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TOWARDS A CHRONOLOGY OF THE CHANSONS OF GILLES BINCHOIS

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Introduction

The chronology and dating of the works of Medieval and Renaissance composers has important ramifications for music history and our knowledge of the development of musical style. However, given the time span that separates us, the sparsity of documentary evidence from the time, and the uncertain or conflicting composer ascriptions that often occur in the manuscripts that survive, any way of gleaning additional information concerning composer chronologies or resolving conflicting manuscript ascriptions is to be welcomed. One such method is the novel analytical framework recently proposed by Beauvois (2017) where a carefully selected set of musical variables associated with the early fifteenth-century chanson repertory is quantitatively evaluated using the graphical multivariate statistical technique of multidimensional scaling. Using this analytical framework, Beauvois (2017) was able to resolve, verify and revise the conflicting manuscript ascriptions, proposed composition dates and hypotheses previously advanced for a number of songs by Arnold and Hugo de Lantins (fl.1423–1432), two stylistically different but contemporaneous composers. However, the present article expands its application, and broadens the scope for inquiry using it, by showing how it can be used to analyse the stylistic changes occurring in the complete secular output of one composer over the duration of his career and establish a chronology for his songs. For this purpose, the songs of Gilles Binchois form an ideal data set for two reasons: (i) a uniform distribution of musical variables across the songs is ensured as all bar three of them adhere to the 3vv-chanson format of a texted upper voice (superius) accompanied by two lower voices having approximately the same range (contratenor and tenor) and (ii) the stylistic effects on his output that might result from changing circumstances, geographical location and the demand of different patrons is minimal, as the majority of his career was spent at the Burgundian Court of Philip the Good (reigned 1419–1467).

In what follows, codes for each song (see the Appendix, Table A1, column 1) are used throughout the main body of the text for brevity and are prefixed by *B-* (e.g. *B-Md*) in order to distinguish them from the manuscript sigla given in the Appendix, Table A2. In addition, to make this article as reader-friendly as possible to those who have the most to gain from using the analytical framework, musicologists with an arts or humanities background, details of the data preparation and statistical and computational matters have been relegated to endnotes. It will be seen that the findings represent a substantial advance on those of Beauvois (2017) as they demonstrate that the

analytical framework can be used to (i) divide Binchois's songs into four style periods approximately 8 to 10 years in length, (ii) date individual songs and manuscripts to within an accuracy of approximately plus or minus two years by mapping biographical data onto the results and (iii) confirm and clarify the findings of previous manuscript studies. Furthermore, the findings are not only internally consistent, but also exhibit a remarkable degree of agreement with the musicological literature that strongly suggests they could be used as a basis for future research. Consequently, given Binchois's status as one of the leading composers of his time (Fallows 2001: 581) and that 'a style chronology [of his songs] can be constructed only with difficulty' (Strohm 1993: 184) and their dates 'must be approximate because the dating of the sources themselves is more relative than fixed' (Slavin 1988: 27), the findings are of great importance to our knowledge of music history and the development of musical style in the fifteenth century. Before the findings themselves can be discussed, however, the two principal components of the analytical framework, multidimensional scaling and the musical variables, need to be described.

Multidimensional Scaling

Multidimensional scaling (MDS) takes a set of variables and transforms it into a matrix of distance values that reflects the similarity or dissimilarity of pairs of objects with respect to these variables. This matrix is then converted into a map or spatial configuration of the objects where the greater the difference between the objects, the greater the distance between them (Everitt and Dunn 2001; Kruskal and Wish 1978). For example, Table 1, the distances in miles between a set of locations in France, can be considered as a matrix of distance values that reflects their similarity or dissimilarity with respect to geographical position. When this distance matrix is processed by MDS, it is converted into a two-dimensional configuration where similar (i.e. less distant) locations are represented by points that are closer together and vice versa, thereby reproducing their relative geographical positions (see Fig. 1).

The axes in an MDS configuration contain no information about what each dimension represents and only the distances between objects are shown. To objectively interpret the configuration, a form of linear multiple regression called ProFit analysis is therefore used where a property of the objects is fitted onto the configuration by treating the x–y coordinates of the objects as the independent variables and the property as the dependent variable. This results in (i) a set of coordinates that can be used to represent the property as a vector, or arrowed line, drawn through the origin in the configuration (x–y coordinates = 0,0) where the coordinates give the head of the arrow and the value of the property increases in its direction (Kruskal and Wish 1978: 35–43) and (ii) an R^2 regression value, which indicates the degree to which a property corresponds to a dimension in the configuration and where the higher the value of R^2, the stronger the relationship, the property being considered as insignificant if R^2 falls below a certain value[1]. For example, if we take Northness and Eastness as properties of the locations in Fig. 1, ProFit analysis allows us to fit them onto the configuration by treating the x–y coordinates of each location as the independent variables and their North latitude and East longitude as the dependent variables. The resulting vectors, labelled North and East in Fig. 1, both have R^2 values of 0.999, indicating almost perfect correspondences with the configuration. Here the relative Northness and Eastness of each location can be assessed by drawing perpendicular lines from the locations to each vector, as shown by those drawn from Cherbourg and Chambéry, which indicate that Cherbourg is more North and less East than Chambéry.

Musical Variables

Beauvois (2017) used MDS to create a two-dimensional configuration of the Lantins' songs from a distance matrix that was derived from the numerical results of a combined dyadic-melodic analysis of the songs. Here, the expression dyadic-melodic ('dyadic/melodic' in Beauvois (2017)) highlights the equal importance in the analysis of both types of variables, one of which examines the horizontal, the other the vertical aspect of the music. This dyadic-melodic analysis recognised that (i) the superius and tenor voices of an early fifteenth-century chanson create a self-sufficient duet that forms the contrapuntal and harmonic core of the work and (ii) this two-part contrapuntal framework, the *Gerüstsatz*, is enriched by a subordinate contratenor voice which contributes to the overall musical texture (Moll 1997: 27–64, 365; see also Crocker 1962, Cumming 2013, Moll 2001 and Strohm 1993: 161). However, unlike the reductive procedure proposed by Margaret Bent (1998: 18–19; 2003a: 87; 2003b: 83) for the analysis of fourteenth- and fifteenth-century counterpoint where the contratenor is removed for separate analysis and the superius is analysed in relation to the tenor after the superius-tenor duet has been stripped of ornamental notes to reduce it to its underlying dyadic or note-against-note counterpoint (the *Gerüstsatz*), Beauvois's (2017) analytical framework examines the surface structure of the music formed by the florid or diminished counterpoint of the work (Bent 2003a: 71–5; Berger 2005: 151–8).

Table 1. The distances in miles between selected locations in France (Avignon, Brest, Cambrai, Chambéry, Cherbourg, Dijon, Foix, Henrichemont, La Rochelle, Orthez, Paris, Strasbourg)

	Av	Bre	Cam	Cha	Cher	Dij	Foix	Hen	LaRoc	Orth	Paris	Stras
Av	0											
Bre	540	0										
Cam	437	369	0									
Cha	124	528	342	0								
Cher	497	156	220	450	0							
Dij	234	448	214	129	345	0						
Foix	175	477	505	279	486	345	0					
Hen	257	334	201	202	249	118	303	0				
LaRoc	329	220	343	343	241	304	259	191	0			
Orth	281	383	500	360	427	387	125	309	186	0		
Paris	359	314	99	283	187	163	409	108	248	400	0	
Stras	349	561	231	225	431	153	488	258	449	539	247	0

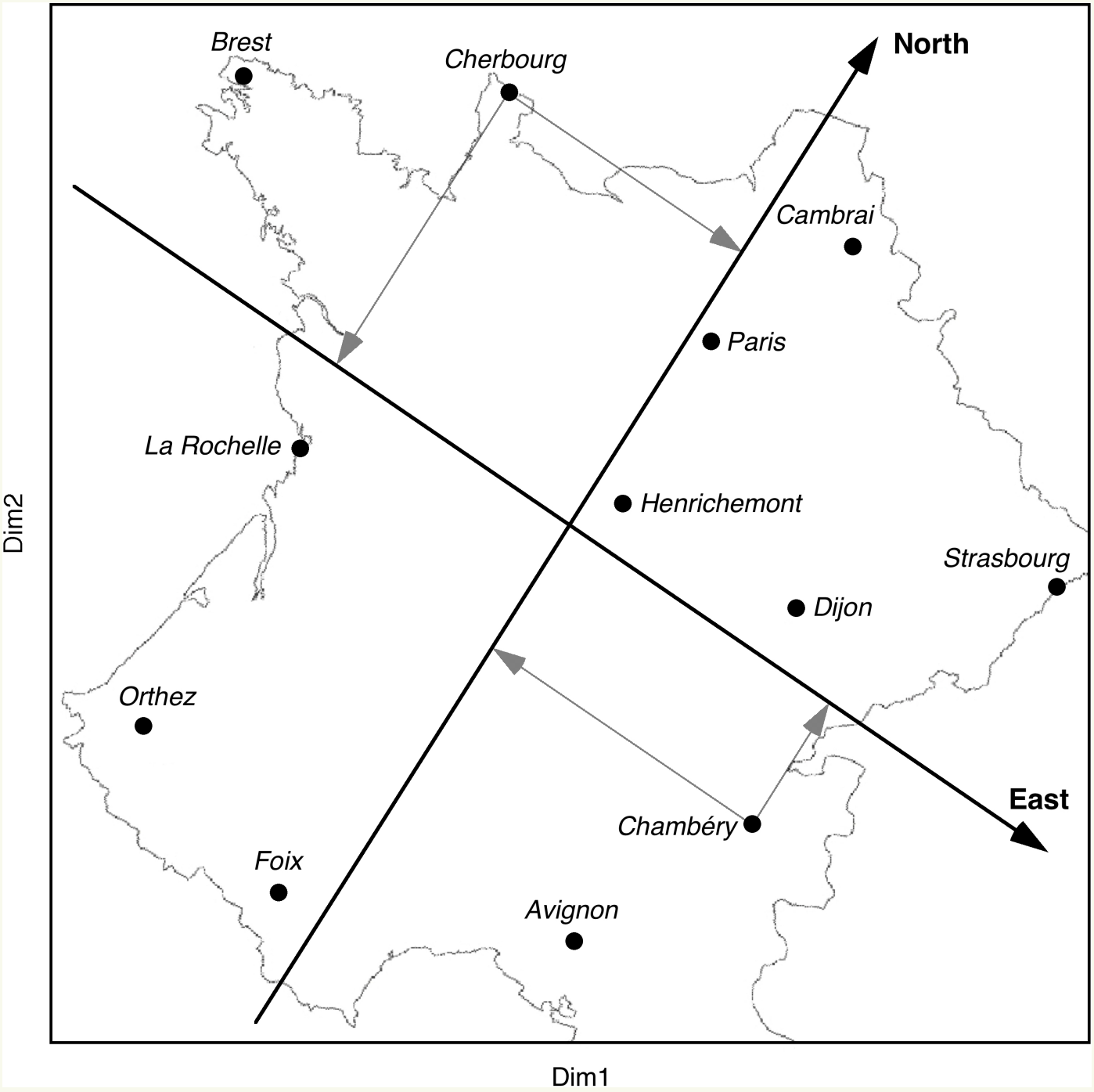
In the dyadic analysis, which was based on the work of Philip Kaye (1989), the time values of each song were reduced according to the mensuration of the song (𝅝 and 𝅜 = 2/4, 𝅗𝅥 and 𝅗𝅥. = 3/4, 𝅘𝅥 = 6/8 and 𝅘𝅥. = 9/8), end-of-section longs were counted as one complete bar of the prevailing mensuration and, for ballades, repeats were ignored and only the *clos* endings used. Next, the percentage occurrences of the dyadic sonorities formed by the superius-tenor duet at the start of every quaver (equivalent to a minim in the above mensurations) were calculated, the highest note being collapsed into the octave for compound intervals. This resulted in eight dyadic variables for each song: *K1, K2, K3, K4, K5, K6, K7* and *K8*, where *K1* is the percentage of unisons formed by the superius-tenor duet, *K2* is the percentage of seconds and ninths formed by the superius-tenor duet, *K3* is the percentage of thirds and tenths formed by the superius-tenor duet and so on (Kaye 1989: 18–19, 23–9). This procedure is illustrated in Ex. 1 where the upper staves show a passage from Binchois's *Ma dame que j'ayme (B-Md)*. Here the arrows and numbers indicate the dyadic sonority at the start of each quaver and the bracketed numbers indicate the sonority after the compound interval was collapsed into the octave. In the melodic analysis, the degree of conjunctness (the predominance of stepwise motion) of the superius, contratenor and tenor voices was assessed by calculating the slope (*ß*) of the power spectrum of the MIDI-pitch sequence of each voice. This resulted in three melodic variables for each song: $ß_S$, $ß_C$ and $ß_T$, where $ß_S$ is the conjunctness of the superius, $ß_C$ is the conjunctness of the contratenor and $ß_T$ is the conjunctness of the tenor, where lower values of *ß* mean that a voice is more disjunct or angular. Here, all the notes were used, not just those occurring at the start of every quaver (minim), and all were considered to have the same duration, as illustrated on the lower staves of Ex. 1, which show the notes of the upper staves and the order in which they would be examined by the melodic analysis. Finally, the analysis assumed that what distinguishes a composer's style is the florid or diminished counterpoint of the work created by the composer's individual treatment and embellishment of the *Gerüstsatz* (i.e. the surface structure of the music, as assessed by the dyadic-melodic analysis in terms of their preferred combinations of superius-tenor intervals and the distribution of conjunctness across the three voices) and that the chronology of their songs would be reflected by changes in their treatment and embellishment of the *Gerüstsatz* over time[2]. See Beauvois (2017, Technical Supplement) for a detailed description of the dyadic-melodic analysis.

