring patterns in Table 4.12 are summarized below in Table 4.13, which displays the frequencies of recurring pitch class and mode degree outlines across modes, and each outline's frequency per rank.

**Table 4.13** Analysis 3: Sub-Analysis 2: L4 U M4: Responsorial Chants: Recurring PCs and MDs

| | | Total | Ranks | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| L4UM4 (PCs) Highly Ranked in ≥3 Modes | G-C | 5 | 2 | 2 | 1 |
| | D-G | 5 | 1 | 2 | 2 |
| | C-F | 3 | 2 | | 1 |
| | A-D | 3 | 1 | 1 | 1 |

| | | Total | Ranks | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| L4UM4 (MDs) Highly Ranked in ≥3 Modes | 1-4 | 6 | 3 | 3 | |
| | 7-3 | 3 | 2 | 1 | |
| | 2-5 | 3 | 1 | 2 | |
| | 5-1 | 3 | | 1 | 2 |

Firstly, the recurrence of 1-4 is the primary pattern because of its frequency and consistently higher ranking; it ranks first or second in every mode for which there are results,

suggesting that mode degrees determine the results. Pursuing successive elimination, we would omit the results explained by 1-4; foremost amongst the remaining patterns are G-C and 7-3 (as well as D-G and 2-5); whether to prioritize pitch classes or mode degrees here is debatable. As shown in Table 4.14 below, G-C appears four times, once more than 7-3, but 7-3 ranks first once more than the former.

**Table 4.14** Analysis 3: Sub-Analysis 2: L4 U M4: Responsorial Chants: After 1-4 Elimination

| | | Total | Ranks | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| L4UM4 (PCs) Highly Ranked in ≥3 Modes | G-C | 4 | 1 | 2 | 1 |
| | D-G | 4 | 1 | 1 | 2 |
| | | | | | |
| | | | | | |

| | | Total | Ranks | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| L4UM4 (MDs) Highly Ranked in ≥3 Modes | 1-4 | 6 | 3 | 3 | |
| | 7-3 | 3 | 2 | 1 | |
| | 2-5 | 3 | 1 | 2 | |
| | 5-1 | 3 | | 1 | 2 |

7-3's higher ranking is not trivial. Whereas a higher frequency shows something common to more modes, higher ranks show greater importance in the respective modes. First-place rankings should be weighted heavily because they are often far more probable than second-place events; in the means graphs for Analysis 3, the difference between first and second place can be as little as 2%, but it is more often very high – as much as 25%. When G-C ranks first, its probability is 36%, but in second, second, and third place respectively, its probabilities are 23%, 12.5%, and 15%. When 7-3 ranks first, its probabilities are 40% and 36%; in second place, its probability is 23%.

If we prioritize frequency, then we eliminate G-C, leaving only D-G occurring more than twice, after whose elimination, what remains is two each of A-D and C-F. On the other hand, if we prioritize higher ranking, then we eliminate 7-3, and then 2-5, and finally 5-1, leaving two 3-6s and one 4-7, or in terms of pitch classes, D-G, G-C, and A-D.

However, I believe that both choices are compromised. As noted above, the process of successive elimination is most appropriate and reliable when the strongest pattern at each step is clear, but after eliminating 1-4, choosing between a pitch-class- and a mode-degree-based interpretation depends on a small or at least controversial difference. Additionally, each option obscures an apparently strong pattern: four recurring mode degree outlines or three (or four) recurring pitch class outlines.

I prepared Table 4.15 below to illustrate a different perspective. It shows all appearances in the summary tables of the four pitch class outlines, their equivalent mode degrees, and the modes in which they appear. It also shows each outline's total number in the intersection of these mode degrees and pitch classes as well as the total number of each outline beyond these intersections in the smaller tables underneath and to the right of the largest table. This presentation of the data shifts the perspective from seeing the outlines as separate to seeing them as members of a group.

**Table 4.15** Analysis 3: Sub-Analysis 2: L4 U M4: Responsorial Chants:
The Recurring PC Outlines and their Equivalent MD Outlines

| | | Mode Degree Outlines | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1-4 | 7-3 | 2-5 | 5-1 | 3-6 | Total |
| PC Outlines | G-C | G-final | A-final | F-final | C-final | E-final | 5 |
| | D-G | D-final | E-final | C-final | G-final | X | 4 |
| | C-F | C-final | D-final | X (B/Bb-final) | F-final | X | 3 |
| | A-D | A-final | X (B/Bb-final) | G-final | X | F-final | 3 |
| | Total | 4 | 3 | 3 | 3 | 2 | |

| | | Total |
|---|---|---|
| PCs Highly Ranked in ≥3 Modes | G-C | 5 |
| | D-G | 5 |
| | C-F | 3 |
| | A-D | 3 |

(D-G occurs once as 4-7)

| | MDs Highly Ranked in ≥3 Modes | | | | |
|---|---|---|---|---|---|
| | 1-4 | 7-3 | 2-5 | 5-1 | (3-6) |
| Total | 7 | 3 | 3 | 3 | (2) |

The table reveals that the four pitch class outlines account for all of the high-ranking mode degree outlines after 1-4 (i.e. 7-3, 2-5, 5-1, and 3-6), with one exception. The converse without the exception is true as well; all of the mode degree outlines account for all of the four pitch class outlines. For example, every high-ranking 7-3 is one of the same four pitch class outlines. Excluding 1-4, every high-ranking G-C is one of the four mode degree outlines. This means that 2-5, for example, is never highly ranked as E-A nor F-B-flat.

Therefore, except for 1-4, the recurring mode degree outlines and the recurring pitch class outlines seem to be coordinated. The correspondence is not perfect due to the probability of A-D as 5-1 being very low (only 5%), which I cannot explanation, but otherwise, the coordination is too strong to ignore.[476]

[476] Examining absences opens a different perspective of the same results while also supporting the coordination between the two types of outlines. There are four pitch class outlines that are rare in (or absent from) the summary tables: E-A, F-B-flat, and B-flat-E-flat or B-E. Their absences can explain the

In conclusion, for leaps and melodic outlines of a fourth in responsorial chants, primarily, mode degrees in the form of the pervasive 1-4 outline have priority over pitch classes, and secondarily, a set of mode degree outlines and a set of pitch class outlines seem to be coordinated.

#### 4.5.3.2.2 Sequences: Results

Table 4.16 below represents the top-ranking outlines of a fourth per mode in sequences. The results are somewhat less consistent than the previous set.

modes in which 7-3, 2-5, and 5-1 do not appear. Where these mode degree outlines would be these pitch class outlines, they are not found. (The converse is not true; absences of E-A, F- B-flat, and B-flat-E-flat and B-E are not limited to the absences of 7-3, 2-5, and 5-1.) In fact, even beyond their absence from the high ranks, these pitch class outlines occur only very rarely, other than their occurrences as 1-4. That pitch class outlines' absence could predict mode degree outlines' absence might demonstrate another way that pitch classes have determinative power here. However, E-A and F-B-flat each occur once, and in second position: as 5-1. Their absence's importance is therefore subordinate to the importance of the primary mode degree outline.

Similarly, we can observe that there are two mode degree outlines that are absent or very rare in the summary tables: 6-2 and 4-7. (In addition, these two outlines occur rarely in general; with one exception, 4-7's probability does not surpass 5%, and 6-2's highest probability is about 9%.) The absence of 6-2 and 4-7 explain almost every instance where the recurring pitch class outlines do not appear. (The converse is not true; the absence of 6-2 and 4-7 are not limited only to the absence of the four recurring pitch class outlines G-C, D-G, C-F, and A-D.) There is an exception, though: 4-7 appears in the summary tables once, in A-final. Other than the one exception, the absence of the two mode degree outlines predicts the pitch class absences, thus demonstrating that pitch classes are, overall, subordinate to mode degrees here. But subordination is principally due to the 1-4 outline that is already recognized as the strongest pattern.

There are two instances where 4-7 and 6-2's absence does not explain the absence of the recurring pitch class outlines: C-F in A-final (as 3-6) and A-D in D-final (as 5-1). It is not clear why these do not occur. 3-6 and 5-1 both occur elsewhere.

In any case, the two cases where the absences of C-F and A-D are not explained by 6-2 and 4-7 show that the pitch class patterns are not so strong that they would occur everywhere they could (beyond where their absence is dictated by 6-2 and 4-7). By contrast, the only case where a mode degree outline is not explained by the absent pitch degree outlines is 5-1 in D-final (as A-D). This asymmetry might indicate that mode degrees are the slightly stronger determinant, but only slightly.

**Table 4.16** Analysis 3: Sub-Analysis 2: L4 U M4: Sequences

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C-F | 7-3 |
| | 2 | D-G | 1-4 |
| | 3 | G-C | 4-7 |

E-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | No E-final monomodal sections | | |

F-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | No F-final monomodal sections | | |

G-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-C | 1-4 |
| | 2 | D-G | 5-1 |
| | 3 | C-F | 4-7 |
| | 4 | A-D | 2-5 |

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-C | 7-3 |
| | 2 | A-D | 1-4 |
| | 3 | D-G | 4-7 |
| | | | |

B-flat-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | No B-flat-final monomodal sections | | |

B-Final*

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs? |
| Rank | 1 | G-C | 6-2 |
| | | | |

C-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C-F | 1-4 |
| | 2 | G-C | 5-1 |

The recurring patterns in Table 4.16 are summarized below in Table 4.17, which displays the frequencies of recurring pitch class and mode degree outlines across modes, and each outline's frequency per rank.

**Table 4.17** Analysis 3: Sub-Analysis 2: L4 U M4: Sequences: Recurring PCs and MDs

| | | Total | Ranks | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| L4UM4 (PCs) Highly Ranked in ≥3 Modes | G-C | 4 | 2 | 1 | 1 |
| | C-F | 3 | 2 | | 1 |
| | D-G | 3 | | 2 | 1 |
| | | | | | |

| | | Total | Ranks | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| L4UM4 (MDs) Highly Ranked in ≥3 Modes | 1-4 | 4 | 2 | 2 | |
| | 4-7 | 3 | | | 3 |
| | | | | | |
| | | | | | |

Once again, we are confronted by a relatively small difference between the most prominent pitch class and mode degree patterns combined with the absence of results from some modes: E-, F-, and B-flat final. The results for these modes are likely missing due to their

monomodal sections being shorter than the minimum length of 80 notes required by the methodology.

Curiously, each interpretation leads to the same results: if we eliminate 1-4 first, which has the higher ranking, then G-C comes next, after which one pair each of C-F and D-G remain. On the other hand, if we eliminate G-C first, then 1-4 comes next, after which, the same pairs of C-F and D-G remain. (See Table 4.18 below.)

**Table 4.18** Analysis 3: Sub-Analysis 2: L4 U M4: Sequences: Eliminating 1-4 or G-C First

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C-F | 7-3 |
| | 2 | D-G | 1-4 |
| | 3 | G-C | 4-7 |

E-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | No E-final monomodal sections | | |

F-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | No F-final monomodal sections | | |

G-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-C | 1-4 |
| | 2 | D-G | 5-1 |
| | 3 | C-F | 4-7 |
| | 4 | A-D | 2-5 |

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-C | 7-3 |
| | 2 | A-D | 1-4 |
| | 3 | D-G | 4-7 |
| | | | |

B-flat-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | No B-flat-final monomodal sections | | |

B-Final*

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs? |
| Rank | (1 | G-C | 6-2) |
| | | | |

C-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C-F | 1-4 |
| | 2 | G-C | 5-1 |

It seems that the mode degree outline 1-4 and the pitch class outlines G-C, D-G, and C-F all seem to determine which fourth-outlines occur in sequences. If either has priority, it is unclear.

We should note, though, that like in responsorial chants, the same four recurring pitch class outlines (G-C, C-F, D-G, and A-D) seem to be recurring in sequences as well, though A-D's third appearance might be lost in the missing E- or F-final results. Furthermore, these outlines are again matched with a limited selection of mode degree outlines, though they are only similar to

and not the same as those in responsorial chants: 1-4, 4-7, 7-3, and probably 5-1. I suspect that here too, beyond 1-4, pitch class and mode degree outlines are inextricably bound together.

I must emphasize, though, that the absence of results for E- and F-final (as well as B-flat-final) distort our conclusions. Results for those modes could confirm or significantly alter the apparent patterns. For now, all conclusions must remain speculative.

It strikes me that the only determinative mode degree outline, 1-4, contains the final, thus emphasizing mode degree 1 again, as in Analysis 1. However, 5-1 contains the final as well and is far less common. The difference in their probabilities might be partly due to more authentic phrases than plagal ones being analyzed and/or partly due to a greater number of descending tetrachord lines to the final across modes, especially at cadences.

Finally, each mode's results can be used as modal reference points, but as a result of the missing modes, I am wary of using the proposed underlying structure of the results as part of the broader point of comparison.

## 4.6 Conclusion

I opened this chapter with the observation that because these analyses have never been performed on modal music before, we had no definitive way of recognizing modal results in the analysis of organum. As a result, I proposed that modal points of comparison be created using plainchant, since it was always considered modal. I chose two plainchant repertories as the reference points based on their historical connections to Notre Dame organum: firstly, twelfth-century responsorial chant repertory that was used as the basis of Parisian organum, and secondly, the Parisian sequence repertory. I also compared each of their styles to organum, which led me to argue that, contrary to Fassler's view, organum shares more stylistic features with responsorial chants than Parisian sequences.

I then pursued a digression. Based on the stylistic comparisons as well as Leonin's poetry, the chant genres used to make organum, and the contrast to contemporary poetry and music, I posited that Notre Dame organum was created partly out of an impetus to celebrate and revitalize the old.

Returning to the main purpose of the chapter, I adapted the methodology to the two plainchant repertories, after which, I proceeded with the three analyses: Mode Profiles, Tendency, and Leaps and Melodic Outlines.

Several conclusions have been reached. The Mode Profiles analysis showed, firstly, that within each mode, usually only the ranking for the top few most frequent pitch classes is consistent. This finding supports the idea of partially defined mode-dependent pitch class hierarchies, beyond which, mode-independent pitch classes possibly take over from mode degrees. Secondly, in both chant repertories, pitch class recurrences were determined by their mode degrees. Furthermore, the fact that the upper ranks of the modes were determined overwhelmingly by the same mode degrees (i.e. mode degrees 1, 2, and 3 in responsorial chants and sequences) across modes shows that the form of the top of each mode's pitch class hierarchy is more or less common to most of the modes. Fourthly, multiple mode degrees often share the top few ranks, which might reflect some flexibility inherent to modality; I expect each hierarchical level to relate to some behaviours or functions, so perhaps some are performed by multiple mode degrees rather than one each. I wonder if this structure relates at all to the apparent vagueness of the pitch class hierarchies implied by the medieval modal theorists. Shared hierarchical levels might prove to be a consistent feature of the modes in future research. Being so different from the structure of tonal pitch class hierarchies, such a feature would be an unexpected and novel discovery.

Analysis 2 revealed that across modes, stepwise motion (usually to semitones if possible and usually descending) plays a more important role in determining tendency than either mode degrees or pitch classes. Not being defined by a final, tendency is a type of mode-independent pitch class behaviour, but because the patterns of tendency are so fundamental that they underlie both mode-dependent and mode-independent pitch class behaviour, tendency does not distinguish either and therefore cannot show the primacy of one over the other. Therefore, the results for this analysis cannot be used to form modal reference points.

Analysis 3's results are more complex. In responsorial chants, fifth-outlines are determined by mode degrees, whereas fourth-outlines are determined primarily by the mode degree outline 1-4 and secondarily by a coordination between four pitch class outlines and four mode degree outlines.

For sequences, Sub-Analysis 1 suggests that pitch classes were determinative. However, the conclusion is badly compromised by the absence of results for F-final (as well as B-flat-final), probably because the monomodal sections were too short to qualify for analysis. The full results could point to very different conclusions. What's more, in both sub-analyses, the first step of recognizing the strongest pattern and eliminating it from consideration could not be performed with great confidence, because the strongest pitch class and mode degree patterns were

exceedingly close to each other. In L5UM5, specifically, the available results seemed strikingly similar to the L5UM5 results for responsorial chants, raising further doubts about the determinants (pitch classes or mode degrees) being so different and strengthening the suspicion that the missing F-final results would tip the scales towards mode degrees. The L4UM4 results were also compromised by holes: E-, F-, and B-flat-final yielded no data. I have speculated, though, that a similar phenomenon as observed in responsorial chants is at play: almost only the intersections between a set of mode degree outlines and a set of pitch class outlines occurred. Nevertheless, without the missing results, our understanding of the larger trends and causes must remain incomplete.

On constructing modal points of comparison: because of the partial consistency of pitch class frequency distributions, no complete distributions can be used as reference points, but the consistent part of the distributions (i.e. the top-ranking notes) can be used as modal reference points. Due to their consistency, the means for Analysis 3 of responsorial chants can be used as modal points of comparison. The sequences results for Analysis 3, in contrast, can only be incomplete reference points, given their flaws. Analysis 2's results cannot be used to form a modal reference point.

# Chapter 5 Analyzing Mode in *Organum Duplum*

At last, we come to the culmination of the thesis: an analysis of *organum duplum*. A glaring methodological question now arises. The theory of mode was developed and used only for plainchant; how should we adapt it to polyphony, and, for the purposes of this study, to florid organum? None of the thirteenth-century theorists explain how to understand mode in a polyphonic context or how to analyze duplum melodies in terms of mode.

As discussed in Chapter 2, medieval theorists from the Carolingians onwards tell us that the mode of a chant is determined from its final note. Based on this stipulation, we could simply look at the last note of the duplum part or of the tenor part in an organum and assign a mode to the entire organum based on that final note. (The tenor and duplum almost always end on the same pitch class, simplifying the choice.) This would be similar to Tinctoris' famous recommendation in 1476 to determine the mode of a polyphonic piece by looking at the final note of the tenor.[477] By my interpretation, though, such an approach would be arbitrary; I expect it to tell us little about the perception of mode across whole pieces and thus about mode's role in the creation of those pieces. As a control or a competing theory, I will analyze organa according to their final notes, but I will also propose an alternative methodology whose basis is more perceptually sound and which I expect to yield better results in the analyses that follow.

A more powerful modal theory should include the principles set forth in Chapters 2 and 3: that mode is heard throughout a chant long before the final note sounds, and that there are numerous investigable structures that uphold mode within a piece. I would suggest that the key to adapting modal theory to florid organum in a way that reflects music perception is the concept of dronality.

## 5.1 Towards a Methodology: Dronality

In 1997, W. A. Mathieu published *Harmonic Experience: Tonal Harmony from Its Natural Origins to Its Modern*.[478] It is highly unusual, combining ear training, composition, music theory, and to a great extent, reflections on the author's own impressions and experiences in these areas.

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[477] Tinctoris, Johannes, *Concerning the Nature and Propriety of Tones. De natura et proprietate tonorum*, trans. Albert Seay, 2nd ed. (Colorado Springs: Colorado College Music Press, 1976), 25.
[478] William Allaudin Mathieu, *Harmonic Experience: Tonal Harmony from its Natural Origins to its Modern Expression* (Rochester, VT: Inner Traditions, 1997).

It also offered the term *dronality* for the first time, which has been taken up by Daniel Harrison in his recent book *Pieces of Tradition: An Analysis of Contemporary Tonal Music*.[479] Harrison has adapted and clarified dronality as one of several tools for analyzing more recent music, but the general principle of dronality need not be limited to any century.

