Differentiae in the *Cantus Manuscript Database*: A Cross-Manuscript Analysis

by

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Table of Contents

List of Tables iv
List of Figures vii
Abstract viii
List of Abbreviations Used ix
Acknowledgements x
Chapter 1: Introduction and *Differentia* Standardization 1
1.1 Overview of the *Differentia* Standardization Project 9
1.2 Analysis enabled by the *Differentia* Standardization Project 11
Chapter 2: *Differentiae* and Mode in Theory and Practise 14
2.1 Theorists' Explanation of *Differentia* and Mode 16
2.2 Elements of Unity and Disparity Within and Between Modes 19
2.3 Multi-Modal *Saeculorum* Openings 28
2.4 Adiastematic *Differentiae* and Modal Identification 33
2.5 Conclusion 46
Chapter 3: *Differentiae* and Antiphon Melodies 49
3.1 Medieval and Modern Explanations 50
3.2 Defining the *Amen*-Antiphon Connection 53
3.2.1 Notes on Data and Data Preparation 53
3.2.2 Common Rules for *Differentia*-Antiphon Connections by Mode 58
3.2.3 The A*men*-Antiphon Connection in Practice 71
3.3 Conclusion 74
Chapter 4: Conclusions and Broader Implications for Differentia-based Cross-Manuscript Analysis 76
4.1 Style of *Differentia* as Geo-Temporal Indicator 78
4.2 Geo-indicative *Saeculorum* Openings 79
4.3 Assessing Manuscript Similarity with *Differentiae* 84
4.4 *Differentiae* over Time 94
4.5 Conclusion 95

Bibliography 98
Manuscripts 98
Theoretical Treatises 113
Secondary Sources..... 123
Appendix A: *Differentia* Standardization Project.....128
Appendix B: Roman *Differentiae* 136
Appendix C: Adiastematic *Differentiae*.....144
Appendix D: *Amen*-Antiphon Connections in *F-Pnm lat. 12044*.....153

List of Tables

Table 1.1. Antiphons ascribed by Johannes Cotto to the following mode 1 *differentia*: a-a-aG-GF-Ga-a 7

Table 1.2. Antiphons assigned to the tonary letters "ag" in the two-volume antiphoner *CH-SGs 390* and *CH-SGs 391*. The *differentia* assigned to the "ag" tonary letters is: a-a-aG-GF-Ga-Ga..... 8

Table 2.1. Use of *tonus peregrinus differentiae* in manuscripts, by century and antiphon..... 16

Table 2.2. Number of unique *differentiae*, by first note (rows) and mode (columns). 20

Table 2.3. Consistency of *amen* to mode, including number of modally-unique and multi-modal *amen* for each mode, and the number of instances of each category of *amen* within 152 manuscripts. 21

Table 2.4. Consistency of *saeculorum* to mode, including number of modally-unique and multi-modal *saeculorum* for each mode, and the number of instances of each category of *saeculorum* within 152 manuscripts..... 23

Table 2.5. Melodic contours of common *saeculorum* openings for each mode..... 26

Table 2.6. Frequently-occurring multi-mode *saeculorum* openings. 29

Table 2.7. *Differentiae* associated with modes 3 and 8 that use the *saeculorum* c-c-c-a for both modes within the same manuscript, but with different *amen* endings, which leaves the mode unambiguous. 32

Table 2.8. Modally-shared *differentiae* within individual manuscripts..... 33

Table 2.9. Appearance of syllabic contour n-n-nd-nd (neutral-neutral-neutral/down-neutral/down) in *differentiae* by mode. 35

Table 2.10. Summary of adiastematic manuscripts..... 36

Table 2.11. Summary of neume patterns for all *saeculorum* openings in each mode found in adiastematic manuscripts with modal indications (9 manuscripts) 37

Table 2.12. Summary of the modal assignments of the antiphons assigned the *differentia* [illegible] in *D-B Mus. 40047*, as identified in 144 other manuscripts indexed in the *Differentiae Database* and the *Cantus Manuscript Database*. 41

Table 2.13. Overlap between *D-B Mus. 40047* (Quedlinburg (Germany), Cathedral, 11th century), and other manuscripts in the *Differentiae Database* and the *Cantus Manuscript Database* that use *differentiae* 118n and 99f. 44

Table 3.1. Summary of data used in the analysis of *differentia*-antiphon connections..... 55

Table 3.2. Definition of 'common' *differentia*-antiphon connections by mode..... 58

Table 3.3. Mode 2 *amen* endings by manuscript 60

Table 3.4. Mode 5 *amen* endings and antiphon openings 61

Table 3.5. Mode 3 *amen* (rows) and antiphon (columns) connections..... 63

Table 3.6. Mode 4 *amen* (rows) to antiphon (columns) connections..... 64

Table 3.7. Mode 7 *amen* (columns) to antiphon (rows) connections 65

Table 3.8. Mode 1 *amen* (rows) to antiphon (columns) connections..... 66

Table 3.9. Mode 1 *amen*-antiphon connections in Cistercian manuscripts (*A-Wn 1799**, D-KNd 1161*, *CDN-Hsmu M2149.L4*, *A-Wn 1799***, and *PL-WRu I F 401*)..... 67

Table 3.10. Mode 8 *amen* (columns) to antiphon (rows) connections. 68

Table 3.11. Summary of possible *amen*-antiphon connections 70

Table 3.12. Summary of *amen*-antiphon connections in *F-Pnm lat. 12044* 73

Table 4.1. Summary of geo-indicative *saeculorum*..... 82

Table 4.2. Similarity scores (greater than 0.50) between *CDN-Lu M2150* and each of the manuscripts in the *Differentiae Database*..... 87

Table 4.3. Summary of similarity scores for manuscripts shown in the map in Figure 4.4. 88

Table 4.4. Summary of manuscripts and their similarity scores, as shown in the map in Figure 4.5. 90

Table 4.5. Summary of manuscripts and their similarity scores shown in Figure 4.6. 91

Table 4.6. Summary of manuscripts and their similarity scores shown in Figure 4.7. 93

Table 4.7. Summary of *saeculorum* variants per century per mode 95

Table A.1. Example of four *differentiae* with the same melodic transcription that are distinct due to their modal designation..... 129

Table A.2. Sample of *differentiae* with their assigned *differentia* ID from two different pitch contours. 133

Table A.3. Fields included in the *Differentiae Database* for each unique *differentia*, with definitions and two examples..... 134

Table B.1. Comparison of *saeculorum* in the Roman octave-species system and the octomodal system, grouped by reciting tone 137

Table B.2. *Differentiae* in *I-Rvat SP B.79* with their octomodal counterparts..... 138

Table C.1. Summary of adiastematic *differentiae* that appear in more than one manuscript 144

Table D.1. *Amen*-antiphon connections in *F-Pnm lat. 12044* 153

List of Figures

Figure 2.1. Map showing provenances of manuscripts that use the *saeculorum* opening c-c-b-a in mode 3 (circle) and mode 8 (square) 30

Figure 2.2. Map showing provenances of manuscripts that use the *saeculorum* opening c-c-c-a in modes 3 (circle) and 8 (square) 31

Figure 2.3. Map of the locations of manuscripts with 99f (circles) and 118n (squares) *differentia* 46

Figure 4.1. Map showing locations of manuscripts with marginally-notated *differentiae* (circles) and tonary letters (squares) 79

Figure 4.2. Map showing the isolated occurrences of certain *saeculorum* patterns in three twelfth-century manuscripts with Beneventan-style antiphons: *I-BV 19* and *20* (Benevento) and *I-MC 542* (Montecassino). 80

Figure 4.3. Maps of geo-indicative *saeculorum*, as identified in Table 4.1. 83

Figure 4.4. Example of one of the geographic regions (Iberia) exhibited by manuscripts' *differentiae* similarity scores: map showing similarity scores of 0.50 or higher between *CDN-Lu M2150* and each of the manuscripts in the *Differentiae Database* (see Table 4.2). 86

Figure 4.5. Map showing geographic proximity of similarity scores (of 0.50 or higher) between *A-Wda D-4* and each of the other manuscripts in the *Differentiae Database* 87

Figure 4.6. Example of the similarity scores of Franciscan manuscripts, based on similarity with *I-Ac 693*, a thirteenth-century manuscript from Central Italy 89

Figure 4.7. Example of the similarity scores between Cistercian manuscripts, based on similarity with the thirteenth-century manuscript *A-Wn 1799*** from Rein 91

Figure 4.8. Example of the similarity scores between Dominican manuscripts, based on similarity with the thirteenth-century manuscript *US-Cai 1911.142b* from Bologna 92

Figure A.1. Entity-relationship diagram for the *Differentiae Database* and the inclusion of manuscript index data (i.e., feast, incipit, Cantus ID, etc.) from the *Cantus Manuscript Database* 135

Abstract

The *differentia* standardization project for the *Cantus Manuscript Database* enables previously unfeasible comparisons of 159 manuscripts from the tenth to the seventeenth centuries containing a total of 129,526 antiphons and *differentiae*. The resulting multi-manuscript *differentia* analysis has two significant outcomes: a clearer understanding of *differentia* function; and the ability to use *differentiae* in assessments of manuscript similarity and provenance. In my thesis, I interrogate and quantify the two underlying assumptions that have persisted in theoretical definitions of *differentiae* since the medieval era: that *differentiae* belong to, and are indicative of, mode; and that their primary melodic function was to provide an appropriate connection between the end of the psalm tone and the beginning of the antiphon. By quantifying how each *differentia* is consistently indicative of both mode and antiphon opening, one can better understand how and why *differentiae* were effective tools for the memorization of antiphons.

List of Abbreviations Used

CMD	*Cantus Manuscript Database*
SSHRC	Social Sciences and Humanities Research Council of Canada
TML	*Thesaurus Musicarum Latinarum*

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Chapter 1: Introduction and *Differentia* Standardization[1]

Medieval plainchant is simultaneously consistent and variable. Despite its immensity, some aspects remain constant throughout time and space and between different institutions, whilst others are particular to one or more influencing factors. Two manuscripts from the same place may differ on the basis of time, type of institution (monastic or secular/cathedral), and/or liturgical contents, whilst two manuscripts from places that lack geographic proximity may be similar as a result of the time, type of institution, and/or liturgical contents. This simultaneity of standardization and variance can encumber multi-manuscript data collection; however, in order to examine the complex web of relationships that influenced chant transmission, large-scale data collection via manuscript indices is imperative, and much has been done in this regard.[2] Once amassed, the issue is no longer a lack of accessible data, but how to effectively and meaningfully analyze and identify relationships within the data. One approach is to

1. Throughout my thesis, bolded texts, including most Figure and Table headings, are hyperlinked to supplemental resources in the *Differentiae Database* (e.g., interactive tables created with the data mapping application "Tableau" and standardized *differentia* data for each theoretical treatise and manuscript included in the database). At the time of publication, the *Differentiae Database* is accessible at the URL (differentiaedatabase.com) but is password protected; the database will be published and publicly available by the end of October 2019. For access to the database prior to this date, please contact the author. The database will also be moving to a new location as part of the Digital Analysis for Chant Trasmission (DACT) project; once moved, the database will be acccesible at dact-chant.ca. Parts of this introduction, particularly that on the *differentia* standardization project for the *Cantus Manuscript Database*, initially appeared as parts of two conference presentations: Rebecca Shaw, "Standardizing a Crowdsourced Field: *Differentiae* in the *Cantus Manuscript Database,*" paper presented at Symposium: Machine-Reading and Crowdsourcing Medieval Music Manuscripts (Eastman School of Music, Rochester, New York, October 26, 2017); and, Rebecca Shaw, "*Differentiae* in the *Cantus Manuscript Database*: Standardization and Musicological Application," in *Proceedings of the 5th International Conference on Digital Libraries for Musicology* (Paris, September 28, 2018): 38-46.

2. See, for instance, the online indices in the *Cantus Index Network*: Debra Lacoste (Project Manager and Principal Researcher) and Jan Koláček (Web Developer), *Cantus: A Database for Latin Ecclesiastical Chant—Inventories of Chant Sources*; Manuel Pedro Ferreira (Director) and Jan Koláček (Webmaster), *Portuguese Early Music Database*; Eva Veselovská (Project Manager and Principal Researcher) and Jan Koláček (Web Developer), *Slovak Early Music Database: Cantus Planus in Slovacia*; Zsuzsa Czagany (Director) and Jan Koláček (Web Developer), *Hungarian Chant Database*; David Eben (Project Manager) and Jan Koláček (Project Developer), *Fontes Cantus Bohemiae: Plainchant Sources in the Czech Lands*; Bartosz Izbicki (Project Manager and Principal Researcher) and Jan Koláček (Webmaster), *Plainchant Sources in Poland: Cantus Planus in Polonia*; and Carmen Julia Gutiérrez (Project Manager) and Jan Koláček (Webmaster), *Musica Hispanica: Spanish Early Music Manuscripts*.

examine a shared component across many manuscripts, which encompass various temporal, geographic, and institutional provenances, and then consider which aspects of the shared component stay the same, which aspects change, and why.

The singing of psalms in medieval plainchant is one such shared element, which was of particular importance in medieval education and Christianity: the psalter (book of psalms) frequently served as a student's Latin textbook and the memorization of the texts therein were the foundation of medieval Christian monastic life.[3] Every week, as part of the Office, monks recited all 150 psalms to formulaic melodies called psalm tones, preceded and followed by antiphons that contextualized each psalm within the topic of the day.[4] At the end of every psalm and before the repetition of the antiphon, monks and nuns recited the doxology to 'Christianize' the Old Testament verses:

> *Gloria Patri, et Filio, et Spiritui Sancto.*
> *Sicut erat in principio, et nunc, et semper, et in saecula saeculorum. Amen.*
>
> Glory [be] to the Father, and to the Son, and to the Holy Ghost.
> As it was in the beginning, and now, and always, and into the ages of ages.
> Amen.

In extant, notated, medieval chant manuscripts, the psalms are rarely written out; their weekly repetition and formulaic recitation style made notation (both textual and musical) redundant. In their place are *differentiae*, six-syllable melodic formulas that define how one should sing the last two words of the doxology, "saeculorum. Amen"; this was the only part of the psalm recitation that was not exclusively standardized to mode. These formulas are typically notated after the end of the antiphon above the abbreviation "Euouae" (the vowels of the medieval spelling of "seculorum. Amen") or

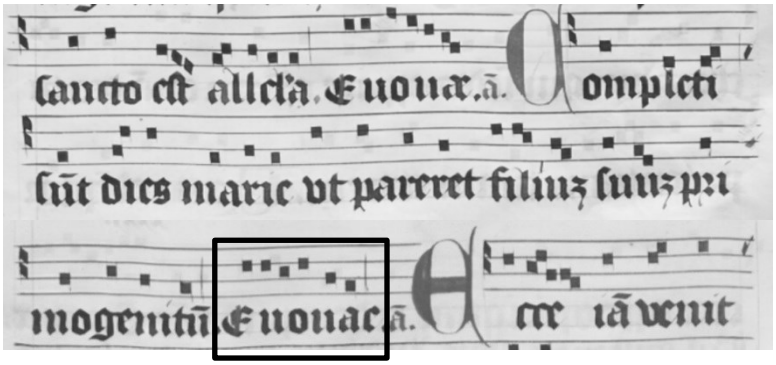
3. Joseph Dyer, "The Singing of Psalms in the Early-Medieval Office," *Speculum* 64, no. 3 (July 1989): 535.

4. Psalms were also sung as part of the Mass during the Introit, Offertory, Gradual, and Communion, but as these used different terminations than those for the Office, and due to the initial focus of the *Cantus Manuscript Database* on indexing antiphoners, my thesis focuses solely on the practice of antiphonal psalmody within the Office. Ruth Steiner, "Cantus Project," in *Notitiae Cantus* (October 1994): 1.

the textual incipit for the psalm.[5] As such, the singing of the psalms consisted of four parts, three of which are notated: the antiphon; the psalm (sung to a formulaic pattern); the *differentia*; and then the antiphon again (see Example 1.1). The *differentia* not only told medieval singers how to sing the last six syllables of the doxology, but also provided them with all of the requisite information for the intonation of the psalm.

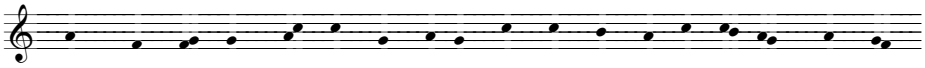
Example 1.1. Realization of a mode 8 antiphon, psalm, and *differentia* from the Christmas Day feast at Vespers, from the *Salzinnes Antiphonal*, *CDN-Hsmu M2149.L4* (1554-1555, ff. 31r-31v).[6]

1 + 4

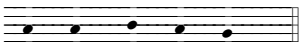


[2] + 3

1. Antiphon



Com- ple- ti sunt di- es ma- ri- e ut pa- re- ret fi- li -um su- um

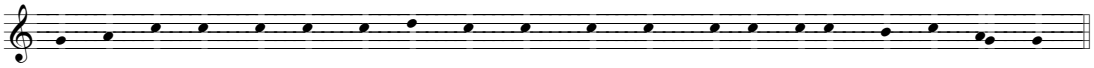


pri- mo- ge- ni- tum.

5. In some manuscripts, *differentiae* are written in the margins of the manuscript or referenced using tonary letters (see section 4.1 of the Conclusion, "Style of *Differentia* as Geo-Temporal Indicator").

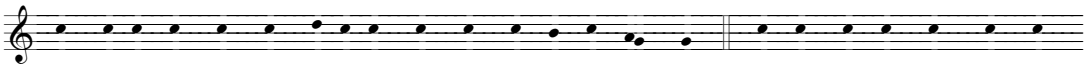
6. Throughout the thesis, manuscripts are referred to by their RISM sigla (e.g., CDN-Hsmu) and the call number or other identifier assigned to the manuscript by the library or archive (e.g., M2149.L4).

2. (a) Psalm 111 (*Beatus vir*): example of the first verse, ending with the doxology[7]



Be- a- tus vir qui ti- met Do- mi- num: in man- da- tis e- jus vo- let ni- mis.

2. (b) Doxology

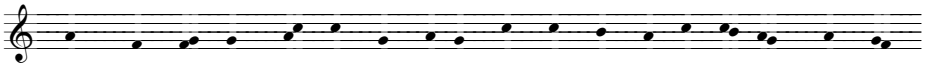


Glo- ri- a Pa- tri, et Fi- li- o, et Spi- ri- tu- i San- cto. Si- cut e- rat in prin- ci-

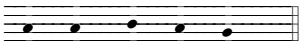
3. *Differentia*

pi- o, et nunc, et sem- per, et in sae- cu- la sae-cu-lo-rum. A-men.

4. Antiphon



Com- ple- ti sunt di- es ma- ri- e ut pa- re- ret fi- li -um su- um



pri- mo- ge- ni- tum.

In addition to their inclusion in manuscripts that contain the liturgy for the Office (antiphoners), *differentiae* also appear in tonaries as a means of hierarchically grouping antiphons within the eight Gregorian modes.[8] That is, within mode 1, there are a

7. Benedictines of Solesmes, eds., *The Liber Usualis* (Tournai: Desclee Company, 1961), 117, 147, 364.

8. A note about terminology: in treatises, medieval theorists assigned principal and variant *differentiae* to each mode, usually reserving the term 'differentia' for the latter in relation to the principal 'saeculorum amen'; however, for simplicity, and because the choice of principal 'saeculorum amen' varies between sources, I use the term *differentia* to refer to all possible formations of the 'saeculorum amen,' whether they are deemed principal or secondary by theorists. Moreover, the distinction between principal and secondary (and tertiary, etc.) *differentiae* is not made in antiphoners, although certain formulas are more common than others. Paul Merkley makes the distinction between the terms *differentiae* and *saeculorum amen*, with the first referring to the group of antiphons in a tonary, and the second to the formula itself. However, as *differentiae* are the mechanisms by which antiphons are

number of distinct *differentiae* to which antiphons may be assigned, nominally on the basis of their antiphon opening, to ensure an appropriate connection between the psalm tone and the repetition of the antiphon. Tonaries were included as parts of theoretical treatises and in antiphoners and other liturgical books. They had three uses: the study and explanation of *differentia*; a means of reference for antiphoners that used alphabetic codes to indicate *differentiae* throughout the manuscript; and/or for pedagogical purposes and the memorization of the antiphons. In each tonary, antiphons are listed by their textual and/or melodic incipit, and, depending on the purpose of the tonary, the scribe may list all of the antiphons associated with each *differentia*, or only a few examples. The latter is more typical in theoretical treatises where the purpose of the tonary is the study and explanation of *differentia* rather than the memorization of the specific antiphons associated with each. For example, the eleventh-century theorist Johannes Cotto lists notated antiphon incipits as a way of defining the melodic openings he deems appropriate to each *differentia* in his tonary, which is part of his theoretical treatise *De Musica*.[9] As shown in Table 1.1, he ascribes antiphons that start on D, F, and G to the mode 1 *differentia* a-aG-GF-Ga-a, although he states that two of the antiphons starting on F (*Hodie Christus natus est* and *A saeculo non est*) may also "fit well enough

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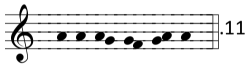
grouped in tonaries and the same formulae group antiphons in antiphoners (although this is not as immediately discernible based on the layout of the manuscript), I use the term *differentia* to refer to all iterations of the music accompanying the text "saeculorum. Amen" (whether in tonaries or antiphoners) and the individual words, *saeculorum* and *amen* to specify the first four syllables of the formula and the last two syllables, respectively. Paul Merkley, "Tonaries and Melodic Families of Antiphons," *Journal of Plainsong and Medieval Music Society* 11 (1988): 23. Several medieval theorists acknowledge the lack of rationality to the ordering of *differentiae* within mode in tonaries, even whilst employing this structure themselves. In the fifteenth-century, Anonymous XI wrote in *Tractatus de Musica plana et Mensurabili*, "Concerning the listing of the above *differentiae*, one might ask why there is an order of importance….I answer that I can find no reason except that their order comes from the good pleasure of the first pope, or the will of those who came after him." Richard Joseph Wingell, "Anonymous XI (CS III): An Edition, Translation, and Commentary" (PhD diss., University of Southern California, 1973), 307-308. Also see Johannes Cotto, *De Musica*, in *Hucbald, Guido, and John on Music: Three Medieval Treatises*, transl. and ed. by Warren Babb and Claude V. Palisca (New Haven: Yale University Press, 1978), 117-118, 152-159; Christopher Page, transl., *Summa musice: A Thirteenth Century Manual for Singers* (Cambridge: Cambridge University Press, 1991), 109-111; REIMAR, f. oijr. Throughout the thesis, upper-case codes (e.g., REIMAR) refer to the codes assigned to specific theoretical treatises transcribed by *Thesaurus Musicarum Latinarum* (TML); for the complete citations of each of these treatises, see **Bibliography: Theoretical Treatises**.

9. Cotto, *De Musica*, transl. and ed. by Babb and Palisca, 162-187.

into the sixth mode if they are ended on its final."[10] Tonaries found in antiphoners and other liturgical manuscripts may similarly provide abbreviated lists of antiphons, with or without notation, for each *differentia* (e.g., *CH-SGs 388*), or they may include a complete list of the antiphons associated with each *differentia*. The two-volume antiphoner *CH-SGs 390* and *391* uses marginal alphabetic codes, or tonary letters (e.g., ab, e, ic, od, v, H, yc, wd) to define which *differentia* should be sung with each antiphon. The tonary defines the melodic formula associated with each code and lists the textual incipits of the antiphons associated with each, in liturgical order (see Table 1.2).

10. JOHDEM, 164; Cotto, *De Musica*, transl. and ed. by Babb and Palisca, 163.

Table 1.1. Antiphons ascribed by Johannes Cotto to the following mode 1 *differentia*:



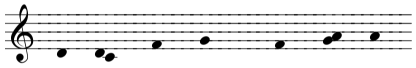
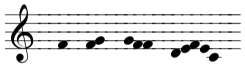
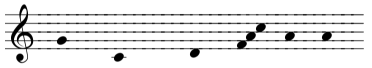
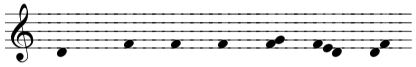
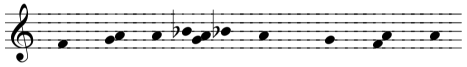
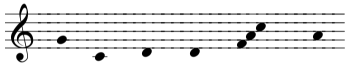
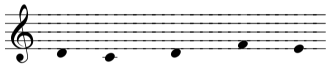
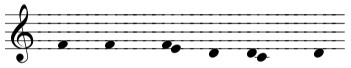
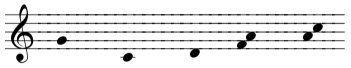
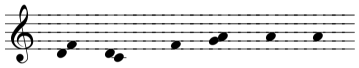
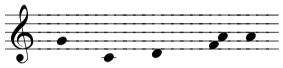
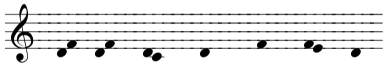
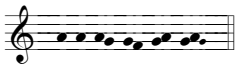
Antiphons starting on D:	**Antiphons starting on F:**	**Antiphons starting on G:**
 Ec- ce no- men Do- mi- ni	 Ip-si so- li	 Te- cum prin- ci- pi- um
 Can- tan- ti- bus or- ga- nis	 Ho- di- e Chri- stus na- tus est	 Is- te est Jo- han- nes
 Jo- han- nes qui- dem	 A sae- cu- lo non est	 Ap- pro- pin- qua- bat
 O pas- tor ae- ter- ne		 A- ve Ma- ri- a
 Si of-fers mu-nus tu-um		

Table 1.2. Antiphons assigned to the tonary letters "ag" in the two-volume antiphoner *CH-SGs 390* and *CH-SGs 391*. The *differentia* assigned to the "ag" tonary letters is:



Antiphon incipits listed after this *differentia* in the tonary (*CH-SGs 391*, pp. 3-4)[12]:

1	*Ecce veniet deus et homo*	16	*Libera me domine et pone*	31	*Adest namque beati Dionysii*
2	*Leva Jerusalem oculos et vide*	17	*Mittens haec mulier in corpus*	32	*Iste sanctus digne in memoriam*
3	*Dies domini sicut fur ita*	18	*Posuerunt super caput ejus causam*	33	*Admirabile est nomen tuum domine*
4	*Erunt prava in directa et*	19	*Mulieres sedentes ad monumentum*	34	*Post discessum beatissimi Martini*
5	*Cum autem esset Stephanus*	20	*Joseph ab Arimathia petivit corpus*	35	*Illo quoque negante jussit afferri*
6	*Jucundus homo qui miseretur*	21	*Tu solus peregrinus es et*	36	*Dum aurora nocti finem daret*
7	*Qui vicerit faciam illum*	22	*Et incipiens a Moyse et*	37	*Vos amici mei estis si*
8	*Tu es discipulus meus in*	23	*Obtulerunt discipuli domino partem piscis*	38	*Jam non dicam vos servos*
9	*Hi sunt qui cum mulieribus*	24	*Tunc praecepit eos omnes igne*	39	*Beatus iste sanctus qui confisus*
10	*Hi sunt qui venerunt ex*	25	*Adoramus te Christe et benedicimus*	40	*Domine dominus noster quam*
11	*Quid hic statis tota die*	26	*Hi qui linguis loquuntur novis*	41	*Quis enim in omnibus sicut*
12	*Hi novissimi una hora fecerunt*	27	*Astiterunt justi ante dominum et*	42	*In omnibus his non peccavit*
13	*Amice non facio tibi injuriam*	28	*Audita est vox infantium et*	43	*A progenie in progenies mise-*
14	*Cor mundum crea in me*	29	*Quae est ista quae ascendit*	44	*Praeceptor per totam noctem*
15	*Vim virtutis suae oblitus est*	30	*Flagrabat in beatissimis martyribus*	45	*Colligite primum zizania et alligate*

12. Ten antiphons designated as "ag" *differentia* throughout the antiphoner are not included in the list of antiphons assigned to "ag" in the tonary: *Saule quid persequeris martyrem meum* (*CH-SGs 390*, p. 58); *Praedicantes praeceptum domini constitutui sunt* (*CH-SGs 390*, p. 65); *Iste sanctus dum pro colligendis* (*CH-SGs 390*, p. 127); *Praedicantes praeceptum domini constituti sunt* (*CH-SGs 391*, p. 12); *Nova bella virginum dominus elegit* (*CH-SGs 391*, p. 17); *Levita Laurentius bonum opus operates* (*CH-SGs 391*, p. 100); *Perpetuis nos domine sancti Joannis* (*CH-SGs 391*, p. 109); *Qui diligitis dominum laetamini in* (*CH-SGs 391*, p. 138); *Sancti spiritus et animae justorum* (*CH-SGs 391*, p. 176); and *Fecit sibi amicos de mammona* (*CH-SGs 391*, p. 193). One antiphon, *O crux admirabilis*, is included in the tonary list, but appears as a responsory verse, not an antiphon, in the antiphoner. Further research comparing the antiphons listed in the tonary with those included in the antiphoner is required to explain these discrepencies.

1.1 Overview of the *Differentia* Standardization Project

In modern manuscript indices, both digital and in print, indexers typically use naming conventions for *differentia* analogous to the hierarchical organization of tonaries, in which they group *differentia* by mode and the indexing system is only applicable to a single manuscript or small group of related manuscripts, indexed by the same individual or individuals.[13] When Ruth Steiner designed the *Cantus Manuscript Database* (CMD) in the 1980s at The Catholic University of America, one of her impetuses for its creation was the study of *differentiae*.[14] While most of the other fields in CMD indices (e.g., text, mode, genre, and liturgical feast) were standardized from the outset, due to technological restrictions of the 128-character punch-card system used at this time, only two characters were allotted to the *differentia* field, impeding its standardization. As such, the codes ascribed to *differentiae* were only applicable to a single manuscript or small group of manuscripts, making cross-manuscript comparison cumbersome and hindering the use of *differentia* in studies of chant transmission and manuscript relationships. Debra Lacoste, the current project manager for CMD, identified the standardization of this field as a priority, and she and Jennifer Bain hired me in September 2016 under the SSHRC-funded *Cantus Ultimus* and *Single Interface for Music Score Searching and Analysis* (SIMSSA) projects to develop a system for standardization and apply it to manuscripts indexed in CMD.

The *differentia* standardization project is a solution to the problem of the cross-manuscript *differentia* comparison, described by Lora Matthews and Paul Merkley as "time consuming and prohibitively clumsy…[taking] half a week to compare one pair of tonaries."[15] Matthews and Merkley were disheartened by the process of comparison

13. Add for example, all of the indices in the *Cantus* network of online databases, and any of their printed indices by the Institute of Medieval Music.

14. Debra Lacoste and Andrew Mitchell, "The CANTUS Database: Progress Report," *Studia Musicologica Academiae Scientiarum Hungaricae* 45, no. 1-2 (2004): 126.

15. Matthews and Merkley question the feasibility and desirability of *differentia* standardization, stating that, "the number and contents of the *differentiae* vary greatly in tonaries and significantly in antiphoners, so it was not desirable or feasible to impose a uniform system on them," even whilst acknowledging the limitations of a non-standardized *differentia* field in the *Cantus Manuscript Database*: "This [non-standardization] limits the immediate usefulness of searches for an antiphon in multiple

between *I-PCsa 65* and two geo-temporally-related tonaries. The *differentia* standardization project and the *Differentiae Database* enable the relatively-straightforward comparison of *differentiae* in 159 manuscripts and 61 tonaries from theoretical treatises, containing a total of 1,416 unique *differentiae* (1,230 of which appear in antiphoners, and 435 of which appear in theoretical treatises). The application of a standardized *differentia* identification system enables one to identify areas of similarity and dissimilarity between manuscripts and to interpret their significance, which would otherwise be impractical. As part of my thesis, I also transferred the *differentia* standardization project data to an interactive online database, with the intention of encouraging cross-manuscript research that incorporates *differentia* and of enabling future manuscript indices to utilize, and contribute to, the standardized *differentia* index.[16]

The standardized *differentia* index is based on the assignation of a unique identifier to each unique *differentia*, regardless of the manuscript in which the *differentia* appears. The unique identifier, or *Differentia* ID, is not meant as a form of analysis; it is simply a means of distinguishing between unique *differentiae*. The *Differentia* ID uses pitch contour as a primary means of identification, but this is not meant to have any analytical significance. I could have assigned random alphanumeric codes to each unique *differentia* to accomplish the same result; however, using pitch contour as the core element of each *Differentia* ID helps the indexer to accurately identify similar and dissimilar *differentiae*. In addition to the unique identifier, the index includes multiple access points, or ways of grouping *differentiae* (e.g., *differentiae* with the same first four syllables, or *saeculorum*; *differentiae* in the same mode; *differentiae* with liquescents; transposed *differentiae*; etc.) so as to enable cross-manuscript research from multiple different entry points. For more on the *Differentia* ID, access

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Cantus files, because it is not evident from the results of a search whether the *differentiae* correspond or not." Lora Matthews and Paul Merkley, "CANTUS and Tonaries," in *The Divine Office in the Latin Middle Ages*, eds. Margot Fassler and Rebecca Baltzer (New York: Oxford University Press, 2000), 545, 552.

16. Rebecca Shaw, *Differentiae Database* (2019), **http://differentiaedatabase.com**.

points included in the standardized *differentia* index, and the standardization process applied to manuscripts indexed in CMD, see **Appendix A**.[17]

1.2 Analysis enabled by the *Differentia* Standardization Project

To date, definitions of *differentia* function have relied heavily on medieval theoretical sources, and assessments of the conformity of *differentia* to such definitions have been primarily predicated on the study of tonaries, with a few studies that examine *differentia* across small groups of geo- and temporally-related antiphoners.[18] While the CMD had significant amounts of *differentia* data, due to the lack of standardization in the *differentia* field, larger cross-manuscript studies were simply unfeasible. Tonary studies of *differentia* are more plentiful due to the relative ease of comparing *differentia* in tonaries. The structure of a tonary isolates each *differentia* within mode and uses it as a means of classification; in other words, the antiphons associated with each *differentia* are already listed in one place. An antiphoner intersperses its *differentiae* with all of its other chants for the Divine Office, so studying relationships between each antiphon, *differentia*, and mode becomes more time

17. Also see, Shaw, "Standardizing a Crowdsourced Field." The standardized *Differentia* ID field is not yet incorporated into the *Cantus Manuscript Database*.

18. For sources that examine the *differentiae* in tonaries see: Michael Bernhard, "The Seligenstadt Tonary," transl. Joseph Dyer, *Plainsong and Medieval Music 13*, no. 2 (2004): 107-125; Clyde W. Brockett, "'Saeculorum Amen' and 'Differentia': Practical versus Theoretical Tradition," *Musica Disciplina 30* (1976): 13-36; Anna Maria Busse Berger, *Medieval Music and the Art of Memory* (Berkeley: University of California Press, 2005), 47-84; Karen Desmond, "Behind the Mirror: Revealing the Contexts of Jacobus's Speculum musicae" (PhD diss., New York University, 2009); 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: Boydell & Brewer Ltd., 2001), 131-145; Matthews and Merkley, "CANTUS and Tonaries," 540–560; and Paul Merkley, "Tonaries, Differentiae, Termination Formulas, and the Reception of Chant," in *Beyond the Moon: Festchrift Luther Dittmer*, ed. Bryan Gillingham and Paul Merkley (Ottawa: Institute of Medieval Music, 1990), 183–194. Any research on *differentiae* in their practical sources bemoans the lack of study in this area due to the difficulty of comparing indices of manuscripts where the naming system for *differentiae* is not standardized. See, for example: Dyer, "The Singing of Psalms," 540; Ruth Steiner, "Thème 29 and the Medieval System of *Differentiae*," in *Gedenkshrift für Walter Pass*, eds. Ruth Steiner and Martin Czernin (Tutzing: Hans Schneider, 2002), 146-147; JoAnn Udovich, "Modality, Office Antiphons, and Psalmody: The Musical Authority of the Twelfth-Century Antiphonal from St.-Denise" (PhD diss., University of North Carolina, 1985); Lila Collamore, "Aquitanian Collections of Office Chants: A Comparative Survey" (PhD diss., The Catholic University of America, 2000), 194-207.

consuming, even if one's study is limited to a single manuscript. As a result of this barrier to research, scholars tend to adopt medieval theorists' definition of the purpose and use of *differentia* without much supporting evidence from antiphoners.

However, with the standardized *differentia* ID, one can now consider questions of *differentia* function across many manuscripts—both practical and theoretical—using computational methods. Combining data from the *Differentiae Database* and the *Cantus Manuscript Database*, in my thesis, I interrogate the two underlying assumptions that have persisted in theoretical definitions of *differentia* since the medieval era: that *differentia* belong to, and are indicative of, mode; and that their primary melodic function was to provide an appropriate connection between the end of the psalm tone and the beginning of the antiphon. While these two functions were and are the primary descriptors of these formulas, the validity of these statements has never been satisfactorily demonstrated and the precise relationship between *differentia* and mode and *differentia* and antiphon has yet to be defined. By analyzing data from 159 European manuscripts from the tenth to the seventeenth centuries with a total of 1,230 unique *differentiae* and 129,526 antiphons that include *differentia* indications (19,975 of which also include searchable melodic data in CMD), I quantify the relationships between *differentia*, mode, and the melodic openings of antiphons, using sources that record the practical tradition of singing *differentia*. In my first chapter, which addresses the relationship between *differentia* and mode, I also incorporate data from 61 medieval theoretical treatises, whose 435 unique *differentiae* underwent the same *differentia* standardization process applied to the manuscripts.[19] Although the study of *differentia* in theoretical sources is not the focus of this thesis, it is useful to consider manuscripts in the context of these contemporary theoretical sources. That is, how do the *differentia* found in manuscripts compare to temporally-related tonaries found within theoretical treatises? Do medieval theorists' understanding and explanation of *differentia* align with extant sources that capture the practical tradition of *differentia* (i.e., antiphoners)?

19. Centre for the History of Music Theory and Literature, *Thesaurus Musicarum Latinarum* (2019), http://www.chmtl.indiana.edu/tml/.

Regardless of provenance-instigated variance, I demonstrate that each *differentia* is consistently indicative of both mode and antiphon opening, and would therefore have been an effective mnemonic and pedagogical tool for the memorization of antiphons. For the modern manuscript indexer, the definition of the precise relationships between *differentia* and mode, and *differentia* and antiphon, also offers new opportunities for the identification of mode in adiastematic manuscripts and for the understanding of what medieval singers deemed 'suitable' in terms of melodic connections. By studying *differentia* from such a large geographic area and temporal span, it is also possible to identify particular *differentiae* and components of *differentiae* that were standardized despite differences of place, time, and/or type of institution (monastic or secular), and those that are indicative of a particular region, time, and/or type of institution. The standardization of *differentia* identification across manuscripts not only offers a new means of analyzing the function of *differentia* within antiphonal psalmody, but also provides a new means of understanding the complex web of relationships that influence the study of chant.