Analysis

Data Set of Songs

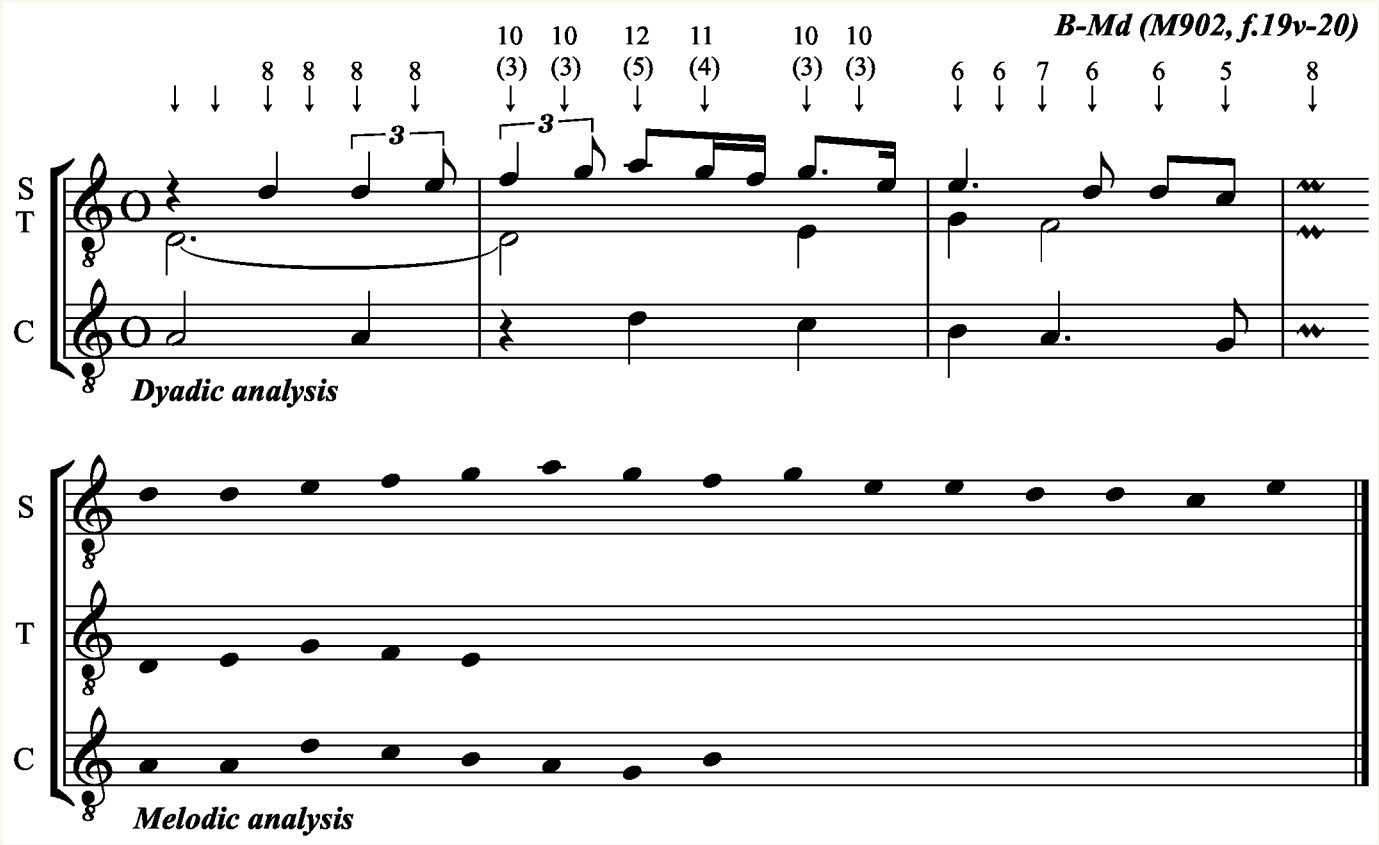
The Binchois songs examined were those in the edition of Wolfgang Rehm (1957), to which the following exclusions and additions were made on the basis of conflicting or uncertain ascriptions and the findings of more recent scholarship, resulting in a data set of 67 songs. Firstly, *B-Amt* was excluded as only the superius and tenor voices are securely by Binchois (Fallows 2001: 588; Slavin 1988: 36–42, 1992a: 30–3). Secondly, all but two of Binchois's songs (*B-Da* and *B-Fam*) adhere to the 3vv-chanson format of a texted upper voice

Figure 1. The resulting two-dimensional configuration when the distance matrix in Table 1 is processed by MDS, along with the property vectors for Northness and Eastness



(superius) accompanied by two lower voices having approximately the same range (contratenor and tenor). Therefore, to ensure a uniform distribution of musical variables across the songs, these two songs were treated as 3vv ones in the following manner. For *B-Da*, which survives in several versions, including a 4vv one with two contratenors, two 3vv-versions were examined: *B-Da1* (superius, solus contratenor, tenor) and *B-Da2* (superius, contratenor primus, tenor)[3]. For *B-Fam*, which survives as a 4vv song with two superius voices, three different versions were examined to see whether the analysis was able to determine which of the two superius voices formed an effective *Gerüstsatz* with the tenor voice: *B-Fam1* (superius 1, superius 2, tenor), *B-Fam2* (superius 1, contratenor, tenor) and *B-Fam3*

Example 1. An extract from Binchois's *Ma dame que j'ayme* (*B-Md*). The upper staves, where the superius and tenor are on the top staff and the contratenor on the bottom, show the dyadic analysis (quaver = minim in the original); the lower staves show the notes of the upper staves that would be examined by the melodic analysis.



(superius 2, contratenor, tenor). Finally, four anonymous songs from the manuscript *EscA* were added which were attributed to Binchois by Walter Kemp (1990) on the basis of style (his Class I category) and included in the worklist of songs in *Binchois Studies* (Kirkman and Slavin 2000b): *B-Amtbm, B-Bv, B-Dlc* and *B-Jvs*[4].

Multidimensional Scaling

The 11 dyadic-melodic variables were directly derived from the MIDI-encoded scores of Binchois's 3vv songs[5] and the MDS analysis, which converted these variables into a distance matrix, indicated that the songs were best represented as points in a two-dimensional configuration[6]. Using an R^2 cutoff of 0.333, the ProFit analysis revealed that five variables ($ß_C$, *K6, K5, K4* and *K2*) significantly increased in value over the configuration. This is shown in Table 2, which gives the R^2 regression values for each variable and the beta weights, a by-product of the regressions that gives the vector coordinates (Dillon and Goldstein 1984: 151)[7]. Here the significant result for *K2* was found to be mainly due to a significant change occurring over the configuration in the proportion of ninths in the superius-tenor duet rather than the proportion of seconds. To make this clear, the *K2* variable and its associated vector are therefore labelled as *k9* in the text and figures below, the lower-case '*k*' indicating a raw, uncombined sonority; in this instance, the compound interval of a ninth. Finally, it was found that the interpretation of the configuration was simplified with no information lost if the *K6, K4* and *k9* vectors were combined into one vector[8]. Figure 2 shows the positions of the songs, along with the vectors of the five significant variables, and the x–y coordinates of each song are given in the Appendix, Table A1 (columns 8 and 9) as *Dim1* and *Dim2*.