Dronality refers to the sense of tonal-centeredness created by a drone or drone effects, where the drone's pitch class is the tonal centre, or less frequently, the dominant. Harrison refers to drones "[producing] deeply embedded, immovable, and solid tonic anchors."[480] As Anthony Baines has pointed out, the use of drones "occurs in many local musical traditions throughout the world, but is by no means ubiquitous."[481] However, I would posit that the perceptual effect of the drone (i.e. dronality) might prove to be universal. This is because of a simple property of acoustics: overtones are only produced above the fundamental, and they are always produced if the fundamental is not a simple sine wave. There are no undertones to a fundamental, physical or perceived. It is likely because of this fact that the lowest-sounding pitch always has the greatest impact on our perception of harmony. As Elizabeth Aubrey has put it: "A drone … inevitably serves to establish some sort of 'tonal' reference point that by its very presence defines some pitches as structurally important and others as ornamental or secondary – which the ear might hear very differently without the drone's presence."[482]

The pre-eminent texture of two-voice organum is *organum purum*: a florid duplum part above long tenor notes, which to me sound like temporary drones. Therefore, we can use dronality to analyze mode in *organum duplum* by interpreting each long tenor pitch-class as establishing a mode or tonal area. Each tenor "drone" would be analyzed as the final of a mode. Therefore, every time the tenor changes pitch-class to another long note, it would be as though a modulation has occurred.

There are obvious advantages to analyzing organum thus. Firstly, it has a basis in historical theory, which I will discuss shortly. Secondly, it reflects the listening experience, making it intuitive (to me, at least).

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[479] Daniel Harrison, *Pieces of Tradition: An Analysis of Contemporary Tonal Music* (New York, NY: Oxford University Press, 2016), 18, footnote 10.
[480] Harrison, *Pieces of Tradition* 18.
[481] Anthony C. Baines, "Drone (i)," in *Grove Music Online* (2018 Jan. 10). <http://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000008192>.
[482] Elizabeth Aubrey, "Non-Liturgical Monophony: Introduction", in *A Performer's Guide to Medieval Music*, ed. Ross W. Duffin (Bloomington, IN: Indiana University Press, 2000), 111.

### 5.1.1 Challenges to the Tenor as a Drone

Treating the tenor as a drone is not without its potential problems, however. I will address four issues: the length of tenor notes, the lowness of tenor notes, voice-crossing between the tenor and the duplum, and a set of optional historical performance practices that could have variously altered the tenor part.

#### 5.1.1.1 Length

For a part to be perceived as and thus function as a normal drone, it must be the lowest part, and it must be sufficiently long. The shortest tenor notes, however, are one duplum-note long, while others are slightly longer but still quite short: two to four duplum-notes long, for example. All of these short tenor notes are too short to function as drones and must therefore be understood as functioning in ways other than as drones; they await exploration in future studies.

In addition, exactly how long a sustained note needs to be for the listener's perception of it to transform from a relatively short sustained note to a drone remains an open question, one to which I return in the methodology section.

Nevertheless, given that the predominant texture of *organum purum* consists of a florid duplum line above long tenor notes, frequently as long as 20 duplum-notes and sometimes longer than 80 duplum-notes, dronality could prove to be a powerful tool with which to study the majority of duplum passages in *organum purum*.

#### 5.1.1.2 Lowness

In addition, the tenor in Notre Dame *organum duplum* is not a particularly low drone; the tenor is often high, at times even sitting within the register of the duplum. The relatively high register for a drone might soften or blur the sense of dronality. Understanding dronality highlights this circumstance as a point of interest, but exploring this observation in depth depends on first establishing dronality as a justified lens through which to analyze organum.

#### 5.1.1.3 Voice-Crossing

Another complication is the fact that the tenor and the duplum sometimes cross, making the tenor the higher part (either in a sustained or intermittent way), thus disrupting the dronality. Dronality can rightly serve to highlight the passages where voice-crossing occurs; it is a point of interest that neither the listener nor the theorist should ignore. Such passages probably should

not be understood through dronality in the way that the rest of the passages could be. Voice-crossing should not be considered a general obstacle for analysis, though, since such passages are rare relative to the main texture of a florid duplum line *above* a sustained tenor. I should note that while voice-crossing is relatively rare, it does occur at least once in most organa. These passages should be addressed in future studies.

#### 5.1.1.4 Historical Performance Practices of the Tenor

More problematic than the above are the historical performance practices of the tenor part. Edward Roesner has explained that "the tenor was not meant to be brought forth as a mere drone," examining three ways the tenor would depart from only sustaining the written long notes.[483]

Firstly, the tenor sometimes inserted silences. The Aberdeen fragment and the Montpellier codex provide examples of notated breaths in the tenor, "suggest[ing] a broader practice … that permits the individual tenor singer to pause for breath as often as he wishes, but in concert with the duplum or another upper part. …. As a result, the tenor singer … contributes subtly to the articulation of the musical fabric."[484] This alone should shift our interpretation of the tenor notes as a straight drone, but while breaths might interrupt the sounding pitch, I do not take them as interrupting the dronality.

There are other contexts in which the tenor might fall silent, however. When the duplum sings a long dissonance against the tenor's long, sustained note (in the middle of the tenor note), Franco of Cologne instructed the reader to take one of two options, the first of which is to "let the tenor be silent…" (*tenor taceat*).[485] Anonymous II, who was heavily influenced by Franco,[486] recommended a similar practice, but in the context of discant, writing:

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[483] Edward Roesner, "The Performance of Parisian Organum," *Early Music* 7:2 (April 1979), 174–189.
[484] Roesner, "The performance of Parisian organum," 175.
[485] Roesner, "The performance of Parisian organum," 176. See also Franco of Cologne, *Ars Cantus Mensurabilis: The Art of Measurable Song (c. 1280),* trans. Rob Wegman, *Academia.edu,* last accessed 2018 Jan. 10, <https://www.academia.edu/2080505/Franco_of_Cologne_The_Art_of_Measurable_Song_c.1280_>: 22.
[486] Roesner, "The performance of Parisian organum," 176.

"Quibus dissonantiis non utitur in longis, nisi tenens velit se fingere vel tacere."

"[Discantus] does not use these dissonances in longs, unless [the voice] holding it wishes it to be so performed or it comes with a rest."[487]

Anonymous II specified that it is the choice of the singer whether or not to include the dissonance against the sustained tenor note. Although the genre of music is discant and not *organum purum*, elsewhere, Anonymous II suggested that the rules given in that section applied to multiple genres, and thus, the rules might have extended to organum as well.[488]

Anonymous IV included similar advice:

"In puro autem organo multiplici via et modo longae et breves cognoscuntur. Uno modo sic: omnis punctus primus, sive fuerit concordans in aliqua concordantia praedict[a]rum sive non, aut erit longa parva vel longa tarda vel media, et hoc in quacumque ligatura, sive fuerit duum vel trium etc. Sed talis erit differentia: si fuerit concordans, tenor erit resonans sive redundans; si vero non fuerit concordans, erit tacens vel quiescens."[489]

"In *organum purum* the longs and breves are recognized by many different ways and methods. One way is as follows: every first note, whether it is a concordant note in one of the aforementioned concords or not, will either be a *longa parva* or a *longa tarda* or a *[longa] media,* whatever ligature it appears in, whether a two-note ligature or a three-note ligature, etc. But the following distinction applies: if it is concordant, the tenor will be sounding or held over; if it is not concordant, [the tenor] will be silent or remain quiet."[490]

Regarding the interpretation of the above passage, I am in agreement with Everist and not Roesner: I believe that "every first note" refers to many kinds of first notes: those beginning an

[487] Anonymous II, *Tractatus de discantu*, ed. and trans. Albert Seay, Text-Translations No. 1 (Colorado Springs: Colorado College Music Press, 1978), 32, 33. See also Roesner, The performance of Parisian organum," 176.
[488] Anonymous II, *Tractatus de discantu*, 22-23.
[489] Reckow, ed., *Der Musiktraktat des Anonymus 4, Teil II: Interpretation der Organum purum-Lehre*, 86.
[490] Yudkin, ed., *The Music Treatise of Anonymous IV*, 78. Roesner writes that "Anonymous IV says something similar regarding *organum triplum*", but I believe that this is incorrect; his citation (Reckow, ed., *Der Musiktraktat des Anonymus 4, Teil I*, 83) does not lead to any such passage, nor can I find any such passage.

organum, those beginning internal clausulae, as well as those opening sections of organum and even individual phrases of an organum. This might clarify what Anonymous IV referred to by "the tenor will be sounding or *held over*" and "[the tenor] will be silent or *remain quiet*" (emphasis mine).[491]

Nevertheless, for all of these cases, my opinion on the impact of the insertion of these rests remains the same as with breaths: a fleeting breath or a rest of one or two or even three notes' duration are hardly significant enough to disturb the dronality, especially if the tenor breaths or rests are coordinated with the breaths in the upper voice(s).

Another practice that could complicate the tenor line is advised by Odington, an English theorist active in the late thirteenth and early fourteenth century who was greatly influenced by Franco:[492] "let the tenor be held *tremulo*…."[493] *Tremulo*, as Roesner explains, "is a word with many connotations … but all of them imply some form of expressive performance."[494] Odington's remarks would seem to encourage the tenor to emphasize the dissonance, explicitly instructing him to hold the note, although the remark was in a different context: that of *currentes* in the duplum, not long dissonant notes in the duplum outside of cadences.[495] Odington actually gave no recommendations for handling long dissonances within *organum purum*, even through the use of rests. Although the *tremulo* is intriguing, I therefore do not see it as altering the dronality.

Earlier, I mentioned only the first of Franco's recommendations for the context in question. The second, in Franco's exact words, is that the tenor *concordantium fingat*.[496] The meaning of this has been subject to some disagreement, but Atkinson has indisputably shown

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[491] See Mark Everist, ed., *Les Organa à deux voix pour l'office du manuscrit de Florence, Biblioteca Medicea-Laurenziana, Plut. 29.1*, Vol. 2 of *Le Magnus liber organi de Notre Dame de Paris* (Monaco: Éditions de l'Oiseau-Lyre, 2003), lxxxix, n. 119. For a rich demonstration of how, for a given *organum purum* passage, tenor rests can be selected from the notated options and inserted to varying effects, see Everist, ed., *Les Organa à deux voix pour l'office du manuscrit de Florence*, Vol. 2 of *Le Magnus liber organi de Notre Dame de Paris*, lxxxix-xc.

[492] Frederick Hammond and Peter M. Lefferts, "Odington, Walter," 2001, *Grove Music Online*, last accessed 2020 June 24. <https://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000020252>; Roesner, "The performance of Parisian organum," 176.

[493] Roesner, "The performance of Parisian organum," 176.

[494] Roesner, "The performance of Parisian organum," 176.

[495] Roesner writes that Odington's recommendation for *tremulo* in the tenor during *currentes* passages in the duplum "suggest[s] that the tenor singer might enhance the flourish by embellishing his own part in an appropriate manner", but he offers no further explanation for what that might mean, and there is no reason to believe that a change of pitch would be involved in the tenor part – quite the contrary. See Roesner, "The performance of Parisian organum," 183.

[496] Franco of Cologne, *Ars cantus mensurabilis*, trans. Wegman, 22.

that the phrase referred to changing the tenor note to be consonant with a duplum note.[497] The tenor changing pitch would affect the dronality, but there is reason to ignore this practice. As Atkinson has explained, the idea of feigning consonance reflects Franco's place in the late-thirteenth century transformation of perspectives of rhythm and notation: "Whereas in Johannes' work, the notes of the upper voice of a section of organum were to be lengthened or shortened according to whether they were consonant or dissonant with the underlying tenor, Franco [placed] the rhythmic component first, and then [said] that if the resultant interval under a long of the duplum [happened] to be a dissonance, then it is the tenor – not the duplum – that should make the adjustment." An organum performance from the time of the production of F (between 1245-1255) would likely never have employed this performance practice.

We should additionally recall that even for Franco, feigning concord was one of two options for a specific context, not the cornerstone of organum performance practice. Given that, in Roesner's words, "…long, dissonant notes elsewhere in the duplum line [were] an integral part of the organum idiom",[498] and given that Pseudo-Garlandia, Lambertus, the St. Emmeram Anonymous, as well as Anonymous VII and even Odington (writing a least a generation later) all wrote nothing regarding avoiding or minimizing dissonance against the sustained tenor in any context, it is reasonable to conclude that for most theorists and probably for most organum performers of the twelfth and thirteenth centuries, long dissonances were not actively avoided, and when they sometimes were, as with Anonymous IV and Anonymous II, the tenor had the option of falling silent.[499] Changing the tenor pitch was the only performance practice that would

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[497] Charles M. Atkinson, "Franco of Cologne on the rhythm of organum purum," *Early Music History* 9 (1990): 8-9. Roesner translates *concordantium fingat* as "let the tenor … feign concord," and he offers two interpretations he considers likely: that the tenor "decrescendo or … the opposite: [hold] the note *as though* it were consonant by singing it forthrightly, even emphasizing the dissonance by crescendoing somewhat on it." Roesner did acknowledge the interpretation where the tenor would briefly change pitch, but he quickly dismissed the idea; Roesner, "The performance of Parisian organum," 176. Roesner's first two interpretations, i.e. either a decrescendo or a confidently sustained dissonance, are repeated in the *Magnus Liber Organi* edition, for which he was the series editor; Everist, ed., *Les Organa à deux voix pour l'office du manuscrit de Florence*, lxxxix. As Atkinson points out, though, "…as both the Latin *se in concordantiam fingat* and the musical example following this sentence show, it is precisely a change of pitch in the tenor that Franco does intend." The Latin original also includes the phrase *ut hic patet* ("as is apparent here") before the musical example, which unambiguously connects the performance practice to the example.

See also the English translations in: Robert Todd Scott, "Franco of Cologne's *Ars cantus mensurabilis*: Complete Critical Edition, with Commentary, Translation, Index Verborum, and Loci Paralleli" (PhD diss., Boston University, Boston, MA, 1999), 246-247; and Franco of Cologne, *Ars cantus mensurabilis*, trans. Wegman, 22.

[498] Roesner, "The performance of Parisian organum," 176.

[499] Roesner has written that Anonymous II and Anonymous IV's instructions are concordant with Franco's (Roesner, "The performance of Parisian organum," 176), but this is only half true. Franco, Anonymous II, and Anonymous IV all advocated breaths and rests in the tenor part, but Franco is the only Notre Dame theorist to have recommended changing tenor pitch, which, as we have seen, would only have occurred

truly disturb dronality, but it was likely uncommon for most of the history of organum in the twelfth and thirteenth centuries.

To summarize briefly, there were three optional performance practices that the tenor might have employed: inserting rests, holding the tenor *tremulo*, and feigning concord. The first two would not, in my opinion, disturb dronality. Feigning would disturb dronality, but firstly, it was likely limited to the late thirteenth century, and secondly, it was probably rare even then. As a result, it is not relevant enough to consider further.

### 5.1.2 Historical Support for Hearing the Tenor as Dronal

Beyond the issues of performance practice, it should be stressed that two of the principal treatises of this repertory describe the long tenor notes of *organum purum* as drones.

The Anonymous of St. Emmeram wrote:

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|---|---|
| "…sive organum speciale, et hoc supra burdonem in tenore…." | "…special organum, and this is above the drone in the tenor…." |

And

| | |
|---|---|
| "…id est, quotiens per se ponitur supra burdonem tenoris…." | "…that is, whenever it is placed by itself above the drone of the tenor…."[500] |

Anonymous IV wrote:

| | |
|---|---|
| "…cuius tenor totius est G continuando et G in fine modo stabili ut in burdone organorum. Et tale exemplum sive simile in pluribus locis organi puri…."[501] | "…of which the tenor of the whole thing is continuing on G and has G at the end in a stable fashion as in the drone of an organ [*burdone organorum*]. And such an example or something similar can be seen or will be able to be seen in several places of *organum purum*…."[502] |

late in the thirteenth century. See also Everist, ed., *Les Organa à deux voix pour l'office du manuscrit de Florence*, lxxxix-xc.

[500] Yudkin, trans. and ed., *De musica mensurata: The Anonymous of St Emmeram*, 284, 285, lines 39, 42.

[501] Reckow, ed., *Der Musiktraktat des Anonymus 4, Teil II: Interpretation der Organum purum-Lehre*, 79.

[502] Yudkin, ed., *The Music Treatise of Anonymous IV*, 70.

For both the St. Emmeram Anonymous and Anonymous IV, the root Latin word used to characterize the tenor parts in *organum purum* is *burdone*. Christopher Page has elucidated the broader use of the word *bourdone* and related words: "When used in connection with parts of instruments in the thirteenth century, its meaning usually lies in the area of 'something which produces an unvarying note, drone'."[503] *Bourdon*, *bordonus*, and *borduni*, were used to denote drones in bagpipes, organs, and fiddles, amongst other instruments.[504] These drones were a stable, prevalent part of the instrumental musical landscape. The vocabulary for them was apparently known to the St. Emmeram Anonymous and Anonymous IV, and most importantly, their descriptions of the tenor as a *burdone* very strongly suggest that they both perceived the tenor as sounding like and therefore functioning as a drone.

Sadly, other theorists wrote very little on the tenor in *organum purum*. Pseudo-Garlandia and Franco wrote nothing that would allow us to understand their perception of the sustained tenor notes or their opinion of the tenor notes' functions, and Lambertus wrote nothing about *organum purum* at all.

### 5.1.3 A Special Case: The *Summa Musice*

There is one other treatise from the time of Notre Dame Polyphony that discusses a droning tenor in a polyphonic context: the *Summa musice*. Written c. 1200,[505] when Notre Dame Polyphony's development and production was possibly reaching its peak with Perotin's two four-voice organa,[506] the *Summa musice* is peculiar for including a discussion of polyphonic practices that have nothing to do with Notre Dame Polyphony but do at times have a striking resemblance to twelfth-century Aquitanian polyphony. The treatise did not originate in France, though, but

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[503] Christopher Page, *Voices and Instruments of the Middle Ages. Instrumental Practice and Songs in France, 1100-1300* (Berkeley, Los Angeles: University of California Press, 1987), 118-119.
[504] For more on bourdon/bordunus/bordone/burdun, see Page, *Voices and Instruments of the Middle Ages*, especially 118-120.
[505] On the dating, see Christopher Page, ed. and trans., *Summa musice: A Thirteenth-Century Manual for Singers* (Cambridge: Cambridge University Press, 1991), 1-12, as well as Michael Bernhard, "La Summa Musice Du Ps.-Jean De Murs: Son Auteur Et Sa Datation," *Revue De Musicologie* 84, no. 1 (1998): 19-25. Bernhard's date of c. 1300 is too late, given firstly, not only the absence of mensural notation in the treatise but lines declaring that such notation did not yet exist; secondly, the much earlier style of organum described; thirdly, the distinct lack of Notre Dame terminology, although Bernhard does have interesting comments on overlapping terms, contrary to Page's claim of total absence of overlap (Page, ed. and trans., *Summa musice*, 30). I am following Page's dating of c.1200.
[506] On the evidence of the dating of Perotin's two four-voiced organa, see Ernest Sanders, "The Question of Perotin's Oeuvre and Dates", in *Festschrift für Walter Wiora zum 30. Dezember 1966*, ed. Ludwig Finscher and Christoph-Hellmut Mahling, 244 (Kassel: Bärenreiter Verlag, 1967). On the controversy of the chronology of Notre Dame Polyphony, see Chapter 1 of this thesis, section 1.2.8, and nn.161-162.

most likely in Southern Germany.[507] At some point, the treatise travelled to France, as evidenced by the fact that the only surviving source is a French manuscript, but since that manuscript was produced at the end of the fourteenth century or in the early fifteenth century, we cannot say when the transmission to France would have occurred.[508] It is highly unlikely to have been influential to anyone of the Notre Dame school, given the almost total absence of terminology, textures, and genres associated with Notre Dame (e.g. *organum purum*, discant, copula, organum, conductus, motet, etc.), the paucity of sources, the scarcity of references to the *Summa musice* or its author(s) in texts associated with Notre Dame, and the fact that the practices described in the *Summa musice* are separate from the Notre Dame repertory.[509] Nevertheless, as I hope to show, the treatise is relevant to the current discussion.