Chapter 2: *Differentiae* and Mode in Theory and Practise[1]

In the treatise *Musica sacra potissimum* (1490), Ladislaus de Zalka relates a story of the invention of the *tonus peregrinus* and its *differentia*:

> In a certain monastery, the monks were gathered together, and the singers began the antiphon prescribed for Eastertide, *Nos qui vivimus*. Suddenly, at the beginning of the psalm the choir providentially became silent, and the abbot blushed, having forgotten the correct *Saeculorum amen*, and he began, not at a high pitch, but on a.lamire [a] and cried out: "On such a tenor will [henceforth] be sung this 'tonus peregrinus': In exitu Israel de Egypto, domus Iacob de populo barbaro."[2]

A similar account also appears in a fifteenth-century treatise by Anonymous XI, and the *tonus peregrinus* and its *differentiae* are frequently described in treatises from the eleventh to the sixteenth centuries in association with this particular antiphon.[3] Although the melodic content of the *tonus peregrinus differentia* included in each

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1. Throughout my thesis, bolded texts, including most Figure and Table headings, are hyperlinked to supplemental resources in the *Differentiae Database* (e.g., interactive tables created with the data mapping application "Tableau" and standardized *differentia* data for each theoretical treatise and manuscript included in the database). At the time of publication, the *Differentiae Database* is accessible at the URL (differentiaedatabase.com) but is password protected; the database will be published and publicly available by the end of October 2019. For access to the database prior to this date, please contact the author. The database will also be moving to a new location as part of the Digital Analysis for Chant Trasmission (DACT) project; once moved, the database will be acccesible at dact-chant.ca.

2. The psalm *In exitu Israel* is set to the *tonus peregrinus* psalm tone and ends with *differentia* 161a. **SZAMUS**, 111; translated in Michael Bernhard, "The Seilgenstadt Tonary," transl. Joseph Dyer, *Plainsong and Medieval Music* 13, no. 2, (2004): 120. Full citations for coded theoretical treatise references (e.g., SZAMUS) are provided in **Bibliography: Theoretical Treatises**. All codes are those assigned by the *Thesaurus Musicarum Latinarum* (TML).

3. **ANO11TDM**, 124. In Anonymous XI's treatise, the *tonus peregrinus* ends with *differentia* 164b. Other treatises that contain *differentiae* for the *tonus peregrinus* in association with the antiphon *Nos qui vivimus* include the following, listed by century:

Eleventh century: **JOHDEM**, 154 (164a); **ANOCST**, 90 (164a); **BECANO**, 157 (164a); **ODOSENS**, 194 (164a)
Thirteenth century: **PETTRA**, 291 (T164aA)
Fourteenth century: **ANOTDS_MVNB4702**, f. 190v (56d)
Fifteenth century: **SZYDMUS**, 68 (164a); **CARTRA**, 449 (164a); **KEINLIL**, 128 (161a); **EICANON_MEUB685**, ff. 377r-377v (161a)
Sixteenth century: **FELOP**, f. Dir (161a); **VOGMUS**, 49 (161a); **FINPRA**, f. Ppiiiir (164c); **LOSERO**, f. d8r (164c); **COCTET3**, f. Ciiiir (161a); **BEUERO2**, 101 (164c); and **WOLENC3**, f. dviiv (161a).

treatise varies (there are currently 21 variants in the *Differentiae Database*, 12 of which appear in theorist treatises or tonaries), and not every treatise contains a *tonus peregrinus differentia*, the story that Ladislaus relates is indicative of medieval theorists' conception of the function of *differentiae* and their connection to mode and psalm tone.

In theory, *differentia* definitions are consistently intertwined with mode, psalm, and antiphon. Ladislaus's abbot forgot the correct *differentia* for *Nos qui vivimus*, which caused him to also forget the correct psalm tone, and resulted in the invention of a new psalm tone and *differentia* with which to intone a specific psalm in connection with a particular antiphon. In practise (i.e., in antiphoners), *tonus peregrinus differentiae* appear sporadically with 17 antiphons other than *Nos qui vivimus* across 57 antiphoners ranging from the eleventh to sixteenth centuries (see Table 2.1). 46 of the *tonus peregrinus differentiae*' 115 appearances are with *Nos qui vivimus*, but it is not restricted to this antiphon, as was prescribed by medieval theorists.[4] Nor were *Nos qui vivimus* antiphons exclusively sung with *tonus peregrinus differentiae*. Of its 54 appearances, 46 are with *tonus peregrinus differentiae*, but 7 are with mode 8 *differentiae* and 1 is with a mode 7 *differentia*. This simultaneous divergence and concordance between theory and practice, with the former more standardized than the latter, is typical of a comparison between *differentiae* in medieval treatises and *differentiae* in antiphoners. In this chapter, I provide an overview of the theoretical conception of the mode-*differentia* relationship and examine how the practical tradition, as recorded in antiphoners, both conforms to and complicates theorists' definitions.[5]

4. Agnes Papp, "Der Tonus peregrinus in der Theorie und Praxis. Eine Gegenüberstellung von spätmittelalterlicher musiktheoretischer Kompendien und Choralhandschriften," *Musicologica Brunensia 51* (2016): 122-123.

5. As all but one manuscript in this study uses the traditional octomodal system (*I-Rvat B.79* adheres to the octave-species of Old Roman chant), this chapter focuses exclusively on these manuscripts. For a comparison of the *differentiae* in *I-Rvat B.79* with octomodal *differentiae*, see **Appendix B**. All sigla follow RISM protocols; full identification of manuscripts is included in the **Bibliography**.

Table 2.1. Use of *tonus peregrinus differentiae* in manuscripts, by century and antiphon.

Antiphon (Cantus ID)	Total mss.	Century: 11th	12th	13th	14th	15th	16th
Nos qui vivimus (003960)	43	1	6	17	8	7	4
Martyres domini dominum (003717)	17	1	4	7	4		1
Angeli domini dominum (001399)	15	1	5	5	4		
Alleluia (001328)	8			1	5	1	1
Sapientia clamitat in laties (004811)	6		1	2	2		1
Cum venerit paraditus quem (002043)	4		1	2	1		
Da pacem domine in diebus (002090)	2			1	1		
Martyres domini domino (203046)	2				2		
Virgines domino dominum (005443)	2		1				1
Dixit dominus mulieri (002287)	1			1			
Domine si tu es jube me (002387)	1						1
In templo domini omnis (003291)	1				1		
Innocentes et recti pro (003350)	1		1				
Justorum animae in manu dei (003538)	1			1			
Occurrunt turbae cum (004107)	1				1		
Angeli dominum domino (200273)	1			1			
Gloriam virginis mundus non (201973)	1						1
Nunc dimittis servum tuum (003975)	1				1		
Total manuscripts with *tonus peregrinus differentiae*	**57**	**1**	**9**	**20**	**14**	**8**	**5**
Total manuscripts included in analysis	**152**[6]	**4**	**27**	**26**	**28**	**26**	**24**

2.1 Theorists' Explanation of *Differentia* and Mode

According to the organization of and discussions within medieval theoretical treatises, there was a direct connection between mode and *differentia*: *differentiae* both belonged to and were indicative of particular modes. Theorists organized their discussions of *differentiae* in modal order and group *differentiae* and antiphons

6. Seven manuscripts in the *Differentiae Database* were excluded from this analysis: *AUS-Sfl 376* (incomplete CMD index), *CZ-Pu VI.E.4c* (*differentiae* in tonary only), *D-KNd 215* (*differentiae* in tonary only), *CZ-HKm II A 1* (incomplete CMD index), *UStPFragm01* (incomplete CMD index), *F-T 571* (incomplete CMD index); and *I-Rvat SP B. 79* (Roman modes). The three tenth-century manuscripts (*CH-SGs 390*, *CH-SGs 391*, and *F-Pnm lat. 1085*) in the *Differentiae Database* do not contain *tonus peregrinus differentiae*.

hierarchically by mode within their tonaries.[7] Perseus and Petrus summarize the mode-*differentia* relationship in *Summa musice*, an early-thirteenth century pedagogical manual for the singing of plainchant:

> A tenor in music…is a certain aptness of melodic construction holding a chant within the bounds of its mode. The tenor keeps guard upon a chant by means of the two words 'saeculorum amen' and chiefly through these and not through others, because they are the end of the versicle which is most frequently performed.[8]

Or, as Adam de Fulda wrote in the fifteenth century: the *differentia* "gives the tone."[9] Simply put, *differentiae* were understood as a means of modal identification and each *differentia* belonged to a specific mode. Variants within a mode were justified by different antiphon openings and regional variance: "…they [*differentiae*] differ in the same tone according to the diverse uses of churches and also according to the beginnings of diverse antiphons."[10] Perseus and Petrus advise singers to consult a tonary to learn the correct *differentiae* for one's institution, until the tonary "becomes a way of

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7. To my knowledge, there are no extant medieval treatises that discuss *differentiae* without discussing mode or organize their discussion of *differentiae* by something other than mode. Starting with the earliest extant tonary that references *differentiae* by Regino of Prüm (late 900s) tonaries list antiphons by *differentiae*, grouped by the eight modes. Regino of Prüm, *Tonarius*, transl. Sister Mary Protase LeRoux (PhD diss., The Catholic University of America, 1965), 137-294.

8. Christopher Page, transl., *Summa musice: A Thirteenth Century Manual for Singers* (Cambridge: Cambridge University Press, 1991), 109. Perseus and Petrus use the term "tenor" to refer to a standard *saeculorum amen* for each mode, and the term *differentiae* to describe variations to the modal standard. However, as not all theorists identify the same standard *saeculorum amen* and to avoid confusion with the definition of "tenor" as the reciting tone of a mode, I use the term *differentiae* to refer to all *saeculorum amen* formulas. Page, transl., *Summa musice*, 111. In the eleventh-century, Johannes Cotto used similar controlling terminology to define *differentiae*: "in music, we call 'tenor' the place where the first syllable of *saeculorum amen* begins. For, like the keys and locks, they control melodies, and they give us a way to identify chant." JOHDEM, 82; Johannes Cotto, *De Musica*, in *Hucbald, Guido, and John on Music: Three Medieval Treatises*, transl. and ed. by Warren Babb and Claude V. Palisca (New Haven: Yale University Press, 1978), 117-118.

9. *…nam finis* ['seculorum amen'] *dat tonum, sicut generale est proverbium: in fine videbitur, cuius toni*. FULMUS2, 355; translation in Peter John Slemon "Adam von Fulda on *Musica Plana* and *Compositio de Musica,* Book II: A Translation and Commentary" (PhD diss., University of British Columbia, 1994), 209. See Slemon's commentary on Adam's use of "tonus" for both mode and psalm tone, 110-111.

10. Johannes de Grocheio, *Ars Musicae*, ed. and transl. by Constant J. Mews, John N. Crossley, Catherine Jeffreys, Leigh McKinnon, and Carol J. Williams (Kalamazoo, Michigan: Medieval Institute Publications, 2011), 105.

life."[11] This definition of *differentia* is typical of the medieval theorist, where the existence of multiple *differentiae* within a mode is a result of musical context and regional variance, and the connection between mode and *differentia* is expressed as an indisputable fact.

This definition persists in modern scholarly explanations of *differentia*, which are predominantly based on these theoretical writings. Harold Powers and Frans Wiering state in their description of medieval modal theory that *differentiae* contribute to a system of "closed systematic modes," which is only complicated by the conflicting modal assignments of antiphons.[12] C.W. Brockett, Jr. also acknowledges the idea of *differentiae* as modal identifiers, but places more emphasis on the intervallic relationship between the antiphon's final and the start of the *differentia* (i.e., the reciting tone), as modally unique, rather than ascribing sole modal-indicatory power to the *differentia*.[13] Moreover, when he states, "Most tonaries acknowledge one standard *saeculorum amen* formula at the beginning of each mode, if only for unequivocally identifying a typical verse's modality," he does not explain why one *saeculorum amen* formula would be able to do so unequivocally, particularly within the context of shared reciting tones.[14] Aurally and visually, the span from the last note of the antiphon to the reciting tone of the psalm tone (and the first note of the *differentia*) is modally-unique, but medieval theorists also hint at something within the *differentia* itself—independent of the antiphon—that is unique to mode. By providing an example of a *differentia* for each mode, theorists made clear associations between specific *differentia* and specific modes, but do not explain why each pattern is appropriate for each mode and what elements of the *differentia* are modally-identifying. The remainder of this chapter attempts to identify this elusive element.

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11. Page, transl., *Summa musice*, 111-112.

12. Harold S. Powers and Frans Wiering, "Medieval Modal Theory," in *Oxford Music Online* (2001). On the conflicting modal assignments of some antiphons, see Hiroki Mori, "Conflicting Assignments of Antiphons between Modes 3 and 8," *Studia Musicologica Academiae Scientiarum Hungaricae* 45 (2004): 179-187.

13. Clyde W. Brockett, "'Saeculorum amen' and 'Differentia': Practical versus Theoretical Tradition," *Musica Disciplina* 30 (1976): 31-32, 34-35.

14. Brockett, "'Saeculorum amen' vs. 'Differentiae'," 32.

2.2 Elements of Unity and Disparity Within and Between Modes

If one accepts the theoretical premise that *differentiae* are indicative of mode, there must be identifiable elements that connect disparate *differentiae* within a single mode and that distinguish *differentiae* of one mode from another. There are two significant elements of modal unity and inter-modal disparity to consider: the reciting tone and the *saeculorum*, or first four syllables of each *differentia*. Reciting tones act as partial modal signifiers as they not only connect *differentiae* within a single mode, but also create what David Huron and Joshua Veltman term 'supra-modal' connections, since modes 1, 4, and 6 share a reciting tone (A), as do modes 3, 5, and 8 (C).[15] Only modes 2 and 7 have modally-distinguishable reciting tones. As each *differentia* starts on the reciting tone, with the only exceptions a result of scribal error or the inventions of wayward singers (according to Johannes Cotto), mode 2 and 7 *differentiae* are quickly recognizable: mode 2 *differentiae* start on F and mode 7 *differentiae* start on D (see Table 2.2).[16] For the remaining modes, however, one must look beyond the first note for the modal signifier.

15. David Huron and Joshua Veltman, "A Cognitive Approach to Medieval Mode: Evidence for an Historical Antecedent to the Major/Minor System," *Empirical Musicology Review* vol. 1, no. 1 (2006): 49.

16. JOHDEM, 154-156; Cotto, *De Musica*, transl. and ed. by Babb and Palisca, 158-159.

Table 2.2. Number of unique *differentiae*, by first note (rows) and mode (columns).

	1 (A)	2 (F)	3 (C)	4 (A)	5 (C)	6 (A)	7 (D)	8 (C)
A	258			364		58		
B			7[17]					
C			214		62			129
D							140	
F		76						
G				2[18]				

Most of the time, one can identify the mode of a *differentia* by the pitches associated with its first four syllables, the *saeculorum*. In a brief discussion of *differentiae* in *The Critical Nexus*, Charles M. Atkinson references the earliest tonary to include *differentiae* by Regino of Prüm and states: "One notices first that the only part of the *saeculorum amen* that changes from one *differentia* to the next is over the *amen*. The opening section [*saeculorum*]…remains the same."[19] Atkinson uses Introit *differentiae* in his example, but the same principle applies to Office-antiphon *differentiae*.[20] In some manuscripts, *differentiae* were abbreviated to the *amen*, suggesting that the *saeculorum* was standardized to mode and did not need to be

17. In tonaries and manuscripts until the twelfth century, B was a common reciting tone for mode 3. See *Commemoratio de Brevis*, as transcribed in Terence Bailey, *The Intonation Formulas of Western Chant* (Toronto: Pontifical Institute of Medieval Studies, 1974), 12, 33; 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* (Cambridge: Boydell & Brewer Ltd., 2001), 135. In my dataset, B is used as the initial note for mode 3 *differentiae* in ***CH-SGs 388***, ***CH-SGs 390***, ***CH-SGs 391***, ***D-SI HB.I.55***, ***A-KR VI 258***,and ***I-BV 20***. It also appears in the eleventh-century tonary, *Liber opusculorum* by Odorannus de Sens (**ODOSENS**, 170). It is possible that mode 8 also used B as a reciting tone before the twelfth century, but evidence of this is "oblique," according to Hiroko Mori, and *differentia* starting on B in mode 8 do not exist in my dataset. Mori, "Conflicting Assignments," 187.

18. Likely scribal errors in ***D-FUl Aa 55*** and ***F-Pnm lat. 15181***.

19. Charles M. Atkinson, *The Critical Nexus: Tone System, Mode, and Notation in Medieval Music* (Oxford: Oxford University Press, 2009), 92.

20. Introit *differentiae* are typically more melismatic than those used with antiphons, which are the focus of this thesis. Medieval theorists' treatises that include both types of *differentiae*, differentiate between the two (and those used with responsories, etc.). See, for example: JOHDEM, 168; ANODMF , 67; ANOCST, 30; ANODEO_MLBLL763, f. 72r; NICCOM, 335; SPANQUA, f. D1v; WYLMUS, 156; JACDIT, 63; EICANON_MEUB685, f. 370v; AMEPRA, 70; SZYDMUS, 51; ANOMCANT_MSAVI44, f. 51r; ANOHOL3_MVNB4774, f. 76v; JOHPAL, 47; SZAMUS, 97; CARTRA, 454; BECANO, 157. The Introit *differentiae* in each of these theoretical sources are not yet included in the *Differentiae Database*. See ***AUS-Sfl 376*** for an example of a manuscript that includes chants for both the Office and Mass, and thus includes Office-antiphon *differentiae* and Introit *differentiae* (e.g., 219a and 225a).

written down.[21] After observing this phenomenon in *E-Tc 44.2*, Lila Collamore concluded that the cantor identified the appropriate psalm tone from the *amen*, as the *amen* endings in this manuscript are predominantly unique to mode.[22] However, after studying a larger dataset, it is evident that the *amen* of a *differentia* is not consistently modally-unique. While many *amen* are unique to mode (150 of 194), largely as a consequence of modal range, their variation is more dependent on the incipit of the subsequent antiphon than concerned with modal identification, as the third chapter explains in detail. Moreover, those *amen* which are not unique to mode are more commonly used than those that are unique to mode (see Table 2.3).

Table 2.3. Consistency of *amen* to mode, including number of modally-unique and multi-modal *amen* for each mode, and the number of instances of each category of *amen* within 152 manuscripts.

Mode	Total *amen*	Multi-modal *amen*[23]	Instances of multi-modal *amen*	Modally-unique *amen*	Instances of modally-unique *amen*
1	64	19	21,290	45	9,026
2	17	1	3[24]	16	9,330
3	45	29	7,265	16	496
4	56	21	7,802	35	8,069
5	15	10	4,608	5	39
6	12	10	7,069	2	145
7	38	14	11,150	24	7,267
8	27	20	34,443	7	257
Total	**194**	**45**	**93,630**	**150**	**34,629**

21. See ***E-Tc 44.2***, ***D-AAm G 20***, and ***F-Pnm lat. 1085***.

22. Lila Diane Collamore, "Aquitanian Collections of Office Chants: A Comparative Survey" (PhD diss., Catholic University of America, 2000), 354; Lila Diane Collamore, "Decoding Mode and *Differentia* in an Eleventh Century Antiphoner," presented at the International Congress on Medieval Studies (Kalamazoo, Michigan, May 7, 1994), 7.

23. Note that the total for the multi-modal *amen* column is not the numerical total of the column, but the total number of *amen* endings that appear in more than one mode. The number of multi-modal *amen* endings for each mode (in each row) is the number of *amen* endings within a mode that also appear in one or more other modes. A single *amen* ending, therefore, is counted more than once across the eight modes, but is only counted once in the total row.

24. The number of overlapping *amen* endings in mode 2 is extremely low because the typical range of the *amen* ending is below that of the other seven modes (i.e., C-D).

The *saeculorum* is more reliably associated with a particular mode (104 of 122), as this portion of the *differentia* immediately follows the psalm tone recitation, which was modally standardized. Although there are still 18 *saeculorum* that appear in more than one mode, the use of these multi-modal *saeculorum* is less frequent than that of multi-modal *amen* (see Table 2.4). Moreover, where these multi-modal *saeculorum* occur, one mode is much more common than the other(s), suggesting that the use of the *saeculorum* for the less common mode is a result of scribal error, a peculiarity specific to a manuscript or manuscripts of a particular provenance, or an exception to the 'rule' for specific antiphons. For manuscripts that abbreviated *differentiae* to their *amen* endings, then, it seems more likely that the cantor would have identified the mode from the preceding antiphon and sung the appropriate *saeculorum*; the *amen* was notated as a visual reminder of the part of the *differentia* that was not modally-standardized, and a reminder of what came next: the repetition of the antiphon.[25]

25. In a recent conference presentation, Lila Collamore also acknowledged this alteration to her earlier interpretation of the abbreviated *differentiae* in *E-Tc 44.2*: "Melody, Mode, and Memory," presented at the 54th International Congress on Medieval Studies (Kalamazoo, Michigan, May 12, 2019), 3-4.

Table 2.4. Consistency of *saeculorum* to mode, including number of modally-unique and multi-modal *saeculorum* for each mode, and the number of instances of each category of *saeculorum* within 152 manuscripts.

Mode	Total *saeculorum*	Multi-modal *saeculorum*[26]	Instances of multi-modal *saeculorum*	Modally-unique *saeculorum*	Instances of modally-unique *saeculorum*
1	16	5	22,739[27]	11	7,577
2	14	0	0	14	9,333
3	36	11	5,732[28]	25	2,029
4	29	5	569	24	15,302
5	7	4	4,642[29]	3	5
6	15	6	131	9	7,083
7	9	0	0	9	18,417
8	19	10	28,077[30]	9	6,623
Total	**122**	**18**	**61,890**	**104**	**66,369**

It is not quite as simple as one *saeculorum* per mode, however, even if one eliminates the possibility of regional variance and examines a single source. In my dataset, there are 158 unique *saeculorum* openings across the eight modes, 122 of which are found in manuscript sources and 84 of which are found in theoretical tonaries. While theoretical and practical sources alike frequently have one *saeculorum* per mode for modes 2, 5, 6, and 7 and the *tonus peregrinus*, the same is not true for modes 1, 3, 4, and 8. In theoretical sources, additional *saeculorum* openings are sometimes reserved for specific antiphons, in much the same way that *tonus peregrinus*

26. As in Table 2.3, the total for the multi-modal *saeculorum* column is not the numerical total of the column, but the total number of *saeculorum* openings that appear in more than one mode. The number of multi-modal *saeculorum* opening for each mode (in each row) is the number of *saeculorum* openings within a mode that also appear in one or more other modes. A single *saeculorum* opening, therefore, is counted more than once across the eight modes, but is only counted once in the total row.

27. The main contributor to this overlap is the *saeculorum* a-a-G-F, which predominantly appears in mode 1 (21,858 instances), but appears twice in mode 4 and four times in mode 6.

28. The main contributors to this overlap are the *saeculorum* openings c-c-cb-ab and c-c-c-a which appear 1,218 and 3760 times respectively in mode 3, but also appear 1 and 52 times each in mode 8.

29. The *saeculorum* c-c-d-b appears 4,635 times in mode 5, but 4 times in mode 3 and 7 times in mode 8.

30. The main contributor to this overlap is the *saeculorum* c-c-b-c, which predominantly appears in mode 8 (23,507 instances), but appears 18 times in mode 3 and once in mode 5.

differentiae are theoretically associated with *Nos qui vivimus*. For example, when theorists include more than one *saeculorum* for mode 2, the secondary *saeculorum* is often associated with *O Sapientia*.[31] More importantly, however, the change to the *saeculorum* is minimal; it is not altered so much that it is unrecognizable as a mode 2 *saeculorum*.

What, then, does a mode 2 *saeculorum* look like and how is it distinguishable from that of any other mode? To determine the parameters of similarity among *saeculorum* openings of the same mode, I compared common modally-unified *saeculorum* openings within my dataset. *Saeculorum* openings were considered common if their frequency score was greater than 0.20. The frequency score for each *saeculorum* was calculated from the average of:

1) the ratio of (A) manuscripts containing each *saeculorum* within mode X to (B) the total number of manuscripts with *saeculorum* in mode X, and
2) the ratio of (C) total appearances of each *saeculorum* within mode X to the total number of mode X *differentiae* and within the dataset.

That is, there are 30,316 mode 1 *differentiae* across 152 manuscripts, and the most common mode 1 *saeculorum* (a-a-G-F) occurs 21,858 times across 132 manuscripts. Therefore, the frequency score of this *saeculorum* is:

Saeculorum frequency score = [(A ÷ B) + (C ÷ D)] ÷ 2
= [(132 ÷ 152) + (21,858 ÷ 30,316)] ÷ 2
= [0.87 + 0.72] ÷ 2
= 0.79

31. See, for example *De origine musice artis* (14th century) where F-F-F-E is the main *saeculorum* and F-F-ED-FE is used with the antiphons *O Sapientia* and *Domine*, which both begin DF-FE-FE-D. A secondary *saeculorum* is also associated with *O Sapientia* (set to the same or similar melodic opening) in Jacobus Leodiensis's *Speculum musicae* (14th century); *De speculation musice* by Walter Odington (15th century); and, *Tractatus de tonis* by Petrus de Cruce Ambianensis (13th century). The same consistency does not appear to be true in antiphoners, where the same *saeculorum* (F-F-ED-FE) occurs 114 times with 84 different antiphons across 6 sources, 3 of which include *O Sapientia*. The need for a different *saeculorum* opening in these instances is unclear, as the *amen* ending, rather than the *saeculorum* opening is more significant when considering the connection between the psalm recitation and the start of the antiphon. ANODEO_MLBLL763, f. 74; JACSP6B, 258; ODIDES, 223; PETTRA, 284.

This calculation ensures that only *saeculorum* that are 'common' both in terms of number of manuscripts and number of instances within each manuscript are considered 'common' to mode. As each *saeculorum*'s score approaches 1.00, the commonality of the *saeculorum* increases.

Within a mode, variants to the most common *saeculorum* are predominantly distinguished only by the repetition of notes, or the removal of repeated notes, or changes in the amplitude of an upward or downward motion (see Table 2.5). Consequently, each mode's *saeculorum* figures share the same basic melodic contour. For instance, the most common mode 1 *saeculorum* is a-a-G-F, followed by a-a-aG-GF, which merely delays the arrival of G and F respectively by repeating the previous note.[32] The third most common mode 1 *saeculorum* further delays the arrival of G and omits the F: a-a-a-G. In mode 4, the top three *saeculorum* openings and their relationship to the first are as follows: a-G-a-b, a-G-a-ba (a added at end as a passing tone to the accompanying *amen* endings, which start on G), and a-G-a-c (b becomes c).[33] Due to minimal nature of these alterations, therefore, modally-unified *saeculorum* patterns are both visually and aurally similar.

Distinctions between modes are slightly more complicated, as some modes share melodic contours (see asterisks in Table 2.5). However, the most common intervallic contours are modally unique, as is the combination of melodic contour and reciting tone, which is significant to the modern indexer when identifying *differentiae* within an adiastematic manuscript (see section 2.4). The melodic contours of modes 2, 3, and the *tonus peregrinus* are all n-s-s-d (neutral-same-same-down) and modes 5 and

32. Commonality calculations are based on frequency of use within and between antiphoners; see Table 2.5. Throughout this chapter, the syllabic division of "sae-cu-lo-rum" is represented by hyphens.

33. Some of these variations are predominantly regional. Czeslaw Grajewski claims that the mode 4 a-G-a-b *saeculorum* is predominantly monastic, while a-G-a-c is predominantly in the cathedral or diocesan tradition, but evidence in the *Differentiae Database* does not support this theory (see **Conclusion**). Czeslaw Grajewski, "La *differentiae* dei salmi come aiuto all'identificazione degli antifonali," *Studi Gregoriani 26* (2010): 171. Rather, a-G-a-b appears to be used in manuscripts from all provenances, whilst a-G-a-c is reserved for manuscripts from Germanic-speaking locations (see Table 4.1 and section 4.2, "Geo-indicative *Saeculorum* Openings"). There is one *differentia* in the dataset that does not use the final a in *saeculorum* a-G-a-ba as a passing tone to the *amen*: a-G-a-ba-b-G. This *differentia* only appears in *HR-Hf Cod. E*.

7 are both n-s-u-d (neutral-same-up-down).[34] However, the modes within each group are distinguishable by both reciting tone and the amplitude of the upward and downward motion:

Group 1 (n-s-s-d):

Mode 2 - down a second, reciting tone F

Mode 3 - down a third, reciting tone C (or B)

Tonus Peregrinus - down a fourth, reciting tone A

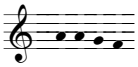
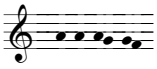
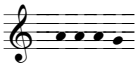
Group 2 (n-s-u-d):

Mode 5 - down a third, reciting tone C

Mode 7 - down second, reciting tone D

Therefore, based on the first four syllables, one can identify the mode of a *differentia* and the psalm tone with which to intone the psalm. In this way, the *saeculorum* keeps "guard upon a chant" in antiphonal psalmody.

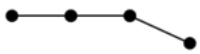
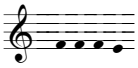
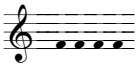
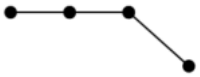
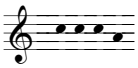
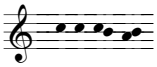
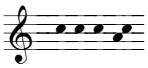
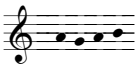
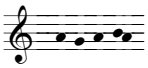
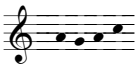
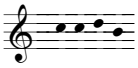
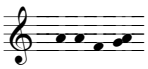
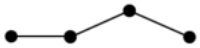
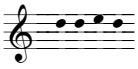
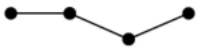
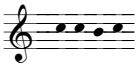
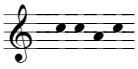
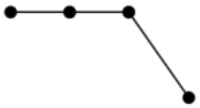
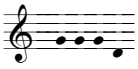
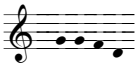
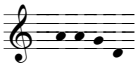
Table 2.5. Melodic contours of common *saeculorum* openings for each mode.[35] Alterations to the most common *saeculorum* opening for each mode are indicated by lowercase letters.

Mode	Intervallic contour[36]	Melodic contour	Melodic transcription	Total mss.	Total *diff.*	Freq. Score
1		N-S-D-D		132	21,858	0.79
		N-S-sD-sD		49	6,880	0.27
		N-S-s-D		60	406	0.20

34. Here, melodic contour is adapted from that used by Emma Hornby and Rebecca Maloy for Old Hispanic chant. See Emma Hornby and Rebecca Maloy, "Melodic Dialects in Old Hispanic Chant," *Plainsong and Medieval Music 25,* no. 1 (2016): 37-72. These melodic contours and the intervallic contour diagrams used in Table 2.5 are also used by *Cantus Ultimus* in their Optical Music Recognition (OMR) contour search, whereby the starting note of each *differentia* is neutral (n) and subsequent notes are either the same (s), down (d), or up (u) in relation to the previous note.

35. Analysis based on 152 manuscripts in octomodal system with complete antiphon data.

36. Intervallic contour diagram is based on the most common *saeculorum* per mode.

Mode	Intervallic contour	Melodic contour	Melodic transcription	Total mss.	Total *diff.*	Freq. Score
2		N-S-S-D*		92	5,701	0.61
		N-S-S-s		69	2,384	0.36
3		N-S-S-D*		130	3,760	0.68
		N-S-Sd-Du		65	1,218	0.30
		N-S-S-Du		61	1,341	0.29
4		N-D-U-U		109	5,819	0.54
		N-D-U-Ud		67	3,231	0.32
		N-D-U-U		51	4,564	0.31
5		N-S-U-D*		148	4,635	1.00
6		N-S-D-UU		135	6,226	0.88
7		N-S-U-D*		145	17,752	0.94
8		N-S-D-U		128	23,507	0.77
		N-S-D-U		120	3,879	0.46
P		N-S-S-D*		26	41	0.41
		N-S-d-D		10	35	0.24
		N-S-d-D		12	23	0.21

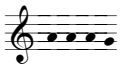
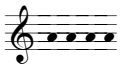
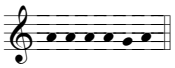
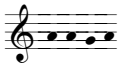
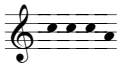
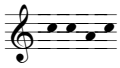
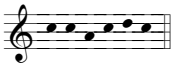
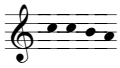
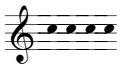
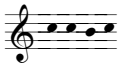
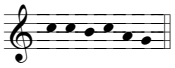
This relationship between *saeculorum* and mode is not clearly defined in extant medieval theoretical sources; perhaps it was (1) not a significant enough consideration to remark upon; (2) common knowledge; or (3) too complicated for the theorist to explain. Johannes de Grocheio alludes to the third possibility in his treatise: "It would be an odious task to explain these diversities [of mode, region, and antiphon openings] at present."[37] The lack of theoretical discussion on the modal unity and disparity of *differentiae* is likely a combination of all three. For the most part, the general contour of each *saeculorum* is indicative of mode and would need no explanation to the medieval singer who sang 150 psalms (and, thus, at least 150 *differentiae*) every week. When the melodic contour of the *saeculorum* is not distinctive (i.e., multi-modal *saeculorum* openings), perhaps the matter was too complex and not worth the theorist's time to explain. In these instances, the singer may simply have been expected to memorize the exceptions to the rule in much the same way that one learns the grammatical exceptions of a language.

2.3 Multi-Modal *Saeculorum* Openings

These exceptions—*saeculorum* openings that appear in more than one mode—connect modes that share a reciting tone, with the most overlap between modes 3 and 8. These overlapping *saeculorum* are more difficult to reconcile with the melodic contour of each mode (as defined in Table 2.5), as they do not belong exclusively to one mode. Some overlapping *saeculorum* are likely a result of scribal error or are isolated exceptions as they only appear with one mode once and the other mode many times: for example, the most common mode 1 *saeculorum* (a-a-G-F) also appears in modes 4, 6, and the *tonus peregrinus*, but these appearances are restricted to a maximum of 3 manuscripts with 5 antiphons, which is extremely negligible considering that the same *saeculorum* appears in mode 1 in 136 manuscripts 22,398 times. However, eight *saeculorum* openings appear consistently in two or more modes (see Table 2.6).

37. Johannes de Grocheio, *Ars Musicae*, 105.

Table 2.6. Frequently-occurring multi-mode *saeculorum* openings.

Saec.	Mode	Mss.	Ant.	Freq.	Cent.	Shared *diff.*[38]	Manuscripts
	1	60	406	0.20	10-16	No	
	4	7	67	0.03	11-16		
	1	19	446	0.07	11-17		*F-AS 893*
	4	44	498	0.16	11-16		
	6	3	74	0.02	12-12	No	
	1	5	27	0.02	13-15		
	3	130	3,760	0.68	10-16	No	
	8	10	52	0.03	12-16		
	3	20	287	0.09	12-16		*I-VCd CLXX*
	8	120	3,879	0.46	10-17		
	3	12	88	0.05	13-16	No	
	8	9	43	0.03	12-14		
	3	9	61	0.03	12-16	No	
	8	29	577	0.10	10-16		
	3	9	18	0.03	12-16		*D-Ma 12o Cmm 1* *F-Pnm lat. 15181*
	8	128	23,507	0.77	10-16		*F-Pnm lat. 15182* *PL-Kkar 4 (Rkp20)*

Multi-modal *saeculorum* openings are predominantly source-specific. That is, while the same *saeculorum* appears in multiple manuscripts in association with more than one mode over a long time period, most individual manuscripts only use the *saeculorum* opening in association with one mode. Significantly, for the medieval singer, there would have been no confusion as to which mode the *saeculorum* belonged. In instances where the same *saeculorum* appears in more than one mode within a manuscript, usually one mode is much more common than the other (i.e., one of the modes is an exception to the rule) and the complete *differentia* (i.e., *saeculorum* and *amen*) is unique to each mode. As Figure 2.1 shows, the *saeculorum* c-c-b-a appears in

38. Where the *differentia* appears more than once in each mode in the same source, i.e. "significant" overlap that cannot be ascribed to scribal error or regional variation. See Table 2.7.

both mode 3 and mode 8, but never appears in both modes within the same manuscript, or even manuscripts from the same place. It was used as a mode 8 *saeculorum* in manuscripts from modern-day England, northern France, Belgium, and the Netherlands, and as a mode 3 *saeculorum* in manuscripts from southern Germany, Austria, Czech Republic, and Hungary. The only exception to this geographic divide is *I-VCd CLXX* (Namur, Belgium), which uses this *saeculorum* in mode 3. Where the same *saeculorum* appears in more than one mode within the same manuscript, the complete *differentia* is unique. For example, the *saeculorum* c-c-c-a appears in most manuscripts as a mode 3 *saeculorum*, but a few sources also use this opening in mode 8, and one manuscript (*CDN-Lu M2150* from Burgos, Spain) only uses it in mode 8 (see Figure 2.2). Of the two manuscripts where the *saeculorum* appears consistently (i.e., more than once) in both modes—*A-Wda D-4* (Kirnberg an der Mank) and *TR-Itks 42* (Esztergom)—each source differentiates between the modes using the *amen*, and the use of this *saeculorum* is more common in mode 3 than mode 8 (see Table 2.7). Again, from the perspective of a singer in a particular institution using a particular book, the modal identification would be absolutely clear.

Figure 2.1. Map showing provenances of manuscripts that use the *saeculorum* opening c-c-b-a in mode 3 (circle) and mode 8 (square).

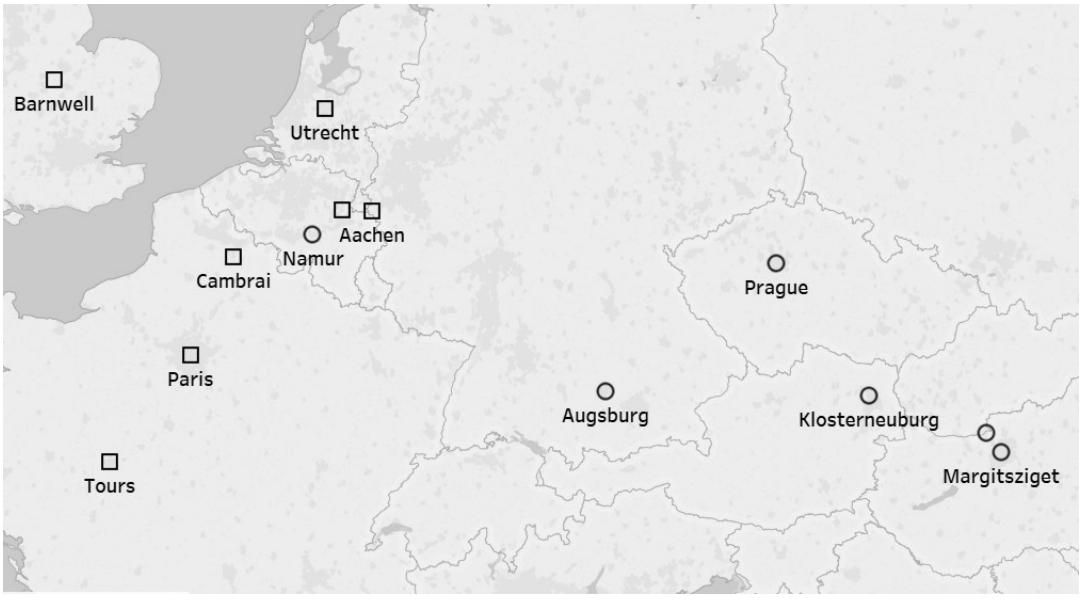


Figure 2.2. Map showing provenances of manuscripts that use the *saeculorum* opening c-c-c-a in modes 3 (circle) and 8 (square). Note that some manuscripts use the same *saeculorum* in more than one mode (provenances labelled); however, complete *differentiae* are unique to each mode (see Table 2.7).