Chronological Grouping of Songs

In Beauvois (2017), a song chronology was established using the following procedure. First, the songs were assigned to separate early, middle and late groups on the basis of manuscript dating and fascicle chronology. This resulted, however, in an MDS configuration where

Table 2. ProFit analysis: multiple regression results for the 11 standardised dyadic-melodic variables in order of descending R^2 value

1 Variable	2 R^2	3 Beta weight Dim1	4 Beta weight Dim2
K5	0.706	0.393	1.755
K2	0.648	1.621	-0.105
$ß_C$	0.416	-0.691	1.174
K6	0.381	-1.244	0.052
K4	0.337	1.159	0.182
$ß_T$	0.252	1.003	0.152
K7	0.244	0.847	-0.558
K8	0.175	0.832	-0.153
K3	0.164	-0.561	-0.631
$ß_S$	0.133	-0.015	-0.782
K1	0.034	-0.121	-0.377

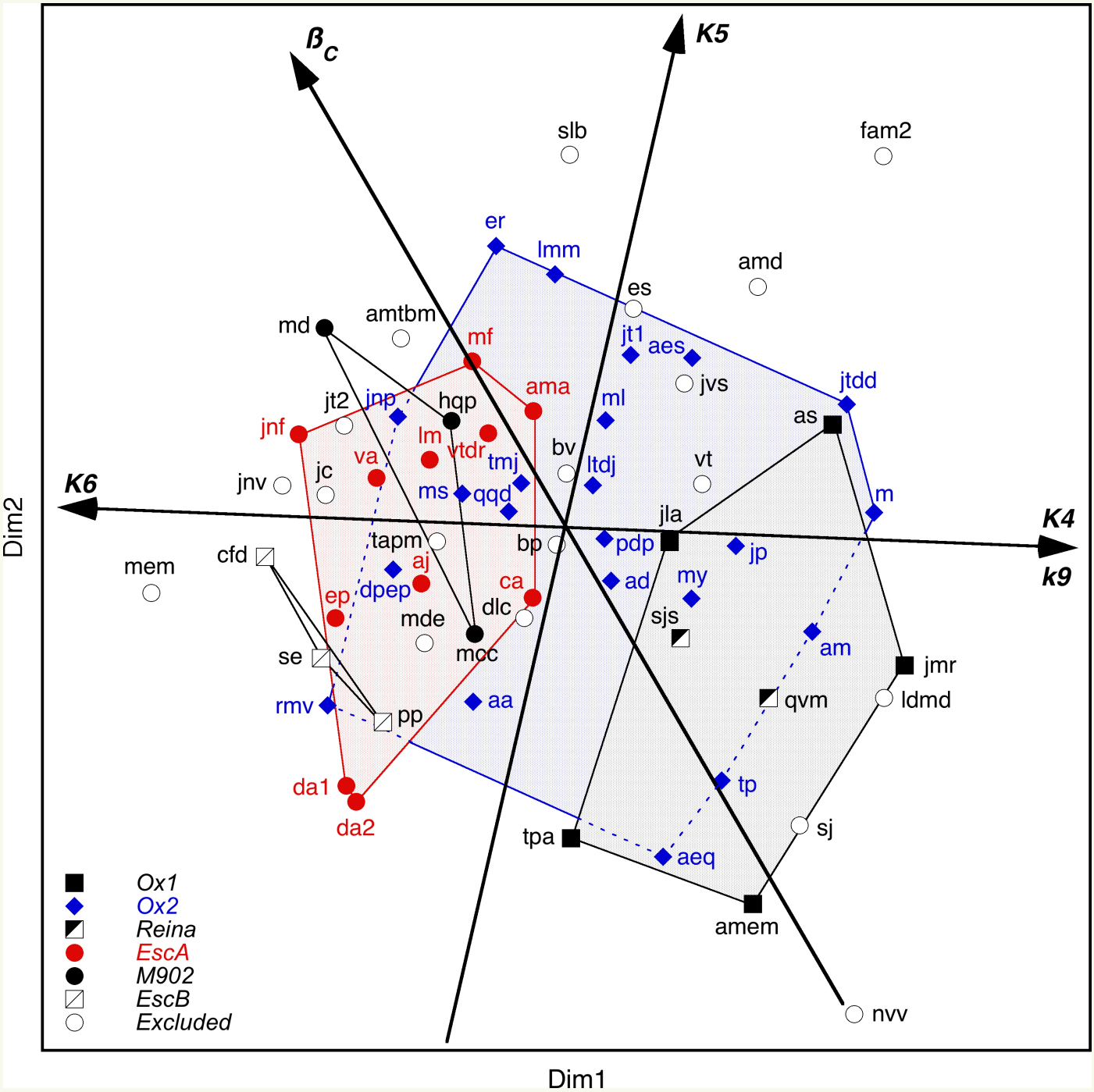
there was a considerable degree of overlap in the areas occupied by the middle and late groups. This situation occurred because these groups contained songs from different stages in each composer's output, creating an admixture of harmonic and melodic characteristics in each group that resulted in broad spreads of values for the dyadic and melodic variables and, consequently, broad spreads for the areas occupied by these groups in the configuration. To compensate for these overlaps, the chronological order of the songs was therefore analysed using the centroids (the midpoints or centres of gravity) of the areas in the configuration occupied by each group, as these evened out the characteristics of the individual songs in each group to reveal the smooth underlying progressions of dyadic-melodic characteristics that reflected the gradual changes that occurred in each composer's style over time. Next, the linear best fits to the centroids were found, which resulted in lines drawn through the configuration (the centroid progressions) for both composers. Finally, in the same way that the perpendicular lines drawn in Fig. 1 from Chambéry and Cherbourg to each vector indicated whether one was more North or East than the other, perpendicular lines were drawn from each composer's songs to their centroid progression to establish whether one song was earlier or later than the other, thereby providing a relative chronology that could be used for dating purposes. In this article, exactly the same procedure was used to arrive at a chronology for Binchois's songs, except that a more extensive screening of the data was required before assigning the songs to a group due to the larger number of problematic songs in Binchois's oeuvre.

Initial Grouping of Songs

The songs were assigned on the basis of their earliest source to one of six chronological manuscript groups. These were derived from the division of the songs into early, middle and late periods on the basis of manuscript chronology and stylistic evidence by Dennis Slavin (1988: 3–4; 1989: 120–1; 1992a: 23; 1992b, 345–6) and the observations of Reinhard Strohm (1993: 442) concerning the late songs (see the Appendix, Table A1, column 6). The manuscript groups, following Slavin's chronology and prefixed by *M-* throughout the main body of the text to distinguish them from the manuscript sigla, were:

- *M-Ox1*: songs in fascicles V and VIII of *Ox*, written c.1426–1429 (Boone 1987: 113);
- *M-Reina*: songs in the third layer (ff.89–119) of *Reina*, written c.1430 (Fallows 1999: 40);
- *M-Ox2*: songs in fascicles IIIx, IIIz, IIy, IV and I of *Ox*, written c.1432–1436 (Boone 1987: 113);
- *M-EscA*: songs in *EscA*, written c.1436–1440 (Fallows 1999: 15) or c.1430–1445 (Kemp 1990: 4);
- *M-M902*: songs in *M902*, written c.1435–1445 (Slavin 1989: 120) or c.1440 (Fallows 1999: 26);
- *M-EscB*: songs in *EscB* copied c.1465 (Southern 1981: XIII–XIV), c.1455–1465 (Slavin 1990), or the late 1450s (Fallows 1999: 15)[9].

Figure 2. The positions of the songs, along with the vectors of the five significant variables, resulting from the MDS analysis of the 11 dyadic-melodic variables. Also shown are the areas in the configuration occupied by the six chronological manuscript groups.



It should be noted here that *M-EscB* does not specifically refer to the manuscript *EscB*, but is instead used to define the latest songs in Binchois's song chronology on the basis of Strohm's (1993: 442) observation that there are seven songs where manuscript evidence indicates a composition date after 1445. Of these seven songs, three (*B-Cfd*, *B-Pp* and *B-Se*) are found in *EscB*, two (*B-Jnv* and *B-Tapm*) are added to *M-EscB* as they are only found in chansonniers compiled after Binchois's death and are therefore almost certainly two of his latest songs and the remaining two (*B-Es* and *B-Mde*) are excluded from *M-EscB* as they are error-ridden (Strohm 1993: 442) and unique to *R1411*, a manuscript dated to the 1440s by Fallows (1999: 42), c.1445 by Haar (2004: 85–6) and c.1450 by Slavin (1988: 210–1). Finally, it should be noted that, as the bulk of Binchois's songs are found in the five manuscripts that the six chronological manuscript

groups are based on, assigning each song to one of the groups on the basis of its earliest source means that each manuscript group effectively functions as a *terminus ante quem* for the songs assigned to it[10].

Data Screening of Problematic Songs

While most of the songs were easily assigned to a manuscript group, 20 songs were initially excluded due to their problematic nature: i.e. conflicting manuscript ascriptions, scholarly attribution to Binchois on stylistic grounds, the presence of errors in the sources, the use of unusual compositional procedures, possibly unreliable ascriptions to Binchois for *unica* in peripheral sources, the existence of musically different versions written in different mensurations, unusual positions in the MDS configuration. To resolve the status of these problematic songs and ensure their correct assignation to one of the six manuscript groups, their positions in Fig. 2 were examined to determine whether they were by Binchois and what group they should be assigned to, the conclusions being adopted for later analyses. Here, three points were borne in mind when assigning a song. Firstly, songs ascribed to a composer, found in a particular manuscript or provisionally assigned to a manuscript group that are outside or widely separated from the composer's, manuscript's or group's region of the configuration are likely to be either anomalous works or incorrectly attributed (Beauvois 2017). Secondly, while an early song can be found in a late source, a late song cannot be found in an early source. Here, the stylistically anomalous song will, in both cases, occupy an unusual position in the MDS configuration compared with the other songs in that source. Finally, the bunching together of the *M-Ox1* songs in Fig. 2 at one end of the *K6-K4*/*k9* vector and the *M-EscA*, *M-M902* and *M-EscB* songs at the other seems to indicate a chronological trend where Binchois's use of fourths and ninths decreased and his use of sixths increased in his superius-tenor duets over the course of his career.

- ***B-Lmm (Ox2 and Tr87)***: As space forbids a full discussion here of the authorship issues arising from the conflicting ascriptions in *Ox* and *Tr87*, this song is addressed separately in the section entitled **Discussion of the Authorship of *B-Lmm*** of the Appendix, where evidence is reviewed that supports the ascription to Binchois in *Ox* and indicates that the ascription to Grossin in *Tr87* is incorrect. Consequently, it is included in *M-Ox2* and its centroid calculation.

- ***B-Jc (EscA), B-Vt (EscB)***: These songs, attributed to Binchois by Rehm (1952: 144–5) and included in his edition of the songs, are both anonymous in their sources. However, Fallows (2000: 209) noted that Rehm 'makes an excellent case for them' and *B-Vt* is also attributed to Binchois by Marix (1939: 188). For *B-Jc*, its position in the *M-EscA* region indicates that Rehm's attribution to Binchois is correct and that it should be included in *M-EscA* and its centroid calculation. For *B-Vt*, its position indicates that Rehm's attribution to Binchois is correct and that it could be included in either *M-Ox1* or *M-Ox2*. However, while *B-Vt* appears to be an early song that is only found in a later source, its assignation to either group is not clear-cut and should therefore be deferred.

- ***B-Amtbm, B-Bv, B-Dlc, B-Jvs (EscA)***: These songs, attributed to Binchois by Kemp (1990), are all anonymous in *EscA*. For *B-Amtbm*, *B-Bv* and *B-Dlc*, their positions close to or in the *M-EscA* region indicate that Kemp's attributions to Binchois are correct and that they should be included in *M-EscA* and its centroid calculation. For *B-Jvs*, its position in the *M-Ox2* region, which is almost equidistant from the *M-Ox1* and *M-EscA* regions, not only indicates that it is, like *B-Vt*, an earlier song that is only found in a later source, but also that Kemp's attribution to Binchois is correct and it should be included in *M-Ox2* and its centroid calculation.