The *Summa musice* describes, amongst numerous topics, five procedures for producing polyphony:

1. *Diaphonia basilica*: a two-part practice of singing a melody over a drone. Unlike in Parisian organum, the drone never changes pitch.[510]
2. *Diaphonia organica*: a practice in which two voices move in mostly contrary motion, cadencing on unisons, fifths, or octaves. The texture seems mostly to be note-against-note, but often, the upper part has many more notes than does the lower part.[511] This practice seems very similar to that of Aquitanian *versus*.[512]
3. *Triphonia basilica*: a three-part practice where two upper voices sing a melody in parallel perfect fourths at the intervals of a fifth and an octave above a drone (the third voice).[513]
4. *Triphonia organica*: a practice where below *diaphonia organica*, a third part is sung in *notis pausatis*, that is, a series of long notes.[514]

[507] Both Page and Bernhard agree that the treatise originates in Southern Germany. Page concludes that the authors were Perseus and Petrus, possibly associated with the cathedral of Würzburg; Bernhard's objections to the attribution are interesting but problematic; see n.508. Page, ed. and trans., *Summa musice*, 1-12; Bernhard, "La Summa Musice Du Ps.-Jean De Murs: Son Auteur Et Sa Datation," 19-25.
[508] Page, ed. and trans., *Summa Musice*, 1.
[509] Page, ed. and trans., *Summa Musice*, 30.
[510] Page, ed. and trans., *Summa musice*, 31, 124, 200-201.
[511] Page, ed. and trans., *Summa musice*, 31-32, 124-126, 200-201.
[512] Planchart, Alejandro Enrique, and Sarah Fuller, "St Martial," 2001, *Grove Music Online*, last accessed 2020 June 26. <https://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000040296>.
[513] Page, ed. and trans., *Summa musice*, 32, 125-126, 201-203.
[514] Page, ed. and trans., *Summa musice*, 32, 125-126, 201-203.

5. *Tetraphonia* is four-part parallel organum of the same form described by the ninth-century treatise *Musica enchiriadis*, where a melody is doubled at the fifth, octave, and twelfth.[515]

For all of the above practices, there is no indication of what the melody is, whether pre-existent or improvised, whether plainchant or otherwise, but given firstly that the subject of the rest of the treatise is plainchant, and secondly, that the treatise is a plainchant manual, that is, a deliberately practical work intended to teach singers for the church, it is likely that the melodies were plainchant of some kind, and that the polyphonic practices were used as part of the liturgy.

The descriptions of the drones and drone-like parts in the first four of the five practices warrant further attention. The drone part for *diaphonia basilica* is described herein:

"Basilica est canendi duobus modis melodia ita quod unus teneat continue notam unam que est quasi basis cantus alterius concinentis…."[516]

"*Basilica* is a manner of singing in two ways so that one singer continuously holds one note which is like a foundation melody for the other singer…."[517]

The drone part is described similarly for *triphonia basilica*:

"Triphonia est melodia sive modus canendi a tribus vel a pluribus, et modis tribus ita scilicet ut ab uno vel pluribus teneatur pro basi continue nota una…."[518]

"*Triphonia* is a music or manner of singing by three or more, and in three ways so that one note is continuously held by one or many as a foundation…."[519]

Simply put, characterizing the drones as the foundation for the upper melodies likely reflects the author(s)'s sense of dronality.

Meanwhile, the description of the lowest part remains similar in *triphonia organica* even though the texture has changed:

[515] Page, ed. and trans., *Summa musice*, 32, 125-126, 201-203; Raymond Erickson, trans., and Claude V. Palisca, ed., *Musica Enchiriadis and Scolica Enchiriadis* (New Haven: Yale University Press, 1995), 22.
[516] Page, ed. and trans., *Summa musice*, 201.
[517] Page, ed. and trans., *Summa musice*, 124.
[518] Page, ed. and trans., *Summa musice*, 201.
[519] Page, ed. and trans., *Summa musice*, 125.

"Organica triphonia est melodia vel modus canendi a tribus vel pluribus, modis tribus diversis ita utu nus vel plures basim teneant in gravibus notis pausatis…."[520]

"*Organica triphonia* is a music or manner of singing employing three or more and in three different ways. One or more must lay the foundation among the *graves* with held notes…."[521]

Note that in *triphonia organica*, the lowest part, unlike in the three preceding methods, is no longer a simple drone, sustaining a single pitch for the duration of the upper melodies. Here, the lowest voice, singing specifically in a low register (the *graves*), is still characterized as a foundation, like the drone in *diaphonia basilica* and *triphonia basilica*, but here, there are multiple held notes (*notis pausatis*), not a single sustained tone as in the *basilica* practices. This suggests that each of the *notis pausatis* were heard as drones, though temporary ones. Sadly, this chapter of *Summa musice* does not include musical examples that would demonstrate exactly how these techniques were realized, nor the exact lengths of the *notis pausatis*, but I suspect that the held notes were long enough to be heard as temporary drones, since, if the *notis pausatis* were too short, they could not be considered as a foundation for the upper parts. This is supported by further general remarks in the treatise on the aforementioned practices:

"Sepe tamen contingit in organica quod pars inferior paucas habet notas et superior multas; tunc vero pauce tractim sunt, multe canende velociter."[522]

"It often happens in 'organica', however, that the lower part has few notes and the upper many; in those cases, the few are to be protracted and the many sung rapidly."[523]

There are stark differences compared to Notre Dame organum, of course. Firstly, unlike in Notre Dame organum, the melodies referred to by *Summa musice* are likely plainchant. Secondly, in three of the methods, the drone is fixed throughout. And thirdly, the way of combining two upper melodies is closer to Aquitanian or older polyphony. Most surprisingly, the fifth polyphonic practice seems to have persevered for over three centuries. It is not entirely clear the repertory with which *Summa musice*'s exceedingly-brief chapter on polyphony should be associated, not quite matching the older Aquitanian and Compostelan repertories nor the concurrent Parisian repertory, but I would guess that it is a faithful witness to a local musical tradition that grew out of or shared a common musical ancestor with Aquitanian polyphonic

[520] Page, ed. and trans., *Summa musice*, 201.
[521] Page, ed. and trans., *Summa musice*, 125.
[522] Page, ed. and trans., *Summa musice*, 202.
[523] Page, ed. and trans., *Summa musice*, 126.

practices, which included simple methods of polyphonically embellishing chants, such as adding a drone or doubling in parallel perfect consonances. Given the influences of John of Afflighem as well as Aquitanian polyphony, *Summa musice* likely presents a record of several historical layers of polyphonic practices accrued and overlaid in its local practice, which was at the same time distinct from Aquitanian polyphony.

I would furthermore suggest that *Summa musice* might preserve a crucial stage in the development of Parisian organum. *Diaphonia basilica* and *triphonia organica* each have a striking feature in common with the organum of Notre Dame, as discussed above: in d*iaphonia basilica*, there is a florid line above a drone, while in *triphonia organica*, we have upper melodies supported by long-held notes in the lowest voice. One could argue that such practices were recorded earlier, namely in the melismatic Aquitanian polyphony. After all, there are pieces of Aquitanian polyphony that contain a florid upper part above long tones in a lower part, somewhat like Parisian organum of the thirteenth century. The comparison, however, is problematic. Firstly, such examples in the Aquitanian repertory are fewer than a handful in number; the texture that became the standard for Parisian polyphony was extremely rare in Aquitanian polyphony.[524] Fuller also clarifies that, in contrast to Parisian *organum duplum*, "even the most elaborate of these pieces are better characterized as moderately florid rather than as richly melismatic. In the florid passages, the upper voice typically has neumes of only 2 to 8 notes against single notes, or neumes of 2 or 3 notes in the lower voice."[525] Secondly, melismatic passages occur over single sustained pitches in the lower voice. In Aquitanian examples, passages where the tenor moves from one sustained pitch to another sustained pitch (below a florid upper part) are not only rare, but to my knowledge, nonexistent. It should be noted as well that theorists before the thirteenth century did not document any practices that would seem to precede or anticipate Parisian organum. The *Summa musice* contains the earliest extant record of two of the practices underlying Notre Dame *organum purum*.

Returning to the idea of the drone, I would posit that if Parisian organum developed from polyphonic practices related to the *Summa musice*'s *triphonia organica*, where the lowest voice was understood to be a holding a series of drones on various pitches, then the similarly-organized tenor parts of Notre Dame *organum duplum* could very likely also have been understood as consisting of a series of drones.

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[524] Sarah Ann Fuller, "Aquitanian Polyphony of the Eleventh and Twelfth Centuries," 3 vols (PhD diss., University of California, Berkeley, 1969), 1:7-8.

[525] Fuller, "Aquitanian Polyphony of the Eleventh and Twelfth Centuries," 1:7-8. On the sustained-note texture in Aquitanian polyphony, see also Hendrik van der Werf, *The Oldest Extant Part Music and the Origin of Western Polyphony*, 2 vols. (Rochester, NY: Hendrik van der Werf, 1993), 1:28-31.

## 5.2 Methodology

Let us turn now to the methodology for this chapter, in which I synthesize the preceding considerations.

The sample of pieces to be analyzed consists of all of the two-voice organa from the Florence Manuscript (F; Pluteo 29.1), as edited by Mark Everist in volumes II, III, and IV of the most recent *Magnus Liber Organi* edition.[526]

I perform on organa dupla the three principal analyses of the methodology:

1. Mode Profiles (pitch-class frequency distributions);
2. Tendency (conditional probabilities of successive pitch-classes);
3. Leaps and Melodic Outlines.

Furthermore, as in the previous chapter, I perform the Pearson-Dendrogram Cluster Analysis as part of each analysis across the given units of music (i.e. pieces, phrases) of each mode.

I apply the three analyses to the sample of organa grouped using two different sampling methods, which I outline below. Common to both methods, though, are the following:

1. In both methods and all three analyses, only *organum purum* sections are studied.
2. All *clausulae*, which are in the texture of discant, are excluded.
3. *Copula* sections are also excluded. In copula, the duplum has measured rhythm and sustained notes in the tenor. They tend to be composed of melodic sequences or an antecedent-consequent-like phrase-structure. Although they do have the sustained-note tenors of *organum purum*, their phrase-structures and measured rhythm introduce complications beyond the bounds of the present study.
4. Chant sections are excluded as well, except in the determination of finals.
5. In both methods, I exclude ambitus from consideration. This is partly because the duplum's ranges tend to be extensive, often spanning an eleventh or a twelfth, which is most relevant to the analyses of whole pieces. It is also unclear how ambitus would

[526] Mark Everist, ed., *Les Organa à deux voix pour l'office du manuscrit de Florence, Biblioteca Medicea-Laurenziana, Plut. 29.1*. Vol. 2 of *Le Magnus liber organi de Notre Dame de Paris* (Monaco: Éditions de l'Oiseau-Lyre, 2003); Mark Everist, ed., *Les Organa à deux voix pour la messe (de Noël à la Fête de Saint-Pierre et Saint-Paul) du manuscrit de Florence, Biblioteca Medicea-Laurenziana, Plut. 29.1*, Vol. 3 of *Le Magnus liber organi de Notre Dame de Paris* (Monaco: Éditions de l'Oiseau-Lyre, 2001); *Les Organa à deux voix pour pour la messe (de L'Assomption au Commun des Saints) du manuscrit de Florence, Biblioteca Medicea-Laurenziana, Plut. 29.1*, Vol. 4 of *Le Magnus liber organi de Notre Dame de Paris* (Monaco: Éditions de l'Oiseau-Lyre, 2002).

function in a polyphonic setting; if we define ambitus based on the relative position of the final within the range of the music, but we also consider the tenor to be dronal, then the final is always at the bottom of the range, making every phrase authentic. This is most relevant to the analysis of organum phrases.

### 5.2.1 Sampling Method 1: Organa by Chant-Final

Earlier in this chapter, I recalled the overly simplistic recommendation of medieval theorists to determine the mode of any plainchant only by referring to the chant's final note, and I suggested that one could follow that recommendation with organum as well, taking the final note of the tenor as the sole modal determinant and organizing principle for the analyzed piece. The idea inherent in this method is that of saturated monomodality: each organum has only one mode throughout, which is determined solely by the final note of the tenor, which, for clarity's sake, I term the *chant-final*. The three analyses are performed for each entire organum of each chant-final without differentiating any internal modal regions from the supposed main mode. This method ignores dronality and, more generally, the responsive, changeable perception of mode that leads to modulation, as explored in Chapter 2.

To summarize, in the first sampling method, the organa are organized by mode, where mode is defined solely by chant-final; then the three analyses are applied to all of the organa of each modal group.

### 5.2.2 Sampling Method 2: Organum Phrases by Tenor PC

To define my second sampling method more precisely, I propose a new term: *organum phrase*. An *organum phrase* delineates any passage of music that sounds with a single tenor note. The length of a phrase is defined by the number of notes in the duplum; it can be as short as one note long, and there is no maximum length. Note that organum phrases are distinct from the alignment of syllables and notes in the tenor part; as long as the tenor sings a new note, a new phrase can begin before a new syllable is introduced.[527]

The second sampling method is based on my observations of modulation and dronality. Because of dronality, each tenor note lower than the duplum part and having a minimum length is interpreted as becoming a drone and thus a temporary tonal centre. As a result, I suggest that

[527] Although not essential for defining the sampling method, I would also propose the term *organum syllable* to refer to the music that sounds simultaneously with a single tenor syllable. Its length, like that of a phrase, is defined by the number of notes in the duplum. Syllables often contain multiple phrases.

with regard to mode, the long tenor notes might function as finals, and so each tenor note (of a minimum length and relative lowness) defines a modal region.

In this sampling method, therefore, all of the *organum purum* phrases are organized by tenor pitch-class, independent of most other features, such as the mode of the whole organum as defined by the chant-final. The tenor pitch class is considered as the final of the phrase for the purposes of modally classifying the phrase; the tenor is not counted in the analyses. I then apply the three analyses to all of the duplum parts of the organum phrases of each modal group.

Because of the limits of this method's premise, the analyses must be adapted to account for a few special cases: repeated tenor notes, phrase-boundaries, various phrase lengths, and voice-crossing. I address each of these below.

#### 5.2.2.1 Modally Geminate Phrases

The tenor in *organum purum* often repeats notes, which, in this framework, creates consecutive phrases of the same mode. I call such phrases *modally geminate phrases*. The basis of this method produces no modal reason to divide such phrases. On the contrary, it produces the expectation that the duplum's modal features will persist without change through successive modally geminate phrases. As a result, modally geminate phrases are analyzed as single phrases.

#### 5.2.2.2 Phrase-Boundaries

Another complication arises due to the artificial division of phrases for the sake of analysis. When organum is performed, the duplum often continues its melody fluidly across phrases; there are usually no breaks between phrases. When the tenor note changes, though, the duplum might immediately change with it, or it might only "react" to the new tenor note after some time, perhaps before the new tenor pitch class becomes established as the new tonal centre. The music at phrase-boundaries, therefore, might be somewhat transitional rather than representative of most of the phrase, though it might not be as well. As a result of this uncertainty, in this method, I take information at phrase-boundaries other than pitch-class frequencies to be special cases and thus to be omitted from analysis. The events of the last note of one phrase to the first note of the next phrase are discarded for Analyses 2 and 3: Tendency and Leaps and Melodic Outlines; any melodic outlines that are formed across phrase-boundaries are discarded altogether. Note that because modally geminate phrases are treated as single phrases, events at the phrase boundary between them are not discarded.

#### 5.2.2.3 Phrase Lengths

Because this method investigates whether or not dronality can predict modal behaviour of the duplum part, any passages where dronality cannot be established must be excluded from the analyses. As noted earlier, one of the two main requirements for dronality to be established is that the given tenor note must be sustained long enough to sound like a drone, but at what length a tenor note begins to sound dronal is unclear, as is the specific point at which the tenor sounds unambiguously dronal.

The tenor notes within *organum purum* sections are predominantly long, but the range of all phrase lengths is extremely wide: from one duplum-note to well beyond fifty duplum-notes long. Those tenor notes longer than twenty duplum-notes are, in my opinion, obviously dronal, and I would even go so far as to suggest that they would be perceived as such with near-universality. Meanwhile, as I wrote earlier, the shortest tenor notes cannot be considered dronal. I have therefore excluded the shortest phrases from analysis. The phrase lengths in between, however, are more difficult to classify. As a first approximation, though, I have developed the following classification of phrase lengths in *organum purum* based on my musical intuition:

**Table 5.1** Phrase Length Divisions

| Name | Length (in duplum notes) |
|---|---|
| Minimal phrases | 1 |
| Near-minimal phrases | 2-3 |
| Very short phrases | 4-7 |
| Short phrases | 8-13 |
| Medium phrases | 14-19 |
| Long phrases | ≥ 20 |

This categorization is rough. I am not convinced that there is a clear division in function between phrases supported by long and medium and even short tenor notes. I am also not convinced of the exact boundaries between categories; they approximate my musical intuition, but in this context, my musical intuition is fuzzy at best. Of course, all of these strict divisions ignore the speed at which the duplum sings. It is therefore more accurate to explain that I have

developed these categories from my experience singing and listening to recordings of organum.[528] Nevertheless, there is a rationale behind the categories I have presented, which is as follows:

Firstly, minimal, near-minimal, and even very short phrases are likely too short for the tenor to be perceived as a drone; they are unambiguously not dronal. In such cases, when the tenor sings the subsequent note, I am not yet surprised by the tonal change, because the preceding note did not have enough time to establish itself as a tonal centre through dronality. Very short phrases might be exceptional here, but I am assuming that this is not the case.

Secondly, long phrases sound unambiguously dronal. When the next tenor note arrives, it usually sounds either surprising or expected – surprising because the tonal centre defined by the drone has suddenly changed, or expected because the conventions of the genre dictated that the tenor note would eventually change; the likelihood of that change increases after extremely long tenor notes (e.g. those more than fifty duplum-notes long).

Thirdly, short and medium phrases lie in the range where I expect the onset of dronality to occur, although exactly where is unknown. Because of the general style of the genre, when I hear a sustained note, I find that by the eighth note, I am inclined to hear the tenor as dronal, and if the tenor changes pitch after only a few notes, then I am somewhat surprised, though not as surprised as after sixteen notes, for example.

I should note that short phrases remain short enough that a string of them can create a vague sense of periodicity, which can be heard as undermining dronality by shifting the perception of the tenor as the tonal centre to something more analogous to the root of a chord, which is understood to be more fleeting than a tonal region. My position, however, is that dronality and periodicity of phrases can easily coexist, since every tenor note is expected to be temporary, and I hear shorter dronal phrases simply as shorter modal regions.

This differentiation between phrase length categories makes it possible to analyze phrases of each category separately. Should the current analyses show that long phrases were shaped by dronality, then future studies could investigate whether or not short phrases are modal, and whether the duplum becomes more modal as the phrases get longer. The dronality in long phrases would have to be established first, though.

I therefore perform the three analyses on two filtered forms of the organum phrases organized by tenor PC:

[528] I am most familiar with the following two recordings: Red Byrd, *Magister Leoninus* (Hyperion 66944, 1997); Red Byrd, *Magister Leoninus* (Hyperion 67289, 2001).

1. Sampling method 2a: Long phrases: phrases at least twenty duplum notes long;
2. Sampling method 2b: Medium phrases: phrases between fourteen and nineteen duplum notes long.

The statistical analyses need as many notes per phrase as possible to produce reliable results. I therefore analyze long phrases first for the most reliable results followed by medium phrases, whose shorter length (sample unit size) might compromise the statistical results to some extent.[529]

#### 5.2.2.4 Voice-Crossing

After tenor-note length, the second main required condition for dronality to be established is the lowness of the tenor relative to the duplum. Therefore, although I have decided, based on my own musical intuition, to include passages where the tenor notes are in a relatively high register or where they are close to the duplum part, I have chosen to exclude from the analyses all passages with voice-crossing, i.e. where the duplum descends below the tenor, due to the voice-crossing's disruption of the sense of the tenor as a drone.

Furthermore, because of the disrupted dronality, it is not at all clear to me how the music following that disruption should be interpreted. Therefore, I have also chosen to exclude from analysis all of the music that follows the voice-crossing until the tenor changes pitch-classes, even if the duplum returns to its relatively higher position before the new tenor note. This means that if the following phrase is modally geminate with the first (i.e. the tenor has the same pitch-class), then all of the music in the second phrase is excluded as well.