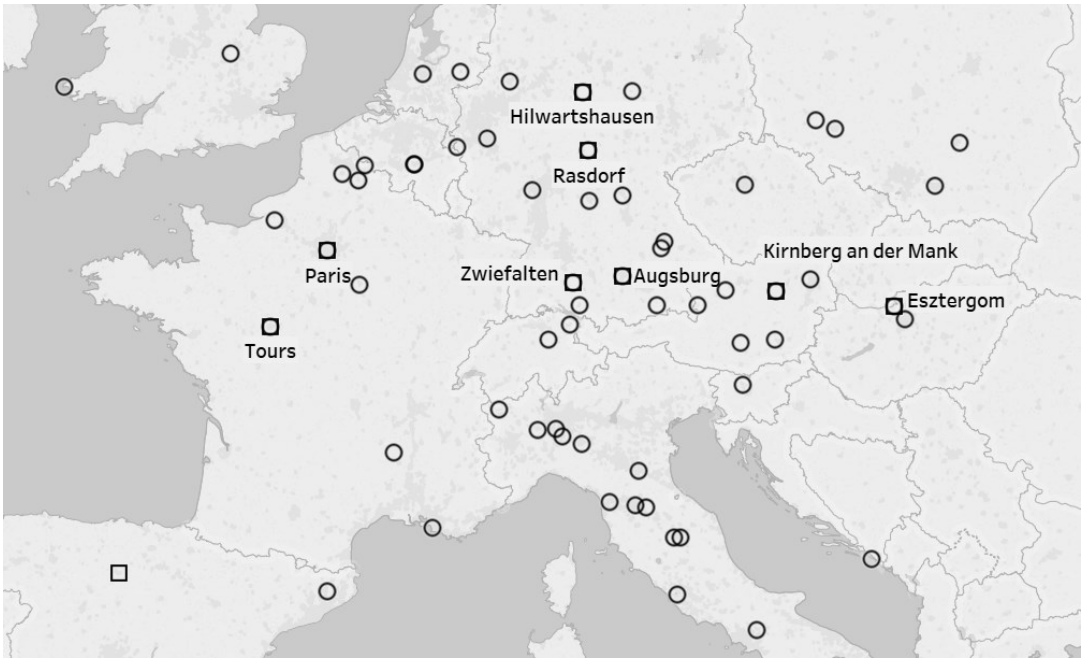
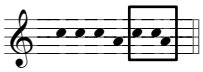
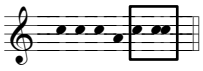
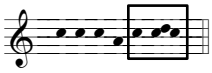
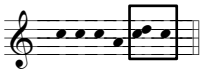
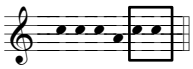
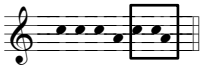
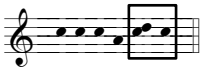


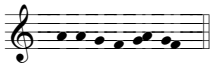
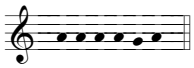
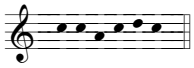
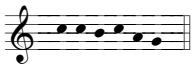
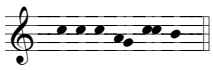
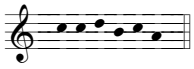
Table 2.7. *Differentiae* associated with modes 3 and 8 that use the *saeculorum* c-c-c-a with both modes within the same manuscript, but different *amen* endings, which leaves the mode unambiguous. Only *differentiae* that occur more than once in each manuscript are included in the table. Note that, although these manuscripts use this *saeculorum* in mode 8, it is still more commonly associated with mode 3; its use in mode 8 is an exception to the 'rule'.

Manuscript	*Differentiae*	Mode	*Diff.* ID	No. of Occurrences	Total by mode
A-Wda D-4		3	89b	47	**49**
			86m	2	
		8	99q	8	15
			99i	7	
TR-Itks 42		3	86b	7	**77**
			89b	70	
		8	99i	29	29

There are six instances when identical *differentiae* are used in more than one mode more than once within individual manuscripts. However, similar to instances where just the *saeculorum* is shared between modes within the same manuscript, there is a clear imbalance in favour of one of the modes within the manuscript (see Table 2.8). For instance, the *differentia* c-c-b-c-a-G is used in both modes 3 and 8 in four manuscripts, but its use in mode 3 is negligible in comparison to its use in mode 8. Perhaps its use in mode 3 is a scribal error; or a conscious exception to the rule; or the remnants of a less modally-contingent system of *differentiae*.[39] Regardless, the overlap is not significant enough to render the *differentia*'s modal assignation confusing to the singer.

39. Falconer, "The Modes before the Modes," 138-142.

Table 2.8. Modally-shared *differentiae* within individual manuscripts.

Shared *Differentia*	Manuscript	Mode	*Diff.* ID	Antiphons
	*E-Tc 44.1*	1	69b	**40**
		6	69v	2
	*F-AS 893*	1	11b	**35**
		4	11a	7
	*I-VCd CLXX*	5	99h	3
		8	99d	**53**
	*D-Ma 12o Cmm 1*	3	118r	3
		8	118a	**317**
	F-Pnm lat. 15181	3	118r	2
		8	118a	**283**
	F-Pnm lat. 15182	3	118r	5
		8	118a	**231**
	PL-Kkar 4 (Rkp 20)	3	118r	2
		8	118a	**46**
	*P-BRs No32*	3	213a	**30**
		8	213d	3
	*I-VCd CLXX*	5	129a	**44**
		8	129d	7

2.4 Adiastematic *Differentiae* and Modal Identification

For the modern indexer, the ability to identify the mode of a *differentia* based on its *saeculorum* is, for the most part, simply a way to confirm the mode of the antiphon. In some instances, like the antiphons of *Hildegard of Bingen* (in *D-WII2* and *B-DEa 9*), one can use the *differentia* to confirm the mode of an antiphon whose range makes its assignation as a plagal or authentic mode ambiguous. For example, the range of *O splendidissima gemma et serenum* (*B-DEa 9*, f. 154r) encompasses the typical ranges of both modes 3 and 4; however, the *differentia* assigned to this antiphon, with the *saeculorum* (a-G-a-c), definitively designates it as a mode 4 antiphon. The ability to assign modes based on the appearance of the *saeculorum* is particularly significant to the modern indexer when analyzing manuscripts written in adiastematic neumes. By

applying the understanding of which *saeculorum* patterns belong to which modes and the typical melodic contours of the *saeculorum* openings within each mode, it is possible to identify the modes of adiastematic *differentiae*, and, by extension, the modes of their associated antiphons.

While some neume patterns are less easily ascribed to a specific mode (particularly those that consist solely of single-note neumes), others are immediately identifiable. For example, the syllabic contour n-n-nd-nd (neutral-neutral-neutral, down-neutral, down) appears almost exclusively in mode 1 (see Table 2.9).[40] Within my dataset, there are 12 manuscripts that employ adiastematic notation, each with between 14 and 98 unique *differentia* neume patterns. By comparing the neumatic patterns of each *differentia*'s *saeculorum* with the melodic and syllabic contours of *differentiae* written with pitched notation, one can ascribe provisional melodic transcriptions to these *differentiae*. (See **Appendix C** for a table of these adiastematic *differentiae* and their melodic transcriptions). 10 of the 12 adiastematic manuscripts include modal indicators for each *differentia* by way of Roman numerals (i, ii, iii, etc. for each mode), tonary letters that correspond to each of the eight modes (a, e, i, o, v, H, y, w), and/or the inclusion of a tonary within the manuscript (see Table 2.10). For these manuscripts, the transcription of each *differentia* is relatively straightforward as it is possible to narrow down the most likely melodic realization of the neumes based on the mode and melodic and syllabic contours of each *saeculorum* (see Table 2.11).

40. The syllabic contour, like the melodic contour, is adapted from that used by Emma Hornby and Rebecca Maloy for Old Hispanic chant. Where the melodic contour took into consideration the relationships between syllables, the syllabic contour looks at each syllable individually so that the first note of every syllable is always "neutral." See Hornby and Maloy, "Melodic Dialects in Old Hispanic Chant," 37-72.

Table 2.9. Appearance of syllabic contour n-n-nd-nd (neutral-neutral-neutral/down-neutral/down) in *differentiae* by mode.

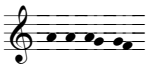
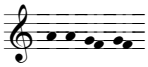
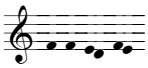
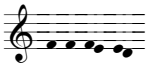
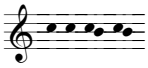
Mode	*Saeculorum*	Manuscripts	Antiphons
1		49	6,680
		1	1
2		6	114
		1	1
8		3	8

Table 2.10. Summary of adiastematic manuscripts. The siglum of each manuscript is linked to its tonary in the *Differentiae Database*.

Siglum	Provenance (Century)	Modal indication?	Unique *diff.*	Total *diff.* identified
A-KR VI 258	Sankt Polten (13th)	Roman numerals	14	20
A-LIs 290[41]	Kremsmünster (12th)	Roman numerals	16	76
A-SF XI 480	Regensburg (14th)	Roman numerals	98	1,197
A-Wn 1890	South Germany / Austria (12th)	Tonary letters[42]	29	1,853
CH-SGs 388[43]	St. Gall (12th)	Tonary letters	38	1,982
CH-SGs 390	St. Gall (10th)	Tonary letters	39	932
CH-SGs 391	St. Gall (10th)	Tonary letters	35	1,088
CZ-Pu VI.E.4c	Prague (12th)	Tonary[44]	28	28
D-B Mus. 40047[45]	Quedlinburg (11th)	None	78	1,394
D-SI HB.I.55	Weingarten (12th)	Tonary letters[46]	33	1,639
GB-Ob Can. Lit. 202[47]	South Germany (13th)	None	35	1,883
GOTTSCHALK	Lambach (12th)	Tonary letters[48]	28	316
Totals			221	12,408

41. Mode not identified in *Cantus Manuscript Database* index because of adiastematic neumes.

42. *Differentiae* written in margins of manuscripts. Some *differentiae* include modal designations, via tonary letters, whilst others do not (typically after the first appearance of a *differentia* tonary letters are no longer used), which means that the scribe expected the mode to be clear thereafter from the neumation.

43. Transcriptions of St. Gall manuscripts based on that in P. Ephrem Omlin, *Die Sankt-Gallischen Tonarbuchstaben* (Engelberg, Stiftsdruckerei, 1934), 156-174, 202-221.

44. *Differentiae* are not referenced throughout the manuscript, but it includes a tonary in adiastematic notation (f. 8v).

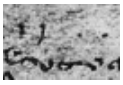
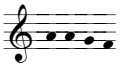
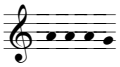
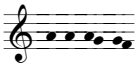
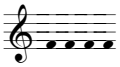
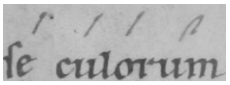
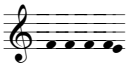
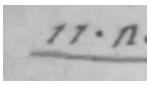
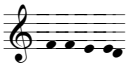
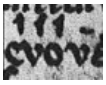
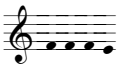
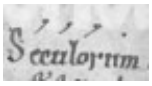
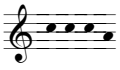
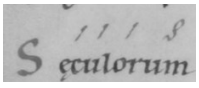
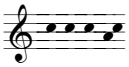
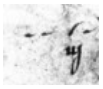
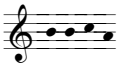
45. *Differentiae* not yet indexed in *Cantus Manuscript Database*.

46. This manuscript indicates *differentiae* both by neumes (outer margins) and tonary letters (inner margins), which reference an incomplete tonary at the end of the manuscript (ff. ff. 191r-191v; modes 4 to 8). The *differentiae* indexed in the *Differentiae Database* are from the outer margins of the manuscript.The neumed *differentiae* appear to consolodiate some differences identified by tonary letters; for instance, *differentiae* identified as ah and ak by tonary letters use the same neume pattern in the outer margins. Keith Glaeske, Inventory of "Stuttgart, Württembergische Landesbibliothek, HB.I.55," in *Cantus Manuscript 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-). Accessed April 25, 2019, **http://cantus.uwaterloo.ca/source/123637**.

47. Modes of antiphons and *differentiae* not identified in *Cantus Manuscript Database*.

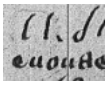
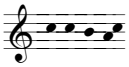
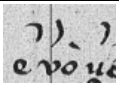
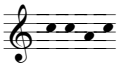
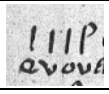
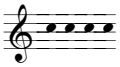
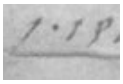
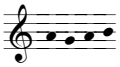
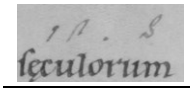
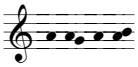
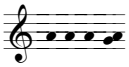
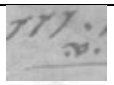
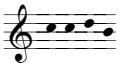
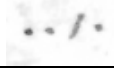
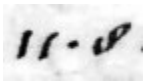
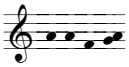
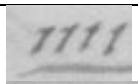
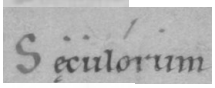
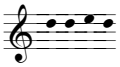
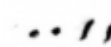
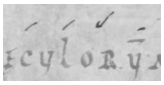
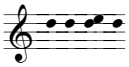
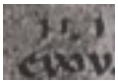
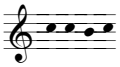
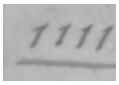
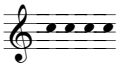
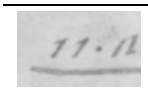
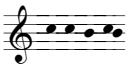
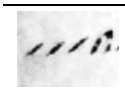
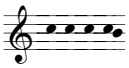
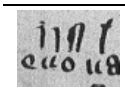
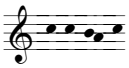
48. Tonary letters in this manuscript were interpreted using the tonary *Engelberg 102* (ff. 139v-141r), with transcriptions of adiastematic neumes based on that in Omlin, *Die Sankt-Gallischen Tonarbuchstaben*, 156-174, 202-221. See Lisa Fagin Davis's discussion of the Gottschalk tonary letters in *The Gottschalk Antiphonary: Music and Liturgy in Twelfth-Century Lambach* (Cambridge: Cambridge University Press, 2000), 67-72.

Table 2.11. Summary of neume patterns for all *saeculorum* openings in each mode found in adiastematic manuscripts with modal indications (9 manuscripts[49]). A "likely transcription" for each pattern is proposed, based on the neume pattern and *saeculorum* found in manuscripts with pitched notation and antiphon data (141 manuscripts and 118,955 antiphons). This table does not recognize liquescent variations of otherwise similar *differentiae*.

Mode	Neume patterns	No. of adiast. mss.	Likely transc.	No. of mss.	No. of inst.	Other possible transc. (no. of mss.)[50]
1		2		130	21,856	
		8		52	328	a-a-a-F (2)
		9		38	4,348	a-a-GF-GF (1)
2		7		64	2,208	
		4		5	164	F-F-F-ED (4)
		3		3	211	
		1		91	5,699	F-F-F-C (6)
3		7		121	3,529	c-c-c-b (9) c-c-c-G (1)
		8		52	1,151	c-c-c-ab (13) c-c-c-bc (1)
		5		Only appears in adiastematic mss.		

49. As *GOTTSCHALK* only includes tonary letters and no accompanying tonary, this manuscript was omitted from the table.

50. This column takes into consideration not only the melodic contour of each *saeculorum* but also the relationship between virga and punctum, whereby (in relation to each other) a punctum typically indicates a lower note and a virga a higher note. Nancy van Deusen, "Graphic Habits and Musical Intention: The Continuity of Notational Signs," in *The Harp and the Soul: Essays in Medieval Music* (Lewiston: The Edwin Mellen Press, 1989), 47, 51-57; David Hiley, *Western Plainchant: A Handbook* (Oxford: Clarendon Press, 1993), 341.

Mode	Neume patterns	No. of adiast. mss.	Likely transc.	No. of mss.	No. of inst.	Other possible transc. (no. of mss.)
3 (cont.)		1		1	41	c-c-b-ab (2)
		1		19	281	
		1		7	59	
4		9		99	4,750	a-G-a-c (48)
		3		6	42	a-aG-a-ac (1)
		1		1	1	
5		6		138	4,344	
		2				
6		9		124	5,707	a-a-F-Gb (1) a-a-G-Ga (1) a-a-G-Fa (1) a-a-G-ab (1)
7		8				
		3		135	15,459	d-d-f-d (7) d-d-e-c (2) d-d-d-d (1)
		1				
		4		10	830	
8		2		125	23,091	c-c-a-c (119)
		8		19	253	
		5		14	2,420	
		4		1	4	c-c-c-aG (1)
		1		3	479	c-c-cb-c (1)

Two manuscripts (*D-B Mus. 40047* and *GB-Ob Can. Lit. 202*) do not include modal indicators with their *differentiae*, so the modern reader must surmise not only the most likely melodic transcriptions, but also the mode of each *differentia* based on its neume pattern. It is possible that these two manuscripts were used in conjunction with an as-yet-unidentified tonary that clarifies their modal division of *differentiae*. As Perseus and Petrus write, one should "always have [a tonary]…to hand."[51] More than 800 years later, this is not always possible. It is, however, possible to assign modes and melodic transcriptions to the *saeculorum* in these manuscripts according to what is most likely, based on a comparison with other adiastematic notations, regional clusters, and associated antiphons.

Determining the modes and melodic transcriptions of adiastematic *differentiae* is an iterative analytical process, in which the indexer must follow these steps:

1. Is the *saeculorum* of the *differentia* is unique to mode? Some adiastematic *saeculorum* neume formations are easily identified as a particular mode, but others are more ambiguous: only appears in mode 1, but could be mode 1, 2, 3, or 5, based on Table 2.11. Mode 4 *saeculorum* neume patterns are almost entirely unique to mode, as this is the only mode where *differentiae* regularly change pitch on the second syllable; all other modes usually delay this change until at least the third syllable. If the *saeculorum* is modally-identifying, skip to step 3.
2. If the *saeculorum* neume pattern is not unique to mode, examine which antiphons the *differentia* appears with in the manuscript and determine which modes are most common for these antiphons.[52] While there are several conflicting modal assignments for antiphons across the 153 manuscripts included in the *Differentiae Database* and cross-referenced with

51. Page, transl., *Summa musice*, 112-113.
52. See **Incipit Search** tool in the *Differentiae Database*.

indices in the *Cantus Manuscript Database*, one can usually identify a "typical"—i.e., most common—modal assignment for each.[53]

3. Once the mode of the *differentia* has been identified, check Table 2.11 to see if there is more than one option for its melodic transcription. If there is only one possible transcription, skip to step 5.
4. If there are multiple possible transcriptions for the *saeculorum* (within the mode), check to see if either of the *saeculorum* openings is geo-indicative, i.e., whether one *saeculorum* only appears in a particular geographic region.[54] For more on geo-indicative *saeculorum* openings, see section 4.2.
5. Combining data identified thus far for the *differentia* (mode, and one or two possible melodic transcriptions of the *saeculorum*) with the syllabic contour of the complete *differentia* (including *amen*), and whether the *differentia* includes liquescents, or not, identify all possible melodic transcriptions for the *differentia*. (All of these components of *differentia* identification are possible filters within the *Differentiae Database*.) If there is only one possible melodic transcription, the identification process is complete. If there are multiple possibilities, proceed to step 6.
6. Identify which (non-adiastematic) manuscripts use the *differentia* identified as possibilities in step 5 and identify which antiphons are used within each manuscript with each *differentia*. Identify the manuscript that has the most overlap with the adiastematic source in terms of *differentia*-antiphon connections, and the geographic, temporal, and institutional provenance of the manuscript. Use the same *differentia* transcription as this manuscript.

More definitive *differentia* neume patterns (like those identified in step 1) and those that are only used with select antiphons are relatively quick to identify and transcribe. Those that are more ambiguous and require all six steps for identification may take

53. For more on multi-mode antiphons, see Mori, "Conflicting Assignments of Antiphons," 179-187. Also see Chapter 2 and the Conclusion for more on the relationship between *differentiae*, antiphons, and geography.

54. See the interactive **Map by Saeculorum and Mode** in the *Differentiae Database*.

longer. However, it is worth the time and methodical approach so that the most accurate possible *differentia* may be identified for each adiastematic neume pattern within the manuscript.

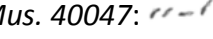
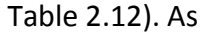
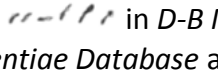
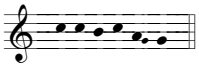
To demonstrate this process, I will use one of the more ambiguous *differentia* from *D-B Mus. 40047*:  . The neume pattern of this *saeculorum* appears in both modes 3 and mode 8 in Table 2.11. Within *D-B Mus. 40047*, it appears with 249 antiphons; these antiphons also appear in 144 other manuscripts (excluding *I-Rvat SP B.79* as it does not follow the octomodal system) indexed in the *Differentiae Database* and the *Cantus Manuscript Database* for a total of 11,877 antiphon instances. Of these, the vast majority are in mode 8, but these antiphons also appear in all of the other modes (see Table 2.12). As such, *D-B Mus. 40047*'s  is most likely a mode 8 *differentia.* Revisiting Table 2.11 to determine its melodic transcription, one can see that it has two possible transcriptions: c-c-b-c or c-c-a-c; the first appears in 125 manuscripts with 23,686 antiphons and the second in 119 manuscripts with 3,877 antiphons. The relative commonality of each *saeculorum* suggests that c-c-b-c is the more likely transcription of the *differentia*'s *saeculorum.* Unfortunately, neither of the possible transcriptions of this *saeculorum* are geo-indicative (see section 4.2) as both appear in manuscripts from a wide range of geographic, temporal, and institutional provenances, so we cannot use this to support an argument for one melodic transcription over the other.

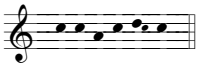
Table 2.12. Summary of the modal assignments of the antiphons assigned the *differentia*  in *D-B Mus. 40047*, as identified in 144 other manuscripts indexed in the *Differentiae Database* and the *Cantus Manuscript Database*.

Mode	No. of antiphons	No. of manuscripts
Mode 1	360	118
Mode 2	26	1
Mode 3	43	34
Mode 4	213	104
Mode 5	6	6
Mode 6	183	64
Mode 7	108	66
Mode 8	10,844	144

Using the data about the *differentia* that is most likely based on commonality within the dataset (mode 8, *saeculorum* of c-c-b-c), as well as the presence of a liquescent on the second-last syllable and a complete syllabic contour of n-n-n-n-n-n, this is most likely *differentia* 118n:



If we transcribe the *differentia* using the c-c-a-c *saeculorum* instead of the c-c-b-c *saeculorum*, the only possible *differentia* that meets all of the other criteria is 99f:

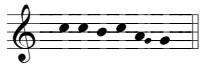


Differentia 118n appears in 2 other manuscripts and *differentia* 99f appears in 5 other manuscripts (see Table 2.13). Despite the marginally higher commonality of the latter *differentia*, if one considers not just the commonality of each *differentia* but also the overlap between *differentia*-antiphon associations in *D-B Mus. 40047* and that in each of the manuscripts containing *differentiae* 99f and 118n, it becomes clear that the *differentia* in *D-B Mus. 40047* is—in all likelihood—118n. 16 of the antiphons in *GB-WO F. 160* that use *differentia* 118n also appear in *D-B Mus. 40047* with . By comparison, only two antiphons that appear in *B-TO olv 64* in association with the 99f *differentia* also appear in *D-B Mus. 40047* with . Significantly, *GB-WO F. 160* is also the closest manuscript to *D-B Mus. 40047* in the dataset in terms its geographic, temporal, and institutional provenance. They were both used at cathedrals: *D-B Mus. 40047* in Quedlinburg in the twelfth century and *GB-WO F. 160* in Worcester in the eleventh century (see Figure 2.4 and Table 2.13). *B-TO olv. 63* (Tongeren, Cathedral, fourteenth century) is also geographically and institutionally related to *D-B Mus. 40047* but is more distant in terms of temporal provenance and more limited in its overlap with *differentia*-antiphon associations. Therefore, despite the ambiguity of the modal assignation and melodic transcription of this neume pattern in *D-B Mus. 40047*, by comparing its use in this manuscript with its use in other manuscripts in the *Differentiae Database* and the *Cantus Manuscript Database*, it can be almost conclusively ascribed

the *differentia* ID 118n. If, as more manuscripts are added to the database, further information arises that changes our melodic interpretation of this *differentia* (and the other adiastematic *differentiae* identified with this process in the *Differentiae Database*), the digital format of the *Differentiae Database* makes any alterations instantaneous.

While the modal identification and melodic transcriptions of some adiastematic *differentiae* may be more or less ambiguous than this example, a convincing educated guess of both is possible using data from the *Differentiae Database* and the *Cantus Manuscript Database*. The individual study of the *differentiae* in each of these manuscripts, and how they fit into the context of other manuscripts and their *differentiae*, would be a series of worthwhile investigations of their own, but, for now, a brief overview of how the modern indexer can use *differentiae* to identify antiphons' modes, and how one can use cross-manuscript data in the *Differentiae Database* to transcribe adastematic *differentiae* will have to suffice. By processing adiastematic manuscripts with the method outlined here, these manuscripts can be the included in future cross-manuscript studies of *differentiae*, mode, and antiphons, rather than omitting them based on their supposed notational limitations (within the context of our modern dependence on pitched notational systems) and/ or separating the study of adiastematic *differentiae* from those with pitched notation.

Table 2.13. Overlap between *D-B Mus. 40047* (Quedlinburg (Germany), Cathedral, 11th century), and other manuscripts in the *Differentiae Database* and the *Cantus Manuscript Database* that use *differentiae* 118n and 99f.

***Diff.* ID**	**Melodic Transcription**	**Manuscripts**	**Provenance**	**Overlapping antiphons with *D-B Mus. 40047*** (Cantus ID)	**Overlap**	**Total**
118n		*A-VOR 287*	Salzburg (Austria) Benedictine monastery 14th century	none	0	1
		GB-WO F. 160	Worcester (England) Cathedral 12th century	*Christo datus est principatus* (001788) *Expandens manus suas ad deum* (002795) *Extollens quaedam mulier* (002827) *Fontes aquarum sanctificati* (002888) *Hymnum dicamus alleluia* (003153) *In circuitu tuo domine lumen* (003208) *Laetamini in domino et* (003564) *Lapidaverunt Stephanum et* (003576) *Malos male perdet et vineam* (003686) *Miserere mei fili David quid* (003776) *O per omnia laudabilem virum* (004052) *Oremus omnes ad dominum Jesum* (004191) *Qui major est vestrum erit* (004477) *Tamquam sponsus dominus* (005101) *Venient ad te qui detrahebant* (005331) *Venite benedicti patris mei* (005350)	16	58

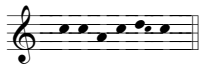
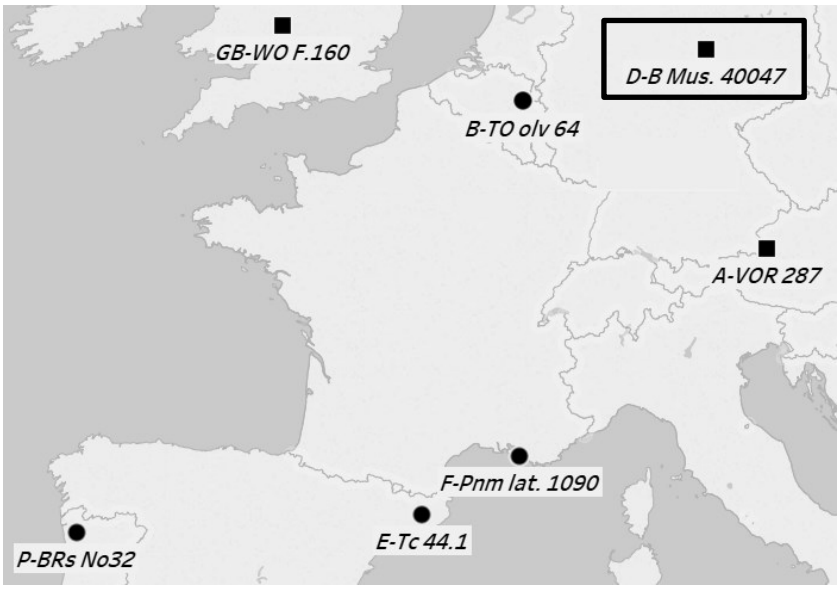
***Diff.* ID**	**Melodic Transcription**	**Manuscripts**	**Provenance**	**Overlapping antiphons with *D-B Mus. 40047*** (Cantus ID)	**Overlap**	**Total**
99f		*B-TO olv 63*	Tongeren (Belgium) Cathedral 14th century	none	0	41
		B-TO olv 64	Tongeren (Belgium) Cathedral 14th century	*Ite et vos in vineam meam et* (003461) *Lumen ad revelationem gentium* (003645)	2	40
		E-Tc 44.1	Tavernoles (Spain) Benedictine monastery 11th century	none	0	2
		F-Pnm lat. 1090	Marseille (France) Cathedral 12th century	none	0	21
		P-BRs No32	Braga (Portugal) Cathedral 16th century	none	0	1

Figure 2.3. Map of the locations of manuscripts with 99f (circles) and 118n (squares) *differentia*. Note the relative geographic proximity of each group, with the exception of *B-TO olv 63 and 64*.



2.5 Conclusion

The relationship between *saeculorum* and mode in theoretical treatises and manuscripts is comparable to linguistic grammar and attempts to codify it and teach it to students. Commonly-used *saeculorum* follow general and unique patterns within a mode in much the same way that the majority of verbs in a given language are conjugated into different tenses based on a standard set of rules. Medieval theoretical treatises take this general rule and assume that *differentiae* are unique to mode; instances of modal ambiguity are simply the exceptions to the rule that must be memorized, much like the conjugation of *être* or *sein* in French and German. To a non-native speaker, the memorization of these exceptions can be a tedious and onerous task, but to the child who grew up speaking the language—or singing the *differentiae*—these exceptions are no more exceptional than breathing.

The question that remains, then, is why the exceptions exist. One could dismiss them as simply evidence of the initial oral tradition in chant, as evidence of human

creation, or as an effort to provide melodic variety within a highly formulaic style.[52] These answers may be correct, but are not necessarily satisfactory to the modern scholar attempting to understand the practise of antiphonal psalmody. In some instances, *saeculorum* variations are a result of regional influences. Other exceptions may be a result of efforts to highlight particular antiphons or feast days, although this requires further investigation. *Saeculorum* that are common to more than one mode may be the remnants of a pre-modal practise of singing the psalms that was more dependent on reciting tones rather than modal finals, but without the existence of earlier manuscripts, whether antiphoners or tonaries, this is difficult to prove one way or the other.[53] In this thesis, I stay within the bounds of the octomodal tradition of *differentiae*, as represented in written sources, after the adoption of mode in chant. Within these sources, the relatively-consistent modal unity and disparity of the *saeculorum* allows these four syllables to act as modal identifiers for *differentiae* and antiphons, acting as a visual and aural reminder of mode in the transition from psalm tone to antiphon. While the manuscript sources have greater variety than the theoretical sources, they do not invalidate the underlying premise of *differentiae* definitions in medieval theoretical treatises: *differentiae* (and, more specifically, *saeculorum*) are, for the most part, specific to mode, and as such serve as modal subcategories, not only in tonaries where this is evident from their layout, but also in

52. Some theorists advocated for a single *differentiae* (not just a single *saeculorum*) per mode, but, as evidenced by the number of *differentiae* per manuscript in the *Differentiae Database*, their efforts were largely unheeded at this time. See, for example, the following fifteenth and sixteenth century theorist tonaries, all of which specify a single *differentiae* for each mode: **VANREM**, **CONNOV**, **SAEMUS**, **ANOLEIP**, **FABMUS2**, and **SPANQUA**. The Cistercian monk Guy d'Eu also advocated for a single *differentiae* per mode, but provided a tonary more consistent with practice (i.e., more than one *differentiae* per mode). Joseph Dyer, "The Singing of Psalms in the Early-Medieval Office," *Speculum 64*, no. 3 (July 1989): 549.

53. For more on this debate, see: Brockett, "' Saeculorum Amen' and 'Differentia'," 16-17, 35; Fiona McAlpine, "Beginnings and Endings: Defining the Mode in Medieval Chant," *Studio Muscologica Academiae Scientiarum Hungaricae 45* (2004): 165-166; Agnes Papp, "Tonar und *differentia*: Geschichte, Funktion, Deutungen," *Studia Musicologica 56*, no. 2-3 (2015): 135-136; Falconer, "The Modes before the Modes," 138. Comparisons with other liturgical traditions, like that in *I-Rvat SP B.79* (Old Roman repertory), that also use *differentiae* but were not part of the octomodal tradition, may prove enlightening (see Appendix B). Johannes de Olomons also includes *differentiae* for Ambrosian chant in his fifteenth-century treatise *Palma Choralis*. JOHPAL, 48-68. Also on Ambrosian *differentiae* (or *clausulae*), see Brockett, "' Saeculorum Amen' and 'Differentia'," 27.

liturgical manuscripts that record the practical tradition of antiphonal psalmody. Each *differentia*, therefore, and its *saeculorum* in particular, not only told the medieval singer how to sing these four syllables of the doxology, but also reminded her of the psalm tone with which to intone the psalm and the mode of the upcoming repetition of the antiphon.

Chapter 3: *Differentiae* and Antiphon Melodies[1]

While the first chapter focused on the *saeculorum* of the *differentia* as an indicator of modal assignment, this chapter focuses on the connection between the *amen* of the *differentia* and the return of the antiphon within the larger antiphon-psalm-antiphon performance structure. Despite variation across *saeculorum* openings within a mode and between manuscripts, each mode's *saeculorum* patterns retain a similar and unique melodic profile, as demonstrated in Chapter 1. This type of standardization to mode is not as apparent in the *amen* portion of a *differentia*: within a mode, *amen* endings lack consistency and the same melodic setting can be found in multiple modes. The simple a-G descending figure, for instance, is commonly used in modes 1, 3, 4, and 8.[2] The *saeculorum* of the *differentia* has already established the mode and psalm tone connection so it is unnecessary to re-establish it in the *amen*. Instead, the *amen* is predominantly dependent on the melodic opening of the antiphon. Although the end of each antiphon is standardized to mode (i.e., the antiphon ends on the final), the opening is not, so the *amen* forms the melodic bridge from the *saeculorum* to the start of the antiphon, wherever that may be.

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1. Throughout my thesis, bolded texts, including most Figure and Table headings, are hyperlinked to supplemental resources in the *Differentiae Database* (e.g., interactive tables created with the data mapping application "Tableau" and standardized *differentia* data for each theoretical treatise and manuscript included in the database). At the time of publication, the *Differentiae Database* is accessible at the URL (differentiaedatabase.com) but is password protected; the database will be published and publicly available by the end of October 2019. For access to the database prior to this date, please contact the author. The database will also be moving to a new location as part of the Digital Analysis for Chant Trasmission (DACT) project; once moved, the database will be acccesible at dact-chant.ca. An earlier version of this chapter, with analysis of *differentiae*-antiphon connection in mode 1 only was presented by the author at the Digital Libraries for Musicology Conference in Paris (September 2018). Rebecca Shaw, "*Differentiae* in the *Cantus Manuscript Database*: Standardization and Musicological Application," in *Proceedings of the 5th International Conference on Digital Libraries for Musicology* (Paris, September 28, 2018), 38-46.

2. Throughout this chapter, a hyphen indicates the syllabic separation of *a-men*. Thus, cd-d represents a two-note rising figure on "a-" and a single note on "-men". While some of the same *amen* can appear in multiple modes, it functions differently in each mode. For example the a-G 'a-men' precedes antiphons that start on F, G, or a in mode 1, but in mode 3, the same *amen* precedes antiphons starting on E.

Theorists and musicologists, both medieval and modern, have struggled to explain the musical realities and rationalization of this transition. That is, why one *amen* might be favoured over another for different antiphons and whether the selection of the *amen* was logically determined based on characteristics of the antiphon opening. This chapter combines data from the *Differentiae Database* with melodic transcriptions of antiphons in the *Cantus Manuscript Database* to identify common connections within each mode. Accounting for naturally-occurring exceptions that arise whenever humans are involved and a strict system is not clearly defined, the connections created between *amen* endings and antiphon openings are not random, but supported and determined by unwritten rules.[3]

3.1 Medieval and Modern Explanations

Medieval theorists typically acknowledged the existence of a connection between *differentiae* and antiphon openings but neither clearly defined the connections nor the reason(s) for their appropriateness. The eleventh-century theorist Johannes Cotto assigned specific melodic antiphon incipits of between one and four notes to each *differentia* in the tonary of his treatise *De Musica*: "The first *differentia* of the third tone [c-c-c-ac-a-Ga] fits antiphons ascending by a whole tone from the lichanos meson [G] and, after repeating that note, proceeding a semiditone higher [creating an antiphon opening of: G-a-ac]."[4] However, he does not explain why this *differentia* is appropriate for this particular antiphon opening. Johannes de Grocheio (fl. ca. 1300) acknowledges the connection but does not explain it further or provide examples; Perseus and Petrus (ca. 1200) write that *differentiae* are required and determined by different antiphon openings "and thus an easier transition may be made," but they do not define what they

3. See Keith Falconer's comments on the "grey areas" when attempting "to construct a system out of human affairs." Keith Falconer, "The Modes before the Modes: Antiphons and *Differentia* in Western Chant," in *The Study of Medieval Chant: Paths and Bridges, East and West*, ed. Peter Jeffery (Cambridge: Boydell & Brewer Ltd., 2001): 132.