- ***B-Es, B-Fam, B-Mde* (*R1411*)**: All three of these *unica* in *R1411* are problematic: *B-Fam* because it is composed for 4vv and uses a pre-existent melody as its tenor voice and *B-Es* and *B-Mde* because they are error-ridden (Strohm 1993: 442). With respect to their positions in the MDS configuration, *B-Es* and *B-Mde* are both found in the central song cluster (the relatively compact group of songs surrounding the origin in the MDS configuration) and, of the three 3vv-versions of *B-Fam*, the version closest to the central song cluster is *B-Fam2* (superius 1, contratenor, tenor). While the position of *B-Fam2* outside the central song cluster is almost certainly due to the deviation of *B-Fam* from Binchois's regular harmonic and melodic practice (i.e. its 4vv-texture and use of a pre-existent melody as the tenor voice), this was the only version of *B-Fam* that ended with a 6/3 – 8/5 cadence as one might expect to find in a 3vv-chanson of the period, indicating that the analysis was able to determine which superius voice formed an effective *Gerüstsatz* with the tenor voice and which combination of voices was the most similar to Binchois's other 3vv songs. However, the wide degree of separation of these songs in the MDS configuration, the position of *B-Fam2* outside the central song cluster and the error-ridden

nature of *B-Es* and *B-Mde*, while offering no evidence to contradict their ascription to Binchois in *R1411*, strongly suggest that they should be excluded from the six manuscript groups to prevent the results of the centroid calculations being skewed. Finally, it should be noted that the example of *B-Fam2* raises the possibility that other songs may occupy unusual positions in the MDS configuration as a consequence of being stylistic experiments, particularly if the experimental nature of the song is one that directly affects the dyadic and melodic variables. If this is the case, then this has ramifications for Beauvois's (2017) study of the songs of Arnold and Hugo de Lantins. There, it was concluded that while the position of Hugo's *Je suy exent* in the MDS configuration broadly agreed with the composition date of 1423 proposed for it by Fallows (1987a: 278–9), the reason it was not adjacent to Hugo's other songs composed c.1423 was that Hugo's working in an *ars subtilior* idiom resulted in a deviation from his regular harmonic and melodic practice and, consequently, a position in the MDS configuration that was atypical for this date in his output. However, it was also found that while *Helas emy* is ascribed to Arnold in *Q15*, its position in the MDS configuration was clearly separated from the remaining songs of both composers, a situation that occurred due to its having higher $ß_S$, $ß_C$ and *K3* values than the other songs, resulting in an extreme position beyond the end of the *K3* vector. This, and other evidence, led to the conclusion that the *Q15* ascription was incorrect and that *Helas emy* was by neither composer and should be excluded from their oeuvres. However, the cases of *B-Fam2*, *B-Sj* and *B-Slb* discussed here, as well as Hugo's *Je suy exent*, raise the possibility that the *Q15* ascription is, in fact, correct and that *Helas emy* was a stylistic experiment by Arnold where he composed a superius-tenor duet that was rich in thirds and where the superius and contratenor voices, possibly as a result of this, were more conjunct than his usual practice, all of which resulted in a highly unusual position in the MDS configuration. However, it should be noted that even if *Helas emy* was a stylistic experiment by Arnold, its exclusion by Beauvois (2017: 542n13) from the analysis of the Lantins songs is still justified as, due to the relatively small number of songs being examined, its atypical style will distort Arnold's profile of characteristics and undermine the reliability of the analysis, a situation that also applies to Grandemange's (2008) inclusion of *Helas emy* in Arnold's oeuvre.

- ***B-Jnv, B-Tapm (Niv):*** While both songs are ascribed to Binchois in *Niv*, *B-Jnv* is ascribed to Du Fay in *MC* and *B-Tapm* has two contrary ascriptions to Frye in *Lab* and *Mel* (Alden 2010: 116). For *B-Jnv*, its position close to *B-Cfd* and on the periphery of the central song cluster like the other late songs of *M-EscB*, along with the manuscript evidence indicating a composition date after 1445 (Strohm 1993: 442), not only offers no evidence to contradict the ascription to Binchois in *Niv*, but also indicates that it should be included in *M-EscB* and its centroid calculation[11]. For *B-Tapm*, while its position in the central song cluster indicates that some of its musical characteristics fit Binchois's style well, thereby possibly explaining why it was ascribed to him in *Niv*, it also differs from the other late songs (*B-Jnv*, *B-Cfd*, *B-Se* and *B-Pp*), all of which are found in an arc at the periphery of the cluster. This, and the two contrary ascriptions to Frye (*in Lab* and *Mel*), therefore suggests that the attributions of *B-Tapm* to Frye by Strohm (1993: 442) and Fallows (2014: 258) on the basis of stylistic and codicological evidence are probably correct and that this song should be excluded from Binchois's oeuvre until further evidence appears to decide the issue[12].

- ***B-Bp* (*Stras), B-Ldmd (Tr87), B-Amd and B-Mem* (*St.Em*)**: These four *unica* are problematic, as they are all found in peripheral sources where the ascriptions to Binchois may not be reliable. For *B-Bp*, its position indicates that the ascription to Binchois in *Stras* is correct and that it could be included in *M-Ox2* or *M-EscA*. Due to the overlap between the *M-Ox2* and *M-EscA* regions of the configuration, however, its assignation to either group is not clear-cut and should therefore be deferred. For *B-Ldmd*, its position not only indicates that the ascription to Binchois in *Tr87* is correct, but also that it is one of his earliest songs and should be included in *M-Ox1* and its centroid calculation. For *B-Amd*, its position outside the central song cluster raises some doubts as to Binchois's authorship and suggests that it should be excluded from his oeuvre. This conclusion is supported by Slavin (1988: 203–4), who noted that the 'attribution to Binchois is questionable on stylistic grounds. None of the basic tenets of his style are violated, but this chanson would represent a weak effort'. For *B-Mem*, its position outside the central song cluster raises some doubts as to Binchois's authorship. Furthermore, its position at the extreme *K6* end of the *K6-K4*/*k9* vector, which makes it contemporaneous with Binchois's latest songs, is anomalous, as a later song cannot be found in an early source. These findings, taken together, indicate that *B-Mem* is not by Binchois and should therefore be excluded from his oeuvre. This conclusion is supported by Slavin (1988: 204), who remarks that 'Fallows noted that the difficulties with this piece were that it is convincing neither as a Magnificat, nor as a chanson' and that 'If the music had been composed as a secular song it would have been a setting of a three-line rondeau, a type without counterpart in Binchois' oeuvre and otherwise very unusual in the fifteenth century'.

- ***B-Jt2 (Reina)***: David Fallows (1990: 71), after comparing the two versions of this song, concluded that *B-Jt1* in *Ox* is 'a considered revision' of *B-Jt2* and that this revision was almost certainly carried out by Binchois himself. Evidence to support this conclusion becomes apparent if we compare the positions of both versions and the other two *Reina* songs (*B-Qvm* and *B-Sjs*) along the *K6-K4/k9* vector. Firstly, the position of *B-Jt2* in relation to the vectors indicates a low proportion of fourths and ninths in its superius-tenor duet. However, this not only runs contrary to the apparent chronological trend in Binchois's output where the early songs have a high proportion of fourths and ninths in the superius-tenor duet compared with the later songs, but also indicates that it is contemporaneous with the later songs in *EscA* and *M902*. Therefore, as a late song cannot be found in an early source, these anomalous findings strongly suggest that *B-Jt2* does not truly reflect Binchois's harmonic and melodic practice at the time it was written. Secondly, the position of *B-Jt1* is closer to the other two *Reina* songs and the *M-Ox1* songs (all of which fall into Slavin's earliest song category) at the *K4/k9* end of the vector. As their positions in the MDS configuration indicate that these songs have similar harmonic and melodic characteristics, this strongly suggests that *B-Jt1* is contemporaneous with the two other *Reina* songs and is a better representation of Binchois's style in the early period of his output than *B-Jt2*. Finally, a comparison of both versions indicates that it is the ornamentation of the superius voice of *B-Jt1* that dramatically increases the proportion of fourths and ninths in the superius-tenor duet and consequently *K4* and *k9*, resulting in its position closer to the *K4/k9* end of the vector. Taken together, this strongly suggests that *Reina* contains a preliminary or draft version of this song which was later revised by Binchois with an ornamented superius voice to bring it in line with his current harmonic and melodic practice. Therefore, the *Ox* version of this song (*B-Jt1*) should be considered the definitive one and the *Reina* version (*B-Jt2*) excluded from *M-Reina* and its centroid calculation.

- ***B-Nvv (Ox2), B-Sj and B-Slb (EscA)***: These three songs are all problematic due to their unusual positions in the MDS configuration. For *B-Nvv*, its position at the edge of the configuration at the beginning of the $ß_C$ vector is almost certainly due to its extreme shortness in length, which results in biased $ß_S$, $ß_C$ and $ß_T$ values and, consequently, an unusual position in the configuration, an effect described more fully in Beauvois (2017, Technical Supplement: 5), Eke et al. (2002) and Beauvois (2007). However, while this offers no evidence to contradict the ascription to Binchois in *Ox*, this song should be excluded from *M-Ox2* and its centroid calculation as its position in the configuration, which is unrepresentative of the other *M-Ox2* songs, will skew the result of the centroid calculation. For *B-Sj*, its position in the configuration, which is due to a combination of a low $ß_C$ value and a high proportion of fourths (*K4*) and seconds (*k9*) in its superius-tenor duet, characteristics it shares with its near neighbour *B-Ldmd*, would initially suggest that it is one of Binchois's earliest songs and that it should be included in *M-Ox1*. However, while explicitly ascribed to him in both *EscA* and *Tr87*, and appearing to be an early song that is only found in a later source, its marked distance from the other *M-EscA* songs raises the possibility that this song is a stylistic experiment that, like *B-Jt2*, does not reflect Binchois's harmonic and melodic practice at the time it was composed, thereby resulting in a position in the configuration that is unrepresentative of the other *M-EscA* songs. This hypothesis is supported by this song being copied in *Tr87* at the same time as another *M-EscA* song (*B-Ama*), strongly suggesting that both songs are contemporaneous (see the section entitled **Songs in *Tr87*** below), and by a number of pilot analyses which found that the most consistent and coherent results were obtained when this song was excluded from the manuscript groups and centroid calculations. For these reasons, while the ascriptions to Binchois in *EscA* and *Tr87* may be correct, this song should be excluded from *M-EscA*, *M-Ox1* and their centroid calculations. Finally, if we proceed round the edge of the configuration from the top right-hand side in a clockwise direction, all but one of the outliers from the central song cluster are explicable: the position of *B-Fam2* outside the central song cluster is almost certainly due to it being a 4vv stylistic experiment using a pre-existent melody as a tenor voice; the position of *B-Nvv* at the edge of the configuration is due to its extreme shortness; and *B-Mem*, as shown above, is almost certainly not by Binchois. This leaves one remaining outlier: *B-Slb*. While this song is ascribed to Binchois in *Tr87*, it is unascribed in *EscA*, which raises some doubts as to his authorship. Here, its position at the high end of the *K5* vector is due to it being the song with the highest proportion of fifths in its superius-tenor duet. Furthermore, its $ß_S$, $ß_C$ and $ß_T$ values are not only in the top ten, but also result in this song having the highest total *ß* value when they are added together. That is, not only is the conjunctness of the individual voices high, but this song is also the most conjunct overall. Taken together, this not only strongly suggests that this song is either not by Binchois or is another one of his stylistic experiments, but also that it should be excluded from *M-EscA* and its centroid calculation as its position in the configuration, which is unrepresentative of the other *M-EscA* songs, will skew the result of the centroid calculation (concerning this song, see also the **Postscript** below).