Similarly to events at phrase boundaries, successive pitch-class probabilities, leaps, and any melodic outlines that are formed across the voice-crossing boundary, that is, across the point where voice-crossing begins, are excluded from analysis.

[529] To appreciate the statistical implications of the different sample unit sizes, let us consider the percentage of total probability given to each note. In a twenty-note-long phrase, each note makes up 5% of the total; in a fourteen-note-long phrase, each note makes up about 7% of the total. The difference might seem slight, but differences accumulate quickly enough. Just three notes in a twenty-note-long phrase already account for 15% of the notes, but three notes in a fourteen-note phrase account for about 21%. The smaller the sample unit size (in this case, phrase length), the fewer notes it takes to make a big difference in distributions; small changes can seem to radically alter distributions. In such a context, differences that have no perceptual impact for the listener might be realized as huge statistical differences in the results.

## 5.3 Results

### 5.3.1 Interpreting the Results

The results are interpreted in several steps. The first step is to determine whether the results are random or not random – whether or not there are prevailing patterns in the analyses. If the results are random, then organum is not modal, at least not according to the premises of my method. If the results of any analysis are not random, then two subsequent steps are required: the patterns are analyzed compared to the analogous chant analyses' results from the previous chapter. The chant results are the reference points for determining whether the current results are modal or at least modal in the same way. If the organum results are the same as or very similar to the chant results, then we can confidently declare organum to be modal with respect to the specific analysis. If they are different, then a third step arises: we must ask whether the results are modal in a new way that is consistent with the principles of mode extrapolated in Chapter 3 or whether they are best explained by another principle, like consonance.

For all of the graphs showing the results of the analyses performed in this chapter, see Appendix F: Chapter 5 Organum Results.[530] This results section and the graphs in Appendix F are both organized by analytical method first, then sampling method (i.e. organa by chant-final, organum phrases by tenor pitch class). In Appendix F, each sampling method section is further subdivided into pitch classes and mode degrees. Each pitch class graph is also displayed as a mode degree graph, where the data is the same except for the labelling and the colour coding.

I have used graphs of arithmetic means for Analyses 1 and 3, employing the same algorithm as I did in Chapter 4 to produce summary tables. The tables' format is also the same. Unless specified otherwise, the distribution of means should not be understood as a representative distribution for all of the results; rather, they are used as analytical tools in conjunction with the cluster analyses to highlight the most likely events.

To facilitate comparisons to the modal reference points, in the same summary tables, **bold** typeface is used to denote events (notes or outlines) that also appear in the analogous responsorial chants tables, and *italics* are used to denote events that also appear in the analogous sequences tables. An asterisk next to a note or outline denotes a difference of two or more ranks (e.g. first rank to third rank) when comparing that event's position in the results here to its position in the plainchant results. Changes of only one rank are not noted.

[530] As a reminder, for instructions on how to read the graphs therein, see Appendix D: Guide to Reading the Results.

All comparisons between organa or organum phrases and the two plainchant genres are conducted mode-by-mode, i.e. any concordances found between two repertories are concordances within a single mode. For example, if one pitch class is counted as a point of intersection between organa and sequences, it is because that pitch class appears highly ranked in one mode for organa and in the same mode for sequences.

Lastly, for the sake of consistency and transparency, I have included in the tables below all pitch classes that the algorithm selects from the means graphs while also shading in grey and bracketing the pitch classes that I believe should not be included in the high-ranks tables because of their random ranking in the cluster analysis graphs, just as I did in Chapter 4.

### 5.3.2 Analysis 1 Mode Degrees

#### 5.3.2.1 Sampling Method 1: Organa by Chant-Final: Results

The means in these results do not represent consistent trends in the data. In fact, the cluster analysis results are mostly random, with pitch class ranks varying drastically; across the stacks for most modes, most pitch classes hold almost every rank. As a result, many of the high-ranking pitch classes in the means graph are, in my opinion, artificially created by the means calculation and thus should not be considered. The very low level of consistency across clusters leads me to seriously doubt the ranking from the means graphs except, in most cases, for the first two and sometimes three results, which alone are visibly more consistent in the cluster analysis graphs.

The very few consistently ranked pitch classes could suggest very few well-defined pitch class hierarchy levels or unrepresentative results. Furthermore, in some modes, some single ranks are held by multiple pitch classes, potentially matching the same kind of structure found in the plainchant results.

Table 5.2 below represents the highest-ranking pitch classes and mode degrees per mode in organa by chant-final.

**Table 5.2** Analysis 1 Mode Profiles: Organa by Chant-Final

D-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | *A* | *5* |
| 2 | C | 7 |
| 2 | ***D*** | ***1*** |
| 3 | B | 6 |
| 4 | G | 4 |

E-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | ***D**** | ***7**** |
| 1 | *C* | *6* |
| 2 | ***E*** | ***1*** |
| 3 | A | 4 |
| 3 | B | 5 |

F-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | E | 7 |
| 1 | D | 6 |
| 2 | C | 5 |
| 3 | F | 1 |
| 4 | G | 2 |
| 4 | A | 3 |

G-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | ***D**** | ***5**** |
| 2 | E | 6 |
| 3 | C | 4 |
| 4 | G | 1 |
| 5 | F | 7 |

A-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | ***D**** | ***4**** |
| 1 | ***C**** | ***3**** |
| 2 | E | 5 |
| 3 | A | 1 |
| 3 | B | 2 |

Bb-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| No B-flat-final organa | | |

B-Final

| Rank | Most Likely PCs | Most Likely MDs? |
|---|---|---|
| No B-final organa | | |

C-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | ***D*** | ***2*** |
| 2 | ***E*** | ***3*** |
| 2 | C | 1 |
| 3 | G | 5 |
| 4 | F | 4 |

Comparing the above table with Chapter 4's Analysis 1 results reveals that ten of the fourteen notes in the table (10/14), approximately 71%, agree with at least one of the reference points.

Five of the six modes for which we have results have some overlap with responsories and/or sequences. The degree of correspondence varies by mode: the number of notes per mode that overlap with at least one of the modal points of comparison range from zero to three, with half the modes having two each.[531]

[531] The details are: F-final has no overlap with the modal points of comparison; G-final has only one note in common with the plainchant results, and the ranking differs by two ranks; D-final, A-final, C-final each have two points of intersection with the modal reference points; E-final has three pitch classes shared with the modal points of comparison.

There are two reasons to doubt the match between the above results and those of plainchant, however. Firstly, in the cluster analysis graphs, the probabilities are much more evenly spread out than in either chant repertory's results. The even spread is represented graphically by almost-equal bar-heights in a stack, making the bars appear somewhat like uniform blocks, as in Figure 3.3. More evenly spread probabilities show more variability, which implies more randomness.[532] For just a few of the many examples, see D-final, clusters 61, 62, 63, 64 and E-final, clusters 17, 18, 19, and leaf 0. By contrast, the results of Analysis 1 in Chapter 4 were much more unevenly distributed, with huge disparities between the most and least likely pitch classes, leading to much clearer, more consistent, and more meaningful rankings. Secondly, the results are far less consistent than those of the chant repertories.

Both the nearly even bar-heights and the scattered, inconsistent ranks of pitch classes could be the outcome of diverse distributions being averaged-out.

The recurring pitch class and mode degree patterns in Table 5.2 above are summarized below in Table 5.3; it displays (1) the pitch classes (PCs) and mode degrees (MDs) that appear in at least three modes in the previous table, (2) the total number of times each pitch class or mode degree appears, and (3) the number of times it appears in each rank. The results are organized by total frequency, then by rank. For example, the first row of the left table should be read as "the pitch class D ranks highly in six modes: first place in five modes, and second place in one mode."

**Table 5.3** Analysis 1 Mode Profiles: Organa by Chant-Final: Recurring PCs and MDs

| | | Total | Ranks | |
|---|---|---|---|---|
| | | | 1 | 2 |
| PCs Highly Ranked in ≥3 Modes | D | 6 | 5 | 1 |
| | E | 4 | 3 | 1 |
| | C | 3 | 2 | 1 |
| | | | | |

| | | Total | Ranks | |
|---|---|---|---|---|
| | | | 1 | 2 |
| MDs Highly Ranked in ≥3 Modes | 6 | 3 | 2 | 1 |
| | 7 | 3 | 2 | 1 |
| | | | | |
| | | | | |

The most frequently recurring and highly ranked notes across modes are pitch classes, not mode degrees. The fact that the highest-ranking notes across the modes are predicted by a pitch

[532] To make this concept more intuitive, consider fair dice. For a die to be considered fair, when it is rolled, each of its six possible numbers must be equally likely outcomes. If some outcomes are more likely than others, then the die would be loaded or weighted – not fair at all. In contrast to a fair die, there is more order in the outcomes of rolling a loaded die. To say that rolling a (fair) die has equally probable outcomes means that the outcome is random and thus relatively unpredictable (which makes a game fun to play!).

class pattern and not by a mode degree pattern is contrary to the pattern in the plainchant results and not modal.

To summarize, while there are many points of intersection between the results for organa by chant-final and the results for plainchant, the points of intersection are, contrary to the plainchant results, explained not by a mode degree pattern but by a pitch class pattern. Furthermore, I have raised two important doubts regarding the validity of these results: how evenly spread out the probabilities are in each mode and how inconsistent the rankings of most pitch classes are in each mode's cluster analysis graphs.

#### 5.3.2.2 Sampling Method 2a: Long Organum Phrases by Tenor PC: Results

In contrast to the results for whole organa, many stacks in the cluster analysis graphs for long organum phrases (≥20 notes) show uneven probability distributions, e.g. D-final, plot 3 of 5, leaves 25, 28, 29, 30, 32. However, like the results for whole organa, many stacks in the cluster analysis graphs for long organum phrases show relatively even probability distributions, indicating more randomness, e.g. D-final, plot 1 of 5, clusters 141 and 143, and plot 2 of 5, cluster 131. These more random results weaken the trends emerging from the data. Nevertheless, the far greater number of uneven graphs demonstrate that there is much more order than randomness.

That order is reflected by the much more consistent ranking of notes across clusters within most modes than in the results for whole organa.[533] The consistency is lower than in the chant results, though, and not very high in general. While there are a few highly consistent trends, there are many more trends that I would characterize as only *moderately consistent*. Moderately consistent notes in a trend are very likely to occur and thus be prominent across clusters, but without consistent ranks, instead being likely to occur somewhere in a range of ranks, namely the top three or four. Note that this definition differs from multiple notes consistently sharing a single rank, where the probabilities of those notes are repeatedly equal or close to equal. Moderately consistent notes' probabilities can vary widely, and relative ranks between notes in a moderately consistent trend are also changeable; although three notes might frequently recur together in the first three ranks, their order within those ranks can vary greatly. In fact, the absolute ranks can sometimes also change, at times moving from first-through-third to second-through-fourth.

[533] G-final and C-final are exceptional in this respect, having much more variable results, though still containing rough trends.

In the summary tables, I have denoted moderately consistent trends using vertical bars. Because the ranking of such notes is not fixed, their ranks are less meaningful, and should not be used strictly when determining patterns. Therefore, in the tables summarizing the recurring pitch classes and mode degrees (e.g. Table 5.5), I have added a new column labelled "|x|", which gives the number of moderately consistent occurrences of the given note.[534]

On a separate note, the consistent or moderately consistent trends in long organum phrases almost always involve more pitch classes than do the organa trends (compare Table 5.2 and Table 5.4), which further demonstrates stronger patterns in long phrases compared to pieces.

Table 5.4 below represents the highest-ranking notes per mode in long organum phrases by tenor pitch class.[535]

[534] Please note that these vertical bars have no connection to absolute value, even though the notation is the same. In this chapter, the vertical bars refer only to moderately consistent trends.
[535] The two asterisks following mode labels indicate that I have changed notes' ranks based on the cluster analysis compared to the means, because the latter was distorted by outliers. In E-final, even though the means graph puts E ahead of D, E has a more inconsistent ranking, and D is more often more probable than E. In C-final, C is far too inconsistent to be ranked.

**Table 5.4** Analysis 1 Mode Profiles: Long Organum Phrases by Tenor PC

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | *A* | *5* |
| | | ***D*** | ***1*** |
| | 2 | C | 7 |
| | | B | 6 |
| | 3 | G | 4 |
| | | | |

E-Final Modes*

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | B | 5 |
| | 2 | ***D*** | ***7*** |
| | 3 | ***E*** | ***1*** |
| | 4 | *C* | *6* |
| | | | |
| | | | |

F-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | **C** | **5** |
| | 2 | D | 6 |
| | 3 | E | 7 |
| | 4 | **F** | **1** |
| | | | |
| | | | |

G-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | ***D**** | ***5**** |
| | 2 | **C** | **4** |
| | 3 | E | 6 |
| | 4 | ***G*** | ***1*** |
| | 5 | B | 3 |

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | E | 5 |
| | 2 | *D* | *4* |
| | 3 | F | 6 |
| | 4 | C | 3 |
| | 5 | A | 1 |

Bb-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | A | 7 |
| | 2 | G | 6 |
| | 3 | F | 5 |
| | 4 | Bb | 1 |
| | | | |

B-Final

| | Most Likely | |
|---|---|---|
| | PCs | MDs? |
| Rank | No B-final results | |

C-Final Modes*

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | *G* | *5* |
| | 2 | A | 2 |
| | 3 | ***F**** | ***4**** |
| | | ***E*** | ***3*** |
| | 4 | C | 1 |

A comparison with the analogous results in Chapter 4 reveals that fourteen of the twenty-seven total notes in the table (14/27), approximately 52%, match at least one of the plainchant results. The agreement is less than that between whole organa and the reference points.

All seven modes for which we have results have some overlap with responsorial chants and/or sequences. The degree of correspondence varies by mode: the number of notes per mode that overlap with the results of at least one of the modal points of comparison ranges from zero to three, with about half the modes having three notes each – higher overall than in organa.[536]

[536] The details are: B-flat-final has no points of intersection with the modal points of comparison, because there are no B-flat-final results in the plainchant results; A-final has one note that overlaps with one of the modal points of comparison; D- and F-final each have two points of intersection with the plainchant results; E-, G-, and C-final each have three notes overlapping with the plainchant results.

The recurring patterns in Table 5.4 above are summarized below in Table 5.5, which, just like Table 5.3, displays the frequencies of recurring pitch classes (PCs) and mode degrees (MDs) across modes, and each pitch class and mode degree's frequency per rank.

**Table 5.5** Analysis 1 Mode Profiles: Long Organum Phrases by Tenor PC: Recurring PCs and MDs

| | | Total | Ranks | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | \|x\| |
| PCs Highly Ranked in ≥3 Modes | D | 5 | 2 | 2 | | | \|1\| |
| | E | 5 | 1 | | | | \|4\| |
| | C | 4 | | | | | \|4\| |
| | F | 4 | | | 1 | | \|3\| |
| | A | 3 | 1 | | | | \|2\| |
| | G | 3 | | | | | \|3\| |

| | | Total | Ranks | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | \|x\| |
| MDs Highly Ranked in ≥3 Modes | 5 | 7 | 4 | | | | \|3\| |
| | 6 | 6 | | | 1 | | \|5\| |
| | 1 | 5 | 1 | | | 1 | \|3\| |
| | 7 | 4 | | 1 | | | \|3\| |
| | 4 | 3 | | 1 | | | \|2\| |
| | | | | | | | |

The strongest pattern is unquestionably formed by mode degree 5 appearing in all seven modes, in first rank in just over half. Successive elimination reveals that the series of dominant patterns is mode degrees 5, 6, 1, 7, and 4 (see Table 5.6 below).[537] Mode degrees determine the results.

[537] Alternatively, even though I am not prioritizing ranking as much in this analysis because of the many moderately consistent trends, one could argue that pitch class D should be prioritized over mode degree 6 because of its three stable first- and second-position appearances, subordinating mode degree 6's greater frequency by two. In this case, the same process of elimination gives the following hierarchy: 5, D, 6, 1, 7. Although I believe that, because of mode degree 6's prevalence, this is a weaker interpretation, it still shows that mode degrees are primarily determinant, but here, with one exception.

**Table 5.6** Analysis 1: Long Organum Phrases: Successive Elimination: 5, 6, 1, 7, 4

D-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | *A* | *5* |
| 1 | ***D*** | ***1*** |
| 2 | C | 7 |
| 2 | B | 6 |
| 3 | G | 4 |

E-Final Modes*

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | B | 5 |
| 2 | ***D*** | ***7*** |
| 3 | ***E*** | ***1*** |
| 4 | C | 6 |

F-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | **C** | **5** |
| 2 | D | 6 |
| 3 | E | 7 |
| 4 | **F** | **1** |

G-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | ***D**** | ***5**** |
| 2 | **C** | **4** |
| 3 | E | 6 |
| 4 | ***G*** | ***1*** |
| 5 | B | 3 |

A-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | E | 5 |
| 2 | *D* | *4* |
| 3 | F | 6 |
| 4 | C | 3 |
| 5 | A | 1 |

Bb-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | A | 7 |
| 2 | G | 6 |
| 3 | F | 5 |
| 4 | Bb | 1 |

B-Final

| Rank | Most Likely PCs | Most Likely MDs? |
|---|---|---|
| No B-final organa | | |

C-Final Modes*

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | *G* | *5* |
| 2 | A | 2 |
| 3 | ***F*** | ***4*** |
| 3 | ***E*** | ***3*** |
| 4 | C | 1 |

Although moderately consistent trends predominate in these results, the results nevertheless exhibit strong patterns. I believe that these two facts taken together indicate a partially defined pitch class hierarchy, but also a weaker hierarchy.

Furthermore, even though both the long organum phrases results and the responsorial chants results are determined by mode degrees, their mode degree patterns differ. Both plainchant genres were defined by mode degrees 1, 2, 3 (and 4), whereas long organum phrases are defined by mode degrees 5, 6, 1, and 7. In the context of organum phrases, though, mode degrees actually refer to intervals above the tenor, which means that the pattern might result from polyphonic concerns, namely consonance.

Although the two patterns differ, I would argue that long organum phrases' pitch content do reflect modality, though a different and perhaps new kind. Firstly, I will address the alternative explanation of consonance as the results' primary determinant. Consonance would explain the

predominance of mode degrees 1 and 5, i.e. the unison, octave, and fifth above the tenor.[538] However, since Pseudo-Garlandia classified fifths and fourths together as the only two middling concords, if consonance were determinative, then fourths should be much more prominent.[539] Instead, fifths abound, while fourths are the scarcest recurring interval, ranking highly only thrice. Additionally, thirds only rank highly once (in C-final), even though Pseudo-Garlandia classified them as incomplete concords, one level less consonant than fifths and fourths. Strangely, much more prominent than fourths and thirds are sixths and sevenths, even though Pseudo-Garlandia classified them as discords: major sevenths are complete discords, minor sixths are middling discords, and major sixths and minor sevenths are incomplete discords.[540] Moreover, major and minor sixths rank highly thrice each, and major sixths have only marginally – perhaps even negligibly – higher ranking overall than minor sixths. Similarly, major and minor sevenths rank highly twice each, and with comparable ranking as well. Therefore, consonance seems not to explain these results well.

It is also possible, though, that 5, 6, 1, 7 is not a *modal* pattern, but simply a pattern of melodic construction unique to long organum phrases. However, this conclusion without mode would, in my opinion, ignore the perceptual impact of mode degrees 5 and 1 in that pattern.

Mode degrees 5 and 1 are, of course, the modal nodes, which define every final and thus every mode. The modal nodes being prominent without mode degree 4 also being prominent (which would point towards consonance) emphasize the tenor as the tonal centre: the final. If a pattern other than 1, 2, 3, 4 could define mode, it would be one containing 5 and 1 both highly ranked.