4. Johannes Cotto, *De Musica*, in *Hucbald, Guido, and John on Music: Three Medieval Treatises*, transl. and ed. by Warren Babb and Claude V. Palisca (New Haven: Yale University Press, 1978), 170.

mean by "easier"; and in *Commemoratio Brevis* (tenth century), following a section on *differentiae* (each ascribed to specific antiphon openings, as in *De Musica*), the writer makes the derisive comment: "For the sake of the slower-witted brethren these illustrative examples have been amassed here perhaps at greater length than will be necessary."[5] If only he had considered the 'fools' who would try to make sense of his examples more than a millennium later. Whether they felt that it was unnecessary to do so, too complicated an undertaking, or some combination of the two, the result is the same: there are numerous accounts that state directly or indirectly that the variety of *differentiae* within a mode was at least partially contingent on musical characteristics of the subsequent antiphon, but none that explain precisely how one knew which *amen* to assign to which antiphon. Some theorists acknowledge the connection explicitly, whilst others do so implicitly via musical examples, introducing each new *differentia* with an antiphon opening that they deem appropriate.[6] The specific logic behind the connections, however, remains unwritten.

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5. Johannes de Grocheio, *Ars musice*, ed. and transl. by Constant J. Mews, John N. Crossley, Catherine Jeffreys, Leigh McKinnon, and Carol J. Williams (Kalamazoo: Medieval Institute Publications, 2011), 104-105; Christopher Page, transl., *Summa musice: A Thirteenth Century Manual for Singers* (Cambridge: Cambridge University Press, 1991), 111; *Commemoratio Brevis de Tonis et Psalmis Modulandis*, ed. and transl. by Terence Bailey (Ottawa: The University of Ottawa Press, 1979), 98-99. Perseus and Petrus also state that the number of *differentiae* per mode is directly related to the number of different antiphon openings. However, within my dataset, this is not entirely true; while there are only two commonly-used *amen* endings for mode 2, there are 31 unique two-note pitch contours that might follow in the antiphon opening, the same as in mode 3, which has nine commonly-used *amen* endings. See **Appendix C** and Table 14.

6. It is beyond the scope of this thesis to examine each of the theoretical sources in detail, but the following sources acknowledge the *differentiae*-antiphon connection, both explicitly (marked by an asterisk) and/or implicitly (through association with particular antiphon openings), listed in chronological order: ANOCST, 30-92; *ANODMF, 54-69; BECANO, 152-157; *JOHDEM, 156-197; *ABGURAM, 181-183; *BERTON, 269-276; AMEPRA, 34-75; ANOARSMU, 77-93; ARITRA, 261-268; LAMTRAC_MSBCLV30, 21r-24r; *ODIDES, 220-234; PETTRA, 282-291; *ANODEO_MLBLL763, 72r-73r; *ANOTDS_MVNB4702, 88v-90v; *GUISTON, 66-135; HEHESUMM_MVBM8-24, 37r-44r; JACDIT, 60-87; *JACSP6B, 226-300; *ODINT, 117-149; QUAPRIB3, 235-245; *ANO11TDM, 62-77; ANOSUM, 66-99; BONBRE, 48-55; *CARTRA, 451-483; *GAFPM1, bivr-civr; *GALRITS1, 363-367; *JOHPAL, 42-68; KEINLIL, 123-128; *MSAVI44, 46b-59r; SZAMUS, 49a-61b; SZYDMUS, 47-72; *UGODEC1A, 103-130; *WYLMUS, 54-202; and *WOLENC3, eiiiv-fviiv. Full citations for coded theoretical treatise references (e.g., SZAMUS) are provided in **Bibliography: Theoretical Treatises**. All codes are those assigned by the *Thesaurus Musicarum Latinarum* (TML). Also see Brockett's comments about the custom of introducing *differentiae* in connection with antiphon openings in medieval treatises, specifically the *Commemoratio Brevis*: Clyde W. Brockett, "'Saeculorum Amen' and 'Differentia': Practical versus Theoretical Tradition," *Musica Disciplina 30* (1976): 32. Further research to compare the antiphon openings assigned to *differentiae* in theoretical sources, as compared

Like their medieval counterparts, most modern scholars have avoided the issue of the *differentia*-antiphon connection predominantly due to the difficulty in comprehensively addressing this question without sufficient digital tools for the cross-manuscript comparison of *differentiae*. The existence of the connection is either provided as a definition of their function without subsequent analysis or explanation, or the matter of the connection is avoided entirely.[7] In the largest cross-manuscript study of *differentiae* until now, Joseph Dyer only makes a few observations on the *differentia*-antiphon connection: "In most cases the *differentia* performs its function of linking psalm and antiphon well," whereby the opening notes of the antiphon are mirrored in the *differentia* and the two are linked by unison, but other connections are "somewhat clumsy."[8] Those connections that Dyer identifies as clumsy—leaps of a third or fourth—are actually quite common in my dataset. What one might perceive as clumsy today may well have been deemed acceptable in the medieval era. Moreover, such a vague explanation of the *differentia*-antiphon connection explains little more than its medieval predecessors.

Other scholars are reluctant to assign much, or any, significance to a possible connection between *differentiae* and antiphons. Michel Huglo and Joan Halmo write in the *Grove Music Online* article on antiphons that,

> The psalm tone ending (*differentia*, *diffinitio*, or *varietas*) can be chosen with the first notes of the antiphon in mind to ensure a smooth progression between the psalm and the recurring antiphon. While the latter explanation became the

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to my findings in this chapter (based on antiphoners and notated breviaries), would be a worthwhile undertaking. Most of the theoretical sources examined prior to the sixteenth century introduce *differentiae* in conjunction with the opening first few notes of antiphons that the author deems "appropriate" to the *differentia*. Starting in the fifteenth century, however, theorists begin to list *differentiae* without such exemplary antiphons, suggesting that the appropriateness of the *differentiae*-antiphon connection began to lose significance at this time.

7. For example, see JoAnn Udovich, "Modality, Office Antiphons, and Psalmody: The Musical Authority of the Twelfth-Century Antiphonal from St.-Denis," (PhD diss., The University of North Carolina at Chapel Hill, 1985), 47; Edward Nowacki, "The Latin Antiphon and the Question of Frequency of Interpolation," *Plainsong and Medieval Music 21,* no. 1 (2012): 35; Lila Diane Collamore, "Aquitanian Collections of Office Chants: A Comparative Survey" (PhD diss., The Catholic University of America, 2000), 195; Falconer, "The Modes before the Modes," 136-137.

8. Joseph Dyer, "The Singing of Psalms in the Early-Medieval Office," *Speculum 64*, no. 3 (July 1989): 555.

> conventional one put forth by many theorists, there is often no perceptibly close relationship between the psalm tone ending and the opening of the antiphon.[9]

Similarly, in a study of the conflicting assignments of antiphons in tonaries, Paul Merkley claims that there is, at times, "no consistent relationship between the *saeculorum amen* formulas and the incipits of the antiphons assigned to them."[10] If one focuses on the interval of connection between the last notes of *differentiae* and the first notes of their accompanying antiphons, like Merkley, this is a logical conclusion; *differentiae* can approach antiphons by intervals ranging from a unison to a sixth. However, expanding the length of musical analysis to include the last two syllables of each *differentia* and the first few notes of each antiphon reveals consistent relationships, albeit with exceptions. Given medieval theorists' acknowledgement of a connection, though ill-explained, it is likely that there were at least some consistent relationships. The exceptions to these relationships may be explained as products of human creation and a lack of an explicit, standardized system at the point of *differentiae*' creation and use.

3.2 Defining the *Amen*-Antiphon Connection

3.2.1 Notes on Data and Data Preparation

The *differentia* standardization project, in combination with searchable melodic data available in the *Cantus Manuscript Database*, enables us to assess and quantify these theoretical assumptions about the relationship between *differentiae* and antiphon openings using data from manuscripts that capture the practical tradition of antiphonal psalmody. The remainder of this chapter defines the types of connections created between *differentiae* and antiphons: first, through a cross-manuscript analysis, by

9. Michel Huglo and Joan Halmo, "Antiphon," in *Grove Music Online* (2001), para. 15.

10. Paul Merkley, "Conflicting Assignments of Antiphons in Italian Tonaries" (PhD diss., Harvard University, 1985), 249-250. Also see Paul Merkley, "Tonaries and Melodic Families of Antiphons," *Journal of the Plainsong and Medieval Music Society 11* (1988): 17. Elsewhere, he points to small tonaries of one antiphon per *differentia* as potential evidence of the mnemonic function of *differentia* (and thus, a relatively strict connection between *differentiae* and antiphons). Paul Merkley, "Tonaries, *Differentiae*, Termination Formulas and the Reception of Chant," in *Beyond the Moon: Festchrift Luther Ditmer* (Ottawa: Institute of Medieval Music, 1990), 193.

mode, of 38 manuscripts containing 19,975 antiphons and 314 unique *differentiae*; and then, by examining how a single manuscript both adheres to, and differs from, these constructed 'rules'. For the first part, it is important to remember that the defined connections will not—and cannot—account for every possible *differentia*-antiphon connection that might be found in any given manuscript. All statements should be interpreted as if preceded by "usually." There will always be exceptions to the rule and each manuscript contains slightly different arrays of *amen* endings and antiphons, so each manuscript may make a slightly different array of connections. Despite this element of variation, it is possible to observe common traits in the data, and the definition of such commonalities between manuscripts enables one to better assess the function of *differentia*-antiphon connections in individual manuscripts. In order to assess a manuscript's deviation and/or conformity, there must be something to deviate from and conform to. Manuscripts with similar sets of deviations and conformities could suggest shared provenances or other relationships, as I detail in the conclusion of the thesis.

The identification of common *differentia*-antiphon connections requires two types of standardized and digital data: that for the *differentiae* (specifically, the *amen* endings) and that for antiphon openings. The former is available through the *Differentiae Database* and the latter is available for some manuscripts indexed in the *Cantus Manuscript Database*. Digitally-searchable melodic data from medieval chant manuscripts currently relies on manual input, so all of the melodies for chants indexed in *Cantus* are not yet available, but there is sufficient data for my purposes. See Table 3.1 for a summary of the data used in this chapter.

Table 3.1. Summary of data used in the analysis of *differentia*-antiphon connections. Only non-transposed antiphons (and *differentiae*) with, at minimum, transcribed melodic incipits were included.[11]

Manuscript[12]	**No. of antiphons**	**No. of unique *differentiae***
A-KN 1012	539	30
A-KN 1018	790	27
*A-Wn 1799***	1,088	20
B-DEa 9	21	10
CDN-Hsmu M2149.L4	721	16
CH-E 611	2,004	75
CH-Fco 2	1,348	41
D-KA Aug. LX	1,054	41
D-KNd 1161	637	15
D-Mbs Clm 4303 to 4306	1,472	40
D-WI1 2	7	6
DK-Kk 3449 8o [01] I to [17] XVII	2,302	62
F-Pnm lat. 12044	1,742	42
F-Pnm lat. 15181	1,305	34
I-Ac 693	821	55
NL-Uu 406	2,063	61
PL-Klk 1	9	5
PL-WRu I F 401	1,014	14
PL-WRu R 503	8	5
Totals	**18,945**	**267**

The analysis of the *differentia*-antiphon connection compares the *amen* portion of each *differentia* with the first two to four notes of the pitch contour for each antiphon. Based on medieval theorists' examples of *differentiae* in conjunction with antiphon openings, only the first few notes of each are significant in determining an

11. Transposed *differentiae* and their antiphons were omitted from the study on the assumption that they would function the same, or at least similarly, to their non-transposed counterparts. However, this is an area for further research and analysis.

12. The *D-Mbs Clm* manuscripts and the *DK-Kk 3449 8o* manuscripts are grouped together as they each contain individual volumes that make up complete antiphoners. All sigla follow RISM protocols; full identification of manuscripts is included in the **Bibliography**.

appropriate connection; how the antiphon proceeds has no effect on the *amen*.[13] Anonymous XI even writes that "the beginning of the antiphons represents full knowledge or satiety of the melody of the music to come."[14] Including complete antiphons in their examples of the *differentia*-antiphon connection, therefore, was redundant, as the entire antiphon could be anticipated within its first few notes.[15] From an analytical perspective, examining antiphons beyond the first four notes of their pitch contours quickly becomes unfeasible without computational methods of easily measuring similarity between multiple melodies; of the 19,975 antiphon melodies, there are 16,533 unique pitch contours. Adversely, simply reducing the antiphons to their first note is insufficient as one cannot assess the opening melody of the antiphon for range, direction of motion, and whether this motion is by step or leap, all of which are factors that can influence *amen* selection. Following the example of medieval theorists, I categorized the antiphons in my dataset according to their opening pitch contours of 2, 3, and 4 notes (to offer flexibility in analysis), which resulted in groups of 77, 185, and 519 antiphon opening types respectively.[16]

Previous scholars have suggested other means of grouping antiphon melodies, usually based on a specific repertory and not easily applicable to my dataset and adaptable to my purposes.[17] For instance, Gevaert identified 47 antiphon themes,

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13. In his treatise *Tractatus de musica plana* (fifteenth century), Monachus Carthusiensis divides the *differentiae* of each mode based on the first note of the subsequent antiphon (i.e., "In C, antiphona…In D, antiphona…In E, antiphona…"), but provides antiphon examples that go beyond the first note. CARTRA, 452. None of the examined medieval treatises and tonaries (see Bibliography) gave complete antiphons to demonstrate their connection to *differentiae*.

14. ANO11TDM, 46. Translated in Richard Joseph Wingell, "Anonymous XI (CS III): An Edition, Translation, and Commentary" (PhD diss., University of Southern California, 1973), 218.

15. Of course, this deserves much more explanation, but is an analytical problem for another time.

16. I categorized the antiphons by pitch contour rather than maintaining syllabic divisions and pitch repetitions, as pitch contours resulted in comparatively fewer unique groups and I was primarily interested in antiphons with similar melodic openings rather than the application of these similar melodic openings to dissimilar syllabic structures.

17. See, for example, those listed by JoAnn Udovich in her dissertation "Modality, Office Antiphons, and Psalmody," 47-49. Also, Laszlo Dobszay, "Experiences in the Musical Classification of Antiphons," in *Papers Read at the Third Meeting of Cantus Planus,* Tihany, Hungary, September 19-24, 1988 (Budapest: Hungarian Academy of Sciences, 1990): 145. Dobszay largely ignored antiphon incipits "since essentially identical antiphons may begin in different ways," but the antiphon incipits are of prime importance when considering *amen* endings and *differentiae*-antiphon connections.

primarily based on their incipits and Regino's tonary (ca. 870), but when computationally applied to my dataset, nearly 16,000 antiphons remain that would need to be individually and manually assessed and assigned to a theme.[18] As such, it was simpler and more appropriate for my purposes to computationally create groups of antiphons based on melodic data downloaded from *Cantus*. In other words, I let the data determine its own antiphon opening types, rather than forcing an external method of classification onto the data.

As the purpose of this cross-manuscript comparison was the identification of common *differentia*-antiphon connections, only those connections that frequently occurred within the dataset were considered. I defined common relationships using a variation of the frequency ratio score employed in chapter 1 for determining common *saeculorum*. Here, I calculated the ratio of the number of instances of a unique connection within a mode to the total instances of *amen*-antiphon connections in the same mode. For example, the *amen* Ga-Ga leads to 100 antiphons in mode 1 that start with an opening pitch contour of Da. There are a total of 4,451 connections in mode 1 in my dataset. Therefore, the Ga-Ga to Da connection has a commonality score of 0.02247. I included any connection that scored with a commonality score of 0.002 or higher, which omits connections that occur 2-11 times within the dataset, proportional to the number of antiphons in each mode (see Table 3.2). Connections that occur so infrequently were likely a result of scribal error or exceptions found within a single manuscript—i.e., regional peculiarities.

18. François Auguste Geveart, *La Mélopée Antique dans le Chant de l'Église Latine* (Gand: Librairie Générale de Ad. Hoste, 1895), 230-381. Also see Ruth Steiner, "Thème 29 and the Medieval System of *Differentiae*," in *Gedenkschrift für Walter Pass* (Tutzing: Hans Schneider, 2002), 141-156. Steiner examines *differentiae* and antiphons using one of Geveart's themes and the *Cantus Manuscript Database*. She comes to the conclusion that "While certain sources do indeed use *differentiae* to keep chants on Thème 29 separate from the rest, others do not…[and] the classification methods that define them vary from one source to another. It is thus not surprising that the usual explanation of their role in general [the idea of a 'smooth connection']…fails to address the more interesting function that some of them have in certain sources" (p. 154). I would add that relying on Geveart's themes exclusively fails to address some of the more interesting cross-manuscript consistencies across the possible *differentiae*-antiphon connections.

Table 3.2. Definition of 'common' *differentia*-antiphon connections by mode. *Differentiae* are grouped by their 'amen' and antiphons are grouped by the first two notes of their pitch contour. *Tonus peregrinus differentiae* and their associated antiphons were omitted from the analysis as there were insufficient examples (19) of in the data set. Only non-transposed antiphons and *differentiae* were included.

Mode	**Total connections**	**Unique** *amen* endings	**Unique antiphon openings**[19]	**Unique connections**	**Common relationships** (Commonality score: >0.002)	**Unique 'common' connections**	**Total 'common' connections**
1	4,451	24	43	161	9+	44	4,196
2	1,296	7	33	64	3+	33	1,255
3	1,298	19	31	94	3+	38	1,227
4	2,002	26	42	167	5+	48	1,811
5	693	5	27	39	2+	22	676
6	931	2	22	23	2+	19	927
7	2,936	14	43	159	6+	40	2,726
8	5,318	16	43	107	11+	32	5,160
Totals:	**18, 925**	**85**	**70**	**738**		**263**[20]	**17,978**

3.2.2 Common Rules for *Differentia*-Antiphon Connections by Mode

The data reveals a series of underlying rules for each mode that indicate how and why each *amen* might have been deemed appropriate for certain antiphon openings. Three modes (2, 6, and 5) have very little variation in their *amen* endings. Mode 6 antiphons are preceded by the same *amen* ending (G-F), regardless of how the antiphon begins, and modes 2 and 5 have two and three common *amen* endings

19. Where the antiphons are grouped by the first two notes of their pitch contour.

20. Although I do not do so in this chapter, it might be worthwhile to examine the 12 connections that appear in multiple modes. From a cursorary glance, it would seem that some *amen* endings that appear in multiple modes lead to antiphons with the same opening contours in multiple modes. For example the *amen* a-G leads to antiphons opening on aG in modes 1 and 8, and the *amen* c-ba leads to antiphons opening on Ga in modes 3 and 7. The overlap here between modes is not a result of shared reciting tones (as with multi-modal *saeculorum*) but shared or similar ranges.

respectively.[21] Mode 2 *amen* endings are either set to C-D or CD-D, the selection of which is largely source-dependent (see Table 3.3). The only manuscript that regularly uses both endings is *CH-E 611* (as well as a third ending, E-CD), and the reasoning behind which ending is used when requires further source-specific analysis. The selection of one or the other *amen* does not appear to be contingent on the antiphon opening, part of the Office, whether it was sung in the *Temporale* or *Sanctorale*, or the location within the manuscript. However, the difference between the *amen* endings is negligible, so perhaps they were simply employed to provide melodic variety and selected based on the cantor's personal preference. Otherwise, one *amen* was considered sufficient for all mode 2 antiphons in a source.[22]

21. A slight variation, G-FG, of the common mode 6 *amen* precedes two antiphons in *DK-Kk 3449 8o* which open F-G, but it is not clear why this variation is used, and it is not used elsewhere in the dataset. Johannes Cotto, among others (see *differentiae* **8a**, **265a**, and **8g**), includes this variant in his tonary, but does not explain why it is present or in which situations it should be used. He simply states, "*Una est huic modo differentia huius modi*" (This mode has one *differentia* as follows). JOHDEM, 186; Cotto, *De Musica*, transl. and ed. by Babb and Palisca, 179.

22. See, for example, BERTON, 270.

Table 3.3. Mode 2 *amen* endings by manuscript. The number of antiphons that follow each *amen* is indicated for each source. The table excludes *amen* endings that only appear one or two times within a single manuscript.

Siglum	C-D	CD-D	E-CD
F-Pnm lat. 12044	135		
D-Mbs Clm 4303 to 4306	127		
CH-Fco 2	125		
F-Pnm lat. 15181	96		
CDN-Hsmu M2149.L4	53		
PL-WRu I F 401	48		
D-KNd 1161	38		
*A-Wn 1799***	52	3	
CH-E 611	38	78	6
I-Ac 693	4	64	
NL-Uu 406		144	
DK-Kk 3449 8o II to XVII		137	
D-KA Aug. LX		55	
A-KN 1018		47	
A-KN 1012		36	

Mode 5 has one standard *amen*, c-a, which is used with all types of antiphon openings and in all manuscript sources, and two other *amen* endings that appear in some sources, but not others (see Table 3.4).[23] The first, c-aG, adds a passing tone between the standard *amen* and the beginning of its associated antiphons, all of which start on F. The second, c-ac, either creates a unison connection to the start of the antiphon or approaches the antiphon by a downward fifth.

23. The following sources use the c-aG *amen*: *NL-Uu 406* (22 of 91), *A-KN 1012* (11 of 21), *A-KN 1018* (12 of 24), *CH-E 611* (10 of 61), *D-Mbs Clm 4303 to 4306* (14 of 56), *D-KA Aug. LX* (7 of 21), *DK-Kk 3449 8o I to XVII* (16 of 111), and *PL-WRu R 503* (1 of 1). The following sources use the c-ac *amen*: *F-Pnm lat. 12044* (14 of 56), *D-Mbs Clm 4303 to 4306* (10 of 56), and *I-Ac 693* (3 of 25). Numbers in brackets indicate the number of mode 5 antiphons using the indicated *amen* out of the total mode 5 antiphons in the manuscript.

Table 3.4. Mode 5 *amen* endings and antiphon openings. Numbers indicate the number of antiphons in the dataset that are preceded by each 'amen' (columns) and have the two-note opening contour (rows)

	c-a	c-ac	c-aG
aG	118		
aF	111		
ca	43		
ac	10		
Ga	9		
Gc	3		
GF	3		
ab	2		
ba	2		
bG	2		
ED	2		
cd	64	6	
cb	63	6	
Fa	116	13	76
FG	13		8
ce			3
Fc			3

The limited variation within *amen* endings for modes 6, 2, and 5 is consistent with medieval theoretical sources, most of which acknowledge the limited variation within these modes and attribute it to comparatively less variation in their possible antiphon openings.[24] That is, there are fewer possible *amen* endings, because fewer different transitions were required. Within the dataset, mode 2 antiphons mostly start on C, D, or F; mode 5 antiphons start on F, G, a, or c; and mode 6 antiphons predominantly start on F (see **Appendix C**). The variation in antiphon openings for these modes is more extensive and closer to the other modes than theoretical sources seem to acknowledge, as one might expect from sources that transcribe a practical tradition as compared to those that try to make sense of and standardize the tradition. When the *amen* is varied (particularly in mode 5), it is dependent on the following antiphon.

24. See, for example, BERTON, 270, 273-274; JOHDEM, 169, 182-188; and Page, transl., *Summa musice*, 111-112.

However, for the most part, it appears as if adjustments to the *amen* in modes 2, 5, and 6 were unnecessary for the creation of an 'appropriate' connection. These three modes also have the fewest antiphons (1,296, 693, and 931 respectively), so perhaps multiple divisions of the antiphons (regardless of how they opened) were simply not necessary. This would suggest, for these modes at least, that the selection of the *amen* was more dependent on the division of antiphons into appropriately-sized groups for memorization purposes than creating the 'ideal' melodic connection from the end of the doxology back to the beginning of the antiphon. This does not, however, account for the multiple *amen* options in mode 3, which also has relatively few antiphons within the dataset (1,298).

The remaining modes' (1, 3, 4, 7, and 8) *amen* and antiphon connections are more varied and indicative of an attempt to adjust the *amen* in accordance with the antiphon's melodic incipit on a more consistent basis. The common connections within each mode can be summarized as a series of 'rules.' The subsequent five paragraphs define these rules for each mode, in order of increasing complexity, which parallels an increase in the number of antiphons found in each mode. That is, more antiphons lead to greater variety in possible *amen*-antiphon connections.

In mode 3, there are two groups of possible connections: *amen* endings that start each syllable with a and G respectively lead to antiphons that contain E (the final) in their opening gesture, whilst *amen* endings that feature c (the reciting tone) lead to antiphons that do not contain E and start within a higher range (see Table 3.5). As such, in this mode, the range of the *amen* is indicative of the range of the subsequent antiphon opening; higher *amen* endings lead to higher antiphon openings and lower *amen* endings lead to lower antiphon openings.

Table 3.5. Mode 3 *amen* (rows) and antiphon (columns) connections.

	a-Ga	a-G	a-GE	a-GF	G-FG	ac-c	c-b	c-ba	c-c	c-ca
ED	96	59	38	23						
EF	24	35	27	8						
EG	17	25	17	10						
FE	3		5	5						
ab	3									
Ga		35[25]			3		100		31	46
ac							4	4		
cG									3	
CD								3		
FG								7		
ca						3	7	3	5	
Gb							6	11		
Gc						6	27	138	25	15

Mode 4 has three categories of *amen*-antiphon connections, with a few outliers (see Table 3.6). Antiphons that begin on D or C and ascend by step are preceded by *amen* endings that move downward from *G* towards the start of the antiphon, and antiphons that open near G and a are preceded by *amen* endings that feature the same notes. Three *amen* endings (GF-E, GFE-E, and G-E) are closely related to the first group of descending *amen* endings, but appear with a larger variety of antiphon openings. Significantly, though, with a few exceptions concerning the GF-E *amen* (noted in the table), these three *amen* endings are mostly used with lower antiphon openings, and do not overlap with the second group of *amen*-antiphon connections, which centre around G and a. The specific use of this third group of *amen* endings in relation to the first group is largely source-dependent.

25. The only exception to the mode 3 *amen*-antiphon 'rules' is the a-G *amen*, which is also occasionally used for antiphons that start with a *Ga* contour. However, this particular relationship is limited to six or fewer connections within a single manuscript and is only used in certain manuscripts, where it is the exception, rather than the rule. For an example of its use in *F-Pnm lat. 15181*, see later in this chapter.

Table 3.6. Mode 4 *amen* (rows) to antiphon (columns) connections

	G-E	GF-E	GFE-E	G-ED	G-EF	G-EFD	G-EFED	G-FE	GF-ED	G-EG	G-a	a-Ga	G-Ga	a-G	a-b
DC	6														
CD	45	16	22	46		11	23	17	8						
DE	62	25	9		142					127[26]					
ED	215	14	14								8[27]				
EF	122	23	11												
FD	145	69	22												
FE	188	106	55												
FG	24	7	7												
DF	14	8													
cG	30[28]														
Ga	9[29]									46	5	6	8	15	11
EG	16[30]	5									12			13	
GF	5	5									7				
aG													7		

The range of mode 7 antiphon openings is much more limited than any other mode, so the connections made between *amen* and antiphon opening are more restrained in their variety, but still evident (see Table 3.7). There are two main categories of mode 7 antiphon openings: those that contain G in their opening gesture; and those that do not, which have a higher range. The first group of antiphons are either preceded by an *amen* that descends towards the start of the antiphon (e.g., c-ba and c-cb), or by an *amen* that ends on d or e, and thus approaches the start of the antiphon by leap downwards. The latter *amen* endings lead to antiphons that also contain a leap in

26. The overlap between the two categories here is manuscript specific: G-EG *amen* endings are predominantly used to precede DE antiphon openings in the following manuscripts*: A-KN 1018, D-KA Aug LX*, and *DK-Kk 3449 8o [01] to [17]*. In *NL-Uu 406*, the same *amen* is more commonly followed by antiphons opening with Ga.

27. Infrequent *amen.* Used with ED antiphons in the following manuscripts: *A-Wn 1799*** (1); *CDN-Hsmu M2149.L4* (1); and *F-Pnm lat. 15181* (6).

28. Connection only occurs in *NL-Uu 406*.

29. Infrequent connection. Only occurs 1-5 times in 3 manuscripts.

30. Infrequent connection. Only occurs 1-5 times in 7 manuscripts.

their opening gesture (i.e., not Ga). The second, higher range group of antiphon openings are preceded by *amen* endings that stay close to c (often containing c in both syllables) and approach the antiphon by unison, step, or third. As in all modes, the specific division of antiphon openings between *amen* endings is more specific in individual sources.

Table 3.7. Mode 7 *amen* (columns) to antiphon (rows) connections

	c-ba	c-cb	c-cd	c-d	c-e	dc-d	c-bd	c-c	c-bc	c-b	c-dc	cd-c
CD	6											
GF	7											
aG	7											
Ga	270	8										
Gc	226	34	9									
Gb	727	49	46					12[31]				
Gd	15		39	17	19	115	82[32]					
bc							36				78	
bd							30			15		
db							144	74	385	42		
dc							17	12	69			
de								9	20			
ab										15		
ad									12	10		
cb											27	9
cd											18	

Mode 1 *amen* endings fit into two categories: those that descend from G to D and those that centre around G and a. Each category leads to particular types of antiphon openings (see Table 3.8) with the exception of Ga-G, the most common *amen* in mode 1, which is used with all types of antiphon openings. Like mode 4, the use of this common *amen* is largely source-dependent and often used as a substitute in manuscripts that do not include *amen* endings for both categories described above. For

31. Infrequent connection. Occurs 2 to 7 times each in the following manuscripts: *A-KN 1012*, *A-KN 1018*, *DK-Kk 3449 8o.*

32. Exclusively in Cistercian manuscripts (*A-Wn 1799***, *CDN-Hsmu M2149.L4*, *D-KNd 1161*, and *PL-WRu 401*). All other manuscripts precede GD antiphons with one of the *amen* endings from the first group. For more on the consistency of *differentiae* within Cistercian manuscripts, see Conclusion.

example, the four Cistercian manuscripts (*A-Wn 1799**, *D-KNd 1161*, *CDN-Hsmu M2149.L4*, *A-Wn 1799***, and *PL-WRu I F 401*) do not use a descending *amen*; they substitute Ga-G (see Table 3.9).[33] With the exception of this *amen*, descending *amen* endings lead to ascending antiphons, connected by unison, which may be preceded by a lower neighbour. The second category of *amen* endings can be subdivided into two categories: those that contain two notes on each syllable and those that do not. The first subcategory connects to antiphons by leap and these antiphons often also contain leaps in their ascending opening contour. The second subcategory does not connect by leap and always leads to antiphons that start closer to a (the reciting tone).

Table 3.8. Mode 1 *amen* (rows) to antiphon (columns) connections

	Ga-G	a-G	aG-a	G-a	G-aG	G-Ga	G-GaG	Ga-Ga	Ga-GF	GF-Ga	G-GFED	Ga-GFD	Ga-GFED	GF-D
aG	11	18	21	127		53								
Fa	23	27	10	34	17									
FE	28			21		42								
FG	119	13			56		121							
FD	23													
FC	105													
EC	21													
GC	24													
DC	826								161		50	12	35	
DE	184								35		13			18
DF	563								66		80	18	14	
CD	298							95			96	177	296	
Da	81							100		58				
CE									9					

33. The descending mode 1 *amen* a-GFED occurs once in *CDN-Hsmu M2149.L4*.

Table 3.9. Mode 1 *amen*-antiphon connections in Cistercian manuscripts (*A-Wn 1799**, D-KNd 1161*, *CDN-Hsmu M2149.L4*, *A-Wn 1799***, and *PL-WRu I F 401*).

	Ga-G	G-a
DC	185	
DF	146	
CD	129	
FG	62	
DE	44	
Da	28	
FC	22	
FE	11	13
Ga	5	
FD	4	
ac	3	
aG	3	58
Fa		23
aF		7

Mode 8, which is the most frequently-used mode for antiphons, has two main *amen* categories that lead to two different types of antiphon openings, and one *amen* (a-G), which is common to most antiphon openings, like in modes 1, 2, 5, and 6. As in other modes, the application of this *amen* is largely source-dependent. For the remaining *amen* endings, those that feature a and G lead to antiphons whose openings range from E to G, whilst those set in a higher range (featuring c and d) lead to antiphons that similarly open within this higher range (see Table 3.10). The only exception to these groups is a-Ga, which predominantly functions as a 'high' *amen* (despite its use of a and G); this *amen*, unlike the others in the first category of 'low' *amen* endings ends in an upward trajectory, suggesting that the subsequent antiphon begins at a higher pitch. It only commonly functions as a 'low' *amen* in *F-Pnm lat. 12044* to approach antiphons that open with FG.

Table 3.10. Mode 8 *amen* (columns) to antiphon (rows) connections.

	a-G	a-GaG	a-GaGF	a-Ga	c-cd	cd-c	d-c
aG	65						
Fa	34						
CD	29						
DE	27						
DF	17						
ac	61						
aE	33						
aF	293						
Ga	727						
Gb	42						
Gc	1,145						
GD	217						
GE	40						
GF	798						
EF	26	144					
FG	419	83	11	52[34]			
ca	16			32		17	47
cb	22			113	11	43	419
cd						55	106
cG				16			

With the exception of modes 3 and 7, all modes have an *amen* that is common to all, or most, antiphon openings (within a cross-manuscript study), similar to the idea of a 'principal' *saeculorum amen* within theoretical sources. In discussions of *differentiae* in theoretical treatises, authors usually assign a principal *saeculorum amen* to each mode as a means of demonstrating variance from the principal, based on antiphonal considerations.[35] The existence of common *amen* endings (and entire *differentiae*) in manuscripts is suggestive of the same mindset, whereby variant *amen* endings are dependent on antiphon openings, but a common *amen* exists that can be used in all situations, particularly when a variant *amen* is not appropriate or does not exist. The variant *amen* endings are indicative of particular antiphon openings (see

34. Only used with FG in *F-Pnm lat. 12044*.

35. See, for example, Johannes Cotto's treatise which comments on this practise even whilst employing it. JOHDEM, 161-162. Also, Page, transl., *Summa musice*, 111.

summary in Table 3.11), but if a particular type of *amen* was not in use at a particular institution, the modally-common *amen* was substituted. Of those *amen* endings that are differentiated, the following general rules usually apply, regardless of mode:

1) Descending *amen* endings (over more than a second) anticipate ascending antiphons, which are connected by unison or step
2) Antiphons preceded by leap also contain leaps in their opening contour
3) A lower neighbour note in the *amen* may anticipate a connection by leap to the start of the antiphon (e.g., c-ac in mode 5 and GF-Ga in mode 1)[36]
4) *Amen* endings with limited range ('unison-type') lead to antiphons with similar, limited, opening ranges
5) *Amen* endings never connect by an ascending leap. The connection is usually by descending leap, step, or unison, and very rarely by ascending second or third.

General features of the antiphon opening (i.e., range, direction, and type of motion) are thus frequently suggested by the preceding *amen*. The *amen* is 'appropriate' to the antiphon.

36. Brockett ends his article on *differentiae* with the comment, "Why admit myriads of terminations, when only one—the unison—appropriate to the sixth mode, conventional in the responsorial verse Antiphon, and emphasized by the *modulatio psalmi*, forges a much more solid connection." However, sometimes a unison connection is not appropriate. Antiphons that contain leaps in their opening melodies are frequently approached by a leaped connection in the opposite direction, in anticipation of the antiphon opening. Always connecting by unison would also create 'too many' *amen* variants when part of the purpose of *differentiae* was to categorize and group antiphons for pedagogical and mnemonic purposes. Brockett, "'Saeculorum Amen' and 'Differentia'," 35-36.

Table 3.11. Summary of possible *amen*-antiphon connections. The 'signifying factor' column indicates the predominant means by which a connection was deemed appropriate in each mode (i.e., range, type of motion, and/or direction of motion). The 'connection type' column indicates the most common intervals from the *amen* to the antiphon, and the 'antiphon' column defines any distinguishing features regarding the antiphon opening. As modes 2, 5, and 6, have no, or limited, antiphonally-dependent *amen* endings, these modes are not included in the table.

Mode	Signifying Factor	*Amen*	Connection Type	Antiphon[37]
1	type and direction of motion	descending (G to D)	unison ↓2	ascending, mostly by step
		G and a (with two notes per syllable)	↓3-6	ascending, with leaps
		G and a (other)	unison ↓2-3 ↑2	around F-a (limited range), no leaps
3	range	a[x]-G[x] (lower range)	unison ↓2-4	contain E (lower range)
		contain c (higher range)	unison ↓2-4	do not contain E (higher range, G to c)
4	range	descending (from G)	↓2-3	beginning on D or C, ascending by step
		featuring G and/or a	unison ↓2-3	beginning around G or a
7	range and type of motion	descending (c-ba, c-cb)	↓2-3	ascending, leap from G to d (sometimes partially filled in)
		ending on d (or e)[38]	↓5-6	ascending leap up from G
		unison-type around c	unison ↓2-3 ↑2	mostly stepwise, stays close to c

37. This column takes into consideration more than the first two notes of the antiphon where necessary. For example, a descending mode 1 *amen* (G to D) usually connects by unison to initially-ascending antiphons, but their first two notes may be a descending step: Ga-GFED sometimes connects to antiphons that begin DC, but then their trajectory continues upward (DCDE or DCDF). The two-syllable G and a *amen* Ga-Ga leads to antiphons that open with a leap, but this may be preceded by a lower neighbour, e.g., CDa.

38. Only in *NL-Uu 406*. The *amen* c-bd falls into the third category of mode 7 *amen* endings (those that stay close to c).

Mode	Signifying Factor	*Amen*	Connection Type	Antiphon
8	range	contain a and G	unison ↓2-3	range from E to G, upward trajectory
		contain c and d	unison ↓2	start on c, initial downward trajectory
		a-Ga	↑3	

3.2.3 The A*men*-Antiphon Connection in Practice

In the daily life of a medieval singer of antiphonal psalmody, the appropriateness and analysis of the *amen*-antiphon connection was probably not a topic of daily discussion. However, the appropriateness of the connection and the grouping of similar antiphon openings by their *amen* within a mode, would undoubtedly have made the singing of antiphonal psalmody easier and more predictable. The singing of psalms and their antiphons was meant as a contemplative ritual, which awkward and unusual connections between the *amen* and the repeat of the antiphon would have disrupted.[39] The connections created within a single manuscript, should, therefore, be consistent and understandable within the guidelines outlined above, with few exceptions.

A case study of a single manuscript will demonstrate how these connections would work for a particular singer encountering books from a single institution. *F-Pnm lat. 12044* is a twelfth-century antiphoner from the male, Cluniac monastery of St.-Maur-des-Fossés, east of Paris.[40] It contains 57 unique *differentiae* (15 of which are transposed) for 2,419 antiphons. At the time of analysis, the *Cantus Manuscript Database* included melodic transcriptions for 1,877 of these antiphons, 1,742 of which are not transposed. A brief examination of the *amen*-antiphon connections within this

39. Dyer, "The Singing of the Psalms," 535-536; Joseph Dyer, "Moastic Psalmody of the Middle Ages," *Revue Benedictine 99*, no. 1-2 (1989: 74.