Song Chronology

The decisions as to whether a problematic song was by Binchois, which of the six chronological manuscript groups it should be assigned to, and whether it should be included in a centroid calculation are collated in Table 3, listed in the Appendix, Table A1 (column 7) and incorporated into Fig. 3. To determine the chronology of Binchois's songs, the manuscript-group centroids were taken to be the midpoints of the positions in the MDS configuration of the songs in each group and the linear best fit to the centroids (the centroid progression, shown in Fig. 3 as a dotted line) was calculated. To obtain a more reliable fit, the *M-Reina* and *M-M902* centroids were excluded as their positions were determined on the basis of only two and three songs, respectively, and the centroid progression was instead found by calculating the linear best fit to the *M-Ox1*, *M-Ox2*, *M-EscA* and *M-EscB* centroids. After this linear-fit procedure, which pilot analyses found produced the best results, centroids were calculated for later analysis for manuscripts that contained three or more songs by Binchois: *Pz*, *PC3*, *Stras*, *St.Em* and *R1411*. Next, to create a relative chronology of the songs and the manuscripts themselves that could be used for dating purposes, perpendicular lines were drawn from the centroid progression to the songs and the individual centroids to determine whether one was earlier or later than the other. This is illustrated in Fig. 4, which shows the centroid progression and the perpendicular lines for selected songs and manuscript-group centroids in green and where *B-Jmr* and *B-Cfd* are the earliest and latest songs, respectively. While these perpendicular lines are omitted from Fig. 3 for clarity, the resulting chronology of the songs and centroids and their distances along the centroid progression are given in Tables 4 and 5 (columns 1–3). Here it should be noted that because the *K6-K4/k9* vector was the mean of the separate *K6*, *K4* and *k9* vectors, the centroid progression was used to determine the song chronology instead of the vector as it was more closely grounded in the historical reality, being based on the manuscript transmission of Binchois's songs.

Stylistic Change and the MDS Configuration

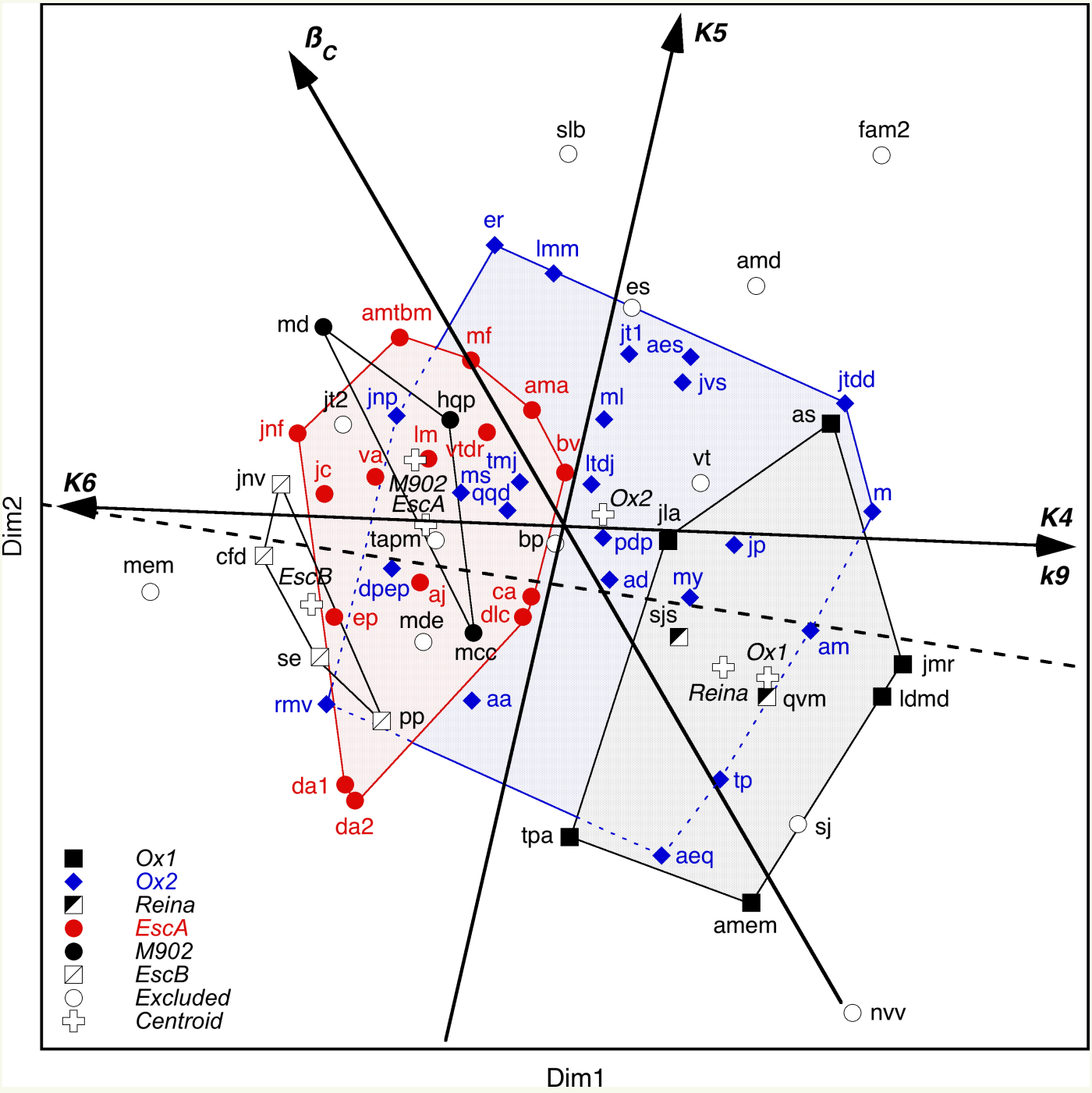
The MDS configuration shown in Figs. 2 and 3 represents the stylistic continuum occupied by Binchois's songs where (i) songs at any given stage of his output will exhibit a limited range of values for the dyadic and melodic variables as they would tend to be similar in style, (ii) the gradual changes that occurred over time in his treatment of the superius-tenor duet and the individual voices (as measured by the dyadic and melodic variables, respectively) are reflected by the positions of the songs along the centroid progression and (iii) the centroid progression acts as a chronological gauge that runs from the earliest to the latest song. These three factors and the way they interact are illustrated in Moving Image 1, which is a redrawn and animated version of Fig. 4. Here, the white circle in the dark band represents Binchois, the dark band represents the limited range of values for the dyadic and melodic variables at any given stage of his output due to the songs being similar in style and the movement of the band from right to left along the centroid progression, which is similar to the way that a transparent cursor with a hairline travels along the length of a slide rule, represents the gradual changes that occurred in the values of the dyadic and melodic variables due to his treatment of the superius-tenor duet and the individual voices changing over time. However, while a steady rate of movement of the band along the centroid progression (i.e. stylistic change) is assumed given the Euclidean (linear) nature of the MDS configuration and the results of Beauvois (2017) which indicated that the Lantins' styles changed at a similar rate over time, the spread of the band either side of the circle is arbitrary, as the degree of variability in the dyadic-melodic variables at any given point in Binchois's output cannot be determined.

Conversion of Distances to Stylistic Dates

The sweep of the band along the centroid progression in Moving Image 1 indicates three things with respect to the manuscripts and manuscript groups. First, they effectively function as snapshots of Binchois's output over periods of time. Second, because songs with similar harmonic and melodic characteristics will be close to each other, manuscripts and manuscript groups containing songs from approximately the same period in Binchois's life will occupy relatively small areas of the configuration. Finally, manuscripts and manuscript groups containing a mixture of earlier and later songs or songs from a period of rapid stylistic change in his output will occupy larger areas of the configuration due to the broader spreads of values for the dyadic and melodic variables resulting from the admixture of harmonic and melodic characteristics of songs with markedly different compositional characteristics. In other words, groups of songs composed over short time spans will tend to occupy smaller areas in the configuration than those composed over longer time spans or from periods of rapid stylistic change.

With this in mind, the distances of the songs and centroids along the centroid progression can be converted into their stylistic dates by fixing the dates of the beginning and the end points of the centroid progression according to Binchois's biography (see Fallows 2001: 578–9). Firstly, we know that the 'earliest known documents mentioning the composer are in the accounts of St. Waudru, Mons, where

Figure 3. Figure 2 redrawn to incorporate the decisions shown in Table 3 as to whether a problematic song was by Binchois and to which of the six chronological manuscript groups it should be assigned. Also shown, as a dotted line, is the centroid progression: the linear best fit to the manuscript-group centroids.



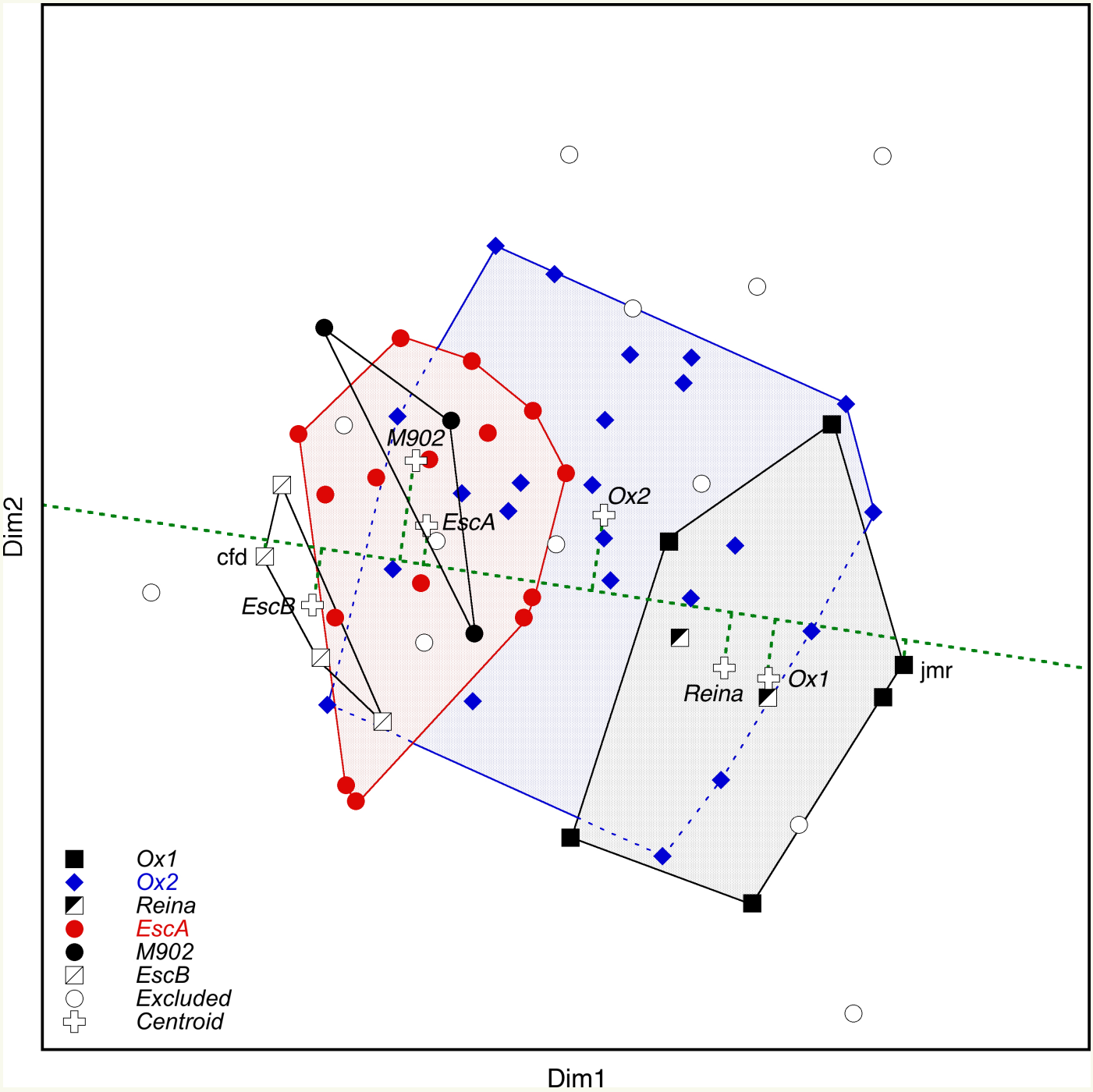
he played the organ from 8 December 1419'. Secondly, we know that 'Soignies was Binchois retirement home. He was appointed provost of the Collegiate Church of St. Vincent in 1452 and any payments in the Burgundian Court accounts after the end of February 1453 have the annotation that he was "paid even though he was absent"'. Furthermore, Sean Gallagher has noted that his