In sum: Analysis 1 shows that long organum phrases have a lower percentage of correspondence with the modal points of comparison than do whole organa, though the degree of correspondence per mode is higher overall than in organa. In long phrases, the mode degree

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[538] One might also have expected variety to have been another determinant of the results, which would predict fewer unisons and octaves due to the fact that they do not add variety in polyphony, since their pitch class is already sounding. However, the results show mode degree 1 to be very common.

[539] Johannes de Garlandia, *De Mensurabili Musica*, trans. Rob Wegman, *Academia.edu*, last accessed 2018 January 27, since taken down. Pages 14-15. <https://princeton.academia.edu/RobCWegman/Translations>. In addition, the unison and octave are complete concords, a category more consonant than middling concords, but mode degree 1 appears less frequently than mode degrees 5 or 6.

The consonance and dissonance classification schemes of the Anonymous of St. Emmeram and Anonymous IV are very similar to Pseudo-Garlandia's and were probably based on his: Yudkin, trans. and ed., *De musica mensurata: The Anonymous of St Emmeram*, 258-263; Yudkin, ed., *The Music Treatise of Anonymous IV*, 57-59. See also Yudkin, "The Rhythm of Organum Purum", 375.

[540] Johannes de Garlandia, *De Mensurabili Musica*, trans. Rob Wegman, *Academia.edu*, last accessed 2018 January 27, since taken down. Pages 16-17. <https://princeton.academia.edu/RobCWegman/Translations>.

pattern 5, 6, 1, 7 has primacy in determining the highest-ranking notes. Finally, I have argued that although the prevailing pattern is different from that of the plainchant results, it should still be understood as modal, firstly, because consonance does not aptly explain the results, and secondly, because of the perceptual impact of the high prominence of mode degrees 5 and 1 in the pattern.

#### 5.3.2.3 Sampling Method 2b: Medium Organum Phrases by Tenor PC: Results

The results for medium organum phrases (14 to 19 notes) are remarkably similar to the results for long phrases, so their discussion will be brief.

Medium organum phrases also have some stacks with relatively even probability distributions, indicating more randomness, e.g. D-final, plot 3 of 9, clusters 277 and 283. There are many more stacks with uneven probability distributions, though, e.g. D-final, plot 3 of 9, clusters 272, 273, 279, 292, 296. The more random results weaken the trends slightly, but there is generally much more order than randomness.

However, medium organum phrases' results are markedly less consistent than those for long phrases; most trends are only moderately consistent. In G- and especially C-final, even the most consistent notes are borderline-inconsistent. The lower consistency might indicate more "noise" in the data, possibly due to the smaller sample unit size, i.e. the shorter phrase lengths. This inconsistency could thus indicate that dronality is weaker due to the shorter tenor notes. As in the previous section, I have denoted moderately consistent trends in the summary tables using vertical bars.

Table 5.7 below represents the highest-ranking notes per mode in medium organum phrases by tenor pitch class.

**Table 5.7** Analysis 1 Mode Profiles: Medium Organum Phrases by Tenor PC

D-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | *A** | *5** |
| | ***D*** | ***1*** |
| 2 | C | 7 |
| | B | 6 |
| 3 | ***G*** | ***4*** |

E-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | B | 5 |
| 2 | *C* | *6* |
| | ***D*** | ***7*** |
| 3 | ***E*** | ***1*** |
| 4 | A | 4 |

F-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | C | 5 |
| 2 | D | 6 |
| 3 | E | 1 |
| 4 | **F*** | **2*** |
| 5 | A | 3 |

G-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | ***D**** | ***5**** |
| 2 | ***C*** | ***4*** |
| 3 | ***G**** | ***1**** |
| 4 | ***A**** | ***2**** |
| | B | 3 |

A-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | E | 5 |
| 2 | ***D**** | ***4**** |
| 3 | ***C*** | ***3*** |
| | ***A**** | ***1**** |
| 4 | F | 6 |

Bb-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | F | 5 |
| 2 | G | 6 |
| | A | 7 |
| | | |
| | | |

B-Final

| Rank | Most Likely PCs | Most Likely MDs? |
|---|---|---|
| No B-final results | | |

C-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | *G** | *5** |
| 2 | *C* | *1* |
| | A | 6 |
| 3 | F | 4 |
| | E | 3 |

Sixteen of the twenty-nine total notes in the table (16/29), approximately 55%, match at least one of the plainchant results – very close to the values for long phrases. The degree of correspondence varies by mode as well.

The recurring patterns in Table 5.7 are summarized below in Table 5.8, which displays the frequencies of recurring pitch classes (PCs) and mode degrees (MDs) across modes, and each pitch class and mode degree's frequency per rank.

**Table 5.8** Analysis 1 Mode Profiles: Medium Organum Phrases by Tenor PC: Recurring PCs and MDs

| | | Total | Ranks | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | \|x\| |
| PCs Highly Ranked in ≥3 Modes | C | 6 | | | | | \|6\| |
| | A | 5 | 1 | 1 | | | \|3\| |
| | D | 5 | 1 | | | | \|4\| |
| | G | 4 | | 1 | | | \|3\| |
| | E | 3 | 1 | | | | \|2\| |
| | F | 3 | 1 | | | | \|2\| |

| | | Total | Ranks | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | \|x\| |
| MDs Highly Ranked in ≥3 Modes | 5 | 7 | 4 | | | | \|3\| |
| | 1 | 6 | 1 | | | | \|5\| |
| | 6 | 5 | 1 | | | | \|4\| |
| | 7 | 3 | | 1 | | | \|2\| |
| | 4 | 3 | | | | | \|3\| |
| | | | | | | | |

The strongest pattern is, again, unquestionably formed by mode degree 5. Successive elimination reveals that the series of dominant patterns is mode degrees 5, 1, 6, 7, and 4 (see Table 5.9 below).

**Table 5.9** Analysis 1: Medium Organum Phrases: Successive Elimination: 5, 1, 6, 7, 4

D-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | *A** | *5** |
| | ***D*** | ***1*** |
| 2 | C | 7 |
| | B | 6 |
| 3 | ***G*** | ***4*** |

E-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | B | 5 |
| 2 | *C* | *6* |
| | ***D*** | ***7*** |
| 3 | ***E*** | ***1*** |
| (4) | A | 4 |

F-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | C | 5 |
| 2 | D | 6 |
| 3 | E | 1 |
| 4 | **F*** | **2*** |
| (5) | A | 3 |

G-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | ***D**** | ***5**** |
| 2 | ***C*** | ***4*** |
| 3 | ***G**** | ***1**** |
| 4 | ***A**** | ***2**** |
| | B | 3 |

A-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | E | 5 |
| 2 | ***D**** | ***4**** |
| 3 | ***C*** | ***3*** |
| | ***A**** | ***1**** |
| 4 | F | 6 |

Bb-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | F | 5 |
| 2 | G | 6 |
| | A | 7 |
| | | |
| | | |

B-Final

| Rank | Most Likely PCs | Most Likely MDs? |
|---|---|---|
| | No B-final results | |

C-Final Modes

| Rank | Most Likely PCs | Most Likely MDs |
|---|---|---|
| 1 | *G** | *5** |
| 2 | *C* | *1* |
| | A | 6 |
| (3) | F | 4 |
| | E | 3 |

After 6, there is a possibility of eliminating C instead of 7, which would give the pattern 5, 1, 6, C (see Table 5.10 below).

**Table 5.10** Analysis 1: Medium Organum Phrases: Successive Elimination: 5, 1, 6: C or 7?

| | | Total | Ranks | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | \|x\| |
| PCs Highly Ranked in ≥3 Modes | **C** | **3** | | | | | **\|3\|** |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

| | | Total | Ranks | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | \|x\| |
| MDs Highly Ranked in ≥3 Modes | 5 | 7 | 4 | | | | \|3\| |
| | 1 | 6 | 1 | | | | \|5\| |
| | 6 | 5 | 1 | | | | \|4\| |
| | **7** | **3** | | **1** | | | **\|2\|** |
| | 4 | 3 | | | | | \|3\| |

Given the overall strength of mode degrees, though, I prefer the former. In fact, 5, 1, 6, 7, 4 is almost the same pattern that prevails in the long organum phrases results, except that mode degrees 1 and 6 are switched. Consequently, my interpretation of these results is the same as my interpretation of the results for long phrases.

### 5.3.3 Analysis 2 Tendency

Although Analysis 2 in Chapter 4 established no modal reference point, I have included for the reader's interest a comparison of whole organa and plainchant tendencies. Just as in Chapter 4, the results for the tendency analysis of whole organa are multitudinous but generally consistent, so I have also produced means graphs as analytical tools.

Because the results for organum phrases are very similar overall, I have not analyzed them separately; the present discussion should be read as applying to phrases as well.

#### 5.3.3.1 Comparing Chant and Organa Grouped by Chant-Final

Table 5.11 below summarizes the comparison between the tendencies of responsorial chants and organa. Each row gives a mode for both chant and organum results; the pitch classes in the columns represent the first of the two pitches in tendency (the given pitch class), and in each mode, they are categorized according to the degree of similarity between that pitch class' tendency distribution in chant and its tendency distribution in organa.

Almost all of the tendencies are mostly or somewhat similar. Dissimilarities are rare and minor. I am confident that the similarities reflect that the same principles of favouring stepwise motion, semitone motion, and descent determine duplum tendency. I do not believe that these

similarities should be given weight for an analysis of modality, because the tendency patterns do not distinguish modal from non-modal melodic material.

Lastly, since the differences between the distributions for responsorial chants and for sequences are few and slight, the similarities between organa and responsorial chants should be similar to those between organa and sequences.

**Table 5.11** Analysis 2: Tendency: Chant vs Organa

| | | Degree of Similarity between Probability Distributions by Given Pitch Class | | | |
|---|---|---|---|---|---|
| | | Similar | Middling | Dissimilar | Absent from Chant |
| Mode by Final | D | E, F, G, B-flat, B | A, C | D | |
| | E | E, F, G, B-flat, B, C | D, A | | |
| | F | E, B | D, G, A, B-flat | F | E-flat, F-sharp |
| | G | E, B | D, A, B-flat, C | F, G | E-flat, F-sharp |
| | A | D, G, B-flat, B, C | E, F | A | F-sharp |
| | B-flat | | | ** | |
| | B | | | ** | |
| | C | E, F, G, C | D, B | A, B-flat | |

** There are no organa with these finals.

## 5.3.4 Analysis 3 Leaps and Melodic Outlines

### 5.3.4.1 Sub-Analysis 1: L5 U M5

#### 5.3.4.1.1 Sampling Method 1: Organa by Chant-Final: Results

Table 5.12 below represents the top-ranking outlines of a fifth in organa. These results are consistent and should be taken as representative.

**Table 5.12** Analysis 3: Sub-Analysis 1: L5 U M5: Organa

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-D | 4-1 |
| | 2 | ***D-A*** | ***1-5*** |
| | 3 | A-E | 5-2 |
| | | | |

E-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-D | 3-7 |
| | 2 | ***D-A*** | ***7-4*** |
| | 3 | F-C | 2-6 |
| | | | |

F-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C-G | 5-2 |
| | 2 | D-A | 6-3 |
| | 3 | G-D | 2-6 |
| | (4 | A-E | 3-7) |

G-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | *D-A* | *5-2* |
| | | ***G-D*** | ***1-5*** |
| | 2 | *C-G* | *4-1* |
| | 3 | *A-E* | *2-6* |
| | | | |

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C-G | 3-7 |
| | 2 | ***G-D*** | ***7-4*** |
| | 3 | ***D-A**** | ***4-1**** |
| | | F-C | 6-3 |
| | 4 | *A-E* | *1-5* |

Bb-Final Modes

| | Most Likely | |
|---|---|---|
| | PCs | MDs |
| Rank | No B-flat-final organa | |

B-Final

| | Most Likely | |
|---|---|---|
| | PCs | MDs? |
| Rank | No B-final organa | |

C-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | *G-D* | *5-2* |
| | 2 | **A-E** | **6-3** |
| | 3 | ***C-G*** | ***1-5*** |

Twelve of the twenty-one outlines in the table (12/21), approximately 57%, agree with at least one of the modal reference points.

Five of the six modes have some overlap with responsories and/or sequences. The degree of correspondence varies by mode: the number of notes per mode that overlap with at least one of the modal points of comparison range from zero to four.[541]

The recurring patterns in Table 5.12 are summarized below in Table 5.13, which displays the frequencies of recurring pitch class outlines and mode degree outlines across modes, and each outline's frequency per rank.

[541] The details are: F-final has no points of intersection; D- and E-final each share one outline with a reference point; C-final has two, which is all of its outlines; A-final has three (out of five total outlines), although one of them does not rank highly; G-final shares all four of its outlines with the plainchant results.

**Table 5.13** Analysis 3: Sub-Analysis 1: L5 U M5: Organa: Recurring PCs and MDs

| | | Total | Ranks | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| L5UM5 (PCs) Highly Ranked in ≥3 Modes | G-D | 6 | 4 | 1 | 1 |
| | D-A | 5 | 1 | 3 | 1 |
| | C-G | 3 | 2 | 1 | |
| | A-E | 3 | | 1 | 2 |

| | | Total | Ranks | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| L5UM5 (MDs) Highly Ranked in ≥3 Modes | 5-2 | 3 | 1 | | |
| | 6-3 | 3 | | 2 | 1 |
| | | | | | |
| | | | | | |

Given the preponderance of the G-D and D-A fifths across the modes, outnumbering and outranking the prominent mode-degree figures, mode-independent pitch classes appear to be more determinative of fifths leaps and melodic outlines than mode degrees. Successive elimination shows that after G-D and D-A, the dominant patterns are C-G, then A-E, and lastly F-C.

An odd contradiction emerges from the two perspectives of the data elaborated here: a majority of the most likely fifth-outlines in organa match those found in sequences, and are apparently determined by pitch classes, also as they seem to be in sequences. We should recall, though, that the sequence determinants are questionable. The structure underlying the more reliable responsorial chants results contrasts the structure underlying organa's results.

#### 5.3.4.1.2 Sampling Method 2a: Long Organum Phrases by Tenor PC: Results

Table 5.14 below represents the top-ranking outlines of a fifth in long organum phrases. These results should be taken as representative.

**Table 5.14** Analysis 3: Sub-Analysis 1: L5 U M5: Long Organum Phrases

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-D | 4-1 |
| | 2 | ***D-A*** | ***1-5*** |
| | 3 | A-E | 5-2 |

E-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | A-E | 4-1 |
| | | | |
| | | | |

F-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | **F-C** | **1-5** |
| | 2 | Bb-F | 4-1 |
| | | G-D | 2-6 |

G-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | ***G-D*** | ***1-5*** |
| | 2 | *C-G* | *4-1* |

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | ***D-A*** | ***4-1*** |
| | 2 | *A-E* | *1-5* |

Bb-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | No B-flat-final results | | |

B-Final

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs? |
| Rank | No B-final results | | |

C-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | ***C-G*** | ***1-5*** |
| | 2 | **F-C** | **4-1** |
| | | **A-E** | **6-3** |
| | 3 | **D-A*** | **2-6*** |
| | | *G-D* | *5-2* |

Eleven of the sixteen outlines in the table (11/16), or approximately 69%, agree with at least one of the reference points. The agreement is greater than that between whole organa and the reference points.

Five of the six modes for which we have results have some overlap with at least one of the two plainchant repertories. The degree of correspondence varies by mode: the number of notes per mode that overlap with at least one of the modal points of comparison range from zero to five, with each of two thirds of the modes having two or three overlapping notes.[542]

The recurring patterns in Table 5.14 above are summarized below in Table 5.15, which displays the frequencies of recurring pitch class outlines and mode degree outlines across modes, and each outline's frequency per rank.

[542] The details are: E-final has no point of intersection with the modal reference points; D-and F-final each have one of three outlines shared with at least one reference point; G- and A-final each have both of their outlines shared with at least one reference point; C-final has all five of its outlines shared with at least one reference point.

**Table 5.15** Analysis 3: Sub-Analysis 1: L5 U M5: Long Organum Phrases: Recurring PCs and MDs

| | | Total | Ranks | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| PCs Highly Ranked in ≥3 Modes | G-D | 4 | 2 | 1 | 1 |
| | A-E | 4 | 1 | 2 | 1 |
| | D-A | 3 | 1 | 1 | 1 |
| | | | | | |

| | | Total | Ranks | |
|---|---|---|---|---|
| | | | 1 | 2 |
| MDs Highly Ranked in ≥3 Modes | 4-1 | 6 | 3 | 3 |
| | 1-5 | 5 | 3 | 2 |
| | | | | |
| | | | | |

Based on the greater frequency and consistently higher ranking of mode degree patterns, mode degrees overwhelmingly determine which leaps and melodic outlines likely occur. 4-1 is the strongest pattern, but 1-5 is a very close second. Oddly, each one is primary for one half of the modes, and by a wide margin. 4-1 is primary in the "minor" modes (D-, E-, and A-final), while 5-1 is in the "major" modes (F-, G-, and C-final). I do not know why.

The overlap with the chant results is substantial. In addition, because 1-5, the outline bounded by the modal nodes, is so prevalent, the results might appear to be modal. However, the overlap with the chant results is mostly due to 1-5 and 4-1, nothing more specific. Few other outlines rank highly here, none of which appears more than twice. Furthermore, the only other prominent outline in plainchant, 7-4, is not only absent in the highly ranked outlines here, but almost entirely absent from any ranking.[543] Given the preponderance of 4-1 and 1-5, their nearly equal frequency and ranks in Table 5.15, and the near-absence of other outlines, especially 7-4, I believe that consonance best explains these results, not mode.

Consonance is not a perfect explanation, though. Firstly, it does not explain the frequency of 5-2 in D- and C-final and 6-3 in C-final, both outlines being bounded by one discord (2 or 6) and one concord (5 or 3).[544] Consonance also does not explain the frequency of 2-6 in F- and C-final; it is the only fifth-outline bounded by two discords. Consonance would at least explain why 2-6 never appears in the "minor" modes, where the sixth and sometimes the second would be minor and thus more discordant.[545] But then, given that 6-3 occurs in C-final, I would expect consonance

[543] The one exception is negligible: the probability of a 7-4 leap or melodic outline given a leap or melodic outline of a fifth in D-final is a measly 1.43%. In every other mode, the probability is 0%. See Appendix F, subsection F.3.1., 1.1.1.21.2.2 Means Across Modes.

[544] As noted in section 5.3.2.2, Pseudo-Garlandia and the other Notre Dame theorists classified sixths as discords. See, for example, Johannes de Garlandia, *De Mensurabili Musica*, trans. Rob Wegman, *Academia.edu*, last accessed 2018 January 27, since taken down. Pages 16-17. <https://princeton.academia.edu/RobCWegman/Translations>.

[545] Pseudo-Garlandia classified minor seconds as complete discords and major seconds as middling discords. Johannes de Garlandia, *De Mensurabili Musica*, trans. Rob Wegman, *Academia.edu*, last accessed 2018 January 27, since taken down. Page 16. <https://princeton.academia.edu/RobCWegman/Translations>.

to result in 6-3's occurrence where it would be equally concordant: in F-, G-, and B-flat-final. In fact, in the "minor" modes, 7-4 would be more concordant than 5-2, yet it is almost never found. Lastly, consonance does not explain why all five of the highly ranked C-final outlines are those for responsorial chants and sequences.

Nevertheless, all of the above perplexities remain secondary to the pervasive patterns suggesting consonance as the primary principle governing fifth-outlines. A secondary part played by mode could add some clarity, though. If Marchetto da Padova was correct that fifth-outlines signify modes, then perhaps 4-1 and 1-5 were the only outlines that would both not disturb the sense of mode and have boundary notes concordant with the tenor. This double use of fifth-outlines might even explain why 7-4 was not used, though it would imply once more a different sense of mode from that of previous generations. Mode might partly explain why the C-final outlines are so strikingly modal; if for some reason, the concern for consonance diminished only over a C in the tenor, then room would be made for mode to again come to the fore. What that reason could be, though, I have no idea.

I should also point out that to my knowledge, the idea that consonance would control outlines according to their boundary notes has not previously been considered. This could be a novel finding.