40. Denise Gallo and Keith Glaeske, Inventory of "Paris, Bibliothèque nationale de France - Département des Manuscrits, latin 12044," edited by Alessandra Ignesti and Sheila Meadley Dunphy, in *Cantus Manuscript 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-). Also see the **tonary** for this manuscript on the *Differentiae Database*.

manuscript shows that it largely conforms to the 'rules' and categories of connections outlined above with a few of its own peculiarities (see Table 3.12). For example, this manuscript uses the common mode 1 a-G *amen* to approach antiphons by downward leap, and these antiphons contain leaps in their opening contour. While some antiphon openings in this manuscript have two possible *amen* endings (e.g., mode 4 antiphons with an ED opening can be preceded by either a-Ga or aG-Ga *amen* endings), one *amen* ending is always more common than the other, meaning that the less common of the two is the exception to the rule. Most overlaps also occur with the 'common' *amen* to the mode, suggesting that this *amen* was suitable and sufficient for most antiphon openings, whilst antiphon-specific *amen* variants were only appropriate for specific antiphon types.

Each *amen* in this manuscript leads to a particular and consistent set of antiphon openings that conform to the general rules outlined above for *amen*-antiphon connections. For example, the mode 8 *amen* a-Ga is always followed by an antiphon that starts on F, and the same *amen* in mode 3 always leads to antiphons that start on E. Descending *amen* endings (e.g., mode 1's G-GFED) lead down to the start of the antiphon, are connected by step or unison, and the opening of the antiphon is ascending; *amen* endings that connect by downward leap to the start of the antiphon (e.g. mode 7's c-cd and c-d) lead to initially ascending antiphons that usually contain a leap; and so on (see Table 3.12). The *amen* to antiphon connection is thus predictable and the antiphon opening is anticipated within the *amen*.

Table 3.12. Summary of *amen*-antiphon connections in *F-Pnm lat. 12044*. Only connections that occur a minimum of 4 times in the manuscript are indicated. See Table 3.11 for the "Connection rules." See Appendix D for a detailed overview of all *amen*-antiphon connections in this manuscript.

Mode	*Amen*	Connection	Antiphon	Instances
1	descending (G-GFED, Ga-GFED[41])	unison ↓2	ascending, predominantly stepwise	172
	G and a (Ga-GF[42])	↓3	ascending, with leap	5
	G and a (aG-a[43], G-GaG[44], G-Ga)	unison ↓2-3	limited range, no leaps	60
	common (a-G)	↓4-5	opening on D or C, with leap	189
2	common *amen* (C-D)	unison ↓2 ↑3	any	132
3	lower range (a-Ga)	↓4	starting on E	28
	lower-range (a-G)	unison	starting on G, descending	5
	higher range (c-b)	↓3	starting on G, ascending	57
4	common (GFE-E)	unison ↑2 ↓2-3	any	144
	descending (GFE-ED)	↓2	ascending	4
5[45]	common (c-a)	unison ↓3 ↑3	contain a or c	31
	c-ac	↓5	start on F	13

41. The Ga-GFED *amen* is used as an alternative to the G-GFED *amen* for five specific antiphons.

42. Used in this manuscript as an alternative to the descending (G-GFED) *amen* with five specific antiphons.

43. This *amen* mostly leads to antiphons that start Fa and aG (thus, the emphasis on a in the *amen*).

44. This *amen* mostly leads to antiphons that start FG (thus, the emphasis on G in the *amen*).

45. The mode 5 c-ac and c-a *amen* endings are not used within the same feast.

Mode	*Amen*	Connection	Antiphon	Instances
6	common (G-F)	unison ↓2	any	64
7	descending (c-ba)	↓2	ascending, from G	117
	unison-type (c-bc)	↑2	limited-range, starting on d[46]	65
	unison-type (c-dc)	unison ↓2	limited range, starting on b or c	26
	ending on d (c-cd, c-d)	↓5	ascending, leap from G	18
8	contains a and G (a-Ga)	↓3	range E-G	50
	contains c and d (d-c)	unison	start on c	82
	common (a-G[47])	unison ↑2 ↓2	start on G, F or a	351

3.3 Conclusion

There will always be exceptions to the rule when analyzing a musical feature whose rules for use were flexible and lacked clear definition at the point of inception, but the majority of *amen*-antiphon relationships follow a series of specific, unwritten (until now) guidelines that are applicable across manuscripts with minor modifications. The definition of these rules will allow future analyses of *differentiae* in one or more manuscripts to assess connections based on, and in relation to, a data-supported 'norm'.

The consistency of these connections, both within individual manuscripts, and across multiple manuscripts supports the theory of *differentia*'s mnemonic and pedagogical function, as defined by medieval theorists like Johannes Cotto and Perseus

46. The c-bc *amen* mostly leads to antiphons opening db or dc, where the opening direction of the antiphon (down) is the same direction as the neighbour tone of the *amen*.

47. In this manuscript, the a-G mode 8 *amen* acts as an *amen* containing a and G and leads to antiphons that mostly start on G or a.

and Petrus, and discussed by modern scholars in relation to the format and content of tonaries.[48] Through the association of particular *amen* endings with particular types of antiphon openings, the *amen* of a *differentia* acts as an aural reminder of the antiphon opening. That is, if one were to sing a descending mode 1 *amen* (e.g., GF-GFED) in the Cluniac monastery of St.-Maur-des-Fossés in the twelfth century—or anywhere, for that matter—one would know that the subsequent antiphon should begin on D, sometimes preceded by a C, and proceed upwards. By limiting the possible antiphon openings by range, type of motion, and/or direction, *differentiae*, and *amen* endings in particular, act as effective subcategories of mode by which to memorize the antiphons and to remember them in the act of singing the psalms. Thus, the *saeculorum* reminds the singer (and listener) of the mode and psalm tone, and the *amen* reminds the singer of the antiphon melody. The consistency of *amen*-antiphon openings would also ensure that the connection to, and content of, the antiphon opening was predictable, and therefore not jarring to either the singer or the listener within the contemplative ritual of antiphonal psalmody.[49] The use of data from antiphoners, rather than theoretical tonaries, in the assessment of this *differentia*-antiphon connection affords the modern reader a hitherto-unfeasible glimpse into the practical realities of singing the psalms in medieval Europe.

48. See, for example: Cotto, *De Musica*, transl. Babb and Palisca, 161; Page, transl., *Summa musice*, 111-113; Brockett, "'Saeculorum Amen' and 'Differentia'," 35-36; Shaw, "*Differentiae* in the *Cantus Manuscript Database*," 4-8; JOHDEM, 193-198; Anna Maria Busse Berger, *Medieval Music and the Art of Memory* (Berkley: University of California Press, 2005), 47; Matthews and Merkley, "CANTUS and Tonaries," 541; Steiner, "Thème 29 and the Medieval System of Differentiae," 145; Fiona McAlpine, "Beginnings and Endings: Defining the Mode in a Medieval Chant," *Studio Muiscologica Academiae Scientiarum Hungaricae* 45 (2004): 166; Falconer, "The Modes before the Modes," 141.

49. The predictability of the relationships between *amen* endings and antiphon openings within each mode could also help the modern scholar to assign *differentiae* to antiphons in manuscripts where no consistent *differentia* indications are provided throughout the manuscript. For example, *CZ-Pu vi.E.4c* contains a tonary (f. 8v), including an example of a melodic antiphon incipit for each *differentia*, but does not consistently reference the *differentiae* therein throughout the manuscript. Applying the relationships defined in this chapter in conjunction with the tonary in this manuscript could help someone determine which *differentiae* were sung with which antiphons throughout the manuscript. However, this has not yet been attempted and could be an entire research project of its own. *D-KNd 215* similarly contains a tonary and the connection between this tonary and the tonary letters provided throughout the manuscript is unclear. The relationships identified in this chapter could help to unravel this ambiguity.

Chapter 4: Conclusions and Broader Implications for *Differentia*-based Cross-Manuscript Analysis[1]

Of course, mode and antiphon opening are not the only factors that influence the selection of *differentiae* in a manuscript. *Differentiae* are also products of a particular place, time, and monastic order or secular institution. When Perseus and Petrus advise their readers to consult a tonary, it is not just so that they can memorize the relationships between *differentiae*, antiphons, and mode, but also to ensure that the singer follows the customs of her particular institution: "do as the Romans do when in Rome; when you are elsewhere you should sing as they do there."[2] Much like medieval theorists' acknowledgement of a connection between *differentiae* and mode, and *differentiae* and antiphons, most theorists' descriptions of regional variance are limited to cursory statements, much like that of Perseus and Petrus.[3] Treatises that are less pedagogical and more encyclopedic in style provide more extensive comparisons.

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1. Throughout my thesis, bolded texts, including most Figure and Table headings, are hyperlinked to supplemental resources in the *Differentiae Database* (e.g., interactive tables created with the data mapping application "Tableau" and standardized *differentia* data for each theoretical treatise and manuscript included in the database). At the time of publication, the *Differentiae Database* is accessible at the URL (differentiaedatabase.com) but is password protected; the database will be published and publicly available by the end of October 2019. For access to the database prior to this date, please contact the author. The database will also be moving to a new location as part of the Digital Analysis for Chant Trasmission (DACT) project; once moved, the database will be acccesible at dact-chant.ca.

2. Christopher Page, transl., *Summa musice: A Thirteenth Century Manual for Singers* (Cambridge: Cambridge University Press, 1991), 111-112. Others medieval theorists that acknowledge regional variance include: Johannes de Grocheio, *Ars Musicae*, ed. and transl. by Constant J. Mews, John N. Crossley, Catherine Jeffreys, Leigh McKinnon, and Carol J. Williams (Kalamazoo, Michigan: Medieval Institute Publications, 2011), 104-105; Johannes de Muris, *Summa*, in *Scriptores ecclesiastici de musica sacra potissimum*, vol. 3, ed. Martin Gerbert (Hildesheim: Georg Olms Verlagsbuchhandlung, 1963), 231; JACSP6B, 237-238; CARTRA, 460; SZAMUS, f. 52a-52b; Rudolf of St. Trond, *Quaestiones in musica*, ed. Rudolf Steglich, in *Die Quaestiones in musica: Ein Choraltraktat des zentralen Mittelalters und ihr mutmasslicher Verfasser Rudolf von St. Trond (1070-1138)* (Leipzig: Breitkopf und Härtel, 1911), 46. Full citations for coded theoretical treatise references (e.g., SZAMUS) are provided in **Bibliography: Theoretical Treatises**. All codes are those assigned by the *Thesaurus Musicarum Latinarum* (TML).

3. Modern scholars' acknowledgements of regional *differentia* variation are similarly brief: in his study of Italian antiphoners, Joseph Dyer stated that, by the fourteenth century, a core set of *differentiae* was shared by most manuscripts with some regional variation; and Lila Collamore identifies a distinction between *differentiae* found in Aquitanian sources, and those from Provençal, Limousin, Midi, and Iberia. However, both studies are limited in terms of their geo-temporal scope. Joseph Dyer, "The Singing of Psalms in the Early-Medieval Office," *Speculum 64*, no. 3 (July 1989): 568; Lila Diane Collamore, "Aquitanian Collections of Office Chants: A Comparative Survey" (PhD diss., The Catholic University of America, 2000), 202-207.

The English theorist Amerus (fl. 1271) distinguishes between *differentiae* used in England and France and those used by the Roman Curia in his treatise *Practica artis musice*, written during his time with Cardinal Ottobono Fieschi in Italy.[4] The fourteenth-century Franco-Flemish theorist Jacobus of Liège (1260 - after 1330) defines three regions of *differentia* use: Liège churches, French and Roman churches, and monastic orders (particularly Cistercian and Dominican).[5] The relative lack of wide-reaching geographic comparisons of *differentiae* is not surprising as such studies necessitate access to and intimate knowledge of the particular practices of numerous institutions. The fourteenth-century theorist Guido de Sancto Dionysio prefaces his discussion of *differentiae* with an acknowledgement of such limitations:

> It should be known, therefore, that as far as I have been able to put together from our antiphonary and gradual, according to our use as far as concerns antiphons, there are nine *differentiae* of the first tone, and as regards *officia* or introits there are two. Of the second tone, as regards antiphons there is only one, and similarly one as regards introits…[6]

Moreover, contextualizing *differentiae* in practise, rather than theory, a singer did not need to know how to sing *differentiae* at other monasteries or cathedrals; she needed to know how to sing *differentiae* at her own institution.

While certain *differentiae* appear in almost every manuscript, regardless of time or place, others are indicative of a manuscript's temporal, geographic, and/or institutional provenance. To demonstrate the broader significance and implications of cross-manuscript *differentia* analysis, I offer here some suggestions and analytical methods by which understanding a manuscript's *differentiae* can contribute to

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4. AMEPRA, 38-44. F. Albert Gallo, "Amerus [Aluredus, Annuerus, Aumerus]," in *Oxford Music Online* (2001).

5. Karen Desmond, "Behind the Mirror: Revealing the Contexts of Jacobus's *Speculum musicae*" (PhD diss., New York University, 2000), 27-28, 62-63.

6. "Sciendum est igitur quod, quantum colligere potui ex nostro antiphonario et gradali, primi toni secundum usum nostrum quantum ad antiphonas novem sunt differentie et quantum ad officia sive introitus due; secundi vero toni quantum ad antiphonas una tantum et similiter quantum ad introitus unica…." GUISTON, 66; English translation from Guy of Saint-Denis, *Tractatus de Tonis*, eds. and transl. by Constant J. Mews, Carol J. Williams, John N. Crossley, and Catherine Jeffreys (Kalamazoo, Michigan: Medieval Institute Publications, 2017), 101.

considerations of provenance and transmission. Namely, I proffer *differentiae* as a means by which to assess manuscript similarity.

4.1 Style of *Differentia* as Geo-Temporal Indicator

One simple geo-indicative feature of *differentiae* is the way in which they are notated within a manuscript. For the most part, *differentiae* are written within the main writing space of the manuscript, usually immediately following the antiphon with which they are sung; 133 of the 159 manuscripts included in the *Differentiae Database* are written in this way. The visual association of the last note of the each antiphon with the first note of the *differentia* (the reciting tone) is a quick reminder of mode. The remaining manuscripts include their *differentiae* in the margins of the manuscript, either fully notated or referenced with tonary letters. Marginally-notated *differentiae* appear in manuscripts from the eleventh to the fourteenth centuries and are only found in modern-day Netherlands, Germany, and Switzerland. Tonary letters are restricted to a smaller geographic area, as they are, more specifically, from places in close proximity to St. Gall (modern-day Austria and southern Germany) (see Figure 4.1). The tonary letter system originated in tenth-century St. Gall, possibly with Hartker, and is thus limited in its geographic dispersal.[7] Within my dataset, manuscripts using tonary letters are dated from the tenth, twelfth, and fourteenth centuries and are located in St. Gall and nearby Benedictine monasteries. As a geo-indicative feature, the presence of tonary letters could support an argument for south German-Austrian provenance, likely from a Benedictine monastery, for a manuscript or fragment of unknown origins.

7. Lisa Fagin Davis, *The Gottschalk Antiphonary: Music and Liturgy in Twelfth-Century Lambach* (Cambridge: Cambridge University Press, 2000), 67-68. Johannes Cotto, active in or near St. Gall in the early twelfth century, describes these letters in his *De Musica*: "One should also know that by some the phtongi - that is, the tones - are designated by vowels, and the *differentiae* of the tones...by consonants, in this way: a denotes the first tone, e the second, i the third, o the fourth, u [v] the fifth, Greek H the sixth, y the seventh, and ω the eighth. And b indicates the first differentia of any tone, c the second, d the third, g the fourth, and so on, with the mute consonants in alphabetical order." Johannes Cotto, *De Musica*, in *Hucbald, Guido, and John on Music: Three Medieval Treatises*, transl. and ed. by Warren Babb and Claude V. Palisca (New Haven: Yale University Press, 1978), 121.

Figure 4.1. Map showing locations of manuscripts with marginally-notated *differentiae* (circles) and tonary letters (squares).

4.2 Geo-indicative *Saeculorum* Openings

Beyond the types of *differentia* indications in manuscripts, the musical content of these formulas can also be indicative of a manuscript's provenance. While the *saeculorum* of a *differentia* is indicative of its mode and psalm tone, and the *amen* is suggestive of the repetition of the antiphon, a *differentia* is also a product of its time, place, and institution. Some *saeculorum*, for example, only appear in particular manuscripts, related by time, place and/or type of institution. Ten *saeculorum* only appear in *I-BV 19*, *I-BV 20*, and *I-MC 542* (see Figure 4.2), all twelfth-century antiphoners in Beneventan notation that also contain chants written in a Beneventan style, despite the suppression of the Beneventan rite in the eleventh century:[8]

Mode 3: b-b-a-ac, b-b-cb-ab, c-a-ac-a, c-c-d-b, c-c-dc-bc
Mode 4: a-a-a-aba, a-G-b-a

8. Matthew George Peattie, "The Beneventan Antiphon and Influence of Beneventan Style in the South Italian Office" (PhD diss., Harvard University, 2005), 25-26. Thomas Forrest Kelly, *The Beneventan Chant* (Cambridge: Cambridge University Press, 1989), 30-40, 49-50. All sigla follow RISM protocols; full identification of manuscripts is included in the **Bibliography**.

Mode 6: a-a-G-a, a-a-GF-Ga
Mode 8: c-c-ba-c

One of these *saeculorum* in particular (mode 8, c-c-b-a), appears with three Beneventan-style antiphons: *Insigne praeconium* (*I-MC-542*, p. 86); *Mandaverunt Iuliano Caesari* (*I-BV 20*, f. 204r); and *Sancti vero una ore* (*I-BV 20*, f. 278r), in the feasts for Saint Vincent, Saints John and Paul, and the Holy XII Brothers of Benevento, respectively.[9] Due to the isolated occurrences of these *saeculorum* and the manuscripts' connections to Beneventan chant, these *saeculorum* (and their complete *differentiae*), may be remnants of, or at least influenced by, Beneventan psalmody, which, like the Old Roman liturgy in *I-Rvat SP B.79*, followed a different conception of mode.[10]

Figure 4.2. Map showing the isolated occurrences of certain *saeculorum* patterns in three twelfth-century manuscripts with Beneventan-style antiphons: *I-BV 19* and *20* (Benevento) and *I-MC 542* (Montecassino).

9. Peattie indentifies Beneventan-style antiphons in these manuscripts in his dissertation, "The Beneventan Antiphon," 109-126.

10. On Beneventan psalmody, see Peattie, "The Beneventan Antiphon," 57-58; Kelly, *The Beneventan Chant*, 143-153. Note that the *differentiae* indicated as potentially 'Beneventan' here do not correspond with those identified by Kelly from manuscripts containing specifically-Beneventan psalmody (pp. 145-146).

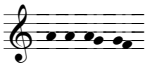
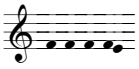
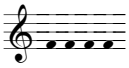
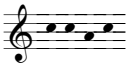
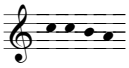
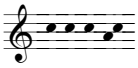
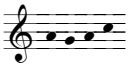
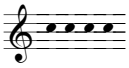
Other clusters of *saeculorum* appear to be divided according to linguistic classifications of the vernacular language, as well as geographic proximity. Certain *saeculorum* predominantly appear in manuscripts from Germanic- and Slavonic-language regions, with a few extensions into Italy (see Table 4.1 and Figure 4.3, Group 1).[11] Others appear only in manuscripts where the vernacular language was one of the Romance languages (Group 2), and some only appear in manuscripts from Iberia (modern-day Portugal and Spain), sometimes also including French manuscripts (Group 3). A smaller cluster of manuscripts near St. Gall contain unique, geo-indicative *saeculorum* as well (Group 4), and others are only found in English manuscripts and/or along the northwest coast of Europe (Group 5). Some of these clusters of *saeculorum* are also used for specific antiphons. For example, the mode 5 *saeculorum* c-c-a-b only appears in manuscripts containing Sarum chant and liturgy (*GB-Cu Mm.ii.9* and *GB-AB 20541 E*), and is specifically associated with the antiphon *Alma redemptoris* for the Octave of the Nativity of Mary.[12] Similarly, the mode 6 *saeculorum* a-a-F-a only appears in St. Gall-area manuscripts (*A-Wda D-4*, *DK-Kk 3449 8o XV*, and *SI-Lna 19*) with the antiphons *Benedixit filii* and *Benedictus domini*.

11. Langauge classifications in this thesis (i.e., Germanic, Slavonic, and Romance languages) follow the classifications in Glanville Price, ed., *Encyclopedia of the Languages of Europe* (Oxford: Blackwell Publishers Ltd., 1998), 206-208,376-379, 436-439. They are not politically-defined regions, merely linguistic groups. Germanic languages include Icelandic, Faroese, Norwegian, Swedish, Danish, English, Frisian, German, Yiddish, Dutch, Afrikaans, and Gothic, although you will notice that not all of these languages are represented within the dataset. English manuscripts form a separate subset of geo-indicative *saeculorum* from the rest of the Germanic-languages, so are identified separately in Table 3.1 and Figure 3.3. Manuscripts from the St. Gall area also have their own subset of geo-indicative *saeculorum* specific to this region, but not the rest of the Germanic- and Slavonic- speaking area, and are thus given their own category in Table 3.1 and Figure 3.3. Slavonic languages include Slovene, Serbo-Croat, Bulgarian, Macedonian, Old Church Slavonic, Czech, Slovak, Polish, Sorbian, Cassubian, Polabian, Russian, Ukranian, and Belarusian. Romance languages include Portugues, Spanish, Catalan, Occitan, French, Rhaeto-Romance, Sardinian, Italian, Dalmatian, and Romanian. As with English and St.-Gall area manuscripts, manuscripts from Spanish- and Portuguese-speaking countries also have their own subset of geo-indicative *saeculorum*, as identified in Table 3.1 and Figure 3.3.

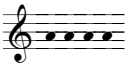
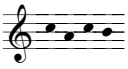
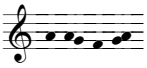
12. The same *saeculorum* appears with mode 3 antiphons in *SI-Lna 18* and *19.*

Table 4.1. Summary of geo-indicative *saeculorum*. Exceptions to the groupings are indicated in the footnotes. See corresponding maps in Figure 4.3.

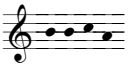
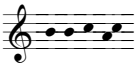
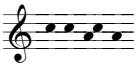
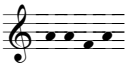
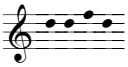
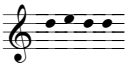
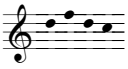
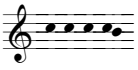
Group 1: Germanic and Slavonic languages

Mode	*Saeculorum*
1	
2	 [13]
2	 [15]
3	 [18]
3	
3	
4	
8	

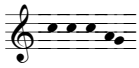
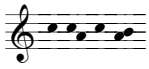
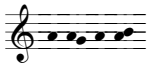
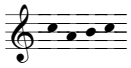
Group 2: Romance languages

Mode	*Saeculorum*
1	
3	 [14]
6	 [16]

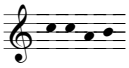
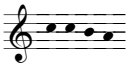
Group 4: St. Gall area

3	
3	
3	
6	
7	
7	
7	
8	

Group 3: Iberia

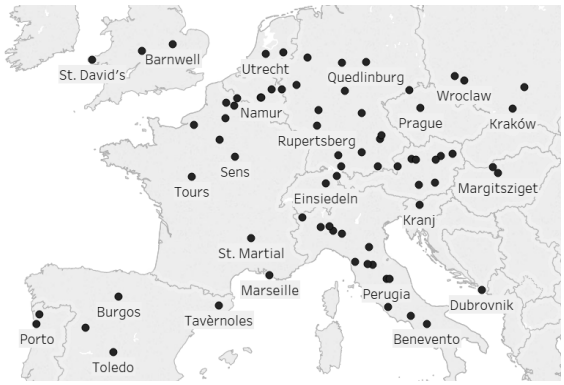
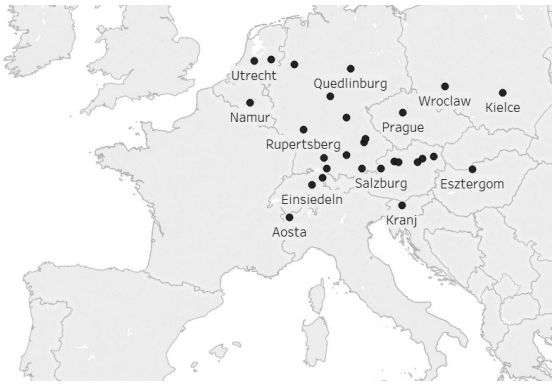
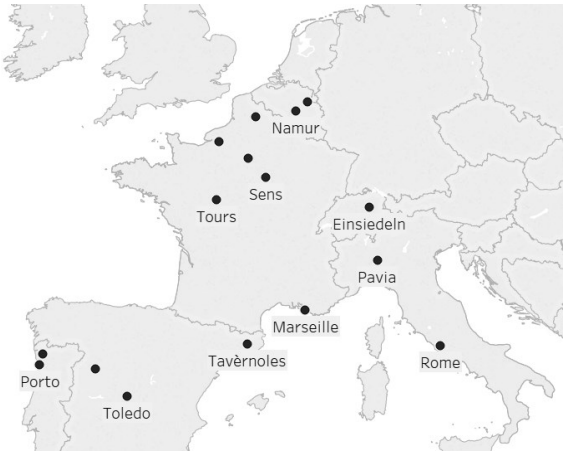
Mode	*Saeculorum*
3	
3	
4	 [17]
8	 [19]

Group 5: England and Northwest Europe

5	
8	

13. Exception: *US-NYcub Plimpton 41* (Perugia)
14. Exception: *H-Bu lat. 118* (Margitsziget)
15. Exceptions (Franciscan manuscripts): *US-NYcub Plimpton 41* (Perugia); *D-Ma 12o Cmm 1*, *I-Ac 693* and *694*, *I-Ad 5*, and *I-Nn vi.E.20* (Central Italy)
16. Exception: *UStPFragm01* (Utrecht)
17. Exception: *CH-SGs 388*, *390*, and *391* (St. Gall)
18. Exception: *I-Ad 5* (Central Italy)
19. Exception: *F-Pnm lat. 1085* (St. Martial)

Figure 4.3. Maps of geo-indicative *saeculorum*, as identified in Table 4.1.

All manuscripts	Group 1: Germanic and Slavonic
	
Group 2: Romance languages	**Group 3: Iberia**
	
Group 4: St. Gall-area	**Group 5: England and Northwest Europe**
	

The presence of such geo-indicative *saeculorum* could be used in the future as a means to support arguments for the provenance of a manuscript or fragment. For example, the manuscript *CDN-Lu M2150* was likely held at the Burgos monastic library in Granada, Spain (according to a book-dealer in Paris), but its origin prior to this is uncertain. As the manuscript has several lacunae, does not contain any saints' feast days, and has no identifying marks, one cannot use these features to help identify the manuscript's provenance. A Spanish origin for the manuscript is loosely supported by the spelling of "Velum" as "Belum" on f. 49r, but "this single misspelling is insufficient to secure Spanish provenance."[20] However, the manuscript contains all four geo-indicative Iberian *saeculorum* (see Table 4.1 and Figure 4.3), suggesting that it is, indeed, of Spanish origin.[21]

Geographically-clustered *saeculorum*, particularly clusters that contain several manuscripts, show the practical reality of singing *differentiae* in medieval Europe; while certain *differentiae* were prevalent regardless of time and place, identifiable patterns of regional variance reveal intriguing correlations between spoken languages, previous chant traditions, and the specific melodic formulation of *differentiae*, with possible implications for understanding earlier psalmodic practices and the relationships between linguistic accent and singing style.

4.3 Assessing Manuscript Similarity with *Differentiae*

One way of using *differentiae* (and its components) to identify related manuscripts is to determine which manuscripts include a particular *differentia*. If only a small group of manuscripts contain this *differentia*, there is likely a reason for the

20. Debra Lacoste, "A Late-Medieval Antiphoner at the University of Western Ontario," in *Chant and its Peripheries: Essays in Honour of Terence Bailey*, eds. Bryan Gillingham and Paul Merkley (Ottawa: Institute of Medieval Music, 1998), 310.

21. A Spanish provenance is also supported by a comparison of the *differentiae* found in this manuscript with all of the other manuscripts in the *Differentiae Database*. It only shares a similarity score (see next section) of 0.50 or higher with manuscripts from modern-day Portugal and Spain: *E-SA 5* to *8* (Salamanca, fourteenth century), *AUS-Sfl 376* (Spain, seventeenth century), *P-BRs No32* (Braga, sixteenth century), *E-Tc 44.1* (Tavernoles, eleventh century) and *E-Tc 44.2* (Toledo, eleventh century).

manuscript grouping, whether geographical, liturgical, institutional, temporal, etc. Another way to approach the assessment of manuscript similarity using *differentiae* is to consider the ratio of shared *differentiae* between two sources. If none of the *differentiae* in manuscript A appear in manuscript B, it would suggest that the chant traditions of the two manuscripts are unrelated; if all of the *differentiae* in A are also in B, it would suggest that there is an extremely close connection between the manuscripts. To examine the similarity of *differentiae* between the manuscripts included in my cross-manuscript analysis, I calculated the similarity score of each manuscript (A) in comparison to each other manuscript (B), using the following calculation.

$$\text{Similarity score for A and B} = \frac{[(\text{Shared diff.} \div \text{Total A}) + (\text{Shared diff.} \div \text{Total B})]}{2}$$

For example, *CH-Fco 2* has 44 total *differentiae* and *D-Ma 12o Cmm 1* has 52 total *differentiae*; 27 *differentiae* appear in both manuscripts. Therefore, *CH-Fco 2* and *D-Ma 12o Cmm 1* have a similarity score of:

$$\text{Similarity score for } \textit{CH-Fco 2} \text{ and } \textit{D-Ma 12o Cmm 1} = \frac{[(27 \div 44) + (27 \div 52)]}{2}$$
$$= (0.61+0.52) \div 2$$
$$= 0.57$$

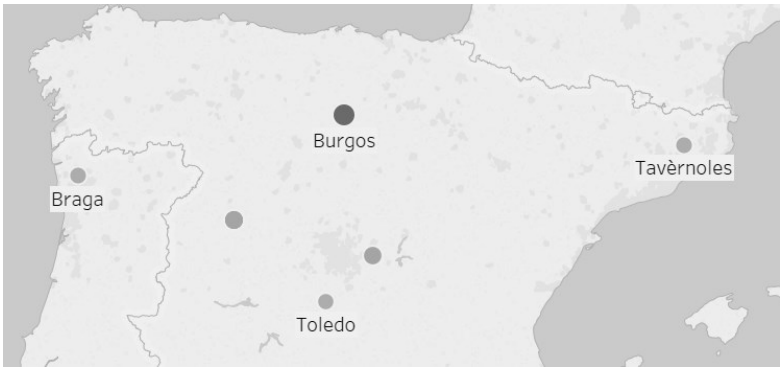
As each score approaches 1.00, the level of similarity between two manuscripts increases.[22]

Manuscripts with high similarity scores (i.e., 0.50 or higher) are typically related by place and/or monastic order. As one might expect, manuscripts from exactly the same location (e.g., the Klosterneuburg manuscripts, *A-Gu 29* and *30*, *DK-Kk 3449 8o I* to *XVII*), have the highest degree of similarity amongst themselves. Other connections reflect the geographic regions defined by shared *saeculorum* (see Figure 4.4) and/or highlight similarities between manuscripts from the same type of institution. *A-Wda D-4*, a volume of a fifteenth-century antiphoner from the Vienna Dompropstei Kirnberg an

22. The similarity scores for *F-Pnm lat. 12601* were excluded from this analysis, as it only has one *differentia*.

der Mank, not only has a high similarity score with its other two volumes (*A-Wda C-10* and *C-11*), but also other non-monastic ('cathedral') manuscripts from Germanic- and Slavonic-speaking areas in Europe, predominantly from the fifteenth and sixteenth centuries (see Figure 4.5). Franciscan, Cistercian, and Dominican manuscripts also have high degrees of similarity amongst their own orders, reflecting their engagement in musical reform and liturgical standardization (see Figures 3.6, 3.7, and 3.8).[23] These similarity scores reveal the degree of overlap (in terms of unique *differentiae*) between two manuscripts. The same concept could be adapted in the future to incorporate not only similarity in terms of unique *differentiae*, but also the pairing of *differentiae* with specific antiphon texts and melodies, although that would be a major study of its own.

Figure 4.4. Example of one of the geographic regions (Iberia) exhibited by manuscripts' *differentiae* similarity scores: map showing similarity scores of 0.50 or higher between *CDN-Lu M2150* and each of the manuscripts in the *Differentiae Database* (see Table 4.2).



23. Hiley David Hiley, *Western Plainchant: A Handbook* (Oxford: Clarendon Press, 1993), 609-611. Mary Berry, "Franciscan Friars," in *Oxford Music Online* (2001). Dominican manuscripts also share high similarity scores with many other manuscripts. As shown in Chapter 2, Cistercian manuscripts eliminate some *amen* endings within each mode, as a means of standardization. The Dominicans similarly ascribed particular *differentiae* in each mode to specific antiphon openings. Whether these rules are realized in their manuscripts has yet to be determined, as none of the Dominican manuscripts included in the *Differentiae Database* and *Cantus Manuscript Database* include searchable, melodic data. However, given the high degree of similarity between these manuscripts, based on which *differentiae* they include, it seems likely that the standardization within these manuscripts also extends to the connection between *differentiae* and antiphons. Also of note is the close proximity of *differentiae* found in manuscripts from the Carmelite, Dominican, and Cistercian orders (e.g., *D-KNd 1161*). On the theoretical standardization of *differentiae* by Dominicans, see Hieronymus de Moravia's treatise *Tractatus de musica*, translated by Laura Weber, "Intellectual Currents in Thirteenth Century Paris: A Translation and Commentary on Jerome of Moravia's *Tractatus de Musica*" (PhD diss., Yale University, 2009), 359-373. Weber also compares and discusses the consistency of *differentiae* within Dominican treatises and tonaries, 151-152, 180-181.

Table 4.2. Similarity scores (greater than 0.50) between *CDN-Lu M2150* and each of the manuscripts in the *Differentiae Database*. Also see map in Figure 4.3.

Manuscript Siglum	Location	Monastic Order/ Cathedral	Century	Similarity Score
CDN-Lu M2150	Burgos(?)	Cistercian(?)	16th	1.00
E-SA 7	Salamanca	Cathedral	14th	0.72
E-SA 8	Salamanca	Cathedral	14th	0.71
AUS-Sfl 376	Spain	Hieronymite	17th	0.70
E-SA 5	Salamanca	Cathedral	14th	0.69
E-SA 6	Salamanca	Cathedral	14th	0.65
P-BRs No32	Braga	Cathedral	16th	0.59
E-Tc 44.1	Tavernoles	Benedictine	11th	0.57
E-Tc 44.2	Toledo	Cathedral	11th	0.54

Figure 4.5. Map showing geographic proximity of similarity scores (of 0.50 or higher) between *A-Wda D-4* and each of the other manuscripts in the *Differentiae Database*. All similar manuscripts were used at secular, non-monastic institutions in the fifteenth and sixteenth centuries, with the exception of *CZ-Pst DE I 7* (Esztergom, Cathedral, thirteenth century). See Table 4.3 for a summary of the manuscripts shown in the map and their similarity scores.

Table 4.3. Summary of similarity scores for manuscripts shown in the map in Figure 4.4.

Manuscript Siglum	Location	Monastic Order/ Cathedral	Century	Similarity Score
A-Wda C-10	Kirnberg an der Mank	Cathedral	15th	1.00
A-Wda C-11	Kirnberg an der Mank	Cathedral	15th	0.69
D-Kk 3449 8o [05] V	Augsburg	Cathedral	16th	0.68
D-Kk 3449 8o [16] XVI	Augsburg	Cathedral	16th	0.66
D-Kk 3449 8o [02] II	Augsburg	Cathedral	16th	0.62
A-Wda D-4	Kirnberg an der Mank	Cathedral	15th	0.62
D-Kk 3449 8o [07] VII	Augsburg	Cathedral	16th	0.61
D-Kk 3449 8o [03] III	Augsburg	Cathedral	16th	0.61
D-Kk 3449 8o[01] I	Augsburg	Cathedral	16th	0.61
D-Kk 3449 8o [14] XIV	Augsburg	Cathedral	16th	0.60
SI-Lna 19 (olim 18)	Kranj	Cathedral	15th	0.60
SI-Lna 18 (olim 17)	Kranj	Cathedral	15th	0.60
D-Kk 3449 8o [06] VI	Augsburg	Cathedral	16th	0.59
D-Kk 3449 8o [17] XVII	Augsburg	Cathedral	16th	0.59
D-Kk 3449 8o [10] X	Augsburg	Cathedral	16th	0.59
D-Kk 3449 8o [09] IX	Augsburg	Cathedral	16th	0.58
D-Kk 3449 8o [04] IV	Augsburg	Cathedral	16th	0.58
D-Kk 3449 8o [08] VIII	Augsburg	Cathedral	16th	0.54
D-Kk 3449 8o [11] XI	Augsburg	Cathedral	16th	0.54
CZ-HKm II A 1	Hradec Králové	Cathedral	15th	0.53
D-Kk 3449 8o [15] XV	Augsburg	Cathedral	16th	0.53
D-Kk 3449 8o [12] XII	Augsburg	Cathedral	16th	0.53
D-Kk 3449 8o [13] XIII	Augsburg	Cathedral	16th	0.51
CZ-Pst DE I 7	Esztergom	Cathedral	13th	0.50

Figure 4.6. Example of the similarity scores of Franciscan manuscripts, based on similarity with *I-Ac 693*, a thirteenth-century manuscript from Central Italy. Franciscan manuscripts are marked by an "X" on the map. Other manuscripts that also have 0.50 or higher similarity scores with *I-Ac 693* include those from Benedictine (□); Augustinian (○); and Dominican (+) monasteries. See Table 4.4 for a summary of the manuscripts and their similarity scores.

Table 4.4. Summary of manuscripts and their similarity scores, as shown in the map in Figure 4.5.