> move to Soignies in 1453 marked the end of his formal service to the Duke of Burgundy, and perhaps also his career as a composer. The absence of works by Binchois securely dateable to the 1450s, combined with his occupying a position at Saint-Vincent not directly related to music, has led to a view of the composer's last years as musically inactive. (Gallagher 2000: 27)

Table 3. The decisions, made on the basis of their positions in the MDS configuration shown in Fig. 2, concerning the final assignations of the excluded songs to the chronological manuscript groups *M-Ox1*, *M-Reina*, *M-Ox2*, *M-EscA*, *M-M902* and *M-EscB* and their inclusion in the centroid calculations. Here, column 2 = the earliest manuscript the song is found in, column 3 = the manuscript group indicated by the position of the song in the configuration, column 4 = the final manuscript group assignation, column 5 = inclusion in the centroid calculation for the final manuscript group, column 6 = authorship of the song and column 7 = the reason for the exclusion from a final manuscript group or centroid calculation.

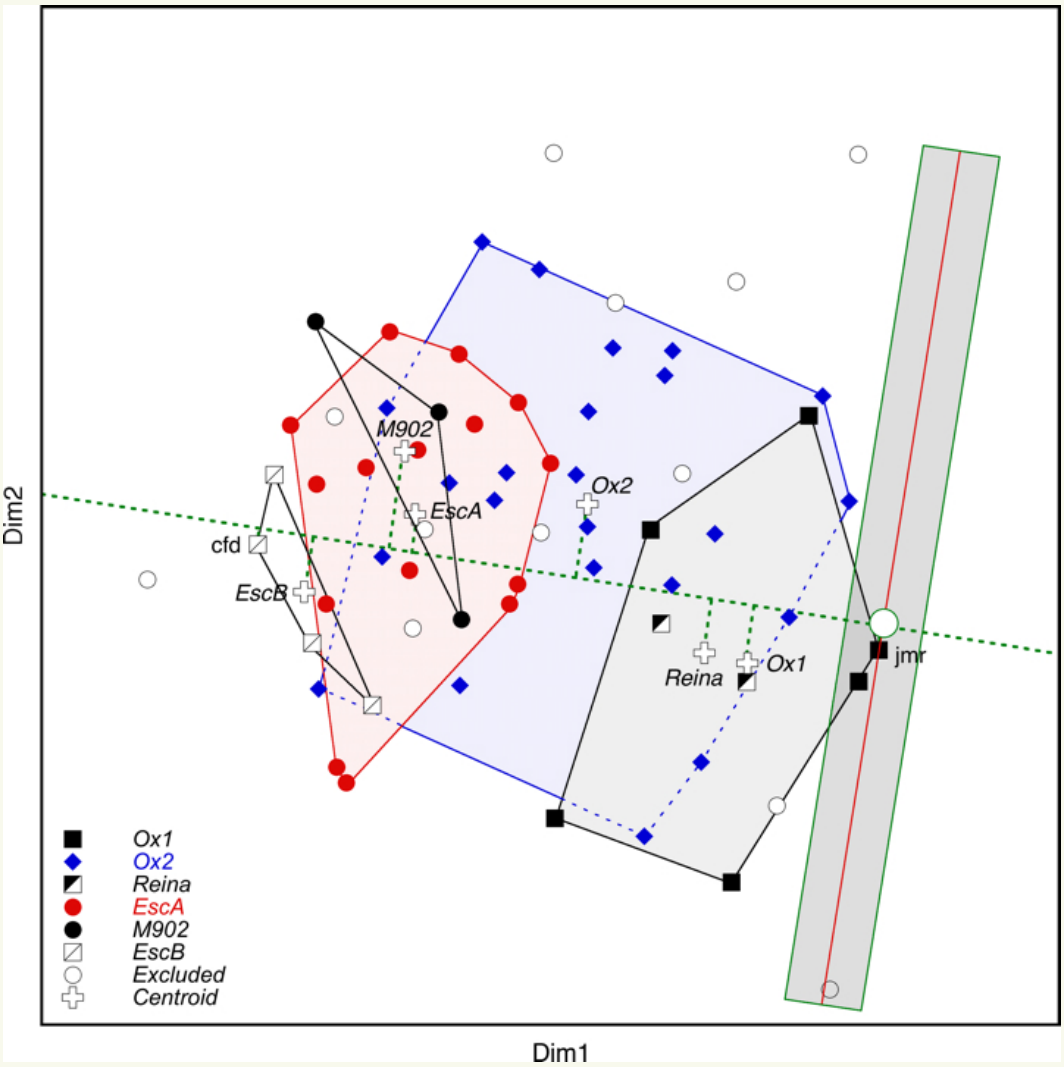
1 Song	2 Source	3 Indicated MS-group	4 Final MS-group	5 Centroid calculation	6 Authorship	7 Reason for exclusion
Amd	*St.Em*	—	—	—	*Not Binchois*	Position is outside the central song cluster.
Amtbm	*EscA*	*EscA*	*EscA*	*EscA*	*Binchois*	
Bp	*Stras*	*Ox2 or EscA*	—	—	*Binchois*	Assignation to *Ox2* or *EscA* is unclear.
Bv	*EscA*	*EscA*	*EscA*	*EscA*	*Binchois*	
Dlc	*EscA*	*EscA*	*EscA*	*EscA*	*Binchois*	
Es	*R1411*	—	—	—	*Binchois*	Error-ridden nature will skew any centroid calculation.
Fam2	*R1411*	—	—	—	*Binchois*	Position is outside the central song cluster.
Jc	*EscA*	*EscA*	*EscA*	*EscA*	*Binchois*	
Jnv	*Niv*	*EscB*	*EscB*	*EscB*	*Probably Binchois*	
Jt2	*Reina*	—	—	—	*Binchois*	Position indicates it is a draft or preliminary version of the song.
Jvs	*EscA*	*Ox2*	*Ox2*	*Ox2*	*Binchois*	
Ldmd	*Tr87*	*Ox1*	*Ox1*	*Ox1*	*Binchois*	
Lmm	*Ox2*	*Ox2*	*Ox2*	*Ox2*	*Probably Binchois*	
Mde	*R1411*	—	—	—	*Binchois*	Error-ridden nature will skew any centroid calculation.
Mem	*St.Em*	—	—	—	*Not Binchois*	Position is outside the central song cluster.
Nvv	*Ox2*	*Ox2*	—	—	*Binchois*	Position is unrepresentative of the other *Ox2* songs.
Sj	*EscA*	*Ox1*	—	—	*Probably Binchois*	Position is unrepresentative of the other *EscA* songs.
Slb	*EscA*	—	—	—	*Probably Binchois*	Position is unrepresentative of the other *EscA* songs.
Tapm	*Niv*	—	—	—	*Probably Frye*	Position differs from the other late songs.
Vt	*EscB*	*Ox1 or Ox2*	—	—	*Binchois*	Assignation to *Ox2* or *EscA* is unclear.

Figure 4. An example of how the perpendicular lines drawn from the centroid progression to selected songs and manuscript-group centroids can be used to determine the relative chronology of the songs and manuscripts



Finally, we know Binchois died in Soignies on 20 September 1460. Pilot analyses using this information revealed that the best results were obtained by assuming that the centroid progression covered a 33-year time span delineated by composition dates c.1419 for his earliest song (*B-Jmr*) and c.1452 for his latest song (*B-Cfd*). When mapped onto this time span, the distances of the songs and centroids along the centroid progression resulted in the stylistic dates given in column 4 of Table 4.

Moving Image 1. Figure 4 redrawn and animated to demonstrate how the gradual changes that occurred in Binchois's style over time are reflected by the positions of the songs in the stylistic continuum represented by the MDS configuration. Here, the white circle in the dark band represents Binchois, the dark band represents the limited range of values for the dyadic and melodic variables at any given stage of Binchois's output and each step of the band along the centroid progression is at roughly two-year intervals. Click the image to view the animation.



Conversion of Stylistic Dates into Equivalent Chronological Dates

To convert the stylistic dates into their equivalent chronological (EC) dates, pilot analyses revealed that the best results were obtained when the following procedure was used. Firstly, the EC dates for the manuscript and manuscript-group centroids were taken to be equivalent to their stylistic dates, as the stylistic differences of the songs in each manuscript and manuscript group would cancel each other out. Secondly, the EC dates for the songs at the beginning and end points of the centroid progression were taken to be equivalent to their stylistic dates, as the latter had been fixed on the basis of biographical information. Thirdly, the EC dates for the songs with stylistic dates more than two years after the EC date of their associated manuscript-group centroid were taken to be equivalent to the EC date of the centroid, as the manuscript group effectively functioned as a *terminus ante quem* for that song. Finally, for the remaining songs, the EC dates were taken to be equivalent to their stylistic dates. To make this clear, songs excluded from the manuscript groups have EC dates in brackets in column 5 of Table 4 and songs with stylistic dates more than two years after the EC date of their associated manuscript-group centroid have EC dates prefaced by the ≤ sign to indicate the *terminus ante quem* for that song.