Lastly, it intrigues me that the primary determinant of fifth-outlines, i.e. consonance, contrasts the primary determinant of pitch probabilities, i.e. mode. Since the former could have been consciously controlled and the latter likely could not have been, singer-composers of organum might have consciously prioritized consonance when selecting outlines of a fifth, but they might have also unconsciously sung modally in other ways, as reflected by the mode degree probabilities.

To conclude, I believe that consonance is the primary factor governing leaps and melodic outlines of a fifth in long organum phrases – possibly deliberately. I have further suggested that mode could be a minor secondary factor.

#### 5.3.4.1.3 Sampling Method 2b: Medium Organum Phrases by Tenor PC: Results

Table 5.16 below represents the top-ranking outlines of a fifth in medium organum phrases. These results should be taken as representative.

**Table 5.16** Analysis 3: Sub-Analysis 1: L5 U M5: Medium Organum Phrases

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-D | 4-1 |
| | 2 | D-A | 1-5 |
| | 3 | A-E | 5-2 |
| | | | |

E-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | A-E | 4-1 |
| | 2 | G-D | 3-7 |
| | | | |
| | | | |

F-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | F-C | 1-5 |
| | 2 | A-E | 3-7 |
| | 3 | D-A | 6-3 |
| | | Bb-F | 4-1 |

G-D is absent in F-Final.

G-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-D | 1-5 |
| | 2 | C-G | 4-1 |
| | | | |

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | A-E | 1-5 |
| | 2 | D-A | 4-1 |
| | | | |

A-E and D-A's ranks are reversed, but their probabilities are close.

B-flat-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | No B-flat-final stanzas | | |

B-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | No B-final stanzas | | |

C-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C-G | 1-5 |
| | 2 | D-A | 2-6 |
| | | F-C | 4-1 |

G-D is not likely enough to be included in the table, but it still appears in the means.
A-E is absent in C-Final.

Rather than outlining the usual details, it is sufficient to note that the above summary tables are almost the same as those for long phrases. In Table 5.16 above, underlining denotes outlines that occurred in long phrases but were too unlikely to rank highly (compare the long phrases means table, Appendix F, subsection F.3.1, 1.1.1.27.1.2 with Table 5.14). I have noted all other differences to long organum phrases below the relevant mode's table.

The recurring patterns in Table 5.16 are summarized below in Table 5.17.

**Table 5.17** Analysis 3: Sub-Analysis 1: L5 U M5: Medium Organum Phrases: Recurring PCs and MDs

| | | Total | Ranks | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| PCs Highly Ranked in ≥3Modes | D-A | 4 | | 3 | 1 | |
| | A-E | 4 | 2 | 1 | 1 | |
| | G-D | 3 | 2 | 1 | | |
| | | | | | | |

| | | Total | Ranks | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| MDs Highly Ranked in ≥3 Modes | 4-1 | 6 | 2 | 3 | 1 | |
| | 1-5 | 5 | 4 | 1 | | |
| | | | | | | |
| | | | | | | |

Again, the same two mode degree outlines have primacy: 4-1 and 1-5. Here, it is not as clear which outline is primary, but the difference is inconsequential. In long phrases, the two outlines were very close as well. Consequently, my interpretation of these results is the same as my interpretation of the results for long phrases.

### 5.3.4.2 Sub-Analysis 2: L4 U M4

The results of the analysis of leaps and melodic outlines of a fourth within each mode for both organa and organum phrases are only somewhat consistent across clusters – noticeably less consistent than the L5UM5 results. As in Chapter 4, I believe that the increased variety in the results is due to the shorter length of the outline.

#### 5.3.4.2.1 Sampling Method 1: Organa by Chant-Final: Results

Table 5.18 below represents the top-ranking outlines of a fourth in organa.

**Table 5.18** Analysis 3: Sub-Analysis 2: L4 U M4: Organa

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-C | 4-7 |
| | | A-D | 5-1 |
| | 2 | ***D-G*** | ***1-4*** |
| | | ***C-F*** | ***7-3*** |

E-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C-F | 6-2 |
| | | **G-C*** | **3-6*** |
| | 2 | A-D | 4-7 |
| | (3 | D-G | 7-3) |

F-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | **C-F*** | **5-1*** |
| | 2 | **G-C** | **2-5** |
| | 3 | D-G | 6-2 |
| | (4 | E-A | 7-3) |

G-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | ***D-G**** | ***5-1**** |
| | 2 | ***G-C*** | ***1-4*** |
| | 3 | E-A | 6-2 |
| | 4 | *C-F* | *4-7* |

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | ***G-C*** | ***7-3*** |
| | 2 | C-F | 3-6 |
| | 3 | ***D-G*** | ***4-7*** |
| | (4 | A-D | 1-4) |

Bb-Final Modes

| | Most Likely | |
|---|---|---|
| | PCs | MDs |
| Rank | No B-flat-final organa | |

B-Final

| | Most Likely | |
|---|---|---|
| | PCs | MDs |
| Rank | No B-final organa | |

C-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | **D-G** | **2-5** |
| | 2 | ***C-F*** | ***1-4*** |
| | 3 | ***G-C*** | ***5-1*** |
| | (4 | B-E | 7-3) |

Thirteen of the twenty outlines in the table (13/20), or 65%, match at least one of the plainchant genres' results.

All six modes have some overlap with the plainchant results, and the degree of correspondence is relatively consistent across modes: the number of notes per mode that overlap with at least one of the modal points of comparison range from one to three, with half the modes having two notes each.[546]

The recurring patterns in Table 5.18 are summarized below in Table 5.19, which displays the frequencies of recurring pitch class and mode degree outlines across modes, and each outline's frequency per rank.

[546] The details are: E-final has one point of intersection; D-, F-, and A-final have two points of intersection each; G- and C-final have three points of intersection each.

**Table 5.19** Analysis 3: Sub-Analysis 2: L4 U M4: Organa: Recurring PCs and MDs

| | | Total | Ranks | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| L5UM5 (PCs) Highly Ranked in ≥3 Modes | G-C | 6 | 3 | 2 | 1 | |
| | C-F | 6 | 2 | 3 | | 1 |
| | D-G | 5 | 2 | 1 | 2 | |
| | | | | | | |

| | | Total | Ranks | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| L5UM5 (MDs) Highly Ranked in ≥3 Modes | 5-1 | 4 | 3 | | 1 | |
| | 4-7 | 4 | 1 | 1 | 1 | 1 |
| | 6-2 | 3 | 1 | | 2 | |
| | 1-4 | 3 | | 3 | | |

Pitch classes dominate these results. G-C, D-G, and C-F all appear in all six modes, almost always in the top two ranks; no mode degree patterns compare, including 5-1 occurring three times in first place. Therefore, mode-independent pitch class behaviour appears to be determinative of fourth-outlines in organa.

These results disagree with the analogous responsorial chants results, which were dictated primarily by a mode degree outline and secondarily by intersecting mode degree and pitch class outlines. The sequences results seemed to be dictated by pitch classes, but the results were unreliable.

#### 5.3.4.2.2 Sampling Method 2a: Long Organum Phrases by Tenor PC

Table 5.20 below represents the top-ranking outlines of a fourth in long organum phrases. These results should be taken as representative.

**Table 5.20** Analysis 3 Leaps and Melodic Outlines: L4 U M4: Long Organum Phrases

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | A-D | 5-1 |
| | 2 | ***D-G*** | ***1-4*** |
| | 3 | G-C | 4-7 |

E-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | B-E | 5-1 |
| | 2 | A-D | 4-7 |
| | | | |

F-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | **C-F*** | **5-1*** |
| | 2 | ***A-D*** | ***3-6*** |
| | 3 | ***G-C**** | ***2-5**** |

G-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | ***G-C*** | ***1-4*** |
| | 2 | ***D-G*** | ***5-1*** |
| | 3 | C-F | 4-7 |
| | | | |

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | E-A | 5-1 |
| | 2 | C-F | 3-6 |
| | 3 | ***D-G*** | ***4-7*** |
| | 4 | ***A-D**** | ***1-4**** |

Bb-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | F-Bb | 5-1 |
| | | D-G | 3-6 |
| | | | |
| | | | |

B-Final

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs? |
| Rank | No B-final results | | |

C-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | ***G-C*** | ***5-1*** |
| | 2 | ***C-F*** | ***1-4*** |
| | 3 | ***D-G*** | ***2-5*** |

Eleven of the twenty outlines in the table (11/20), or 55%, agree with at least one of the reference points. The agreement is less than that between whole organa and the points of comparison.

Five of the seven modes have some overlap with at least one of the two plainchant repertories. The degree of correspondence varies moderately by mode: the number of notes per mode that overlap with at least one of the plainchant results range from zero to three, with just over half the modes having two or three – less consistent but higher overall than in organa.[547]

The recurring patterns in Table 5.20 are summarized below in Table 5.21, which displays the frequencies of recurring pitch class and mode degree outlines across modes, and each outline's frequency per rank.

[547] The details are: E- and B-flat final have no points of intersection with the chant results; D-final shares one outline with at least one reference point; G-and A-final each have two outlines shared with at least one reference point; F- and C-final both have all three of their outlines shared with at least one reference point.

**Table 5.21** Analysis 3: Sub-Analysis 2: L4 U M4: Long Organum Phrases: Recurring PCs and MDs

| | | Total | Ranks | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| PCs Highly Ranked in ≥3 Modes | D-G | 5 | 1 | 2 | 2 | |
| | G-C | 4 | 2 | | 2 | |
| | A-D | 4 | 1 | 2 | | 1 |
| | C-F | 3 | | 2 | 1 | |

| | | Total | Ranks | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| MDs Highly Ranked in ≥3 Modes | 5-1 | 7 | 6 | 1 | | |
| | 1-4 | 4 | 1 | 2 | | 1 |
| | 4-7 | 4 | | 1 | 3 | |
| | 3-6 | 3 | 1 | 2 | | |

The 5-1 outline, bounded by the modal nodes, is obviously primary in these results, holding first place in every mode except for one, where it holds second place. Successive elimination reveals that although 1-4 is technically the top remaining pattern, 1-4 and D-G are equal in frequency and extremely close in ranking, as shown in Table 5.22 below.

**Table 5.22** Analysis 3: Sub-Analysis 2: L4 U M4: Long Organum Phrases: After 5-1: 1-4 or D-G?

| | | Total | Ranks | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| PCs Highly Ranked in ≥3 Modes | **D-G** | **4** | **1** | **1** | **2** | |
| | G-C | 3 | 1 | | 2 | |
| | C-F | 3 | | 2 | 1 | |
| | A-D | 3 | | 2 | | 1 |

| | | Total | Ranks | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| MDs Highly Ranked in ≥3 Modes | 5-1 | 7 | 6 | 1 | | |
| | **1-4** | **4** | **1** | **2** | | **1** |
| | 4-7 | 4 | | 1 | 3 | |
| | 3-6 | 3 | 1 | 2 | | |

As noted in the previous chapter, the process of successive elimination is most appropriate and reliable when the strongest pattern at each step is clear. Additionally, the recurring D-G, G-C, A-D, and C-F outlines form too strong a pattern to ignore; few other pitch class outlines rank highly across the modes, and what's more, the set of four pitch class outlines includes the most common fourth-outlines found in both plainchant genres (see Table 4.13, Table 4.16, and Table 4.17).

As in the analogous analysis of responsorial chants in Chapter 4, Table 5.23 below shows all appearances in the summary tables of the four pitch class outlines and their equivalent mode degrees according to the modes in which they appear. This presentation of the data shifts the perspective from seeing the outlines as separate to seeing them as members of a group.

**Table 5.23** Analysis 3: Sub-Analysis 2: L4 U M4: Long Org. Phrases: The Recurring PC Outlines and their Equivalent MD Outlines

| | | Mode Degree Outlines | | | | | |
|---|---|---|---|---|---|---|---|
| | | 5-1 | 1-4 | 4-7 | 3-6 | 2-5 | Total |
| PC Outlines | D-G | G-final | D-final | A-final | Bb-final | C-final | 5 |
| | G-C | C-final | G-final | D-final | X | F-final | 4 |
| | A-D | D-final | A-final | E-final | F-final | X | 4 |
| | C-F | F-final | C-final | G-final | A-final | X | 4 |
| | Total | 4 | 4 | 4 | 3 | 2 | |

| | | Total |
|---|---|---|
| PCs Highly Ranked in ≥3 Modes | D-G | 5 |
| | G-C | 4 |
| | A-D | 4 |
| | C-F | 4 |

| | MDs Highly Ranked in ≥3 Modes | | | | |
|---|---|---|---|---|---|
| | 5-1 | 1-4 | 4-7 | 3-6 | (2-5) |
| Total | 7 | 4 | 4 | 3 | (2) |

The table reveals that, like with responsorial chants, the four pitch class outlines account for all of the high-ranking mode degree outlines after 5-1 (i.e. 1-4, 4-7, 3-6, and 2-5) and vice-versa. For example, every high-ranking 1-4 is one of the same four pitch class outlines, and, excluding 5-1, every high-ranking D-G is one of the four mode degree outlines. Each pitch class outline occurs once as 1-4 and once as 4-7; three outlines occur as 3-6, except for G-C, though it does appear as 2-5, but we should not assume that 2-5 is substituting 3-6 here, since D-G occurs as both 2-5 and 3-6. Therefore, except for 5-1, the recurring mode degree outlines and the recurring pitch class outlines seem to be coordinated.[548]

[548] Examining absences opens a different perspective of the same results while also supporting the coordination between the two types of outlines. There are four pitch class outlines that are rare in (or absent from) the summary tables: E-A, F-B-flat, and B-flat-E-flat or B-E. Their absences can explain the modes in which 1-4, 4-7, and 3-6 do not appear. Where these mode degree outlines would be these pitch class outlines, they are not found. (The converse is not true; the absences of E-A, F- B-flat, and B-flat-E-flat and B-E are not limited to the absences of 1-4, 4-7, and 3-6.) In fact, even beyond their absence from the high ranks, these pitch class outlines occur only very rarely, other than their occurrences as 5-1. That pitch class outlines' absence could predict mode degree outlines' absence might demonstrate another way that pitch classes have determinative power here. However, E-A, F-B-flat, and B-E each occur once, and all in first position: as 5-1. Their absence's importance is therefore subordinate to the importance of the primary mode degree outline.

Similarly, we can observe that there are two mode degree outlines that are absent in the summary tables: 7-3 and 6-2. (In addition, these two outlines occur rarely in general; 7-3 never has a probability higher than 5%, and 6-2's highest probability is about 7%.) The absence of 7-3 and 6-2 explain almost every instance where the recurring pitch class outlines do not appear. (The converse is not true; the absence of 7-3 and 6-2 are not limited only to the absence of the four recurring pitch class outlines D-G, G-C, A-D, and C-F.) The absence of 6-2 and 7-3 from the summary tables is, moreover, without exception. That the mode degree absences predict the pitch class absences without exception demonstrates the primacy of mode degrees here. But this primacy is principally due to the 5-1 outline that is already recognized as the strongest pattern.

There are three instances where 7-3 and 6-2's absence does not explain the absence of the recurring pitch class outlines: G-C in E-final (as 3-6), A-D in G-final (as 2-5), and C-F in B-flat-final (as 2-5). It is not

To summarize, the first determinant of fourth-outlines is the 5-1 outline, and the second determinant is the coordination or intersection between the other four recurring mode degree outlines and the four recurring pitch class outlines.

We should once again consider consonance as an alternative explanation of the results. The two most likely outlines of fourths across the modes, 5-1 and 1-4, are defined by the three strongest concords. Moreover, since thirds are incomplete concords, consonance could explain the many outlines with thirds at one boundary; 3-6 appears as often as 1-4, and with the same ranking as well. The absence of 6-2 could also be explained by consonance, since it is the most discordant fourth-outline possible, being the only one bounded by two dissonances.

However, 6-2 was also one of two outlines absent in each analyzed plainchant repertory (see Table 4.12 and Table 4.16). Furthermore, 3-6 appears often while 7-3 is absent from the high ranks, and since Pseudo-Garlandia classifies major sixths and minor sevenths together as incomplete discords, minor sixths as middling discords, and major sevenths as complete discords, whether 3-6 is actually less discordant than 7-3 depends on the polyphonic context.[549] Here, half of the 3-6 outlines have major sixths (in F- and B-flat-final), and half have minor sixths (in E- and A-final); the latter 3-6s are more discordant than 7-3s with minor sevenths, i.e. those in the "minor" modes. Meanwhile, 4-7 and 2-5 also appear; each has one discordant boundary note, though 2-5 is more discordant and appears in fewer modes. Lastly, while not the most definitively modal outline, 4-7 does appear often enough in the plainchant results (in A-final in responsorial chants and in D-, G-, and A-final in sequences).[550] Finally, consonance does not explain the wide disparity in frequency and rank between 5-1 and 1-4 (see Table 5.21). As a result, I believe that if consonance plays a role, it is only a minor tertiary role.

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clear why these do not occur. 2-5 and 3-6 both occur elsewhere. 3-6 also occurs in a form equally dissonant to G-C in E-final: C-F in A-final, so consonance would not explain the discrepancy. Mode might partially explain 2-5, but I am sceptical: in responsorial chants fourth outlines, 2-5 occurs in F- and C-final, as here, but also in G-final. Technically, A-D does occur in G-tenor phrases, just with slightly too low a probability to be ranked highly: 13%. In addition, 3-6 is unusual in most modes of responsorial chants and practically absent in sequences, not absent only in specific modes, whereas it is common in long organum phrases.

In any case, the three (or two) cases where the absences of G-C, C-F, and A-D (or just the former two) are not explained by the absence of 6-2 and 7-3 show that the pitch class patterns are not so strong that they would occur everywhere that they could (beyond where their absence is dictated by 6-2 and 7-3). By contrast, the only case where a mode degree outline is not explained by the absent pitch degree outlines is 3-6 in E-final (as G-C). This asymmetry might indicate that mode degrees are the slightly stronger determinant, but only slightly.

[549] In fact, while 7-3 does not occur in long organum phrases, it does occur in responsorial chants and sequences, only in D-, E-, and A-final, where the 7 is a minor seventh above the final. Oddly enough, the 3-6 outline in E- and A-final organum is a more dissonant option than 7-3 would be in the same modes.

[550] Even 3-6 occurs twice in the responsorial chants results (in E-final and F-final), also meaning that it might have some modal implication, though very far from the strongest.

Finally, these results are glaringly similar to the analogous plainchant results, especially those for responsorial chants. Most strikingly, the underlying structure of the organum fourth-outlines results and the underlying structure of the plainchant fourth-outlines results are practically identical: the primary determinant is a single mode degree outline, and the secondary determinant is the coordination of the same number of limited pitch class outlines and mode degree outlines. In fact, the pattern of coordinated pitch class and mode degree outlines is even tighter and thus clearer in long organum phrases than in plainchant. The most substantial difference is that the primary fourth-outline for long organum phrases is 5-1, whereas for chant, it is 1-4. The four recurring mode degree outlines also differ somewhat: 5-1, 1-4 ,4-7, 3-6 in long organum phrases, 1-4, 7-3, 2-5, 5-1 in responsorial chants, and 1-4, 4-7 (and possibly 7-3, 5-1) in sequences. Yet while their ranking might differ, the four recurring pitch class outlines are identical: D-G, G-C, A-D, C-F.

Even though the pattern of coordinated pitch class and mode degree outlines is partially final-independent, because it is such a specific and prominent determinant of fourth-outlines in plainchant and thus specific to the modes, I would argue that it should be considered a feature of modality. Consequently, I would argue that fourth-outlines in long organum phrases are determined by mode as well.

An odd ramification of this reasoning is that even final-independent pitch class patterns can be incorporated into certain levels of structure in the modes, and thus become modal – part of what defines modal melodic content. In future research, we might find that there are other final-independent patterns that are unique to the modes and can be used to define modality.