Manuscript Siglum	Location	Monastic Order/ Cathedral	Century	Similarity Score
I-Ac 693	Central Italy	Franciscan	13th	1.00
I-Ac 694	Central Italy	Franciscan	13th	0.78
D-Ma 12o Cmm 1	Central Italy	Franciscan	13th	0.74
HR-Hf Cod. C	Dubrovnik	Franciscan	15th	0.71
US-Cn 24	Central Italy	Franciscan	13th	0.69
HR-Hf Cod. E	Dubrovnik	Franciscan	15th	0.66
HR-Hf Cod. D	Dubrovnik	Franciscan	15th	0.65
HR-Hf Cod. F	Dubrovnik	Franciscan	15th	0.65
H-Bu lat. 118	Margitsziget	Franciscan	14th	0.64
H-Bu lat. 119	Margitsziget	Franciscan	14th	0.63
I-Rvat lat. 8737	Central Italy	Franciscan	13th	0.62
I-Nn vi.E.20	Central Italy	Franciscan	13th	0.61
H-Bu lat. 121	Margitsziget	Franciscan	14th	0.59
I-Ad 5	Central Italy	Franciscan	13th	0.59
US-CHNbcbl 097	South Germany/Austria	Franciscan	14th	0.59
CH-Fco 2	Unknown	Franciscan	13th	0.58
H-Bu lat. 122	Margitsziget	Franciscan	14th	0.57
D-Mbs Clm 4304	Augsburg	Benedictine	16th	0.56
D-Mbs Clm 4303	Augsburg	Benedictine	15th	0.55
D-Mbs Clm 4306	Augsburg	Benedictine	16th	0.53
US-NYcub Plimpton 41	Perugia	Benedictine	15th	0.52
D-W 28 Helmst. (olim D-W 31)	Hilwartshausen	Augustinian	16th	0.52
I-Fl Conv. sopp. 560	Vallombrosa	Benedictine	12th	0.51
HR-Dsmbb III	Dubrovnik	Dominican	15th	0.51
HR-Dsmbb XI	Dubrovnik	Dominican	15th	0.51

Figure 4.7. Example of the similarity scores between Cistercian manuscripts, based on similarity with the thirteenth-century manuscript *A-Wn 1799*** from Rein. In addition to the Cistercian manuscripts (◊), *A-Wn 1799*** also shares similarity scores of 0.50 or higher with Dominican manuscripts (+) from Dubrovnik and Bologna, and Carmelite manuscripts (*) from Mainz. See Table 4.5 for a summary of the similarity scores for the manuscripts shown in this map.

Table 4.5. Summary of manuscripts and their similarity scores shown in Figure 4.6.

Manuscript Siglum	Location	Monastic Order/ Cathedral	Century	Similarity Score
*A-Wn 1799***	Rein	Cistercian	13th	1.00
F-Pnm n.a.lat. 1411	Morimondo	Cistercian	12th	0.83
F-Pnm n.a.lat. 1412	Morimondo	Cistercian	12th	0.81
PL-WRu I F 401	Lubiąż	Cistercian	13th	0.76
CDN-Hsmu M2149.L4	Salzinnes	Cistercian	16th	0.76
D-KNd 1161	Köln	Cistercian	12th	0.71
HR-Dsmbb III	Dubrovnik	Dominican	15th	0.57
HR-Dsmbb XI	Dubrovnik	Dominican	15th	0.57
HR-Dsmbb X	Dubrovnik	Dominican	15th	0.55
D-MZb E	Mainz	Carmelite	15th	0.53
HR-Dsmbb V	Dubrovnik	Dominican	15th	0.53
US-Cai 1911.142b	Bologna	Dominican	13th	0.53

Figure 4.8. Example of the similarity scores between Dominican manuscripts, based on similarity with the thirteenth-century manuscript *US-Cai 1911.142b* from Bologna. Note the geographic spread and variety of monastic orders and secular institutions represented in the map, which is indicative of the high degree of standardization within Dominican manuscripts: Augustinian (○); Benedictine (□); Carmelite (*); Cathedral (Δ); Cistercian (◊); Dominican (+); and Franciscan (X). See Table 4.6 for a summary of the manuscripts and their similarity scores.

Table 4.6. Summary of manuscripts and their similarity scores shown in Figure 4.7.

Manuscript Siglum	Location	Monastic Order/ Cathedral	Century	Similarity Score
US-Cai 1911.142b	Bologna	Dominican	13th	1.00
HR-Dsmbb III	Dubrovnik	Dominican	15th	0.94
HR-Dsmbb XI	Dubrovnik	Dominican	15th	0.94
HR-Dsmbb X	Dubrovnik	Dominican	15th	0.91
HR-Dsmbb V	Dubrovnik	Dominican	15th	0.88
D-MZb E	Mainz	Carmelite	15th	0.76
D-MZb C	Mainz	Carmelite	15th	0.72
D-MZb A	Mainz	Carmelite	15th	0.69
F-Pnm n.a.lat. 1412	Morimondo	Cistercian	12th	0.67
PL-WRu I F 401	Lubiąż	Cistercian	13th	0.67
D-MZb B	Mainz	Carmelite	15th	0.67
D-MZb D	Mainz	Carmelite	15th	0.66
PL-Kkar 2 (Rkp 14)	Kraków	Carmelite	14th	0.66
F-Pnm n.a.lat. 1411	Morimondo	Cistercian	12th	0.65
CDN-Hsmu M2149.L4	Salzinnes	Cistercian	16th	0.64
PL-Kkar 1 (Rkp 12)	Kraków	Carmelite	14th	0.62
D-KNd 1161	Köln	Cistercian	12th	0.60
I-VCd LXXIX	Vercelli	Cathedral	13th	0.59
H-Bu lat. 119	Margitsziget	Franciscan	14th	0.59
H-Bu lat. 122	Margitsziget	Franciscan	14th	0.59
US-NYcub Plimpton 41	Perugia	Benedictine	15th	0.59
PL-Kkar 3 (Rkp 15)	Kraków	Carmelite	15th	0.59
HR-Hf Cod. F	Dubrovnik	Franciscan	15th	0.58
H-Bu lat. 118	Margitsziget	Franciscan	14th	0.58
I-AO 6	Aosta	Cathedral	13th	0.58
HR-Hf Cod. C	Dubrovnik	Franciscan	15th	0.58
US-CHNbcbl 097	S. Germany / Austria	Franciscan	14th	0.57
CH-Fco 2	Unknown	Franciscan	13th	0.57
D-W 28 Helmst.	Hilwartshausen	Augustinian	16th	0.56
HR-Hf Cod. E	Dubrovnik	Franciscan	15th	0.55
H-Bu lat. 121	Margitsziget	Franciscan	14th	0.55
D-W 29 Helmst.	Hilwartshausen	Augustinian	16th	0.54
F-Pnm lat. 15182	Paris	Cathedral	14th	0.54
*A-Wn 1799***	Rein	Cistercian	13th	0.53
F-R 248	Jumièges	Benedictine	13th	0.52
D-Mbs Clm 4303	Augsburg	Benedictine	15th	0.51
HR-Hf Cod. D	Dubrovnik	Franciscan	15th	0.50
I-Rvat lat. 8737	Central Italy	Franciscan	13th	0.50

4.4 *Differentiae* over Time

In addition to being indicative of place and type of institution, the variety of *differentiae* within a manuscript can help to temporally situate the manuscript. Although it is not as straightforward as a decrease in the number of unique *differentiae* per manuscript from the tenth to the sixteenth centuries, as one also must consider the content of the manuscript (i.e., complete or partial antiphoner), the monastic order or church for which it was written, and its location, there is a slight increase in the average similarity scores for each manuscript within the dataset from the tenth to the sixteenth centuries, from 0.18 to 0.31.[24] That is, each manuscript in the tenth century shares an average of 18% of their *differentiae* with every other manuscript in the *Differentiae Database*; and each manuscript in the sixteenth century shares about 31% of its *differentiae* with each of the other manuscripts. Similarly, by comparing the number of unique *saeculorum* openings per mode per century, one notices that, while the most prominent *saeculorum* openings for each mode remain constant, the number of other variants decreases overall, with the most *saeculorum* variants appearing in fourteenth-century manuscripts (see Table 4.7).[25] In other words, Dyer's observation regarding the decrease in local variants in Italian peninsula manuscripts from the twelfth to the fourteenth century, also applies to a much larger geo-temporal set of manuscripts.[26] As time progressed, *differentiae* (likely under the influence of theorists who sought to

24. As there is only one manuscript from the seventeenth century included in the *Differentiae Database* (*AUS-Sfl 376*), it cannot represent an entire century. The standardization of *differentiae* at a particular institution is also evident within individual manuscripts that include revisions to their *differentiae* in a later hand. For instance, the twelfth-century St. Gall antiphoner *CH-SGs 388* contains two interpretations of its tonary letters: one dated from the **twelfth century** (pp. 2-5) and one added at the end of the manuscript, dating from the **fourteenth century** (pp. 495-497). The twelfth century tonary includes 38 unique *differentiae*, whilst the fourteenth-century tonary includes 33 unique *differentiae*, which, among other small alterations, consolidates three of the mode 3 *differentiae* to eliminate the b-b-c-a *saeculorum* opening and two mode 4 *differentiae* to eliminate the inclusion of a liquescent on the final syllable of the *saeculorum*. The fourteenth-century tonary also changes the geo-indicative *saeculorum* of the St. Gall area (mode 8, c-c-c-cb) found in the twelfth-century to c-c-b-cb, a slight variation on the geographically-prevalent c-c-b-c *saeculorum*. This particular *saeculorum* was used in a much wider geographic region than St.Gall (from modern-day France to Poland, the Netherlands to Northern Italy), indicating a much wider geographic influence and higher degree of standardization between the twelfth and the fourteenth centuries.

25. The reason for this 'peak' in the fourteenth century requires further research.

26. Dyer, "The Singing of Psalms," 552.

codify and define these formulae) became increasingly globally standardized. However, certain geo-indicative *differentiae* persisted: despite dating from the sixteenth century, *CDN-Lu M1250* can be almost definitively identified as of Spanish origin due to its *saeculorum* and manuscript similarity scores.

Table 4.7. Summary of *saeculorum* variants per century per mode. Numbers are presented as a ratio of the total *saeculorum* variants per century per mode to the total *saeculorum* variants per mode. The higher the ratio, the more *saeculorum* variants found in manuscripts from that century. As there are fewer representative manuscripts in the dataset for the tenth, eleventh, and seventeenth centuries (3, 5, and 1, respectively), these centuries are excluded from the table.

	Century [Number of manuscripts]				
	12th [34]	**13th** [27]	**14th** [24]	**15th** [28]	**16th** [27]
Mode 1	0.53	0.53	0.65	0.47	0.35
Mode 2	0.44	0.44	0.50	0.44	0.19
Mode 3	0.51	0.38	0.49	0.43	0.38
Mode 4	0.57	0.64	0.54	0.43	0.32
Mode 5	0.14	0.71	0.57	0.14	0.43
Mode 6	0.33	0.33	0.47	0.40	0.27
Mode 7	0.44	0.44	0.78	0.33	0.22
Mode 8	0.60	0.60	0.55	0.40	0.30
Ton. Per.	0.86	0.71	0.57	0.57	0.43
Average	**0.49**	**0.53**	**0.57**	**0.40**	**0.32**

4.5 Conclusion

These deceivingly incidental, six-syllable formulas, sung numerous times every week, thus contain a significant amount of information not only about their own function and use within antiphonal psalmody, but also are an effective means of assessing manuscript similarity and tracing relationships within chant. A multi-manuscript analysis of *differentiae* clarifies, defines, and quantifies the mnemonic and pedagogical function of *differentia* in the process of learning and remembering antiphon melodies and modes. Cross-manuscript *differentia* analysis also offers scholars a new

avenue for assessing manuscript similarity, identifying manuscript provenance, and considering influences of place, time, institution, previous chant traditions, and linguistic accents on the particular melodic material preserved in these manuscripts. The standardization of *differentia* identification enables many avenues for comparison, not all of which are covered by this thesis. Other analyses to consider include:

1. The significance of the inclusion of liquescents in *differentiae* in certain manuscripts;
2. A comparison of specific *differentia*-antiphon connections prescribed in theoretical treatises with those connections evident in manuscripts
3. More detailed comparison of the *differentiae* in manuscripts of different, non-octomodal liturgies (e.g., Beneventan, Old Roman, Ambrosian, and Mozarabic) with octomodal *differentiae*;
4. Whether there is any correlation between particular feast days and *differentiae*, i.e., were some *differentia* only sung on particularly significant feast days within particular institutions; and
5. A similarity score approach to the question of whether shared *differentiae* between manuscripts are also consistently used with the same antiphon texts and melodies (i.e., combining analytical methods demonstrated in Chapters 2 and 3), which would suggest an even closer relationship between manuscripts than that indicated by shared *differentia* formulas.

The last possible analysis listed here is perhaps the most intriguing and possibly has the most potential. Anonymous XI wrote in the fifteenth century that "the beginning of the antiphons represents full knowledge or satiety of the melody of the music to come."[27] This would suggest that the *amen* endings not only anticipate the opening contours of the antiphons, as identified in Chapter 2, but also the complete antiphon, if the opening contour of the antiphon is an indication of "type melodies" as Anonymous XI seems to suggest. This research is beyond the scope of this thesis and requires the application of melody IDs and similarity measures to the antiphon melodies, beyond just their first

27. ANO11TDM, 46. Translated in Richard Joseph Wingell, "Anonymous XI (CS III): An Edition, Translation, and Commentary" (PhD diss., University of Southern California, 1973), 218.

two- to four-note pitch contours.[28] The first step of this direction of analysis, though—the application of standardized *differentia* IDs and the identification of similarity measures for *differentiae*—is complete, or, at least, well on its way. The use of a standardized identifier for *differentiae* and the addition of manuscripts (and theorists' tonaries) to the *Differentiae Database* as part of the process of indexing will only increase opportunities for research and analysis.

28. The creation and assignation of melody IDs to chants in the *Cantus Manuscript Database* was recently included in a successful Social Sciences and Humanities Research Council (SSHRC) Partnership Development Grant, so the ability to do this analysis will soon become possible.

Bibliography

Manuscripts[1]

Listed in alphabetical order, by siglum

Manuscript	Siglum	Century[2]	Provenance	No. of *diff.*[3]	No. of ant.[4]	No. of ant. with *diff.*[5]	No. of mel.[6]
Augsburg Antiphoner (1495); London, British Library, printed book IB. 6753	*AA Impr. 1495*	15th	Augsburg	47	417	403	
Graz, Universitätsbibliothek, 29 (olim 38/8f.)	*A-Gu 29*	14th	Sankt Lambrecht	28	1,811	1,288	
Graz, Universitätsbibliothek, 30 (olim 38/9 f.)	*A-Gu 30*	14th	Sankt Lambrecht	25	2,332	1,299	
Klosterneuburg, Augustiner-Chorherrenstift - Bibliothek, 1010	*A-KN 1010*	12th	Klosterneuburg	27	1,094	368	

1. The following manuscripts are indexed in the *Cantus Manuscript Database*, but omitted from the *differentia* standardization project as they do not contain *differentia*: *D-TRb Abt. 95, Nr.5* (Eichstätt, 11th century, 61 antiphons), *F-AI 44* (Albi, 9th century, 1,271 antiphons), *F-Pnm lat. 1240* (St. Martial, 10th century, 789 antiphons), and *I-CHV* (Chiavenna, 11th century, 950 antiphons).

2. Indicated by century to enable comparison between manuscripts. Some manuscripts include more specific provenances in their descriptions on the *Cantus Manuscript Database*.

3. Number of unique *differentiae* in each manuscript, based on data downloaded from the *Differentiae Database* May 27, 2019.

4. Numbers of antiphons per manuscripts based on indices in the *Cantus Manuscript Database*. Current to May 27, 2019.

5. Numbers of antiphons per manuscripts that also include *differentia* indications, and which were standardized in the *differentia* standardization project. Differences between this column and the "No. of ant." column occur as a result of antiphon incipits in manuscripts (which frequently do not include *differentia* indications). Further research and analysis that identifies the likely *differentia* for each abbreviated antiphon incipit in these manuscripts would be worthwhile. Any unusually large discrepencies between the two columns are explained in footnotes.

6. *Cantus Manuscript Database* indexes downloaded October 5-6, 2018.

Manuscript	Siglum	Century	Provenance	No. of *diff*.	No. of ant.	No. of ant. with *diff*.	No. of mel.
Klosterneuburg, Augustiner-Chorherrenstift - Bibliothek, 1011	*A-KN 1011*	14th	Klosterneuburg	26	1,210	657	
Klosterneuburg, Augustiner-Chorherrenstift - Bibliothek, 1012	*A-KN 1012*	12th	Klosterneuburg	32	961	542	541
Klosterneuburg, Augustiner-Chorherrenstift - Bibliothek, 1013	*A-KN 1013*	12th	Klosterneuburg	29	1,343	860	
Klosterneuburg, Augustiner-Chorherrenstift - Bibliothek, 1015	*A-KN 1015*	14th	Klosterneuburg	27	1,185	900	
Klosterneuburg, Augustiner-Chorherrenstift - Bibliothek, 1017	*A-KN 1017*	13th	Klosterneuburg	29	1,028	737	
Klosterneuburg, Augustiner-Chorherrenstift - Bibliothek, 1018	*A-KN 1018*	14th	Klosterneuburg	28	1,257	791	791
Klosterneuburg, Augustiner-Chorherrenstift - Bibliothek, 589	*A-KN 589*	14th	Klosterneuburg	26	1,283	888	
Kremsmünster, Benediktiner-Stift Kremsmünster - Musikarchiv, Schachtel VI/258	*A-KR VI 258*	13th	Sankt Polten	14	829	20[7]	

7. According to the CMD manuscript description for this manuscript, indexed by Martin Czernin with editorial assistance from Andrew Mitchell: “Some *differentiae* and modal designations for antiphons are visible; these appear to survive from the earliest layer of scribal activity. When the modal number and/or the full *differentia* can be read clearly, these have been entered into the index. The cropping of many of the complete folios has resulted in incomplete *differentiae* in their margins and modal designations which have been obscured or eliminated.” Only those *differentia* identified by Czernin are included in the *Differentiae Database* and the analysis in my thesis. However, a closer analysis of the *differentia* in this manuscript (beyond those identified by Czernin) within the context of other manuscripts in the *Differentiae Database* may help to, at least provisionally, identify those *differentia* obscured or eliminated by time. Martin Czernin, Inventory of "Kremsmünster, Benediktiner-Stift Kremsmünster - Musikarchiv, Schachtel VI/258," edited by Andrew Mitchell, in *Cantus Manuscript 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-).

Manuscript	Siglum	Century	Provenance	No. of *diff*.	No. of ant.	No. of ant. with *diff*.	No. of mel.
Linz, Oberösterreichische Landesbibliothek, 290 (olim 183; Gamma p.19)	*A-LIs 290*	12th	Kremsmünster	16	2,772	76[8]	
Sankt Florian, Augustiner-Chorherrenstift - Bibliothek und Musikarchiv, XI 480	*A-SF XI 480*	14th	Regensburg	98	1,898	1,197[9]	
Ms. University of Sydney. Library. Rare Book and Special Collections Library. Add. Ms. 376	*AUS-Sfl 376*	17th	Spain	21	CMD index in progress		
Vorau, Stiftsbibliothek, 287 (olim XXIX)	*A-VOR 287*	14th	Salzburg	82	2,574	1,946	
Wien, Diözesanarchiv, C-10	*A-Wda C-10*	15th	Kirnberg an der Mank	55	981	903	
Wien, Diözesanarchiv, C-11	*A-Wda C-11*	15th	Kirnberg an der Mank	50	776	682	
Wien, Diözesanarchiv, D-4	*A-Wda D-4*	15th	Kirnberg an der Mank	74	1,784	1,461	`
Wien, Österreichische Nationalbibliothek - Handschriftensammlung, 1799**	*A-Wn 1799***	13th	Rein	27	1,837	1,285	1,282
Wien, Österreichische Nationalbibliothek - Musiksammlung, 1890	*A-Wn 1890*	12th	South Germany / Austria	28	2,692	1,853	

8. In this manuscript, *differentiae* were added for the feasts of Christmas, the Octave of Christmas, Epiphany, and Triduum at a later date; *differentiae* do not appear elsewhere in the manuscript. Martin Czernin, Index for "Linz, Oberösterreichische Landesbibliothek, 290 (olim 183; Gamma p.19)," in *Cantus Manuscript Database*, directed by Debra Lacoste (2011-), Terence Bailey (1997-2010), and Ruth Steiner (1987-1996), web developer, Jan Koláček (2011-).

9. In the original CMD index, Chia-Hsin Ho identified both the modes and *differentiae* of 1,152 antiphons. He deemed 35 *differentiae* modally ambiguous due to the lack of another *differentia* within the same manuscript with the same neume pattern and a Roman numeral indication of mode. Using the method outlined in section 1.4 of my thesis, I was able to assign provisional modes and *differentia* IDs to these ambiguous antiphons and *differentiae*, as well as some others that were considered ambiguous at the time of indexing. Chia-Hsin Ho, Inventory of "Sankt Florian, Augustiner-Chorherrenstift - Bibliothek und Musikarchiv, XI 480," ed. Andrew Mitchell, in *Cantus Manuscript 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-).

Manuscript	Siglum	Century	Provenance	No. of *diff*.	No. of ant.	No. of ant. with *diff*.	No. of mel.
Wien, Österreichische Nationalbibliothek - Musiksammlung, 15489	*A-Wn Mus.Hs.154 89*	13th	Altenberg	58	1,151	950	
Dendermonde, Sint-Pieters-en Paulusabdij, ms. 9	*B-DEa 9*	12th	Rupertsberg	12	34	23[10]	23
Tongeren, Onze-Lieve-Vrouw-Kerk (Our Lady's Church), 63 (olim V)	*B-TO olv 63*	14th	Tongeren	47	1,232	1,086	
Tongeren, Onze-Lieve-Vrouw-Kerk (Our Lady's Church), 64 (olim IV)	*B-TO olv 64*	14th	Tongeren	47	1,239	1,089	
Halifax (Canada), St. Mary's University - Patrick Power Library, M2149.L4 1554	*CDN-Hsmu M2149.L4*	16th	Salzinnes	21	1,070	853	855
London (Canada), University of Western Ontario - Music Library, M2150	*CDN-Lu M2150*	16th	Burgos	25	96	83	
Einsiedeln, Kloster Einsiedeln - Musikbibliothek, 611	*CH-E 611*	14th	Einsiedeln	89	2,644	2,150	2,139
Fribourg, Bibliothèque des Cordeliers, 2	*CH-Fco 2*	13th	Unknown	44	1,628	1,352	1,352
Sankt Gallen, Stiftsbibliothek, 388[11]	*CH-SGs 388*	12th	St. Gall	38	2,766	1,982	
Sankt Gallen, Stiftsbibliothek, 390	*CH-SGs 390*	10th	St. Gall	39	1,114	932	
Sankt Gallen, Stiftsbibliothek, 391	*CH-SGs 391*	10th	St. Gall	35	1,424	1,088	
Hradec Králové Antiphonary II A 1	*CZ-HKm II A 1*	15th	Hradec Králové	50	CMD index in progress		

10. Eleven antiphons, although complete, do not include indications for *differentiae*.

11. This manuscript contains a second tonary added in the fourteenth century. Both tonaries are indexed in the *Differentiae Database*, but only the 'original' tonary was used in conjunction with antiphon data from the *Cantus Manuscript Database*.

Manuscript	Siglum	Century	Provenance	No. of *diff*.	No. of ant.	No. of ant. with *diff*.	No. of mel.
Praha (Prague), Strahovská knihovna (Library of the Royal Canonry of Premonstratensians at Strahov), DE I 7	*CZ-Pst DE I 7*	13th	Esztergom	31	1,239	888	
Prague National Library VI.E.4c	*CZ-Pu VI.E.4c*	12th	Prague	28	CMD index in progress		
Prague National Library XIII.C.4	*CZ-Pu XIII.C.4*	14th	Prague	61	555	527[12]	
Praha (Prague), Národní knihovna České republiky (National Library), XIV B 13	*CZ-Pu XIV B 13*	14th	Prague	78	917	882	
Aachen (Aix-la-Chapelle), Domarchiv, G 20	*D-AAm G 20*	13th	Aachen	86	2,747	2,238	
Berlin, Staatsbibliothek zu Berlin Preußischer Kulturbesitz, Mus. 40047	*D-B Mus. 40047*	11th	Quedlinburg	78	2,203	1,394	
Bamberg, Staatsbibliothek, lit. 25 (olim Ed.IV.11)	*D-BAs lit. 25*	13th	Bamberg	60	995	897	
Fulda, Hessische Landesbibliothek, Aa 55	*D-FUl Aa 55*	14th	Rasdorf	44	1,338	1,008	
Karlsruhe, Badische Landesbibliothek - Musikabteilung, Aug. LX	*D-KA Aug. LX*	12th	Zwiefalten	45	2,720	1,057	1,060
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o I	*DK-Kk 3449 8o [01] I*	16th	Augsburg	25	189	173	173
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o II	*DK-Kk 3449 8o [02] II*	16th	Augsburg	28	201	158	158
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o III	*DK-Kk 3449 8o [03] III*	16th	Augsburg	25	137	121	121

12. Index in progress with incomplete *differentia* field. *Differentia* identified in this manuscript by the author as part of the *differentia* standardization project.

Manuscript	Siglum	Century	Provenance	No. of *diff*.	No. of ant.	No. of ant. with *diff*.	No. of mel.
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o IV	*DK-Kk 3449 8o [04] IV*	16th	Augsburg	25	147	141	141
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o V	*DK-Kk 3449 8o [05] V*	16th	Augsburg	29	158	142	142
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o VI	*DK-Kk 3449 8o [06] VI*	16th	Augsburg	26	204	193	193
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o VII	*DK-Kk 3449 8o [07] VII*	16th	Augsburg	20	113	111	110
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o VIII	*DK-Kk 3449 8o [08] VIII*	16th	Augsburg	17	116	107	107
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o IX	*DK-Kk 3449 8o [09] IX*	16th	Augsburg	25	152	147	146
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o X	*DK-Kk 3449 8o [10] X*	16th	Augsburg	23	130	128	128
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o XI	*DK-Kk 3449 8o [11] XI*	16th	Augsburg	24	128	124	124
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o XII	*DK-Kk 3449 8o [12] XII*	16th	Augsburg	21	188	146	146

Manuscript	Siglum	Century	Provenance	No. of *diff*.	No. of ant.	No. of ant. with *diff*.	No. of mel.
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o XIII	*DK-Kk 3449 8o [13] XIII*	16th	Augsburg	26	174	145	145
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o XIV	*DK-Kk 3449 8o [14] XIV*	16th	Augsburg	22	202	146	146
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o XV	*DK-Kk 3449 8o [15] XV*	16th	Augsburg	29	130	127	127
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o XVI	*DK-Kk 3449 8o [16] XVI*	16th	Augsburg	21	96	92	92
København (Copenhagen), Det kongelige Bibliotek Slotsholmen, Gl. Kgl. S. 3449, 8o XVII	*DK-Kk 3449 8o [17] XVII*	16th	Augsburg	30	129	125	125
Köln, Erzbischöfliche Diözesan- und Dombibliothek, 1161	*D-KNd 1161*	12th	Köln	24	917	758	757
Köln (Cologne), Erzbischöfliche Diözesan- und Dombibliothek, 215	*D-KNd 215*	12th	Würzburg	27	2,385	0[13]	
München, Franziskanerkloster St. Anna - Bibliothek, 12o Cmm 1	*D-Ma 12o Cmm 1*	13th	Central Italy	52	1,742	1,356	
München, Bayerische Staatsbibliothek, Clm 4303	*D-Mbs Clm 4303*	15th	Augsburg	29	729	636	634

13. In *D-KNd 215*, *differentiae* are indicated throughout the manuscript by tonary letters. The manuscript also includes a tonary, which is included in the *Differentiae Database*, but it is not clear how or if the tonary letters align with the tonary; the tonary letters are not included in the tonary, as in *CH-SGs 388*, *390*, and *391*.

Manuscript	**Siglum**	**Century**	**Provenance**	**No. of *diff*.**	**No. of ant.**	**No. of ant. with *diff*.**	**No. of mel.**
München, Bayerische Staatsbibliothek, Clm 4304	*D-Mbs Clm 4304*	16th	Augsburg	28	262	242	195
München, Bayerische Staatsbibliothek, Clm 4305	*D-Mbs Clm 4305*	15th	Augsburg	32	548	443	443
München, Bayerische Staatsbibliothek, Clm 4306	*D-Mbs Clm 4306*	16th	Augsburg	33	1,004	858	200
Mainz, Bischöfliches Dom- und Diözesanmuseum, A	*D-MZb A*	15th	Mainz	21	551	436	
Mainz, Bischöfliches Dom- und Diözesanmuseum, B	*D-MZb B*	15th	Mainz	16	329	289	
Mainz, Bischöfliches Dom- und Diözesanmuseum, C	*D-MZb C*	15th	Mainz	19	518	411	
Mainz, Bischöfliches Dom- und Diözesanmuseum, D	*D-MZb D*	15th	Mainz	23	685	609	
Mainz, Bischöfliches Dom- und Diözesanmuseum, E	*D-MZb E*	15th	Mainz	17	306	266	
Stuttgart, Württembergische Landesbibliothek, HB.I.55	*D-Sl HB.I.55*	12th	Weingarten	33	2,027	1,639	
Wolfenbüttel, Herzog August Bibliothek - Musikabteilung, 28 Helmst. (olim D-W 31)	*D-W 28 Helmst. (olim D-W 31)*	16th	Hilwartshausen	23	1,006	815	
Wolfenbüttel, Herzog August Bibliothek - Musikabteilung, 29 Helmst. (olim D-W 32)	*D-W 29 Helmst. (olim D-W 32)*	16th	Hilwartshausen	25	914	678	

Manuscript	Siglum	Century	Provenance	No. of *diff*.	No. of ant.	No. of ant. with *diff*.	No. of mel.
Wiesbaden, Hochschul- und Landesbibliothek RheinMain, 2 (Riesencodex)	*D-WII 2*	12th	Rupertsberg	6	41	7[14]	7
Salamanca, Catedral - Archivo Musical, 5	*E-SA 5*	14th	Salamanca	24	183	139	
Salamanca, Catedral - Archivo Musical, 6	*E-SA 6*	14th	Salamanca	31	220	217	
Salamanca, Catedral - Archivo Musical, 7	*E-SA 7*	14th	Salamanca	18	111	89	
Salamanca, Catedral - Archivo Musical, 8	*E-SA 8*	14th	Salamanca	23	115	80	
Toledo, Catedral - Archivo y Biblioteca Capítulares, 44.1	*E-Tc 44.1*	11th	Tavèrnoles	43	2,418	561[15]	
Toledo, Catedral - Archivo y Biblioteca Capítulares, 44.2	*E-Tc 44.2*	11th	Toledo	61	2,458	1,952	
Arras, Bibliothèque municipale, 893 (olim 465)	*F-AS 893*	14th	Arras	55	3,384	2,011	
Cambrai, Bibliothèque municipale, 38 (olim 40)	*F-CA 38*	13th	Cambrai	81	2,575	2,140	
Cambrai, Bibliothèque municipale, Impr. XVI C 4	*F-CA Impr. XVI C 4*	16th	Cambrai	40	1,720	1,285	
Paris, Bibliothèque nationale de France - Département des Manuscrits, latin 1085	*F-Pnm lat. 1085*	10th	St. Martial	30	2,449	174[16]	
Paris, Bibliothèque nationale de France - Département des Manuscrits, latin 1090	*F-Pnm lat. 1090*	12th	Marseille	53	1,801	1,641	

14. 34 antiphons, although complete, do not include indications for *differentiae*.

15. *Differentiae* are not included throughout the manuscript and most appear to have been added in a later hand. Lila Collamore, and Keith Glaeske, Inventory of "Toledo, Catedral - Archivo y Biblioteca Capítulares, 44.1," in *Cantus Manuscript 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-).

16. *Differentiae* are included sporadically throughout the manuscript. Further research on where they appear and where they are omitted is required. These *differentiae* are also often abbreviated to the *amen* ending only.

Manuscript	Siglum	Century	Provenance	No. of *diff*.	No. of ant.	No. of ant. with *diff*.	No. of mel.
Paris, Bibliothèque nationale de France - Département des Manuscrits, latin 12044	*F-Pnm lat. 12044*	12th	Paris	57	2,419	1,881	1,877
Paris, Bibliothèque nationale de France - Département des Manuscrits, latin 12601	*F-Pnm lat. 12601*	11th	L'Échelle-Saint-Aurin	1	1,143	1[17]	
Paris, Bibliothèque nationale de France - Département des Manuscrits, latin 15181	*F-Pnm lat. 15181*	14th	Paris	47	2,042	1,457	1,457
Paris, Bibliothèque nationale de France - Département des Manuscrits, latin 15182	*F-Pnm lat. 15182*	14th	Paris	42	1,557	1,171	
Paris, Bibliothèque nationale de France - Département des Manuscrits, nouv. acq. latin 1411	*F-Pnm n.a.lat. 1411*	12th	Morimondo	20	862	698	
Paris, Bibliothèque nationale de France - Département des Manuscrits, nouv. acq. latin 1412	*F-Pnm n.a.lat. 1412*	12th	Morimondo	19	961	876	
Paris, Bibliothèque nationale de France - Département des Manuscrits, nouv. acq. latin 1535	*F-Pnm n.a.lat. 1535*	13th	Sens	42	1,200	1,118	
Rouen, Bibliothèque municipale, 248 (olim A. 339)	*F-R 248*	13th	Jumièges	46	1,278	824	
Troyes, Bibliothèque municipale, 571	*F-T 571*	12th	Troyes	32	CMD index in progress		
Tours, Bibliothèque municipale, 149	*F-TOm 149*	13th	Tours	62	1,554	1,015	
Valenciennes, Bibliothèque municipale, 114	*F-VAL 114*	12th	Saint-Amand	37	2,649	2,055	
Aberystwyth, Llyfrgell Genedlaethol Cymru (National Library of Wales), 20541 E	*GB-AB 20541 E*	14th	St. David's	49	1,984	1,393	

17. There is only one *differentia* in this manuscript, which was added in the margins of f. 78r, along with its antiphon *O quam venerandus es egregie*.

Manuscript	Siglum	Century	Provenance	No. of *diff*.	No. of ant.	No. of ant. with *diff*.	No. of mel.
Cambridge, University Library, Mm.ii.9	*GB-Cu Mm. ii.9*	13th	Barnwell	50	1,898	1,430	
Oxford, Bodleian Library, MS. Canon. Liturg. 202 (olim 19314)	*GB-Ob Can. Lit. 202*	13th	South Germany	35	1,883	74[18]	
Worcester, Cathedral - Music Library, F.160 (olim 1247) (with hymnal)	*GB-WO F.160*	12th	Worcester	53	3,722	2,033	
Gottschalk Antiphoner (fragments)	*GOTTSCHALK*	12th	Lambach	28[19]	648	316	
Budapest, Egyetemi Könyvtár (University Library), lat. 118	*H-Bu lat. 118*	14th	Margitsziget	42	717	630	
Budapest, Egyetemi Könyvtár (University Library), lat. 119	*H-Bu lat. 119*	14th	Margitsziget	25	285	259	
Budapest, Egyetemi Könyvtár (University Library), lat. 121	*H-Bu lat. 121*	14th	Margitsziget	24	318	300	
Budapest, Egyetemi Könyvtár (University Library), lat. 122	*H-Bu lat. 122*	14th	Margitsziget	31	429	368	
Dubrovnik, Franjevacki samostan, Codex Badija III	*HR-Dsmbb III*	15th	Dubrovnik	15	245	225	
Dubrovnik, Franjevacki samostan, Codex Badija V	*HR-Dsmbb V*	15th	Dubrovnik	17	608	601	
Dubrovnik, Franjevacki samostan, Codex Badija X	*HR-Dsmbb X*	15th	Dubrovnik	16	301	295	

18. *Differentiae* are only included in the margins of ff. 29v, 64r, 84v-85r, 86v-87r, 93v-954, 104r, and 129r-130v, for the feasts of Epiphany, Palm Sunday, Ascension Sunday, Pentecost Sunday, Peter and Paul, the Assumption of Mary, the Exaltation of the Cross, and the Dedication of the Church.

19. *Differentiae* in the Gottschalk antiphoner were interpreted using the tonary *Engelberg 102* (twelfth century, ff. 139v-141r). Lisa Fagin Davis, *The Gottschalk Antiphonary: Music and Liturgy in Twelfth-Century Lambach* (Cambridge: Cambridge University Press, 2000), 67-72, 142-166.