Table 4. The chronological order of Binchois's songs and the manuscript, manuscript-group and style-period centroids (in bold) derived from their perpendicular positions relative to the centroid progression obtained from the linear best fit to the *M-Ox1, M-Ox2*, *M-EscA* and *M-EscB* centroids, along with their distances along the progression, stylistic and equivalent chronological (EC) dates and style period. Songs excluded from the manuscript groups have EC dates in brackets in column 5 and songs with stylistic dates more than two years after the EC date of their associated manuscript-group centroid have EC dates prefaced by the ≤ sign to indicate the *terminus ante quem* for that song.

1 Order	2 Song/MS	3 Distance	4 Stylistic date	5 EC date	6 Style period	1 Order	2 Song/MS	3 Distance	4 Stylistic date	5 EC date	6 Style period
1	*Jmr*	0.000	1419	1419	Early	38	*Ama*	1.009	1440	1440	Middle
2	*Nvv*	0.010	1419	(1419)	Early	39	*Tmj*	1.010	1440	≤1435	Trans
3	*Ldmd*	0.038	1420	1420	Early	40	*Slb*	1.018	1440	(1440)	—
4	*M*	0.134	1422	1422	Trans	41	*Qqd*	1.030	1440	≤1435	Trans
5	*Sj*	0.197	1423	(1423)	—	42	*Aa*	1.044	1440	≤1435	Trans
6	*Am*	0.240	1424	1424	Trans	43	***Stras***	1.046	1440	1440	—
7	*Jtdd*	0.243	1424	1424	Trans	44	*Mcc*	1.067	1441	1441	Late
8	*Fam2*	0.249	1424	(1424)	—	45	*Vtdr*	1.111	1442	1442	Middle
9	*As*	0.270	1425	1425	Early	46	*Ms*	1.151	1443	≤1435	Trans
10	*Amem*	0.280	1425	1425	Early	47	*Er*	1.163	1443	≤1435	Trans
11	*Qvm*	0.321	1426	1426	Early	48	*Mf*	1.178	1443	1443	Middle
12	***M-Ox1/Pz***	0.327	1426	1426	Early	49	***St.Em***	1.179	1443	1443	—
13	*Tp*	0.404	1427	1427	Trans	50	*Mde*	1.186	1443	(1443)	—
14	***M-Reina***	0.440	1428	1428	Early	51	*Hqp*	1.206	1444	1444	Middle
15	*Jp*	0.460	1428	1428	Trans	52	***R1411a***	1.216	1444	1444	Late
16	*Aeq*	0.519	1430	1430	Trans	53	*Aj*	1.217	1444	1444	Middle
17	*My*	0.549	1430	1430	Trans	54	***M-EscA***	1.225	1444	1444	—
18	*Sjs*	0.560	1430	≤1428	Early	55	*Lm*	1.244	1445	1445	Middle
19	*Vt*	0.567	1431	(1431)	—	56	*Pp*	1.257	1445	1445	Late
20	*Jla*	0.624	1432	≤1426	Early	57	***R1411b***	1.257	1445	1445	—
21	*Aes*	0.640	1432	1432	Trans	58	***M-M902***	1.276	1445	1445	Late
22	*Jvs*	0.650	1432	1432	Trans	59	*Dpep*	1.291	1445	≤1435	Trans
23	***PC3***	0.681	1433	1433	—	60	*Da2*	1.293	1446	1446	Middle
24	*Tpa*	0.751	1434	1434	Trans	61	*Da1*	1.323	1446	1446	Middle
25	*Ad*	0.753	1434	≤1426	Early	62	*Jnp*	1.338	1446	≤1435	Trans
26	*Pdp*	0.785	1435	1435	Trans	63	*Amtbm*	1.362	1447	≤1444	Middle
27	*Jt1*	0.791	1435	1435	Middle	64	*Va*	1.368	1447	≤1444	Middle
28	***M-Ox2***	0.794	1435	1435	Trans	65	***Late***	1.389	1447	1447	Late
29	*Es*	0.803	1435	(1435)	—	66	*Rmv*	1.399	1448	≤1435	Trans
30	*Ml*	0.828	1436	1436	Trans	67	*Ep*	1.414	1448	≤1444	Middle
31	*Ltdj*	0.834	1436	1436	Trans	68	*Se*	1.434	1448	1448	Late
32	*Bp*	0.900	1437	(1437)	—	69	***M-EscB***	1.474	1449	1449	Late
33	*Bv*	0.904	1438	1438	Middle	70	*Jc*	1.486	1449	≤1444	Middle
34	*Ca*	0.939	1438	1438	Middle	71	*Md*	1.554	1451	≤1445	Late
35	*Dlc*	0.951	1438	1438	Middle	72	*Jnf*	1.576	1451	≤1444	Middle
36	*Lmm*	1.007	1440	≤1435	Trans	73	*Jnv*	1.596	1452	1452	Late
37	***Tr87***	1.008	1440	1440	—	74	*Cfd*	1.610	1452	1452	Late

Table 5. The centroid-progression distances and EC dates of selected items from Table 4 compared with the dates and time spans proposed for them in the literature

1 Slavin MS order	2 Song/MS	3 Distance	4 EC date	5 Proposed dates and time spans
	Jmr	0	1419	—
1	***M-Ox1***	0.327	1426	c.1426–1429
	Pz	0.327	1426	c.1420 or early 1420s, before c.1425, c.1425, c.1426–1429
1	***M-Reina***	0.440	1428	c.1430
	Jvs	0.650	1432	c.1429–1432
	PC3	0.681	1433	mid-1430s, c.1432–1434
2	***M-Ox2***	0.794	1435	c.1432–1436
	Tr87	1.008	1440	c.1433–1445, c.1433–1442
	Stras	1.046	1440	c.1431–1449
	Mf	1.178	1443	1441 or 1445
	St.Em	1.179	1443	c.1439–1443
3	***R1411a***	1.216	1444	1440s, c.1445, c.1450
	M-EscA	1.225	1444	c.1436–1440, c.1430–1445
	R1411b	1.257	1445	1440s, c.1445, c.1450
4	***M-M902***	1.276	1445	c.1435–1445, c.1440
	Da2	1.293	1446	c.1432
	Da1	1.323	1446	after 1432
5	***M-EscB***	1.474	1449	late 1450s, c.1455–1465, c.1465
	Jnv	1.596	1452	1454
	Cfd	1.610	1452	—

Composition Dates

In Table 5, the centroid-progression distances and EC dates of selected songs and manuscript centroids from Table 4 are given along with the dates proposed for them on the basis of manuscript and historical evidence. When the EC and proposed dates are compared, we find the following.

- ***M-Ox1***: The EC date of 1426 for the *M-Ox1* centroid falls within the time span c.1426–1429 proposed for fascicles V and VIII of *Ox* by Graeme Boone (1987: 113) and, given that *M-Ox1* refers to the earliest fascicles in *Ox*, is also close to the start date of 1427 for this manuscript preferred by Fallows (1999: 31; 2000: 203).

- ***Pz***: Although the position of the *Pz* centroid was determined on the basis of only three songs, its EC date of 1427 falls within the time span c.1426–1429 indicated for this manuscript by its eight concordances with *Ox*[13]. These centroid and concordance dates for *Pz* are slightly later than those previously proposed for this manuscript: perhaps c.1420 or the early 1420s (Fallows 1999: 39; 2000: 203), before c.1425 (Plumley 2015: 387) and c.1425 (Berger 2009: 3). The disparity between these dates can be reduced, however, if we bear in mind that (i) all three of Binchois's *Pz* songs are also found in *M-Ox1* and (ii) the greater number of songs in *M-Ox1* will result in a more reliable centroid position. In other words, if we adopt the EC date of the *M-Ox1* centroid (1426) for *Pz*, this provides not only a more accurate date for *Pz*, but also a better fit to the proposed dates while remaining in the time span indicated by the concordances with *Ox*. Consequently, this EC date of 1426 is used for *Pz* in Tables 4 and 5[14].

- ***M-Reina***: Although the position of the *M-Reina* centroid was determined on the basis of only two songs, its EC date of 1428 is close to the date c.1430 proposed for this manuscript by Fallows (1999: 40)[15].

- ***B-Jvs***: The EC date of 1432 for this song falls within the time span c.1429–1432 suggested by the stylistic evidence and the historical evidence associating it with the Earl of Suffolk: (i) 'the tempus perfectum of the music, and particularly the way it is used, seems to support a date soon after 1429' (Fallows 2000: 204), (ii) the text was written by Suffolk in the summer of 1429 (Fallows 1987b: 132) and (iii) 'Suffolk did not return to England until 1432, by which time Binchois was permanently employed by the Duke of Burgundy' (Fallows 2001: 581).

- ***PC3***: The EC date of 1433 for the *PC3* centroid is not only close to the mid-1430s date proposed for this manuscript by Fallows (1995: 24; 1999: 37), but also agrees with Boone's dating of *PC3* to the time of the end of fascicle III of *Ox*, the latter of which he dates to c.1432–1434 (Boone 1987: 113, 134)[16].

- ***M-Ox2***: The EC date of 1435 for the *M-Ox2* centroid falls within the c.1432–1436 time span proposed for fascicles IIIx, IIIz, IIy, IV and I of *Ox* by Boone (1987: 113).

- ***Tr87***: The actual EC date of 1430 for the *Tr87* centroid is earlier than the c.1433–1445 time span proposed for this manuscript by Peter Wright (1989: 106) and the watermark dates, c.1433–1442, established by Suparmi Saunders (1984: Vol.1, 56 and Vol.2, 164, 166, 169) for the six pages on which the Binchois songs are copied. However, when the characteristics of the Binchois songs in *Tr87* are examined in more detail, as described in the section entitled **Songs in *Tr87*** below, not only is the disparity between the EC and proposed dates explained, but also the EC date of 1440 for the revised *Tr87* centroid agrees with the findings of Wright and Saunders despite being determined on the basis of only two songs (*B-Ama* and *B-Lmm*). Consequently, this EC date of 1440 is used for *Tr87* in Tables 4 and 5[17].

- ***Stras***: The EC date of 1440 for the *Stras* centroid not only falls at the midpoint of the time span proposed for this manuscript by Martin Staehelin (1989), who associated it with the Council of Basel (1431–1449) and noted it contained dates of 1442, but is also compatible with Lorenz Welker's (1993) proposal of a completion date well into the 1440s and 'the presence of works by Du Fay and especially Nicholas Merques [which] point to a completion date no earlier than the late 1430s' (Stoessel 2017: 214)[18].

- ***B-Mf***: Kemp (1990: 103–7) proposed three candidates as potential dedicatees of this song: Margaret of Burgundy (Philip the Bold's daughter, d. 8 March 1441), Margaret (John the Fearless' daughter, d. 1441) and Margaret of Scotland (James I of Scotland's daughter, d. 16 August 1445). Here, the EC date of 1443 for this song, while falling at the midpoint of the time span of the above death dates, does not allow us to decide between any of the potential candidates.

- ***St.Em***: The EC date of 1443 for the *St.Em* centroid falls within the c.1439–1443 time span proposed for this manuscript by Ian Rumbold and Peter Wright (2009: 82, 85)[19].

- ***M-EscA***: While the EC date of 1444 for the *M-EscA* centroid falls outside the c.1436–1440 time span proposed for this manuscript by Fallows (1999: 15), it does fall within the longer time span, c.1430–1445, proposed by Kemp (1990: 4).