This finding might also imply that fourth-outlines, in contrast to fifth-outlines, were not, for the most part, consciously controlled by the singer-composers of Notre Dame organum. I believe that only the primacy of 5-1 could have been deliberate, but not the more complex pattern of pitch class and mode degree outlines. Whether the intention of prioritizing 5-1 was to prioritize mode or consonance, the effect of 5-1's primacy, especially in combination with the secondary outline pattern, is a strong sense of mode.

To conclude, I would contend that the primary determinant of fourth-outlines in long organum phrases is the 5-1 mode degree outline and thus mode, and the secondary determinant is the coordinated pitch class and mode degree outlines. If consonance plays a role, it is probably small. Lastly, these results are structurally almost identical to those for responsorial chants and possibly sequences, thus showing that the level of structure of fourth-outlines in long organum phrases is modal overall.

#### 5.3.4.2.3 Sampling Method 2b: Medium Organum Phrases by Tenor PC: Results

Table 5.24 below represents the top-ranking outlines of a fourth in medium organum phrases. These results should be taken as representative.

**Table 5.24** Analysis 3 Leaps and Melodic Outlines: L4 U M4: Medium Organum Phrases

D-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | A-D | 5-1 |
| | 2 | G-C | 4-7 |
| | 3 | D-G | 1-4 |

D-G and G-C have reversed ranks.

E-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | B-E | 5-1 |
| | 2 | A-D | 4-7 |
| | | | |

F-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | C-F | 5-1 |
| | 2 | A-D | 3-6 |
| | 3 | G-C | 2-5 |

G-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-C | 1-4 |
| | 2 | D-G | 5-1 |
| | 3 | <u>A-D</u> | <u>2-5</u> |
| | | C-F | 4-7 |

A-D and C-F now share a rank.

A-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | E-A | 5-1 |
| | 2 | D-G | 4-7 |
| | 3 | C-F | 3-6 |
| | 4 | A-D | 1-4 |

D-G and C-F have reversed ranks, but their probabilities are very close.

Bb-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | F-Bb | 5-1 |
| | | | |
| | | | |
| | | | |

D-G is absent in Bb-final.

B-Final

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs? |
| Rank | No B-final results | | |

C-Final Modes

| | | Most Likely | |
|---|---|---|---|
| | | PCs | MDs |
| Rank | 1 | G-C | 5-1 |
| | 2 | D-G | 2-5 |
| | 3 | C-F | 1-4 |

D-G and C-F have reversed ranks, but their probabilities are close.

As with the L5UM5 analysis of medium organum phrases, it is sufficient to note that the above summary table is almost identical to those for long phrases. <u>Underlining</u> again denotes outlines that occurred in long phrases but were too unlikely to rank highly, and I have noted any other differences to long organum phrases below the relevant mode's table.

The recurring patterns in Table 5.24 above are summarized below in Table 5.25.

**Table 5.25** Analysis 3: Sub-Analysis 2: L4 U M4: Medium Organum Phrases: Recurring PCs and MDs

| | | Total | Ranks | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| PCs Highly Ranked in ≥3 Modes | A-D | 5 | 1 | 2 | 2 | |
| | G-C | 4 | 2 | 1 | 1 | |
| | D-G | 4 | | 3 | 1 | |
| | C-F | 4 | | | 4 | |

| | | Total | Ranks | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| MDs Highly Ranked in ≥3 Modes | 5-1 | 7 | 6 | 1 | | |
| | 1-4 | 4 | 1 | | 2 | 1 |
| | 4-7 | 4 | | 3 | | 1 |
| | 2-5 | 3 | | 1 | 2 | |

Again, the results for medium phrases are almost identical to those for long phrases. The mode degree outline 5-1 is obviously primary in these results, after which, there is a coordination between the same four pitch class outlines and the same mode degree outlines, only with A-D and D-G's ranks switched and with 3-6 and 2-5's ranks switched; both changes are small. See Table 5.26 below. Consequently, my interpretation of these results is the same as my interpretation of the results for long phrases.

**Table 5.26** Analysis 3: Sub-Analysis 2: L4 U M4: Medium Org. Phrases: The Recurring PC Outlines and their Equivalent MD Outlines

| | | Mode Degree Outlines | | | | | |
|---|---|---|---|---|---|---|---|
| | | 5-1 | 1-4 | 4-7 | 2-5 | 3-6 | Total |
| PC Outlines | A-D | D-final | A-final | E-final | G-final | F-final | 5 |
| | G-C | C-final | G-final | D-final | F-final | X | 4 |
| | D-G | G-final | D-final | A-final | C-final | X | 4 |
| | C-F | F-final | C-final | G-final | X | A-final | 4 |
| | Total | 4 | 4 | 4 | 3 | 2 | |

| | | Total |
|---|---|---|
| PCs Highly Ranked in ≥3 Modes | A-D | 5 |
| | G-C | 4 |
| | D-G | 4 |
| | C-F | 4 |

| | MDs Highly Ranked in ≥3 Modes | | | | |
|---|---|---|---|---|---|
| | 5-1 | 1-4 | 4-7 | 2-5 | (3-6) |
| Total | 7 | 4 | 4 | 3 | (2) |

## 5.4 Conclusion

This chapter began with a consideration of how dronality, the perception of a low sustained note as a drone and thus as a tonal centre, could pertain to Parisian *organum duplum*. I presented historical clues that dronality might have been operative in organum: the St. Emmeram Anonymous and Anonymous IV referring to the tenor as a drone, and *Summa musice* connecting a

lower voice singing a series of long tones on different pitches to the idea of droning while describing polyphonic improvisation practices that I believe were precursors to Parisian organum.

Hence, I proposed two complementary sampling methods in the methodology. The first involved analyzing whole organa grouped by their chant-finals. The second involved analyzing long and medium organum phrases grouped by their tenor notes, with the idea that each long tenor note would function as a temporary drone.

I considered challenges to the idea of the tenor as a drone: variable tenor note lengths, variable tenor register, voice-crossing, and various historical performance practices. The issues that I believed could disturb the dronality were incorporated into the methodology of the second sampling method: only tenor notes satisfying a minimum length requirement were included, and all passages where the duplum crosses the tenor were excluded from analysis. I also concatenated consecutive phrases with identical tenor notes (modally geminate phrases), since their tonal centre was expected to be identical.

I performed the three analyses of the methodology on two-part organa from F using the two sampling methods. In each analysis, I compared the results of each sampling method both to each other and to the modal points of comparison from Chapter 4.

I will begin the summary of the results with Analysis 2. Because the patterns of tendency do not distinguish modal from non-modal melodic material, Analysis 2 did not contribute to the discussion of mode in organum. Separately, though, the tendency results for organum were very similar to those for plainchant.

For Analyses 1 and 3, the differences between long and medium organum phrases are negligible. Sampling Method 1 of Analysis 1 found that 71% of the highly ranked pitch classes in organa also ranked highly in at least one of the modal points of comparison, though the degree of correspondence varied across modes. Contrary to the pattern in the plainchant results, however, mode-independent pitch classes determined the organa results. These results also had two major problems illuminated by the cluster analysis: firstly, rankings of pitch classes were exceedingly inconsistent, and secondly, probabilities in almost every stack were too evenly spread out, indicating randomness. Together, these problems gave the impression of various distinct results having been averaged out. Both problems also contrasted the results of plainchant, and more importantly, they greatly weakened the reliability and meaningfulness of the results.

Sampling Method 2 of Analysis 1 found that 52% of the ranked pitch classes in long organum phrases overlapped with one of the plainchant results – much less than organa. The degree of correspondence varied by mode but was slightly higher overall than in organa. Like

with plainchant, mode degrees were shown to have primacy in determining the ranked notes, not pitch classes. I further demonstrated that mode was a significantly better explanation for the mode degree patterns than consonance. Furthermore, each mode had consistent or moderately consistent results for only the top few ranks, which suggests a partially defined pitch class hierarchy. Additionally, in some modes, single ranks were held by multiple pitch classes. A partially defined pitch class hierarchy and shared ranks both matched the structure of the plainchant mode profiles. (The same observations were also present in Sampling Method 1, but with less reliability.) Finally, the results for organum phrases had only one of the two problems plaguing the results for organa, and to a far lesser extent: the cluster analyses showed that some phrases had more evenly distributed pitch classes, but that pitch class proportions were generally much more uneven and that rankings were much more consistent in organum phrases than in organa, demonstrating more order than randomness. I do not know the cause of the random distributions.

Sampling Method 1 of L5 U M5 found that about 57% of the ranked pitch classes in organa also ranked in at least one of the modal points of comparison. Once again, the degree of correspondence varied widely across modes. Pitch classes determined leaps and melodic outlines of a fifth. Although a majority of the outlines in the organa results were found in the plainchant results, the underlying determinant of plainchant, mode, was not the determinant in organa.

Sampling Method 2 of L5 U M5 found that about 69% of the ranked pitch classes in long organum phrases also ranked highly in at least one of the modal points of comparison, more than organa. The degree of correspondence varied across the modes. Consonance had primacy, and mode was potentially a minor secondary factor.

The results of L4 U M4 within each mode for both organa and long organum phrases were notably less consistent across clusters than the L5 U M5 results. As explained in Chapters 3 and 4, I believe that the greater variety in the results was due to the shorter length of the outline.

Sampling Method 1 of L4 U M4 found that about 65% of the ranked pitch classes in organa also ranked in at least one of the modal points of comparison. The degree of correspondence with at least one of the reference points was consistent across modes. Three recurring outlines by pitch class overwhelmingly determined the results here: G-C, D-G, and C-F, which were also the most commonly found pitch class outlines in sequences. These results disagreed with the analogous responsorial chants results. The sequences results seemed to be dictated by pitch classes, but the results were compromised by missing results from three modes.

Sampling Method 2 of L4 U M4 found that about 55% of the ranked pitch classes in long organum phrases also ranked in at least one of the modal points of comparison, less than organa. The degree of correspondence with at least one of the reference points varied across modes. Mode degrees formed the strongest pattern. Secondarily, the results were determined by four recurring pitch class outlines in coordination with four recurring mode degree outlines. The identical two-tiered structure was found in plainchant, including the same pitch class outlines and some of the same mode degree outlines. Because of the primacy of a mode degree pattern and the tight match with such specific structures, I have asserted that the organum phrases fourth-outline results are determined by mode.

How should we make sense of the above? The results of Analyses 1 and 3 revealed that both organa and organum phrases had considerable overlap with the plainchant results, though phrases generally had less. The results for organa, though, showed that mode-independent pitch class patterns were determinative, while for organum phrases, the results showed that mode primarily determined pitch class probabilities and fourth-outlines and that consonance primarily determined fifth-outlines. Each sampling method's results contradict the other, and one might think that we cannot discern which sampling method is right, but I will argue that only the organum phrases have meaningful results and thus, that the *organum purum* passages are, for the most part, organized modally.

Firstly, organum phrases are defined by relatively clear patterns. Secondly, given that there are clear patterns for phrases, it does not make sense to trust the contrasting results of the same analyses for whole pieces, even if pieces also seem to display their own patterns. To illustrate this point, let us suppose, as the organa patterns suggest, that pitch classes were the main organizing principle. Hence, pitch classes should generally be the organizing principle throughout the music, which would preclude an analysis from yielding modal or consonance-based results for most phrases. We might expect some variability, but not such organized variability. For most phrases to be built modally would be an unbelievable coincidence.

Conversely, if mode degrees were the main organizing principle and if modulation were recognized through dronality (where each phrase on a different tenor pitch class would be in a different mode), then the analysis results for each phrase would be modal but the analysis results for entire organa would appear relatively random and highly inconsistent from the averaging-out of multiple distinct distributions.

The crux is that when the same analyses reveal distinctive patterns displayed by each part of a whole but not by the whole composed only of those parts, it is because analyzing the whole entails mashing together the distinctive distributions of the constituents, until the distributions

mostly flatten each other out, as in Figure 5.1 below, or, perhaps worse, provide misleading results when the distributions' unimportant commonalities dominate and thus appear like the overall pattern, as in Figure 5.2 below. In both figures, just like in Figure 3.2 and Figure 3.3, the mean distribution is not representative of any constituent distribution, instead obscuring even the most salient features of each constituent distribution.

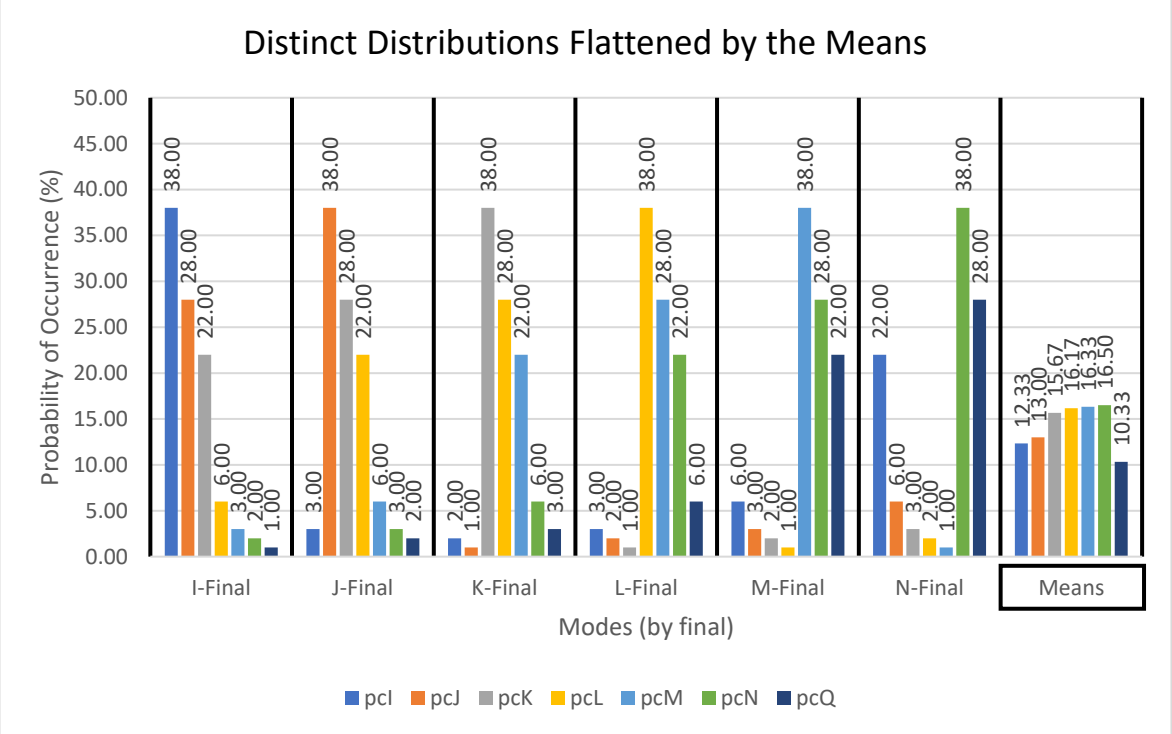


**Figure 5.1** Distinct Distributions Flattened by the Means (Invented Data)

Each mode has the same MD pattern, but the graphs are in terms of PCs. Each PC distribution is distinct and drastically different from the means graph.

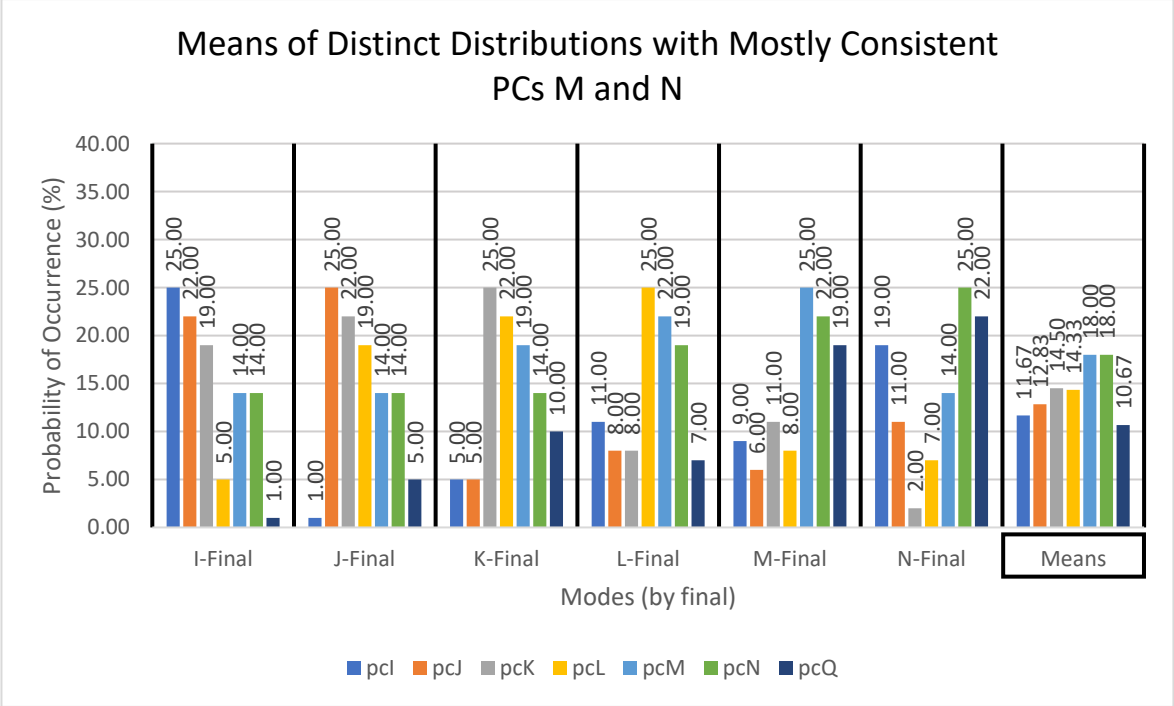


**Figure 5.2** Means of Distinct Distributions with Mostly Consistent PCs M and N (Invented Data) Each mode has the same main MD pattern, but PCs M and N either have 14% each unless the MD pattern gives them higher values. The means graph emphasizes PCs M and N while flattening all else.

One glaring piece of evidence that the results for organa are basically means of all of the organum phrases results is the randomness of the organa results for Analysis 1, as reflected by the relatively even spread of probabilities across pitch classes. In both the chant results and the organum phrases results, pitch class probabilities are usually unevenly distributed.

If the organa results are essentially meaningless, being the artificial output of misused means, then why do the results of Analysis 3, Sampling Method 1 (whole organa) show such clear patterns? I am confident that these patterns are the consequence of the means as well. One possible outcome of calculating the means of two disparate distributions is that the distributions' commonalities accumulate, which together appear like the overall pattern. In organum, every phrase has both mode degree patterns and pitch class patterns, and as we have seen, even if the modes have primacy in determining the patterns, a few pitch class patterns recur in most modes. If a mean of all the phrases is calculated, then the mode degree results of each phrase will likely even out, but if a pitch class pattern that was once secondary or even meaningless in each phrase occurs in many phrases, it will appear dominant, as in Figure 5.2. This effect would explain why the same few pitch class outlines dominated the organa results for both the fifth-outlines analysis and the fourth-outlines analysis.

Even the organa results for Mode Profiles showed some trends; even as random as the results were, the probabilities were not 100% equally distributed – not fully random – but rather seemed to lean a little in one direction or another. I suspect that this leaning is the consequence of individual organa not being composed of an equal number of equally long phrases on each tenor pitch class. Instead, the proportions of time spent with each tenor pitch class might lead to the distributions of the whole being shaped by the greater proportion of phrases on certain tenor pitch classes. For example, if organa with G chant-finals have most phrases or many longer phrases with tenors singing G, i.e. G-final phrases for the duplum, then the amount of time the duplum would spend in G-final would be greater than the amount of time spent in the other modes, skewing the data in that direction while also obscuring the more important inner workings of each phrase.

Therefore, the results of analyzing whole organa should be discarded.