Manuscript	Siglum	Century	Provenance	No. of *diff*.	No. of ant.	No. of ant. with *diff*.	No. of mel.
Dubrovnik, Franjevacki samostan, Codex Badija XI	*HR-Dsmbb XI*	15th	Dubrovnik	15	467	412	
Dubrovnik, Franjevački Samostan (Franciscan Monastery), Cod. C	*HR-Hf Cod. C*	15th	Dubrovnik	27	278	257	
Dubrovnik, Franjevački Samostan (Franciscan Monastery), Cod. D	*HR-Hf Cod. D*	15th	Dubrovnik	31	401	400	
Dubrovnik, Franjevački Samostan (Franciscan Monastery), Cod. E	*HR-Hf Cod. E*	15th	Dubrovnik	30	554	531	
Dubrovnik, Franjevački Samostan (Franciscan Monastery), Cod. F	*HR-Hf Cod. F*	15th	Dubrovnik	33	321	305	
Assisi, Biblioteca comunale, 693	*I-Ac 693*	13th	Central Italy	57	1,086	833	822
Assisi, Biblioteca comunale, 694	*I-Ac 694*	13th	Central Italy	66	1,624	1,210	
Assisi, Cattedrale San Rufino - Archivio e Biblioteca, 5	*I-Ad 5*	13th	Central Italy	52	1,381	1,248	
Aosta, Seminario Maggiore - Biblioteca, 6	*I-AO 6*	13th	Aosta	55	1,271	1,115	
Benevento, Archivio Capitolare, V 19	*I-BV 19*	12th	Benevento	50	910	771	
Benevento, Archivio Capitolare, V 20	*I-BV 20*	12th	Benevento	39	630	535	
Firenze (Florence), Arcivescovado - Biblioteca, s.c.	*I-Far*	12th	Firenze	44	2,053	1,855	
Firenze (Florence), Biblioteca Medicea-Laurenziana, Conv. sopp. 560	*I-Fl Conv. sopp. 560*	12th	Vallombrosa	32	1,576	1,377	
Lucca, Biblioteca Capitolare Feliniana e Biblioteca Arcivescovile, 601	*I-Lc 601*	12th	Lucca	44	1,825	1,604	
Montecassino, Monumento Nazionale di Montecassino - Biblioteca, 542	*I-MC 542*	12th	Montecassino	31	926	738	

Manuscript	Siglum	Century	Provenance	No. of *diff*.	No. of ant.	No. of ant. with *diff*.	No. of mel.
Monza, Basilica di S. Giovanni Battista - Biblioteca Capitolare e Tesoro, 15/79	*I-MZ 15/79*	12th	Pavia	54	1,454	1,259	
Napoli, Biblioteca nazionale Vittorio Emanuele III, vi. E. 20	*I-Nn vi.E.20*	13th	Central Italy	36	1,797	1,335	
Piacenza, Basilica di S. Antonino - Biblioteca e Archivio Capitolari, 65	*I-PCsa 65*	12th	Piacenza	43	2,235	1,728	
Roma, Biblioteca Vallicelliana, C.5	*I-Rv C.5*	11th	Rome	41	2,522	2,072	
Città del Vaticano (Roma), Biblioteca Apostolica Vaticana, Cappella Sistina 27	*I-Rvat Capp.Sist.27*	16th	Rome	16	274	222	
Città del Vaticano (Roma), Biblioteca Apostolica Vaticana, lat. 8737	*I-Rvat lat. 8737*	13th	Central Italy	31	1,477	1,107	
Città del Vaticano (Roma), Biblioteca Apostolica Vaticana, San Pietro B.79	*I-Rvat SP B.79*	12th	Rome	85	1,365	1,152	
Vercelli, Biblioteca Capitolare, CLXX	*I-VCd CLXX*	13th	Namur	57	1,388	1,088	
Vercelli, Biblioteca Capitolare, LXIV	*I-VCd LXIV*	12th	Vercelli	33	839	696	
Vercelli, Biblioteca Capitolare, LXX	*I-VCd LXX*	12th	Vercelli	36	843	790	
Vercelli, Biblioteca Capitolare, LXXIX	*I-VCd LXXIX*	13th	Vercelli	49	1,761	1,424	
Vercelli, Biblioteca Capitolare, XXXVII	*I-VCd XXXVII*	13th	Vercelli	36	1,428	1,393	
Münster Antiphoner (1537)	*MA Impr. 1537*	16th	Münster	46	2,668	2,295	
Den Haag, Koninklijke Bibliotheek - Nationale Bibliotheek van Nederland, 70 E 4	*NL-DHk 70 E 4*	12th	Tongeren	42	151	133	
Utrecht, Universiteitsbibliotheek, Ms. 406 (shelfmark 3 J 7)	*NL-Uu 406*	12th	Utrecht	61	2,795	2,066	2,063

Manuscript	Siglum	Century	Provenance	No. of *diff*.	No. of ant.	No. of ant. with *diff*.	No. of mel.
Zutphen, Stadsarchief en Stedelijke Bibliotheek, 6	*NL-Zu 6*	15th	Zutphen	39	1,620	1,221	
Antiphoner from the Cathedral of Braga, nº32[20]	*P-BRs No32*	16th	Braga	53	861	1,058	
Kielce, Biblioteka Kapituły Katedralnej, Ms. 1	*PL-KIk 1*	14th	Kielce	74	2,516	2,104	10
Kraków, Klastor OO. Karmelitów na Piasku (Carmelite Convent), Ms.1 (rkp. Perg. 12)	*PL-Kkar 1 (Rkp 12)*	14th	Kraków	33	647	567	
Kraków, Klastor OO. Karmelitów na Piasku (Carmelite Convent), Ms.2 (rkp. Perg. 14)	*PL-Kkar 2 (Rkp 14)*	14th	Kraków	35	848	704	
Kraków, Klastor OO. Karmelitów na Piasku (Carmelite Convent), Ms.3 (rkp. Perg. 15)	*PL-Kkar 3 (Rkp 15)*	15th	Kraków	32	836	735	
Kraków, Klastor OO. Karmelitów na Piasku (Carmelite Convent), Ms.4 (rkp. Perg. 20)	*PL-Kkar 4 (Rkp 20)*	15th	Kraków	35	447	258	
Kraków, Klastor OO. Karmelitów na Piasku (Carmelite Convent), Ms.5 (rkp. Perg. 13)	*PL-Kkar 5 (Rkp 13)*	15th	Kraków	45	605	538	
Wroclaw, Biblioteka Uniwersytecka (University Library), I F 401	*PL-WRu I F 401*	13th	Lubiąż	19	1,376	1,134	1,132
Wrocław, Biblioteka Uniwersytecka, Ms. R 503	*PL-WRu R 503*	14th	Wroclaw	59	2,538	1,818	11
Wrocław, Zakład Narodowy im. Ossolińskich, Biblioteka, Rkp. 12025/IV	*PL-WRzno 12025/IV*	14th	Kraków	26	310	255	
Porto 1151	*P-Pm 1151*	15th	Porto	39	887	683	

20. This manuscript is indexed in the *Portuguese Early Music Database*. Dioga Alte da Veiga, Index for "P-BRs (Braga) Arquivo da Sé Ms. 032," in *Portuguese Early Music Database* (2011), directed by Manuel Pedro Ferreira, http://pemdatabase.eu/source/2902.

Manuscript	**Siglum**	**Century**	**Provenance**	**No. of *diff*.**	**No. of ant.**	**No. of ant. with *diff*.**	**No. of mel.**
Ljubljana, Nadškofijski arhiv (Archiepiscopal Archives), 18 (olim 17)	*SI-Lna 18 (olim 17)*	15th	Kranj	49	1,592	1,372	
Ljubljana, Nadškofijski arhiv (Archiepiscopal Archives), 19 (olim 18)	*SI-Lna 19 (olim 18)*	15th	Kranj	49	1,183	1,163	
Istanbul, Topkapı Sarayı Müzesi, Deissmann 42	*TR-Itks 42*	14th	Esztergom	55	2,446	2,049	
Chicago, Art Institute of Chicago, Mrs. William E. Kelley Collection, 1911.142b	*US-Cai 1911.142b*	13th	Bologna	17	267	188	
Franciscan antiphoner, John J. Burns Library, Boston College MS.1996.097	*US-CHNbcbl 097*	14th	South Germany / Austria	34	569	509	
Chicago, Newberry Library, 24	*US-Cn 24*	13th	Central Italy	50	1,832	1,295	
New York, Columbia University, Rare Book and Manuscript Library, Plimpton MS 041	*US-NYcub Plimpton 41*	15th	Perugia	31	237	211	
Utrecht St. Paul's Abbey Antiphonary Fragments	*UStPFragm01*	12th	Utrecht	14	CMD index in progress		
Totals	**159 mss.**	**10th to 17th centuries**		**1,230**	**179,788**	**129,526**	**19, 975**

Theoretical Treatises

All sources were accessed through the *Thesaurus Musicarum Latinarum* (TML). Sources are listed alphabetically by their TML ID, which is also used throughout the thesis as a shorthand citation method. Any translations and commentaries on these sources used in this thesis are listed under "Secondary Sources."

TML ID	Title	Century	Author	Citation (from TML)	No. of *diff.*[1]
ABGURAM	*Regulae de arte musica*	12th	Abbot Guido	de Coussemaker, Edmond, ed. *Scriptorum de musica medii aevi nova series a Gerbertina altera*, vol. 2, 150-192. Paris: Durand, 1864-76; reprint ed., Hildesheim: Olms, 1963.	10
AMEPRA	*Practica artis musicae*	13th	Amerus	Amerus. *Practica Artis Musicae*. Edited by Cesarino Ruini. Neuhausen-Stuttgart: American Institute of Musicology, 1977.	33
ANO11TDM	*Tractatus de Musica Plana et Mensurabili*	15th	Anonymous XI	Wingell, Richard J. "Anonymous XI (CS III): An Edition, Translation, and Commentary," Vol. 1, 1-173. PhD diss., University of Southern California, 1973.	37
ANOARSMU	*Ars musica*	13th	Anonymous	Göllner, Marie Louise ed. *The Manuscript Cod. lat. 5539 of the Bavarian State Library, Musicological Studies and Documents*, vol. 43, 69-94. Neuhausen-Stuttgart: Hänssler-Verlag, American Institute of Musicology, 1993.	29

1. Number of unique *differentiae* in each theoretical treatise, based on data downloaded from the *Differentiae Database* May 27, 2019.

TML ID	Title	Century	Author	Citation (from TML)	No. of *diff.*
ANOCST	*Commentum super tonos*	11th	Anonymous	van Waesberghe, Joseph Smits, ed. *De numero tonorum litterae episcopi A. ad coepiscopum E. missae ac Commentum super tonos episcopi E.* (ad 1000). Divitiae musicae artis A/I, 24-93 (even pages only. Buren: Knuf, 1975.	34
ANODEO_MLBLL763	*De origine musice artis*	14th	Anonymous	London, British Library, *MS Lansdowne 763*, ff. 69r-87v.	44
ANODMF	*De modorum formulis et tonarius*	11th	Anonymous	Brockett, Clyde W., ed. *Anonymi de modorum formulis et tonaries.* Corpus scriptorum de musica, vol. 37, 46-128. American Institute of Musicology / Hänssler-Verlag, 1997.	42
ANOHOL3_MVNB4774	*Tractatus de musica cum glossis*	15th	Anonymous	Vienna, Österreichische Nationalbibliothek, *MS 4774*, ff. 35v-91r.	28
ANOLEIP	*Introductorium musicae*	16th	Anonymous	Riemann, Hugo. "Anonymi Introductorium musicae (c. 1500)." *Monatshefte für Musikgeschichte* 29 (1897; 30 (1898): 1-8, 11-19.	8
ANOLIB	*Jesus. Libellus musicae adiscendae valde utilis et est dialogus. Discipulus et magister sunt locutores*	15th	Anonymous	Anonymus. *Ex codice Vaticano lat. 5129*, ed. Albert Seay. Corpus scriptorum de musica, vol. 9, 21-48. [Rome]: American Institute of Musicology, 1964.	21
ANOMCANT_MSAVI44	*De modis cantandi*	15th	Anonymous	Salzburg, Stiftsbibliothek St. Peter, *MS a.VI.44*, ff. 44v–59v.	27
ANOSUM	*Summula*	15th	Anonymous	Vetter, Eddie, ed. *Summula tractatus metricus de musica glossis commentarioque instructus*. Divitiae musicae artis, A/VIIIa, 39-101. Buren: Knuf, 1988.	35

TML ID	Title	Century	Author	Citation (from TML)	No. of *diff.*
ANOTDS_MVNB4702	*Tractatus de solmisatione*	14th	Anonymous	Vienna, Österreichische Nationalbibliothek, *MS 4702*, ff. 86r–90v.	29
ARITRA	*Tractatus de musica*	13th	Aristotle	de Coussemaker, Edmond, ed. *Scriptorum de musica medii aevi nova series a Gerbertina altera*, Vol. 1, 251-281. Paris: Durand, 1864-76; reprint ed., Hildesheim: Olms, 1963.	25
BECANO	*Tractatus*	11th	Anonymous	Becker, Adolf. "Ein Erfurter Traktat über gregorianische Musik." *Archiv für Musikwissenschaft* 1 (1918-1919): 145-1165, 151-61.	33
BERTON	*Tonale Sancti Bernardi*	12th	Anonymous	Gerbert, Martin, ed. *Scriptores ecclesiastici de musica sacra potissimum*, Vol. 2, 265-277. St. Blaise: Typis San-Blasianis, 1784; reprint ed., Hildesheim: Olms, 1963.	14
BEUERO2	*Erotematum musicae liber secundus*	16th	Fredericus Beurhusius	*Erotematum musicae libri duo, ex optimis huius artis scriptoribus vera perspicuaque methodo descripti*, 68-125. Nuremberg: In officina typographica Catharinae Gerlachin, et Haeredum Ioannis Montani, 1580; repr., Cologne: Arno Volk, 1969.	27
BONBRE	*Breviloquium Musicale*	15th	Bonaventura da Brescia	Bonaventura da Brescia. *Brevis collectio artis musicae*. In Critical Texts, no. 11, edited by Albert Seay. Colorado Springs: Colorado College Music Press, 1980.	44
CARTRA	*Tractatus de musica plana*	15th	Monachus Carthusiensis	de Coussemaker, Edmond, ed. *Scriptorum de musica medii aevi nova series a Gerbertina altera*, Vol. 2, 434-483. Paris: Durand, 1864-76; reprint ed., Hildesheim: Olms, 1963.	55

TML ID	Title	Century	Author	Citation (from TML)	No. of *diff.*
COCTET3	*Tetrachordum musices, tractatus tertius*	16th	Johannes Cochlaeus	*Tetrachordum musices Ioannis Coclei Norici artium magistri Nurnbergae aeditum pro iuuentute Laurentiana in primis dein pro ceteris quoque Musarum Tyrunculis*, ff. Civ-Diiiir. Nurnbergae, impressi in officina excusoria Friderici Peypus, 1514.	31
CONNOV	*Novellus musicae artis tractatus*	15th	Conrad von Zabern	Gümpel, Karl-Werner. *Die Musiktraktate Conrads von Zabern, Akademie der Wissenschaften und der Literatur, Abhandlungen der Geistes- und Sozialwissenschaftlichen Klasse*. Jahrgang 1956, Nr. 4, 184-244. Wiesbaden: Steiner, 1956.	8
EICANON_MEUB685	*Tractatus de musica plana*	15th	Anonymous	Eichstätt, Universitätsbibliothek, *MS st 685 (olim O.26 quarto 27)*, ff. 362r–377v.	33
FABMUS2	*Ad musicam practicam introductio*	16th	Heinrich Faber	*Ad musicam practicam introductio, non modo praecepta, sed exempla quoque ad usum puerorum accomodata, quàm breuissime continens*, ff. L2r-a3v. Nuremberg: In Officina Iohannis Montani, et Vlrici Neuber, 1550.	8
FELOP	*Opusculum musice*	16th	Sebastianus de Felstin	*Opusculum musice compilatum nouiter per dominum Sebastianum presbiterum de Felstin. Pro institutione adolescentum in cantu Simplici seu Gregoriano*. [Cracow: Jan Haller, 1517]; reprint ed., Cracow: Polskie Wydawnictwo Muzyczne, 1979.	30

TML ID	Title	Century	Author	Citation (from TML)	No. of *diff.*
FINPRA	*Practica musica*	16th	Hermann Finck	*Practica musica Hermanni Finckii, exempla variorum signorum, proportionum et canonum, iudicium de tonis, ac quaedam de arte suaviter et artificiose cantandi continens*. Vitebergae, excusa typis haeredum Georgii Rhaw, 1556.	31
GAFPM1	*Practica musice*	15th	Franchino Gaffurio	*Practica musice Franchini Gafori Laudensis*. Milan: Ioannes Petrus de Lomatio, 1496; reprint ed., New York: Broude Bros., 1979.	14
GALRC2	*Ritus canendi [Pars secunda]*	15th	Johannes Gallicus	Johannes Gallicus, *Ritus canendi [Pars secunda]*, ed. Albert Seay, Critical Texts, no. 14. Colorado Springs: Colorado College Music Press, 1981.	32
GALRITS1	*Vera quamque facilis ad cantandum atque brevis introductio*	15th	Johannes Gallicus dictus Carthusiensis seu de Mantua	de Coussemaker, Edmond, ed. *Scriptorum de musica medii aevi nova series a Gerbertina altera*, Vol. 4, 345-372. Paris: Durand, 1864-76; reprint ed., Hildesheim: Olms, 1963.	32
GLADOD1	*Dodecachordum*	16th	Henricus Glareanus	[*Glareani Dodekachordon*], 1-64. Basle: Henrichus Petri, 1547; repr., New York: Broude Bros., 1967.	43
GUEUT	*Utillissime musicales regule*	15th	Guillaume Guerson	*Utillissime musicales Regule cunctis summopere necessarie plani cantus simplisis contrapuncti rerum factarum tonorum et artis accentuandi tam exemplariter quam practice per magistrum Guillermi Guersoni de Villalonga nouitter conpilate.* Paris: Michel Thouloze, [c. 1495].	24
GUISTON	*Tractatus de tonis*	14th	Guido de Sancto Dionysio	van de Klundert, Sieglinde, ed. *Guido von Saint-Denis Tractatus de tonis: Edition und Studien*, Vol. 2, 1-136. Bubenreuth: Hurricane Publishers, 1998.	30
HEHESUMM_MVBM8-24	*Summula*	14th	Henricus Helene	Venice, Biblioteca Nazionale Marciana, *MS lat.VIII.24* (3434), ff. 10r-44r.	31

TML ID	Title	Century	Author	Citation (from TML)	No. of *diff.*
HOFDOC	*Doctrina de tonis seu modis musicis*	16th	Eucharius Hofman	*Doctrina de tonis sev modis mvsicis*. Gryphiswaldiae: Typis Augustini Ferberi, 1582.	15
JACDIT	*Tractatus de intonatione tonorum*	14th	Jacobus Leodiensis	Jacobi Leodiensis. *Tractatus de consonantiis musicalibus, Tractatus de intonatione tonorum, Compendium de musica*. Edited by Joseph Smits van Waesberghe, Eddie Vetter, and Erik Visser. Divitiae musicae artis A/IXa, 47-87. Buren: Knuf, 1988.	33
JACSP6B	*Speculum musicae, Liber sextus*	14th	Jacobus Leodiensis	Jacobi Leodiensis. *Speculum musicae*. Edited by Roger Bragard. Corpus scriptorum de musica, vol. 3/6, 161-317. [Rome]: American Institute of Musicology, 1973.	67
JOHDEM	*De musica cum tonario*	11th	Johannes Affligemensis (Johannes Cotto)	Johannes Affligemensis. *De musica cum tonario*. Edited by J. Smits van Waesberghe. Corpus scriptorum de musica, vol. 1, 43-200. [Rome]: American Institute of Musicology, 1950.	56
JOHPAL	*Palma Choralis*	15th	Johannes de Olomons	Johannes de Olomons. *Palma choralis*. Edited by Albert Seay. Critical Texts, no. 6. Colorado Springs: Colorado College Music Press, 1977.	55
KEINLIL	*Lilium musicae planae*	15th	Michael Keinspeck	Ammel, Winfried, ed. *Michael Keinspeck und sein Musiktraktat "Lilium musicae planae" Basel 1496*. Marburger Beiträge zur Musikforschung, vol. 5, 111-129. Marburg: Görich und Weierhäuser, 1970.	28
LAMTRAC_MSBCLV30	*Tractatus de musica*	13th	Anonymous	Siena, Biblioteca comunale degli Intronati, *MS L.V.30*, ff. 14r–32r.	26

TML ID	Title	Century	Author	Citation (from TML)	No. of *diff.*
LISMUS	*Musica*	16th	Nicolaus Listenius	*Musica Nicolai Listenii ab authore denuo recognita multisque novis regulis et exemplis adaucta*. Nuremberg: Petreius, 1549; reprint in Veröffentlichungen der Musik-Bibliothek Paul Hirsch, vol. 8, Berlin: Martin Breslauer, 1927.	32
LOSERO	*Erotemata musicae practicae*	16th	Luca Lossio	*Erotemata musicae practicae*. Nuremburg: Montanus et Neuberus, 1563; repr., New York: Arnaldo Forni, 1980.	32
MONEPI	*Epitoma utriusque musicae practicae*	16th	Stefan Monetarius	*Epitoma utriusque musicae practicae*. Krakow, 1515; repr., Polskie Wydawnictwo Muzyczne, 1975.	22
NICCOM	*Compendium musicale*	15th	Nicolaus Capuanus	de la Fage, Adrien. *Essais de dipthérographie musicale*, 308-338. Paris: Legouix, 1864.	48
ODIDES	*Summa de Speculatione Musica*	13th	Walter Odington	de Coussemaker, Edmond, ed. *Scriptorum de musica medii aevi nova series a Gerbertina altera*, Vol. 1, 182-250. Paris: Durand, 1864-76; reprint ed., Hildesheim: Olms, 1963.	36
ODOINT	*Intonarium*	14th	Odo	de Coussemaker, Edmond, ed. *Scriptorum de musica medii aevi nova series a Gerbertina altera*, Vol. 2, 117-149. Paris: Durand, 1864-76; reprint ed., Hildesheim: Olms, 1963.	28
ODOSENS	*Liber opusculorum, capitula V-VI*	11th	Odorannus de Sens	Odorannus de Sens. *Opera omnia.* In *Textes édités, traduits et annotés par Robert-Henri Bautier et Monique Gilles, et, pour la partie musicologique, par Marie-Elisabeth Duchez et Michel Huglo*, 150-225. Paris: Centre national de la recherche scientifique, 1972.	32

TML ID	Title	Century	Author	Citation (from TML)	No. of *diff.*
PETTRA	*Tractatus de tonis*	13th	Petrus de Cruce Ambianensis	de Coussemaker, Edmond, ed. *Scriptorum de musica medii aevi nova series a Gerbertina altera*, Vol. 1, 282-292. Paris: Durand, 1864-76; reprint ed., Hildesheim: Olms, 1963.	38
PROPLA	*Plana musica*	15th	Prosdocimo de' Beldomandi	Herlinger, Jan, ed. and trans. *Prosdocimo de' Beldomandi, Plana musica and Musica speculative*. Studies in the History of Music Theory and Literature, vol. 4, 34-154. Urbana and Chicago: University of Illinois Press, 2008.	44
QUAPRIB3	*Quatuor Principalia III*	14th	Anonymous	de Coussemaker, Edmond, ed. *Scriptorum de musica medii aevi nova series a Gerbertina altera*, Vol. 4, 219-254. Paris: Durand, 1864-76; reprint ed., Hildesheim: Olms, 1963.	33
REIMAR	*Margarita philosophica cum additionibus novis: ab auctore suo studiosissima revisione quarto super additis, Liber V: De principiis musicae*	16th	Gregor Reich	*Margarita philosophica, mit einem Vorwort, einer Einleitung und einem neuen Inhaltsverzeichnis von Lutz Geldsetzer*, 175-203. Düsseldorf: Stern-Verlag Janssen & Co., [1973].	31
SAEMUS	*Musica plana atque mensurabilis una cum nonnullis solmisationis regulis certissimis insertis summa diligentia compendiose exarata*	16th	Heinrich Saess	Federhofer-Königs, Renate. "Die Musica plana atque mensurabilis von Heinrich Saess." *Kirchenmusikalisches Jahrbuch 48* (1964): 64-94.	8

TML ID	Title	Century	Author	Citation (from TML)	No. of *diff.*
SPANQUA	*Quaestiones musicae in usum scholae Northusianae*	16th	Johannes Spangenberg	*Quaestiones musicae in usum scholae Northusiane, per Ioannem Spangenberg Herdessianum collectae*. Nuremberg: Iohannes Petreius, 1536.	9
SZAMUS	*Musica*	15th	Ladislaus de Zalka	von Bartha, Dénes. *Das Musiklehrbuch einer ungarischen Klosterschule in der Handschrift von Fürstprimas Szalkai* (1490). Musicologica hungarica, vol. 1, 63-128. Budapest: Magyar nemzeti múzeum, 1934.	35
SZYDMUS	*Musica*	15th	Johannes de Szydlow	Gieburowski, Waclaw. *Die "Musica Magistri Szydlovite": ein polnischer Choraltraktat des XV. Jahrh. und seine Stellung in der Choraltheorie des Mittelalters, mit Beruecksichtigung der Choraltheorie und -Praxis des XV. Jahrh. in Polen, sowie der Nachtridentinischen Choralreform,* 9-72. Posen: St. Adalbert, 1915.	42
UGODEC1A	*Declaratio musicae disciplinae, liber primus*	15th	Ugolino Urbevetanis (Ugolino of Orvieto)	Ugolini Urbevetanis. *Declaratio musicae disciplinae*. Edited by Albert Seay. Corpus scriptorum de musica, vol. 7/1, 13-121. [Rome]: American Institute of Musicology, 1959.	28
VANREM	*Recanetum de musica aurea*	16th	Stephano Vanneo	*Recanetum de musica aurea*. Rome: Valerius Doricus, 1533; reprint, Bologna: Forni, 1969.	8
VOGMUS	*Musicae rudimenta*	16th	Johannes Vogelsang	Federhofer-Koenigs, Renate. "Johannes Vogelsang und sein Musiktraktat (1542): Ein Beitrag zur Musikgeschichte von Feldkirch (Vorarlberg)." *Kirchenmusikalisches Jahrbuch* 49 (1965): 76-113.	31

TML ID	Title	Century	Author	Citation (from TML)	No. of *diff.*
VOLDEM_MIBME.78	*De modo addiscendi Cantum Ecclesiasticum unicus Tractatus*	17th	Claudius Le Vol	Bologna, Museo Internazionale e Biblioteca della Musica, *MS E.78*, ff. 1r–48r.	19
WOLENC3	*Enchiridion musicae, liber III*	16th	Nicolaus Wollick	*Enchiridion musices Nicolai Wollici Barroducensis de gregoriana et figuratiua atque contrapuncto simplici percommode tractans, omnibus cantu oblectantibus perutile et necessarium* (Impressum Parisii impensa honestissimorum virorum Iohannis Parui ad intersignium Leonis Argentei et Francisci Regnault ad intersignium diui Claudii commorantium. Anno virginei partus .1512. 14. kalendas Nouembris), ff. cviiir-giv.	60
WYLMUS	*Musica manualis cum tonale*	15th	Johannes Wylde	Wylde, Johannis. *Musica manualis cum tonale*. Edited by Cecily Sweeney. Corpus scriptorum de musica, vol. 28, 43-206. Neuhausen-Stuttgart: American Institute of Musicology, 1982.	14
WYLMUSI_MLBLL763	*Musica guidonis*	15th	John Wylde	London, British Library, *MS Lansdowne 763*, ff. 3r-51v.	13
Totals	**61 sources**	**11th -17th centuries**			**435**

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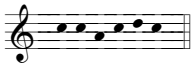
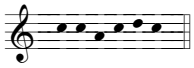
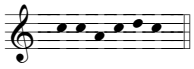
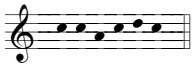
Appendix A: *Differentia* Standardization Project[1]

In the *differentia* standardization project, I assigned a unique identifier to each unique *differentia* and transcribed and automatically computed alternative access points to each *differentia* to enable multiple means of grouping *differentiae.* This allows for various means of analyzing the data. The unique identifier is an artificial naming system, which is not meant to act as a form of analysis upon the data, beyond the identification of 'identical' and 'dissimilar' *differentiae*. *Differentiae* were considered dissimilar based on the following criteria: melodic transcription, inclusion or omission of liquescents, and whether or not the *differentia* is transposed, as well as mode.[2] Except for mode, these distinguishing features are visible within each *differentia*; however, some otherwise identical *differentiae* appear in more than one mode (as is evident from the final of the associated antiphon in relation with the reciting tone of the *differentia*), usually in different manuscripts. *Differentiae* that are otherwise identical except for their modal designations, are considered distinct in the *Differentiae Database*. Similarly, *differentiae* for Roman mode antiphons, as identified in the *Cantus Manuscript Database* index for *I-Rvat SP B.79* (see Appendix B), are also identified as distinct from their octomodal counterparts. Thus, *differentiae* with the same melodic transcription may appear multiple times in the database and with distinct unique identifiers, because each has a different modal designation (see Table A.1)

1. An overview of the *differentia* standardization project was first presented as part of a symposium: Rebecca Shaw, "Standardizing a Crowdsourced Field: *Differentiae* in the *Cantus Manuscript Database*," presented at Symposium: Machine-Reading and Crowdsourcing Medieval Music Manuscripts at the Eastman School of Music (Rochester, New York, October 26, 2017).

2. Initially, each abbreviated *differentia* was identified as unique from its non-abbreviated counterpart to avoid the incorrect interpretation of its 'complete' version. See Shaw, "Standardizing a Crowdsourced Field." However, as the project progressed, I realized that the complete version of abbreviated forms were either included within the same manuscript and/or could be reliably identified. For example, *differentiae* that included repeated notes over the *saeculorum* were sometimes abbreviated by the scribes to four or five syllables, rather than six, omitting the repeated notes. As such, no 'incomplete' *differentiae* are included in the database. In instances where the syllabification of a *differentia* was unclear, resulting in a formula that appears to have seven or more syllables, the most likely syllabification of the *differentiae* was used, based on a comparison of *differentiae* within and between manuscripts. If further information emerges that changes the interpretation of these *differentiae*, alterations to the *Differentiae Database* are easily accomplished due to its digital format.

Table A.1. Example of four *differentiae* with the same melodic transcription that are distinct due to their modal designation.

Melodic transcription	Mode	*Differentia* ID	No. of Antiphoners	No. of Theoretical Tonaries
	3	99a	1	0
	5	99h	2	0
	8	99d	100	44
	Gc (Roman)	99aa	1	0

To enable easy distinction (on the part of the indexer) between identical, similar, and dissimilar *differentiae*, the standardized *differentia* ID uses pitch contour as its basis, with each unique contour assigned an arbitrary number (currently ranging from 1 to 385).[3] Each unique *differentia* within the same contour is distinguished by a lower-case alphabetic suffix; transposed *differentiae* are distinguished by a "T" prefix, but share the same alphabetic suffix as their non-transposed counterpart; and differently-pitched transpositions of the same *differentia* also include an upper-case suffix, following the lower-case suffix. For an example, see Table A.2.

By maintaining these factors of dissimilarity, the application of the standardized *differentia* ID avoids pre-emptive analysis that might omit differences that are of interest to the researcher. It also avoids the reduction of *differentiae* to a hypothetical "root" form, which Joseph Dyer warns against in his study of Italian antiphoners:

3. Initially, I started by assigning *differentia* ID codes based on the inherited system of octomodal hierarchies, where the principal distinguishing feature between *differentiae* (for the assignation of an ID, at least), was mode. However, I quickly realized that the same *differentia* could appear in multiple modes and the inclusion of *I-Rvat SP B.79*, which uses the octave-species of Old Roman chant rather than the Gregorian octomodal system, made this method of standardization problematic. After consulting with Debra Lacoste, Jennifer Bain, Barbara Haggh-Huglo, Joseph Dyer, and Christian Meyer, I implemented a new system of identification, based on pitch contour. A non-modally-based identification system for *differentiae* will also enable the future inclusion of non-octomodal chant traditions that also use *differentiae* (e.g., Roman, Ambrosian, etc.).

> There is a modern inclination to perceive similar *differentiae* as variants of a prototypical *Urform*. Such analysis may seem inviting to twentieth-century ears, because of the parameters of variation found among the *differentiae* within a mode can be so narrow. While I cannot claim that they should *not* be reduced to a small number of *Urformen*…, I can only point out that this kind of reductionism does not represent the perspective of most medieval theorists. They set up large categories for these *differentiae* for use with specific antiphons. Furthermore some of these 'variants' turn up consistently all over Italy and elsewhere in Europe.[4]

While I group *differentiae* based on a variety of criteria throughout my thesis in order to analyze similarity, the *differentia* standardization project and the *differentia* ID is not a form of reductionism, but of enabling comparisons of *differentiae* that are shared between manuscripts.

To apply standardized *differentia* IDs to manuscripts in the *Cantus Manuscript Database*, I completed the following steps:

1. Obtain access to manuscript images and download the index for the manuscript from the *Cantus Manuscript Database*
2. In Excel, sort the manuscript index by mode and *differentia*
3. For each uniquely-identified *differentia*, check a minimum of five instances (where possible) in the digitized manuscript images[5]
4. Assign the standardized *differentia* ID to each unique *differentia* within the manuscript. If a *differentia* does not yet exist within the *differentia* index, create a new *differentia* and assign a new ID based on the parameters outlined above

The addition of further manuscripts to the *Differentiae Database* can be done on a similarly retro-active basis (i.e., to include manuscripts indexed by other chant manuscript databases within the *Cantus* family), or at the point of indexing new manuscripts. While the exact identification of some *differentiae* in some manuscripts is

4. Joseph Dyer, "The Singing of Psalms in the Early-Medieval Office," *Speculum 64*, no. 3 (July 1989): 554-555.

5. This ensures that those *differentiae* identified by the original indexer as 'identical' also match the criteria of same-ness defind for the *differentiae* standardization project. Due to the lack of standardization within the *differentiae* field and the crowdsourced nature of the *Cantus Manuscript Database*, the degree of specificity to which indexers identified unique *differentiae* (particularly distinctions between *differentiae* with and without liquescents) varied. In instances where liquescent variations were not recognized in the original *Cantus* index, a more extensive identification of *differentiae* (i.e., beyond the five-check rule) was necessary.

sometimes ambiguous due to notation style, precision of the scribe, age and physical condition of the manuscript, and access to high-quality images (rather than microfilm), for the most part, *differentiae* can be assigned a specific melodic transcription with certainty. Contentious or uncertain *differentiae* were assigned melodic transcriptions (and a *Differentia* ID) based on what was most likely following comparison with other manuscripts, with the caveat that, should new information arise that changes the melodic interpretation of these *differentiae*, the digital format of the data allows for easy editorial changes.

Although one can analyze *differentiae* based on the pitch contour subsets suggested by the *differentia* ID, this is not the only way of approaching *differentiae*, nor is it necessarily the most effective or inherent means of grouping *differentiae* in a cross-manuscript study. One will notice that throughout my thesis, I do not actually analyze *differentiae* based on pitch contour, but rather focus on mode and the textual word-division of the formulae (the *saeculorum* and the *amen*), as it became clear through analysis that these elements had a greater impact and significance in the assignation of *differentiae* to antiphons within manuscripts. While I define 'similarity' throughout my thesis in terms of mode, shared *saeculorum*, shared *amen*, shared melodic contour (particularly for the transcription of adiastematic *differentiae*), and shared unique *differentiae* (as indicated by the *differentia* ID), future scholars may want to assess similarity using different criteria.

As such, the *Differentiae Database* includes the following fields or access points, in addition to its standardized ID: searchable melodic transcription, *saeculorum*, *amen*, mode, syllabic contour, pitch contour, inclusion of liquescents, and an indication of whether or not the *differentia* is transposed.[6] I identified these fields as useful and pertinent to *differentia*-based inquiries, through my interaction with *differentiae* throughout the *differentia* standardization project, and from the writings of modern

6. Note that liquescents are not included in the identification of pitch contour, and transposed *differentiae* are assigned the pitch contour, *saeculorum*, and *amen* of their non-transposed counterparts.

scholars and medieval theorists.[7] The structure of the database is designed so that further fields can be added with relative ease if a future research project deems them necessary or valuable. See Table A.3 for the definitions of each of the fields currently included in the database and examples. *Differentiae* can be grouped and analyzed using any of these criteria, in any combination, using the search filters in the **Index** on the *Differentiae Database*. Each *differentia* record also connects to a pitch contour record, which identifies details that pertain to all *differentiae* with the same pitch contour, regardless of mode, neumation, and syllabic grouping: melodic transcription, overall direction from first note to last note (up, down, or the same); melodic transcription of the overall movement (from first to last note); and range. Indices of a manuscript's *differentiae* link to the standardized *differentia* ID and reference the previous manuscript-specific *differentia* identification system employed in the *Cantus Manuscript Database* to enable analyses that incorporate data in both databases. See Figure A.1 for a diagram of the complete structure of the *Differentiae Database* and how it relates to manuscript indices in the *Cantus Manuscript Database*. Analyses throughout my thesis make use of data downloaded from the *Differentiae Database* and *Cantus Manuscript Database*.

7. See, for example, Charles M. Atkinson, *The Critical Nexus: Tone System, Mode, and Notation in Medieval Music* (Oxford: Oxford University Press, 2009), 92. Atkinson's statement regarding the consistency of *saeculorum* openings within mode in Regino of Prüm's tonary suggested that a division of each *differentia* by word ("saeculorum" and "amen") would significant significant analytical potential.

Table A.2. Sample of *differentiae* with their assigned *differentia* ID from two different pitch contours.

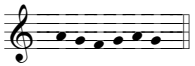
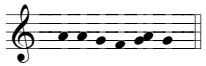
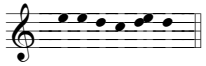
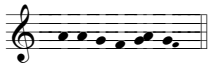
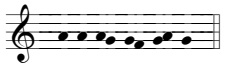
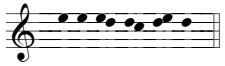
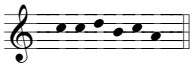
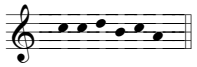
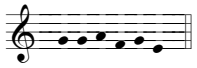
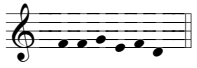
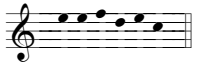
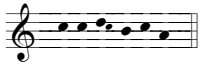
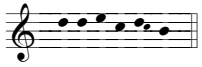
Contour Code	Pitch Contour	*Diff.* ID	Melodic Transcription	Mode	Liqu.?	Trans.?	Comments
66		66d		1	No	No	
		T66d		1	No	Yes	Same as 66d, except transposed (**T**66d)
		66zz		1	Yes	No	Same as 66d, except with a liquescent on the final syllable (66**zz**)
		66r		1	No	No	Same pitch contour as 66d, but different distribution of pitches across syllables (66**r**)
		T66r		1	No	Yes	Same as 66r, except transposed (**T**66r)
129		129a		5	No	No	
		T129aA		5	No	Yes	Same as 129a, except transposed (**T**129a). This *differentia* appears at three different levels of transposition, indicated by the upper-case alphabetic suffixes: **T**129a**A**, **T**129a**B**, **T**129a**C**
		T129aB		5	No	Yes	
		T129aC		5	No	Yes	
		129o		5	Yes	No	Same as 129a, except with a liquescent on second-last syllable (129**o**)
		T129o		5	Yes	Yes	Same as 129o, except transposed (**T**129o). This 'transposition' is likely a scribal error in *GB-WO F. 160*.

Table A.3. Fields included in the *Differentiae Database* for each unique *differentia*, with definitions and two examples. To see the *differentia* page for each of the examples in the *Differentiae Database*, click on the *Differentia* ID for each.

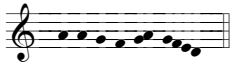
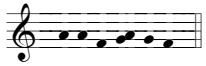
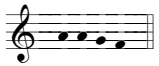
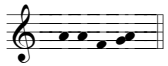
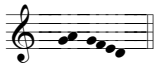
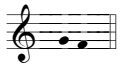
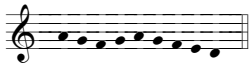
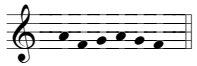
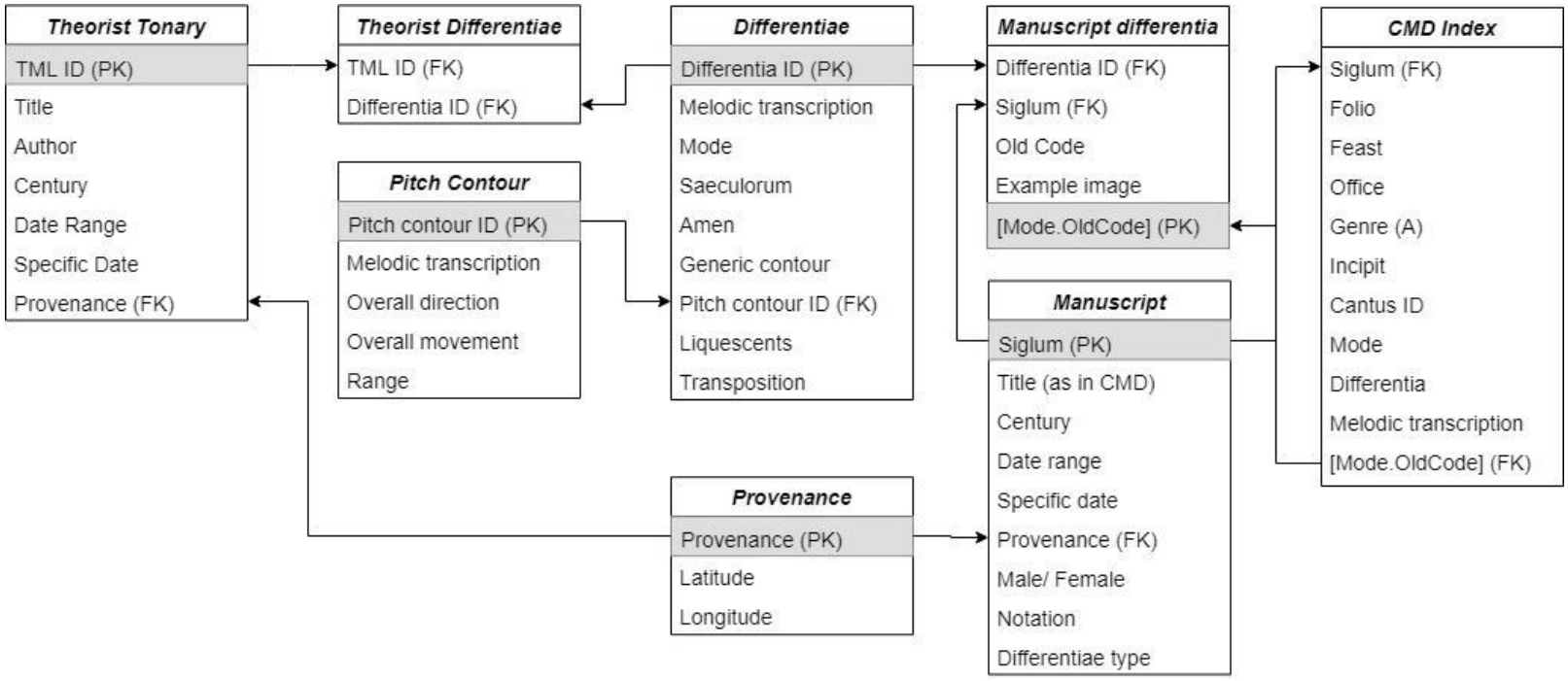
Field	Definition	Example 1	Example 2
***Differentia* ID**	Unique identifier assigned to each unique *differentia*. A *differentia* is considered unique if it differs from another in one or more of the following criteria: melodic transcription, inclusion or omission of liquescents, transposition of the *differentia*, and mode (see Tables A.1 and A.2)	72b	7a
Melodic Transcription	Searchable transcription of the *differentia*.		
Saeculorum	First four syllables of the *differentia*, with any pitch repetition within a syllable and liquescents removed.		
Amen	Last two syllables of the *differentia*, with any pith repetition within a syllable and liquescents removed		
Mode	Mode of the *differentia*	Mode 1	Mode 6
Syllabic Contour	The assignation of alphabetic codes for movement within a syllable ('u' for up and 'd' for down). The first note of every syllable is neutral ('n'). This field helps in the identification of adiastematic *differentiae*.	n-n-n-n-nu-nddd	n-n-n-nu-n-n
Pitch Contour	A melodic transcription of the *differentia* that ignores syllabic divisions and removes all pitch repetition. Transposed *differentiae* are assigned the pitch contour of their non-transposed counter-part.		
Liquescents?	Indicates whether or not the *differentia* includes liquescents (Yes or No).	No	No
Transposed?	Indicates whether or not the *differentia* is transposed (Yes or No).	No	No

Figure A.1. Entity-relationship diagram for the *Differentiae Database* and the inclusion of manuscript index data (i.e., feast, incipit, Cantus ID, etc.) from the *Cantus Manuscript Database*. Only fields used in *differentia* analysis and identification are included in the CMD table. The "Mode.OldCode" field was calculated based on data in the *Cantus Manuscript Database* and the *Differentiae Database* in order to connect the standardized *differentia* ID to data pertaining to individual antiphons within CMD indices, as the standardized *differentia* ID is not yet included in the CMD. In each table "(PK)" refers to the primary key of the table and "(FK)" refers to a foreign key; the primary key of a table is its unique identifier, used to create consistent and reliable connections between tables, and the foreign key of a table is a unique identifier from another table used to link the two tables together. For instance, the *Differentia* ID is the primary key of the *Differentiae* table and appears as a foreign key in the tables for each manuscript's *differentiae* and those found in each theoretical treatise included in the database.



Appendix B: Roman *Differentiae*

One of the manuscripts included in the *Differentiae Database* contains the Old Roman repertory and thus uses a different octave-species instead of the Gregorian octomodal system found in the other manuscripts. While more manuscripts in this tradition will need to be added to the *Differentiae Database* to justify an extensive comparison between the two systems, some conclusions are possible based on one manuscript.

The index for *I-Rvat B. 79* (Rome, twelfth century) uses a two-letter system for octave-species identification, whereby the first letter indicates the final and the second the reciting tone.[1] If the hierarchy of these two letters are reversed—that is, if the reciting tone is given precedence over the final of the antiphon—similarities between the *differentiae* of the Old Roman repertory and that of 'Gregorian' chant are evident. Both systems have a supra-modal grouping based on reciting tone, with multiple finals sharing a common reciting tone. Moreover the reciting tone-final pairings are similar in both systems (reciting tone A with finals D, E, and F; C with E and G), with some additional relationships in the Roman system that are not present in the Gregorian system (e.g., reciting tone D with finals A, C, and G, not just G). As well, Roman and Gregorian *differentiae* share many *saeculorum* openings within these reciting tone-final pairings (see Table B.1), and many complete *differentiae* also overlap (see Table B.2). These similarities in *differentiae* and the equivalent relationship between reciting tones, finals, and *saeculorum* openings between two disparate octave-species systems may be indicative of a pre-octomodal system of *differentiae* organization, whereby *differentiae* grouped antiphons primarily based on reciting tone, not reciting tone and final (i.e. mode). When the modal system was imposed on chant and *differentiae* began to be theoretically categorized according to mode in tonaries, overlaps between modes

1. Andrew Mitchell, Inventory of "Città del Vaticano (Roma), Biblioteca Apostolica Vaticana, San Pietro B.79," edited by Debra Lacoste, in *Cantus Manuscript 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-). Also see Joseph Dyer, "The Singing of Psalms in the Early-Medieval Office," *Speculum 64*, no. 3 (July 1989): 573-577.

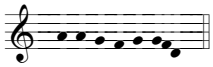
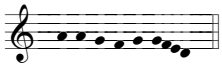
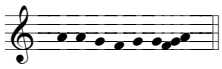
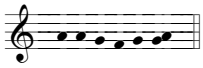
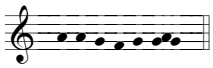
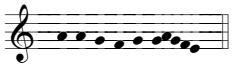
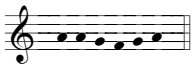
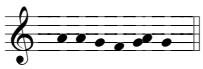
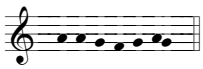
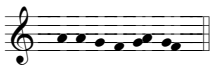
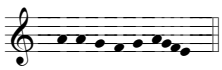
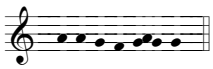
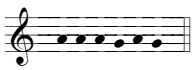
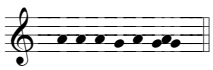
sharing a reciting tone persisted as evidence of the reorganization of a practical tradition into a theoretical construct.

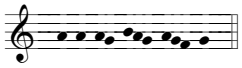
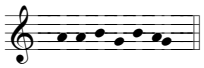
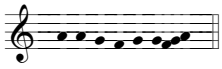
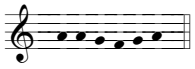
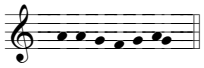
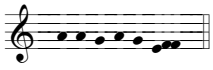
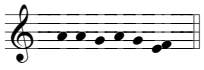
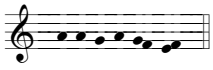
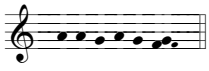
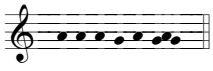
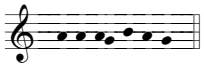
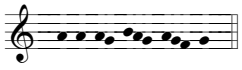
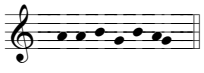
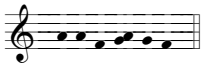
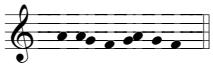
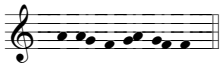
Table B.1. Comparison of *saeculorum* in the Roman octave-species system and the octomodal system, grouped by reciting tone.

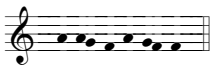
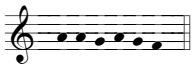
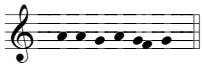
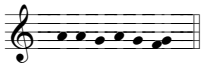
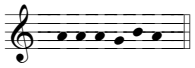
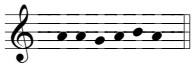
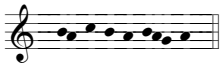
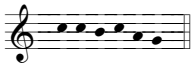
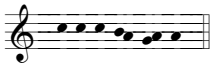
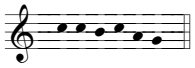
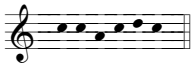
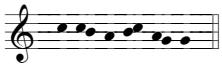
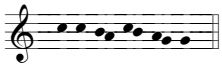
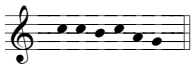
Reciting tone [No. of ant.]	**Finals**	**Equivalent Gregorian modes**	**Shared *saeculorum***	**Roman-only *saeculorum***
A [343]	D	Mode 1	a-a-G-F	a-a-aG-baG
	E	Mode 4	a-a-a-G	a-a-aG-baG
	F	Mode 6	a-a-F-Ga	a-a-aG-b
	G[2]	-	a-aG-F-Ga	
			a-a-G-a	
			a-a-b-G	
B [2]	E	Mode 3?		ba-c-b-a
C [315]	A	Mode 3	c-c-c-ba	c-cb-a-bc
	E	Mode 5	c-c-b-c	c-c-ba-cb
	G	Mode 8	c-c-a-c	
			c-c-d-b	
			c-c-c-c	
D [431]	A	-	d-e-d-d	d-d-c-d
	C	-	d-d-e-c	d-c-e-c
	G	Mode 7	d-d-e-d	
			d-e-d-c	
			d-e-d-d	
E [46]	D	Mode 1, transposed	e-e-d-c	
	E	-	e-e-d-e	
	G	-		
F [15]	C	-		F-F-E-F
	D	Mode 2		F-F-F-ED
G [2]	E	-		G-a-F-G

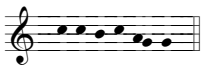
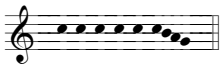
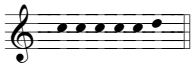
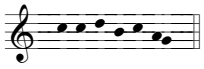
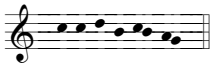
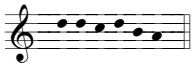
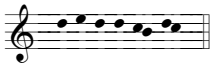
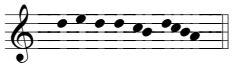
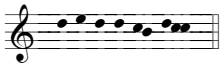
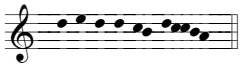
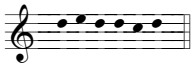
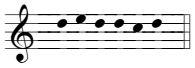
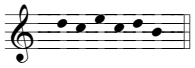
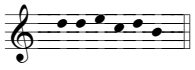
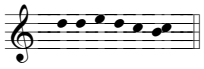
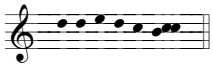
2. Scribal error? Only appears once in manuscript.

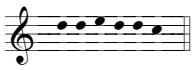
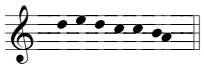
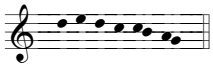
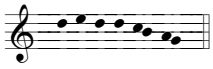
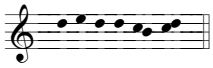
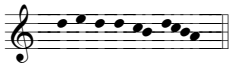
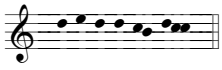
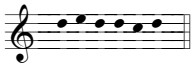
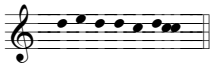
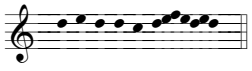
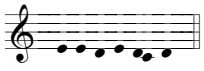
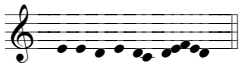
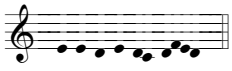
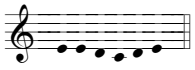
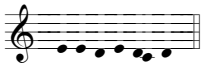
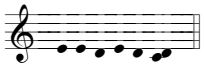
Table B.2. *Differentiae* in *I-Rvat SP B.79* with their octomodal counterparts. Note that *I-Rvat SP B.79* replaces the common mode 7 *saeculorum* D-D-E-D with D-E-D-D. 'Equivalent' *differentiae* in these instances are indicated in square brackets.

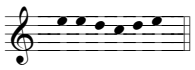
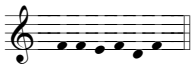
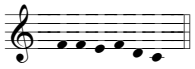
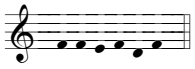
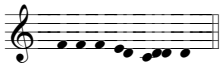
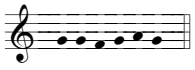
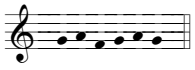
***Diff*. ID**	**Final**	**Rec. Tone**	***Differentia***	**No. of Ant.**	**Equiv. *Diff.***	**Gregorian Mode**	**No. of mss. [No. of ton.]**
74j	D	a		7	74o	1	[2]
75i	D	a		10	75d	1	23 [17]
76b	D	a		12			
64h	D	a		28	64c 64z	1 6	59 [24] 1
66rrr	D	a		9	66l	1	51 [24]
71f	D	a		31			
64v	D	a		79	64b 64j	1 4	89 [35] 1
66sss	D	a		8	66d 66dd	1 6	123 [42] 1
66ttt	D	a		1	66e	1	29 [15]
69d	D	a		2	69b 69v	1 6	63 [23] 1
71g	D	a		2			
66ppp	D	a		18	66ppp	1	1
52u	D	a		5	52a 52l	1 4	50 [19] 2
187a	D	a		23			

Diff. ID	Final	Rec. Tone	*Differentia*	No. of Ant.	Equiv. *Diff.*	Gregorian Mode	No. of mss. [No. of ton.]
202a	D	a		3			
168a	D	a		19			
76c	E	a		1			
64w	E	a		2	64b 64j	1 4	89 [35] 1
66vvv	E	a		3	66e	1	29 [15]
194a	E	a		14			
194b	E	a		4			
193a	E	a		3			
198c	E	a		1			
187b	E	a		1			
195a	E	a		1			
202b	E	a		3			
168b	E	a		1			
7o	F	a		2	7a	6	129 [55]
69s	F	a		5	69i	6	12
69l	F	a		3	69t	6	2

Diff. ID	Final	Rec. Tone	*Differentia*	No. of Ant.	Equiv. *Diff.*	Gregorian Mode	No. of mss. [No. of ton.]
197a	F	a		1			
54f	F	a		12	54a 54d	6 1	2 1
198a	F	a		26			
198b	F	a		1			
55b	F	a		1	55c	4	3 [2]
169c	G	a		1			
196a	E	b		2			
118ii	a	c		1	118r 118a 118c	3 8 5	9 [1] 124 [54] 1
114b	a	c		1	T153e	2T	1
118jj	E	c		6	118r 118a 118c	3 8 5	9 [1] 124 [54] 1
99aa	G	c		8	99d 99h 99a	8 5 3	100 [44] 2 1
170a	G	c		1			
111c	G	c		7			
118ff	G	c		247	118r 118a 118c	3 8 5	9 [1] 124 [54] 1

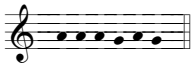
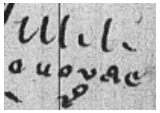
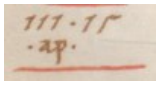
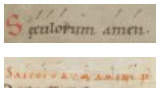
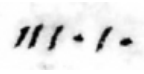
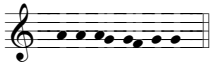
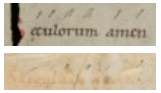
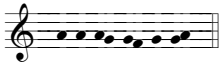
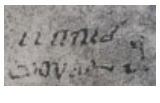
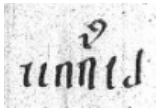
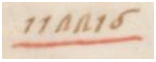
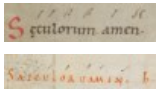
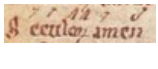
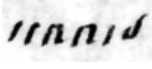
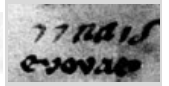
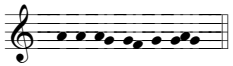
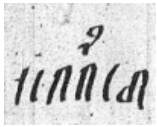
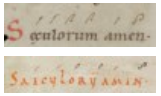
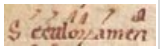
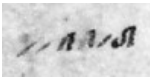
Diff. ID	Final	Rec. Tone	*Differentia*	No. of Ant.	Equiv. *Diff.*	Gregorian Mode	No. of mss. [No. of ton.]
118gg	G	c		3	118aa	8	1
113d	G	c		27			
127d	G	c		9			
131l	G	c		3	131a	5	50 [21]
171a	G	c		2	171b	5	1 [1]
188a	a	d		1			
180b	a	d		3	[148n]	[7]	[1]
363c	a	d		19			
180c	a	d		24			
363b	a	d		28			
147u	a	d		6	[147a]	7	32 [21]
147v	C	d		3	[147a]	7	32 [21]
364a	G	d		1			
178a	G	d		12	T129a 178c	5T 7	3 2
144m	G	d		3	144a	7	95 [41]
144n	G	d		3	144e	7	2 [3]

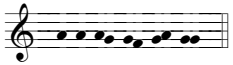
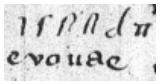
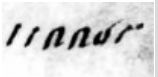
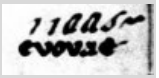
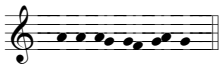
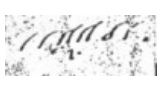
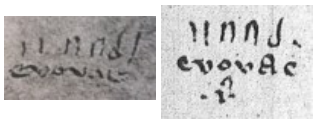
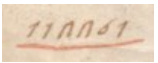
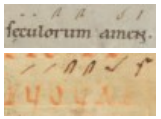
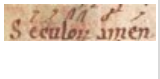
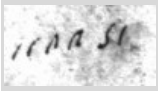
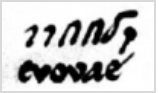
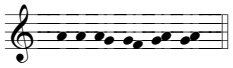
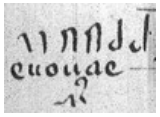
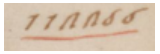
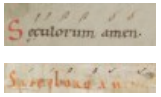
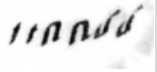
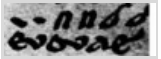
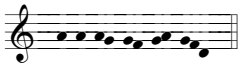
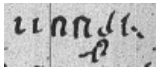
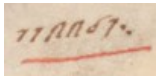
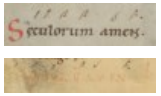
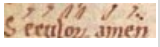
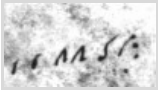
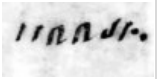
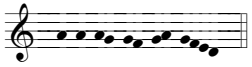
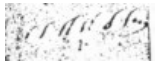
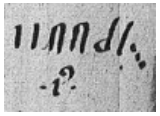
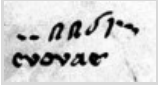
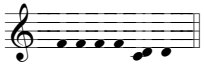
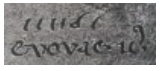
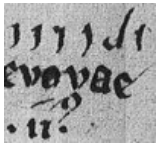
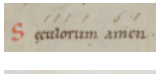
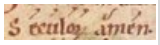
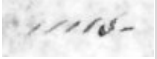
Diff. ID	Final	Rec. Tone	*Differentia*	No. of Ant.	Equiv. *Diff.*	Gregorian Mode	No. of mss. [No. of ton.]
141c	G	d		1	141b	7	1 [1]
143aa	G	d		6	143p	7	2
179b	G	d		102	[179d]	[7]	[2]
179a	G	d		3	[179d]	[7]	[2]
145b	G	d		16	[145a]	[7]	[3]
363a	G	d		2			
180a	G	d		2			
147t	G	d		191	[147a]	7	32 [21]
148c	G	d		1	[148s]	7	6
79a	G	d		1			
184a	D	E		2	[T198a]		
128a	D	E		6			
88a	D	E		1			
222a	E	E		7	T64b	1T	8
184d	E	E		8	[T198a]		
184b	E	E		1	[T198b]		

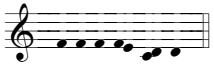
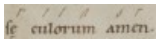
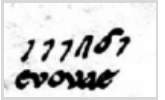
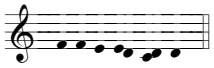
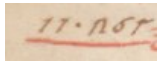
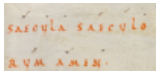
Diff. ID	Final	Rec. Tone	*Differentia*	No. of Ant.	Equiv. *Diff.*	Gregorian Mode	No. of mss. [No. of ton.]
184c	G	e		2	T64b	1T	8
186a	C	F		1			
23a	D	F		3	T118aA	8T	7 [1]
186b	D	F		9			
153f	D	F		2			
192a	E	G		1			
191a	E	G		1			

Appendix C: Adiastematic *Differentiae*

Table C.1. Summary of adiastematic *differentiae* that appear in more than one manuscript. For complete tonaries for each manuscript, see the *Differentiae Database.* Columns in grey indicate manuscripts that do not include modal indications with their *differentiae*. Table sorted by mode and *Differentia* ID. *Differentiae* that only vary by the addition or exclusion of liquescents are listed in the same row of the table.

***Diff.* ID and Transcription**	***A-KR VI/258***	***A-LIs 290***	***A-SF XI 480***	***A-Wn 1890***	***CH-SGs 388, 390 and 391***	***CZ-Pu VI.E.4c***	***D-B Mus. 40047***	***D-SI HB.I.55***	***GB-Ob Can. Lit. 202***
Mode 1									
52a 									
63b 									
64i, 64d, 64a 									
66b, 66h 									

***Diff.* ID and Transcription**	***A-KR VI/258***	***A-LIs 290***	***A-SF XI 480***	***A-Wn 1890***	***CH-SGs 388, 390 and 391***	***CZ-Pu VI.E.4c***	***D-B Mus. 40047***	***D-SI HB.I.55***	***GB-Ob Can. Lit. 202***
66iii, 66s 									
66r 								
67a, 67b, 67f, 67h 									
70b 									
72m 									
Mode 2									
150e, 150n, 150b 									

Diff. ID and Transcription	*A-KR VI/258*	*A-LIs 290*	*A-SF XI 480*	*A-Wn 1890*	*CH-SGs 388, 390 and 391*	*CZ-Pu VI.E.4c*	*D-B Mus. 40047*	*D-SI HB.I.55*	*GB-Ob Can. Lit. 202*
152f 									
153c 									
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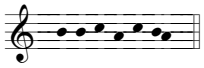
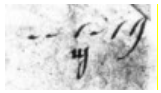
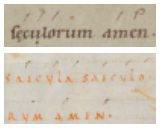
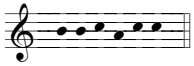
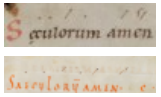
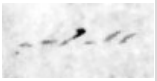
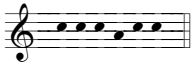
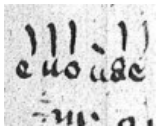
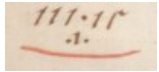
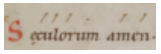
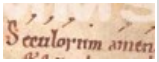
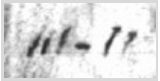
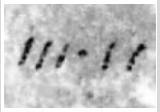
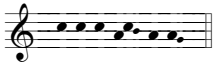
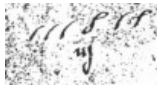
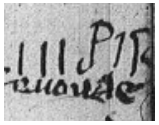
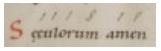
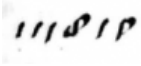
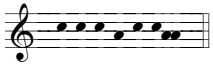
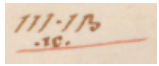
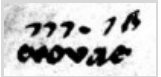
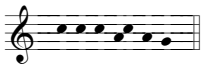
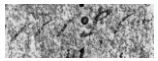
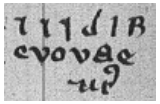
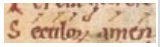
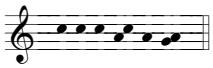
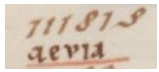
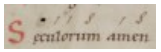
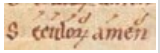
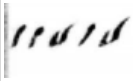
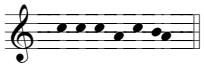
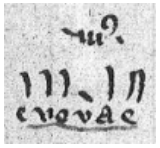
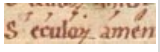
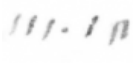
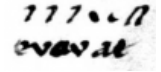
160a 									
172a 									
86b 									
89g 									

Diff. ID and Transcription	*A-KR VI/258*	*A-LIs 290*	*A-SF XI 480*	*A-Wn 1890*	*CH-SGs 388, 390 and 391*	*CZ-Pu VI.E.4c*	*D-B Mus. 40047*	*D-SI HB.I.55*	*GB-Ob Can. Lit. 202*
89i 									
92c, 92a, 92d, 92i, 92n 									
93c, 93a, 93b, 93c, 93n 									
97a 									
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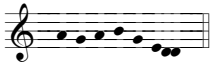
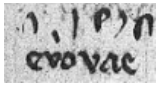
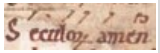
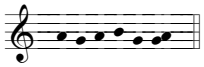
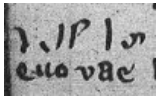
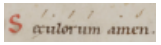
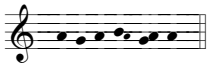
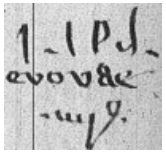
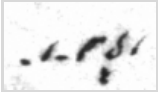
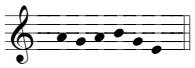
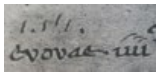
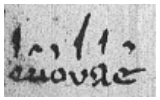
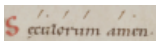
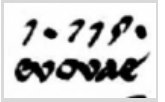
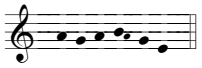
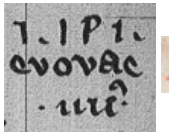
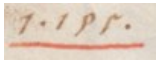
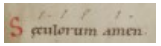
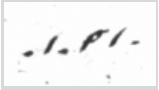
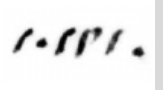
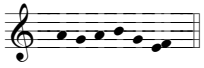
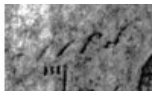
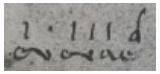
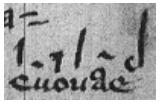
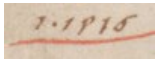
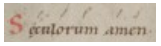
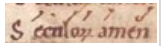
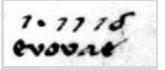
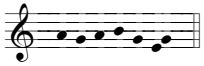
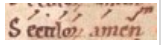
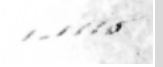
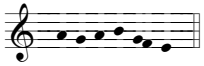
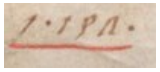
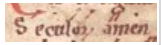
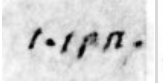
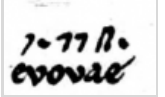
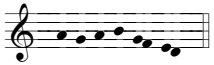
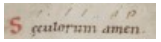
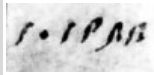
206c, 206b 									
25b, 25d, 25k 									

***Diff.* ID and Transcription**	***A-KR VI/258***	***A-LIs 290***	***A-SF XI 480***	***A-Wn 1890***	***CH-SGs 388, 390 and 391***	***CZ-Pu VI.E.4c***	***D-B Mus. 40047***	***D-SI HB.I.55***	***GB-Ob Can. Lit. 202***
25l 									
27a, 27b, 27e, 27g, 27p, 27l, 27n 									
27b 									
28a, 28b, 28d, 28f 									
31a, 31c, 31d, 31e, 31f, 31g, 31h 									
34b, 34a 									

Diff. ID and Transcription	*A-KR VI/258*	*A-LIs 290*	*A-SF XI 480*	*A-Wn 1890*	*CH-SGs 388, 390 and 391*	*CZ-Pu VI.E.4c*	*D-B Mus. 40047*	*D-SI HB.I.55*	*GB-Ob Can. Lit. 202*
35e, 35d 									
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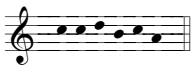
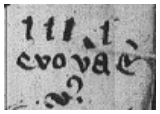
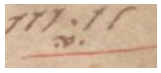
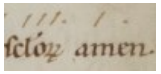
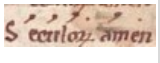
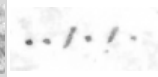
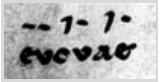
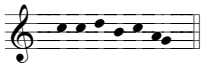
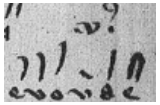
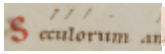
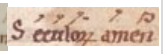
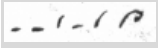
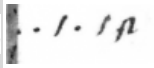
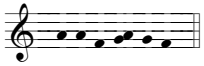
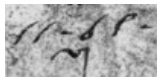
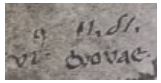
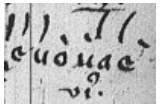
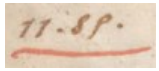
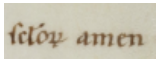
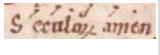
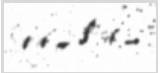
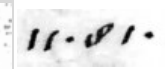
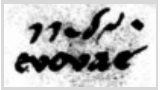
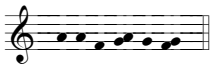
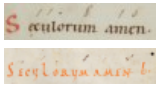
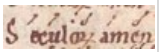
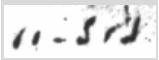
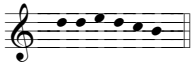
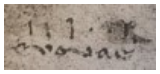
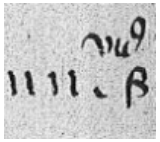
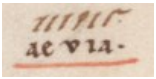
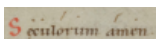
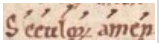
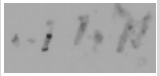
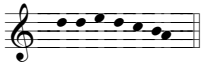
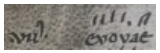
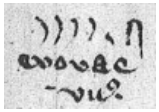
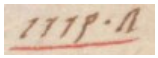
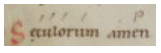
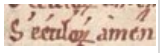
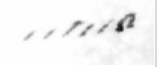
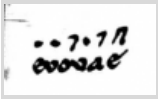
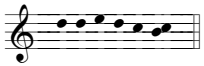
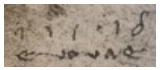
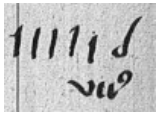
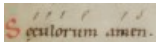
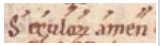
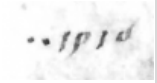
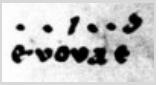
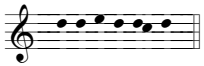
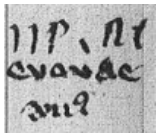
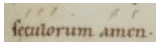
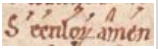
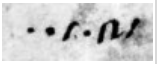
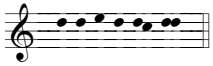
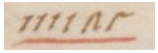
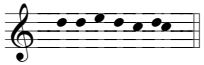
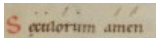
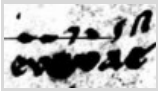
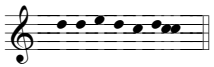
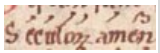
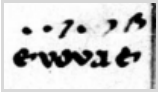
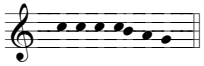
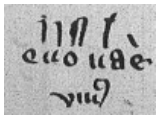
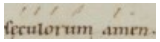
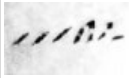
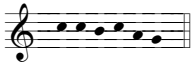
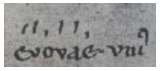
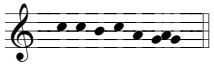
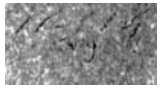
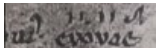
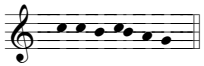
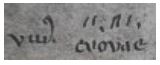
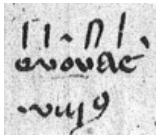
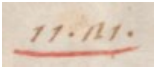
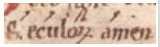
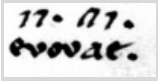
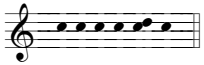
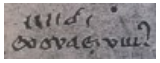
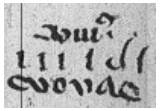
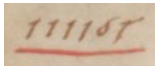
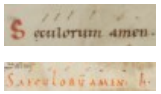
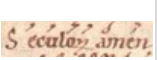
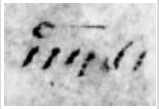
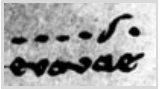
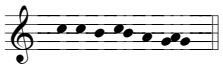
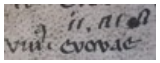
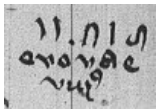
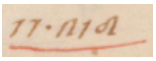
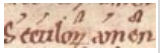
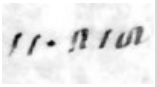
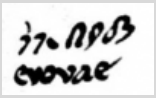
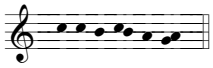
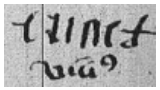
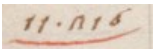
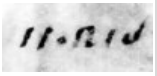
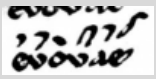
129a, 129b, 129o, 129t 									
131a 									
Mode 6									
7a, 7e, 7g 									
8a, 8b, 8c 									

Diff. ID and Transcription	*A-KR VI/258*	*A-LIs 290*	*A-SF XI 480*	*A-Wn 1890*	*CH-SGs 388, 390 and 391*	*CZ-Pu VI.E.4c*	*D-B Mus. 40047*	*D-SI HB.I.55*	*GB-Ob Can. Lit. 202*
Mode 7									
142a, 142i, 142l, 142m, 142n 									
143b, 143a, 143m, 143s 									
144a, 144b, 144d 									
147c, 147b 									
147n 									

Diff. ID and Transcription	*A-KR VI/258*	*A-LIs 290*	*A-SF XI 480*	*A-Wn 1890*	*CH-SGs 388, 390 and 391*	*CZ-Pu VI.E.4c*	*D-B Mus. 40047*	*D-SI HB.I.55*	*GB-Ob Can. Lit. 202*
148b 									
148s 									
Mode 8									
113e 									
118a, 118b, 118h, 118n 									
120a, 120d 									
123a, 123f 									

Diff. ID and Transcription	*A-KR VI/258*	*A-LIs 290*	*A-SF XI 480*	*A-Wn 1890*	*CH-SGs 388, 390 and 391*	*CZ-Pu VI.E.4c*	*D-B Mus. 40047*	*D-SI HB.I.55*	*GB-Ob Can. Lit. 202*
135b 									
211a, 211b 									
233b, 233a 									

Appendix D: *Amen*-Antiphon Connections in *F-Pnm lat. 12044*

Table D.1. Connections that only occur once in the manuscript are omitted from the table. Notes in brackets indicate the most common third and fourth notes in the antiphon's pitch contour. The table includes the number of instances ("inst.") of each group of *amen*-antiphon connections within the manuscript.

Mode	Connection 'rule'	*Amen*	Antiphon[1]	Inst.	Commentary
1	descending *amen* to ascending antiphon	G-GFED	CD DF DC(DF) DE FD(EF) FE(DF)(Fa)	172	
		Ga-GFED	DC(D)	5	used for specific antiphons
	G and a (two notes per syllable) to antiphon with ascending leap	Ga-GF	DC(F)	5	alternative to descending *amen*, approaches antiphon by leap
	G and a to antiphon with limited range (F-a) and no leaps	aG-a	aG Fa FG(a)	33	mostly antiphons that start Fa and aG (thus emphasis on a in *amen*)
		G-GaG	FG(a) Fa	25	mostly antiphons that start FG (thus emphasis on G in *amen*)
		G-Ga	FE(D)	7	
	institution-specific use	GF-D	FG(F) FE(D)	5	
	common *amen* to all antiphons	Ga-G	DC(FG) DF(G) CD(a) Da(b) DE(F) FC(Da)	189	the 'common' *amen* approaches antiphons starting on *C* or *D* by leap and most antiphons include a leap within the opening four notes of their pitch contour

1. Listed in descending order of commonality within the manuscript.

Mode	Connection 'rule'	*Amen*	Antiphon	Inst.	Commentary
2	common *amen* to all antiphons	C-D	DC DF FE CD DG Da DE FG	132	
3	lower range *amen*, a[x]-G[x], to antiphons with an E	a-Ga	ED EF EG	28	
		aG-Ga	ED	2	much less common than a-Ga
	higher range *amen* (with c) to higher antiphons (without E)	c-b	Ga Gc ac ca	66	Ga antiphons more commonly preceded by this *amen* than by a-G
	institution-specific use	a-G	GE Ga	7	unison connection to antiphons starting on G
4	features *G* and *a* to antiphons starting around *a* or *G*	a-G	EG Ga	4	
	descending *amen* to ascending antiphon	GFE-ED	CD(E)	4	
	common *amen* to all antiphons	GFE-E	FE FD CD(F) ED EF DE FG DF Da aG	149	used with the majority of mode 4 antiphons; few exceptions above

Mode	Connection 'rule'	*Amen*	Antiphon	Inst.	Commentary
5	common *amen* to all antiphons	c-a	aF Fa aG cd Ga Ca cb ac	41	all antiphons contain either a c or a within their first two notes
	c-ac amen to antiphons starting on *F*	c-ac	Fa	13	c-ac and c-a are not used within the same feast
6	common *amen* to all antiphons	G-F	FG FE EF DF FD Fc	71	
7	descending *amen* to ascending antiphon from G	c-ba	Gb(c) Ga(c) Gc	117	
	unison-type *amen* to limited-range antiphons	c-bc	db(d) dc(bc) de(d) cd bd	69	mostly leads to db or dc (where the opening direction of the antiphon is the same direction as the neighbour tone of the *amen*)
		c-dc	cb(c) bd(b) bc(d) cd(c)	26	little overlap with three-note antiphon openings above for c-bc *amen*
		c-b	bd(b)	2	infrequent

Mode	Connection 'rule'	*Amen*	Antiphon	Inst.	Commentary
7 (cont.)	*amen* ending on d to ascending antiphon, leap from G	c-cd	Gd	4	used with four specific antiphons
		c-d	Gd	14	
8	*amen* with a and G to antiphons with range E-G	a-Ga	FG(a) Fa	52	FG(a) antiphons are more commonly preceded by a-Ga *amen* than a-G *amen*
	amen contains c and d to antiphons that start on c	d-c	cb cd ca aG	82	only two antiphons start aG (exception or error?)
	common *amen* to all antiphons	a-G	Gc(a) GF Ga aF FG(a) GD ac aG DF GE DG CD	351	acts as an *amen* with a and G; leads to antiphons that mostly start on G or a