Whether organum phrases are modal is the remaining question. I believe that the answer is mostly "yes". Mode degrees had primacy in Mode Profiles in such a way that they emphasized mode and not consonance, but the prevailing mode degree pattern did not match that of the plainchant repertories. I have argued that the results were nevertheless modal, but in a new way distinct from plainchant. Mode also had primacy in leaps and melodic outlines of a fourth, but unlike in Analysis 1, the results were structurally almost identical to those of plainchant, showing that some of the old-fashioned modality was present as well. Lastly, consonance, either alone or constrained somewhat by mode, determined the outlines of a fifth – maybe, as I have suggested, deliberately. Mode was thus the primary of three main determinants of the melodic content of duplum parts in *organum purum*, along with consonance and mode-independent pitch class patterns.

# Conclusion

The central question of this thesis has been: are the duplum melodies of Notre Dame florid organum modal? In pursuit of the answer, I have broached numerous topics, beginning with historical theory and then proceeding to two corpus studies. While the final results of the previous chapter comprise the culmination of the thesis, each chapter yielded a number of noteworthy observations and conclusions that I will review here. While reviewing the main conclusions of Chapters 4 and 5, I will consider the limitations of the analyses and their results and also draw connections that have not yet been made between the final analyses and earlier sections of the thesis. Finally, I will summarize some of the copious unanswered questions that have arisen throughout the thesis and still await deep attention from scholars.

## Summary of Findings

In the first chapter, I investigated the Notre Dame theorist's thoughts on, firstly, the relevance of the melodic modes and more generally *musica plana* to understanding *musica mensurabilis*, and secondly, the nature of the relationship between *musica mensurabilis* and *musica plana*. All of the major Notre Dame theorists acknowledged plainchant, and two even wrote chant treatises, but discussions connecting plainchant and polyphony are few, short, and heterogenous.

Firstly, Lambertus, Anonymous IV, and Franco wrote that plainchant was the basis for understanding polyphony, while Anonymous IV alone stated that specifically the melodic modes formed the basis for understanding polyphony. On the other hand, Pseudo-Garlandia and the Anonymous of St. Emmeram took no position on the matter.

Secondly, contrary to earlier claims, thirteenth-century views on the nature of the relationship between *musica plana* and *musica mensurabilis* were not monolithic. Whether they were seen as genus and species or two parallel genera depended on the theorist. I observed an odd coupling between theorists' general bent, i.e. conservative or progressive, and the opposite perspective on this subject. I proposed that this mismatch might reflect a decades-long transition in the conception of the nature of the relationship between plainchant and polyphony, from a hierarchical one to a parallel one.

In the second chapter, I examined modal treatises primarily from the ninth through the eleventh centuries through the lens of music cognition, demonstrating that mode was not only a classification tool, but that it was a theory with perceptual relevance as well. Theorists referred

to the individual sound of each mode and claimed that each chant was saturated by its mode. The theorists also agreed that a chant's cohesion, coherence, and order were created by its mode.

I argued, furthermore, that mode's perceptual relevance was weakened by medieval theorists having conflated two purposes of modal theory: capturing the listening experience and classifying the overall mode of each chant. Classification required chants to belong to a single mode, and monomodality became a requirement for a chant's legitimacy. At the same time, almost all theorists prescribed the final note as the primary determinant of the mode, excluding discussion of the impact of any other part of the chant on the perceived mode, leading one to believe the implausible case that when a listener would hear the final note of a chant for the first time, they would project their final sense of mode backwards, retrospectively reinterpreting the whole piece. In fact, the theorists themselves often presupposed or even explicitly described modulation and, relatedly, the perception of mode at the beginnings and middles of chants, e.g. with the recognition of modal melodic formulas and with the special case of modulating psalm tones. Chants, especially complex ones, often modulated, which was possible only because mode was heard throughout each chant. Modal perception was dynamic, sensitive, and responsive. Perceptual modal determination must therefore have relied on pervasive modal structures in the music, which led to the questions of Chapter 3.

The goals of Chapter 3 were, firstly, to identify those pervasive structures that would define mode in general and distinguish each mode from the others, and secondly, to develop an analytical methodology to measure those structures in scores.

In pursuit of the first goal, I returned to medieval modal treatises, showing that their accounts reflect two contradictory classes of structures: mode-dependent and mode-independent pitch class behaviour. The first entailed a pitch class hierarchy unique to each mode, captured by the concept of mode degrees; each degree's relationship to the final would determine the degree's behaviour and perceived quality. I suggested four potential indications of mode degrees' existence: medieval treatises demonstrating a recognition of mode degree qualities; medieval treatises ascribing relative importance to certain degrees; particular mode degrees holding particular positions within phrases and pieces; and lastly, mode-dependent pitch class behaviour. Of these, the latter three indications were found in the treatises.

Meanwhile, mode-independent pitch class behaviour is related to the concept of interval strings, where each pitch class' perceived quality and behaviour in music is determined by its surrounding interval string, which, being a fixed portion of the intervallic structure of the gamut, is independent of any given final. Affinities and hexachords are built around these qualities; they are not final-dependent and therefore not modal. Interval string qualities and related constructs

were extremely popular in the middle ages, appearing in perhaps every modal treatise from the end of the ninth century onwards, suggesting that interval string qualities had some perceptual relevance.

Because of the apparent contradiction between both types of structures, I suggested that analysis of the repertories might show only one of the structures dominating or some kind of hybrid mode-dependent and mode-independent pitch class hierarchy. This special hybrid hierarchy would, I proposed, have fewer strata than one for each pitch class, and it would include an everything-else level.

At the end of the chapter, I established my methodology of three analyses: Mode Profiles, Tendency, and Leaps and Melodic Outlines.

Chapter 4 began with the simple observation that the form of modal results was unknown. Hence, in order to recognize results that would reflect mode, it was necessary firstly to apply the methodology to music that was already recognized as modal, namely plainchant. I proposed two chant repertories to be used as modal points of comparison: firstly, the responsorial chants upon which Notre Dame organa was built, and secondly, twelfth-century Parisian sequences. To establish their appropriateness as reference points for Parisian organum, I discussed the historical connections between organum and each of the two chant repertories. I also compared the three repertories' styles, showing that, although the former was regarded as having greatly influenced the latter, the style of organum has far more in common with that of the older responsorial chant repertories.

I adapted the methodology to the two plainchant repertories, after which, I proceeded with the analyses. Analyses 1 and 3 yielded results that could be used as reference points for organum, but Analysis 2 did not. In addition, many more important conclusions were derived from the results of each analysis.

Analysis 1 had three important conclusions. Firstly, consistent distributions of all pitch classes or mode degrees were not found in any mode, but the top few ranks were consistent for each mode. I argued that this partial consistency was consistent with the idea of a hybrid hierarchy; only the top few levels of each mode's hierarchy were defined, and they were defined by mode-degrees. Secondly, the same few mode degrees held the top ranks for most modes. Thus, the top of each mode's hierarchy had a similar mode-degree-based structure.

Thirdly, single ranks were often shared by two and sometimes even three pitch classes. I expect each hierarchical level to relate to some pitch class behaviours or functions, but with multiple pitch classes holding one rank, many of those behaviours or functions could be

performed by various mode degrees rather than one behaviour or function for each mode degree. I have therefore proposed that this feature of multiple pitch classes in single ranks could reflect some flexibility of modality.

Analysis 2 gave very simple, broad results: all notes, whether pitch classes or mode degrees, across all modes in both repertories exhibit the same basic tendency patterns: they are most likely to move by step; they will more likely move by semitone than by tone where possible; and they usually descend, except for a few notes that usually ascend. Because the patterns are not final-dependent, they are mode-independent, but they do not distinguish mode-independent from mode-dependent pitch class behaviour, because the tendency patterns are so fundamental and so general that they underlie both mode-dependent and mode-independent pitch class behaviour.

The broader implication of Analysis 2's results is that other parameters beyond mode degrees and pitch classes can sometimes determine the behaviour of both. The practical, immediate conclusion was that tendency could not be used to form a modal point of comparison.

Finally, Analysis 3 yielded results pointing in different directions depending largely on the sub-analysis. The analyses of fifth-outlines revealed that mode degrees determined which outlines were most likely.

The analyses of fourth-outlines had more complex results. In responsorial chants, the primary pattern was a mode degree outline that ranked first in every mode. The secondary pattern was an unusual coordination of a limited number of pitch class and mode degree outlines. In sequences, pitch classes seemed to have primacy in determining the likeliest fourth-outlines, but the conclusion was dubious because of the absence of results for three modes. Furthermore, the results that were present seemed to replicate the same pattern that defined responsorial chants, but the missing results made it impossible to confirm the pattern. The sub-analyses' results could function as modal reference points for the organum analyses of Chapter 5, but the sequence results could only partially function thus.

Chapter 5 began with a discussion of dronality, the perception of a low sustained note as a drone and thus as a tonal centre, and the suggestion that the tenors in *organum purum* passages of Notre Dame *organum duplum* could be understood as temporary drones. After providing historical support for the idea from the St. Emmeram Anonymous, Anonymous IV, and *Summa musice*, I proposed two complementary sampling methods in the methodology: analyzing organa by their chant-finals and analyzing organum phrases by their tenor pitch classes.

I adapted the general methodology to the two sampling methods, incorporating considerations of disturbances to dronality that might affect the organum phrase analysis, including tenor register, tenor note-length, voice-crossing, and historical performance practices.

I then proceeded with the analyses. Within each analysis' results, the two sampling methods' results were compared to each other and to the analogous results from Chapter 4.

Analysis 2, as had been established, could not be used to determine if organum was modal.

Analysis 1 and both sub-analyses of Analysis 3 showed that organa and organum phrases both had substantial overlaps with the modal points of comparison, but in two of the three analyses (Analysis 1, and Analysis 3, Sub-Analysis 2), the organa results had higher correspondence with the plainchant results in terms of which figures were present. The results for organa in each analysis showed that pitch class patterns had primacy and that the results were not modal. On the other hand, the organum phrases results were determined primarily by mode, except for fifth-outlines, which were determined primarily by consonance. Analysis 1 showed that pitch probabilities in organum phrases were modal, but in a new way compared to plainchant. Consonance could not adequately explain the results. Analysis 3, Sub-Analysis 1 revealed that fifth-outlines were determined by consonance and that mode might have played a minor secondary role. Analysis 3, Sub-Analysis 2 revealed that fourth-outlines were determined primarily by a mode degree pattern and secondarily by the same unusual coordination of a limited number of pitch class and mode degree outlines as in the analogous analysis of responsorial chants, thus demonstrating that mode determined fourth-outlines as well.

I argued that, given the strength of the patterns defining the results for organum phrases, it did not make sense to consider the organa results as meaningful. My reasoning was that when each part of a whole has a consistent, distinct distribution, analyzing the whole the same way is equivalent to taking the mean of all the parts' distinct distributions, resulting in a mean distribution that is artificial and not representative of the patterns in the music. Additionally, I argued that the apparent patterns in the Analysis 3 organa results were also the outcome of calculating the mean. I also speculated that the patterns in the Analysis 1 organa results might have stemmed from the tenor having spent disproportionate time on certain pitch classes depending on the chant-final.

Based on the results of Analysis 1 and Analysis 3, Sub-Analysis 2, I concluded that the duplum parts of Notre Dame two-part organum are mostly organized modally, though the results

of all three analyses demonstrate that consonance and mode-independent pitch class patterns are determinative as well.

## Broader Implications

Let us briefly connect these results to certain earlier points in the thesis. Firstly, the results confirm dronality as operative in *organum purum*. The results are also in agreement with the St. Emmeram Anonymous and Anonymous IV's comments identifying the tenor in *organum purum* as a drone. Additionally, perhaps the possible connection between Parisian organum and the polyphonic practices described in the *Summa musice* could be understood as more likely now that Notre Dame tenors can also be understood as moving drones. A future study of both *Summa musice* practices and Notre Dame organum might be able to draw fruitful connections between the two.

The results of this thesis also deepen our understanding of the Notre Dame treatises. The results seem to vindicate Anonymous IV's claim that the melodic modes formed the basis for understanding polyphony. The results also support Lambertus and Franco's more general claim that plainchant was the basis for understanding polyphony.

These results also demonstrated that consonance alone is not enough to explain all of the pitch class behaviour in *organum purum*, as is sometimes thought.[551]

I also believe that the results are harmonious with my reading of medieval modal theory, which incorporated the continuous, sensitive perception of mode and the possibility of modulation.

## Limitations

Although I concluded the previous chapter by declaring that the answer to the central question of this thesis is mostly "yes", strictly speaking, the implications of the results are more limited.

[551] Tischler, for example, claimed that the voices added to a plainchant tenor were "governed by the rules of consonance and dissonance and cannot therefore reveal a consistent modal character." This claim, however, was made without any evidence at all. Tischler, "Mode, modulation, and transposition in medieval songs," 278.

The first major limitation is that I only performed these analyses on organa from one source manuscript: F. I have not analyzed any organa from W1 or W2.[552] While I assume that the fundamental melodic language of organum to change from one manuscript to the next, this assumption should be confirmed by analysis.[553]

Secondly, all analyses of organum phrases omitted all voice-crossing passages and the subsequent material from the same phrases in which voice-crossing occurred. One follow-up study to this thesis could be the analysis of those segments of music. I expect that consonance would take over completely from mode, but one never knows.

Thirdly, I noted in Analysis 1 of organum phrases that I believe that the occasional random distributions in the cluster analysis results weaken the trends somewhat, and that their cause is unknown. Another follow-up study could focus only on these phrases.

Fourthly, phrases shorter than fourteen notes were excluded from analysis in Sampling Method 2. Even though most *organum purum* phrases, I believe, are medium and long, there are many phrases shorter than those as well. Because of their shortness, though, statistical analyses could be inappropriate. A different methodology would have to be devised to study minimal through short phrases.

Fifthly, Sampling Method 2 also excluded copula passages from analysis. Their shortness as well as their scarcity could also require an alternative methodology.

Lastly, the clustering could probably be improved. For similar studies, a better system might involve sorting all the leaves' stacks by ranked order of pitch classes or mode degrees, so that, for example, all stacks with D in first place would be displayed together, within which group, all stacks with E in second place would be displayed together, etc. This system would facilitate identifying major trends and distinguishing multiple trends, if any, within a single set of results.

## Avenues for Future Research

This thesis is rife with subjects for future research. Below is only an incomplete list.

[552] *W1* is the common shorthand for Wolfenbüttel, Herzog-August-Bibliothek, Cod. Guelf. 628 Helmst. *W2* is the common shorthand for Wolfenbüttel, Herzog-August-Bibliothek, Cod. Guelf. 1099 Helmst.
[553] I have also not examined any fragments or fragmentary sources, but I do not believe that such sources are appropriate for corpus studies, which require large, representative samples, whereas fragments may or may not be representative, and the number of pieces fragmentary sources contain are usually few.

Conclusion

Numerous possible studies in organum analysis have been broached. One follow-up study would examine the relative amount of time the duplum sings above each tenor pitch class. This study would test my speculation at the end of Chapter 5 that the time is not evenly distributed across pitches, thus leaning the data in certain directions. The results might also reveal that mode shapes the large-scale structure of organa through tenor note length varying according to pitch class.

Plain or ornamented strings of repeated notes like recitation tone figures should be the subject of future research as well. The relative frequency of these strings should be measured; I believe that they are rare, but this is only an impression. Their function should be explored as well.

Fassler has identified motivic development across successive phrases of Parisian sequences and Parisian *organum duplum*. A full study of motivic development for each of these two repertories could greatly enhance the appreciation of melodic design in both.

Finally, I am certain that research on organum phrase lengths would be fruitful. A quantitative analysis of phrase-lengths in general could reveal patterns in organum phrase construction, and a quantitative analysis of consecutive phrase-lengths specifically would shed light on phrase periodicity and variability in *organum duplum*. Such a study would be greatly enriched if combined with an analysis of mode as it is used across phrases in organa, with a study of motivic development, and/or with a study of melodic formulas and how their transformations vary with patterns in organum phrase length.

One of the biggest research projects only begun in my thesis is the study of mode in chant, including mode profiles. Corpus research on mode in chant should be expanded to many more chant genres, but with sensitivity to manuscript sources and chronological layers of chant. It might be wise to use only sources from one location. Finer-grained analysis of mode's transformation across chant layers would greatly deepen our understanding of plainchant.

Relatedly, I would very much like to see the development of mode-finding algorithms, analogous to key-finding algorithms, such as those developed by David Temperley.[554] Such algorithms should be developed with sensitivity to chronological layers of chant and subsequent

[554] See for example, David Temperley, *Music and Probability* (Cambridge, MA: MIT Press, 2007), 49-64, 79-98. The idea of a mode-finding algorithm was first proposed to me by Christopher William White when he and I were discussing material that would become part of Chapter 2 of this thesis. (Private conversation, 2011 April 1.)

repertories, since, as we have seen, the modes are realized differently in each genre studied herein.

Mode-profiles specifically yielded insights into the structure of modal pitch class hierarchies. There remains a question of whether or not such a hybrid mode degree and pitch class hierarchy could be a part of human music cognition. I have proposed the idea based on my readings of historical theory, and I believe that the present results support the idea, but we should also enquire from ethnomusicologists whether or not such a structure has been observed in any music outside of the western classical tradition. If so, it would prove that such a hybrid would at least be cognitively possible. Secondly, music perception and cognition experiments designed to test the cognitive viability of such a hierarchy would also be invaluable. Similarly, scale systems with hierarchies where various individual levels are filled by multiple pitch classes should be investigated as well.

Another modal question that arose was: are cadences of internal phrases on non-final notes always signs of modulation? Are they sometimes, maybe often, maybe even mostly secondary points of arrival within the same mode, like a half cadence in tonality? How could we differentiate between a modulation and a secondary cadence within the same mode? As I noted in Chapter 4, section 4.4.1, to determine whether or not the cadences of internal phrase-finals on notes other than the stanza-final are modulations, and if so, how strong or clear they are, we could begin by comparing analyses of those phrases whose finals match their stanzas' final and analyses of those phrases whose finals do not match their stanza's final. A deep exploration of the issue of modulation vs. non-modulatory secondary cadences, involving both detailed readings of medieval accounts, such as those found in Chapters 2 and 3, and computational analyses of chants would likely be a very rich study to pursue.

Rahn's study of Marchetto da Padova's chapter on modal implication opens further lines of research on mode in chant. Rahn proposed an ordered list of nine criteria to model Marchetto's modal intuitions, but while most of Rahn's criteria are intuitive, some require further interpretation. In addition, his criteria should be tested using a computer to refine or correct them before turning them into a systematic program of analysis of modal implication from leaps and melodic outlines.[555]

Many more analyses investigating mode and, more generally, melodic material than were possible to pursue here should be noted and hopefully developed to deepen our understanding of mode, whether for plainchant or organum or any other polyphonic genre. For one, I had

[555] Rahn, "Marchetto's Theory of Commixture and Interruptions," 117-135.

originally designed a fourth analysis for this thesis, Approaches and Departures. I defined an *approach* as the interval preceding a given pitch class, and I defined a *departure* as the interval following a given pitch class. There were three categories: step, leap, and common tone (for repeated notes). For example, if a D goes to an A, then the A is approached by leap, and the D is departed by leap. This analysis would have examined probability distributions. It is not derived from historical theory, but rather, from the idea in later musics that consonances and dissonances have characteristic approaches and departures. Due to space and time constraints, however, I did not perform this analysis.

Another analysis that I did not pursue here relates to melodic outlines. In Notre Dame organa, one encounters long melodic outlines – sixths, sevenths, and octaves, as well as some longer than an octave, sometimes as long as a twelfth. I am curious about the possibility that the first note or the last note of such melodic outlines might be consistently related to mode (or perhaps to another structural element). It might be, rather, that the highest note or the lowest note of such an outline might be consistent according to some criterion. Alternatively, there might be a distinction between ascending and descending outlines. The results in all of these contexts could be entirely irregular as well, of course. Until preliminary studies are performed, all possibilities are open. I suspect, however, that such an analysis could be limited by the relative infrequency of such outlines, but I am far from certain.

I am certain that there are a great many more analyses of mode, plainchant, and organum waiting to be developed and implemented. I hope that this thesis opens up many such avenues of research for many scholars.

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