- ***R1411***: The EC dates of 1444–1445 for the two *R1411* centroids not only fall within the time span (the 1440s) and are close to the c.1450 date proposed for this manuscript by Fallows (1999: 42) and Slavin (1988: 210–1), respectively, but also agree with the c.1445 date proposed for this manuscript by Haar (2004: 85–6)[20].

- ***M-M902***: Although the position of the *M-M902* centroid was determined on the basis of only three songs, its EC date of 1445 falls within the c.1435–1445 time span proposed for this manuscript by Slavin (1989: 120) and is close to the c.1440 date proposed by Fallows (1999: 26) who, however, noted that this could be a little too early.

- ***B-Da***: While *B-Da2* is very slightly earlier along the centroid progression than *B-Da1*, thereby supporting the composition order proposed by Strohm (1993: 193) for the two 3vv-versions of this song, both have EC dates of 1446, which contradicts his proposed date of c.1432 for *B-Da2*. Here, both versions of *B-Da* are adjacent in the configuration because the only difference between them is their contratenors and, consequently, their β_C values (the degree of contratenor conjunctness). Their adjacency and their EC dates of 1446, which would suggest that both versions are contemporaneous, do, however, support Slavin's opinion that this song was composed some time after the compilation of *Ox* (i.e. after c.1436) and his conclusion that 'there are no firm grounds for asserting compositional priority for any of the versions [of *B-Da*]' (Slavin 1988: 61n36; 1992a: 39).

- ***M-EscB***: The EC date of 1449 for the *M-EscB* centroid is earlier than the c.1455–1465 time span or a date in the late 1450s or c.1465 proposed for this manuscript by Slavin (1990), Fallows (1999: 15) and Southern (1981: XIII–XIV). Furthermore, an EC date of 1448 resulted when the centroid was calculated using only the three late songs found in *EscB* (*B-Cfd*, *B-Pp* and *B-Se*). These EC dates are easily explained, however, by the assumption that Binchois's compositional activity ceased c.1452, which would result in the *M-EscB* and *EscB* songs being earlier songs that are only found in a later source and the consequent disparity between the EC and proposed dates.

- ***B-Jnv***: While the EC date of 1452 is close to the documented performance of this song at the 'Banquet du Voeu' held at Lille on 17 February 1454 (Strohm 1993: 413, 442; Alden 2010: 116), this may not necessarily have been its premiere performance and the song could have been composed some time earlier.

A number of conclusions can be drawn from these comparisons. Firstly, with three exceptions (*M-EscB*, which is easily explained, *Tr87,* which is accounted for in the section entitled **Songs in *Tr87*** below and *B-Da*), the EC dates for all of the manuscript groups and the individual songs fall within the time spans or are close to the dates proposed for them in the musicological literature. Secondly, Table 5 (column 1) indicates that the chronological order of the manuscript centroids corresponds exactly to the chronological order of the manuscript sources of Binchois's songs proposed by Dennis Slavin (1988: 3–4; 1989: 120–1; 1992a: 23; 1992b: 345–6). Taken together, this not only confirms that the best-fit line to the manuscript-group centroids (the centroid progression) acts as a chronological gauge that runs from the earliest to the latest songs of a composer's oeuvre, but also indicates that the distances along the line closely correspond to both the relative lateness of style and the actual time elapsed, with the results in Tables 4 and 5 indicating that the EC dates are probably accurate to within plus or minus two years, a factor that would also account for the disparity between the EC and proposed dates of 1452 and 1454 for *B-Jnv*. Furthermore, as these results were achieved by mapping biographical events onto the configuration, the c.1428 date advanced by Beauvois (2017: 539–40) for Hugo de Lantins' *Tra quante regione* is also supported as (i) the dates of three of the four centroid-progression beginning and end points in that study were fixed on the basis of biographical information and (ii) the position in the MDS configuration of *Tra quante regione* indicated that it was the song that was chronologically and stylistically furthest from Hugo's earliest one. Finally, as the centroid progression is in the same direction as the *K6-K4/k9* vector, this confirms the hypothesis made above that the *K6-K4/k9* vector reflects a chronological trend in Binchois's superius-tenor duets where his use of fourths and ninths decreased and his use of sixths increased over the course of his career.

A Revised Style Chronology for Binchois's Songs

As Table 5 confirms Slavin's chronological ordering of the manuscript sources of Binchois's songs, we are now in a position to map the stylistic changes that occurred in the songs over time and use the six chronological manuscript groups to refine Slavin's division of the songs into early, middle and late periods (see above), as converging evidence indicates that the songs can be divided into four contiguous style periods that correspond to individual manuscript groups or combinations of them: Early (*M-Ox1* and *M-Reina*), Transitional (*M-Ox2*), Middle (*M-EscA*) and Late (*M-M902* and *M-EscB*) as illustrated in Fig. 5, which shows the style periods based on the manuscript groups, and Fig. 6, which shows the mean values of the five significant MDS variables for each of these style periods. Here, the centroid dates in Tables 4 and 5 indicate the following time spans for each style period: Early = *B-Jmr* to *M-Ox1*/*M-Reina* (c.1419–1428) = 10 years; Transitional = *M-Ox1*/*M-Reina* to *M-Ox2* (c.1428–1435) = 8 years; Middle = *M-Ox2* to *M-EscA* (c.1435–1444) = 10 years; Late = *M-EscA* to *B-Cfd* (c.1444–1452) = 9 years (as the Late style period encompasses all the songs composed after *M-EscA* to his last song *B-Cfd*)[21].

The Early, Transitional and Middle Style Periods

Slavin (1988: 4; 1989: 120–1) noted a correlation between Binchois's manuscript chronology and his mensural usage that mirrors a general shift in notational usage that occurred c.1430, where works in triple metre before this date are mostly in 𝅜 and works after this date are mostly in 𝅝 (Besseler 1950: 109–24; see also Boone 1987: 137–9; Reynolds 1974: 350–86; Strohm 1993: 132–5). If we compare the percentage occurrences of the 𝅜/𝅝 mensurations for the songs in the final manuscript groups (see the Appendix, Table A1, column 4), we find *M-Ox1* = 100/0, *M-Reina* (including *B-Jt2*) = 67/33, *M-Ox2* = 43/57 and *M-EscA* = 0/100. Here, the 100% shift from 𝅜 to 𝅝 from *M-Ox1* to *M-EscA* and the slight predominance of 𝅜 songs in *M-Reina* and 𝅝 songs in *M-Ox2* strongly suggests that *M-Ox1* and *M-Reina* represent Binchois's Early style period, *M-EscA* represents his Middle style period and *M-Ox2* effectively represents a Transitional style period between the two. This division into four style periods is supported by the following evidence.

Firstly, all except one of the 11 songs defined by Strohm (1993: 184) as Binchois's earliest on the basis of the role of the contratenor and their rhythmic, mensural and textural characteristics are either in or close to the *M-Ox1* region in Fig. 5, the exception being *B-Er* from *M-Ox2* (see Fig. 7). These are *B-Amem, B-As, B-Jla* and *B-Jmr* from *M-Ox1* and *B-Aeq, B-Am, B-Jp, B-My, B-Nvv* and *B-Tp* from *M-Ox2*. Since these songs, as well as the remaining *M-Ox1* songs (*B-Ldmd* and *B-Tpa*), *B-Qvm* from *M-Reina* and *B-Jtdd* from *M-Ox2* are all in 𝅜, this strongly suggests that *M-Ox1* and *M-Reina* represent Binchois's earliest style period. Secondly, Fig. 7 indicates that (i) two *M-Ox2* songs in 𝅜 (*B-Dpep* and *B-Er*) are clearly separated from the other 𝅜 songs and surrounded by songs in 𝅝 and (ii) the two *M-Reina* songs *B-Qvm* and *B-Sjs* (in 𝅜 and 𝅝, respectively) are close to each other. Here, the positions in the MDS configuration and stylistic dates of *B-Dpep* and *B-Er* indicate that not only are they among the most stylistically advanced of the *M-Ox2* songs, but also that they are stylistically comparable to the later *M-EscA* songs in 𝅝, despite being in 𝅜. Furthermore, the positions of the two *M-Reina* songs indicate that they are not only contemporaneous, but also have similar harmonic and melodic characteristics despite their different mensurations. Taken together, this strongly suggests that Binchois composed the same way in 𝅜 and 𝅝 (i.e. his compositional practice remained independent of his mensural usage) and that his shift in style and mensural usage between *M-Ox1* and *M-EscA* was therefore unrelated to the general shift in mensural usage that occurred c.1430.

Given this and the deliberate nature[22] of Binchois's stylistic choices, his arrival at the Burgundian Court c.1430 (Weller 2000: 51–2) prior to the c.1433 midpoint[23] of his shift in mensural usage and the trends exhibited in Fig. 6 by the five significant MDS variables, where the *K6, K4, k9* and $ß_C$ values for the Transitional style period lie between those of the Early and Middle style periods, a simple explanation suggests itself for the style shift. This is that, while Binchois initially composed almost exclusively in 𝅜 in his Early songs (*M-Ox1* and *M-Reina*), he subsequently tailored his output on his arrival at the Burgundian Court c.1430 to represent the Court's aesthetic choices (Fiala 2015: 438–9) and, in doing so, entered a Transitional style period (*M-Ox2*) where he (i) moved from composing almost exclusively in 𝅜 to composing exclusively in the now-fashionable 𝅝 mensuration, (ii) increased the proportion of sixths (*K6*) and decreased the proportion of ninths (*k9*) and fourths (*K4*) in his superius-tenor duets, the proportion of fifths (*K5*) remaining roughly constant over time and (iii) increased the conjunctness of his contratenor voices ($ß_C$). This accomplished, he arrived at his Middle style period (*M-EscA*) where he cleaved to a uniform style in 𝅝 that was in accord with the Court's aesthetic choices and, in the words of Fallows (2001: 585), stylistically kept 'fairly closely to a middle road, with nothing outrageous or startling' (see also Slavin 1992b: 342). These trends are illustrated in Ex. 2 using extracts from the early song *B-Qvm* and the later song *B-Ep*, where the *K5* values are comparable (12.5% and 8.33%, respectively), *K6* increases from 16.67% to 75%, *k9* and *K4* (4.17% and 25%) decrease to zero, and where the disjunctness of the contratenor of *B-Qvm* stands in marked contrast to the predominantly stepwise movement of that of *B-Ep*.

The Late Style Period

Slavin (1989: 121–2) noted that the manuscript *M902* contains songs that embody changes in Binchois's style and that the ultimate direction of these stylistic changes, his Late style, was difficult to ascertain due to the small number of late pieces and because the three songs attributed to him in sources compiled after his death in 1460 (*B-Cfd*, *B-Jnv* and *B-Tapm,* the last probably by Frye) marked distinct departures from his earlier style. This issue can be resolved, however, if we bear in mind Slavin's observation that stylistic features in *B-Pp* and *B-Se* imply a later composition date than c.1445 and his proposal that these two songs either formed part of *M902* or were composed slightly later (Slavin 1988: 218, 228; 1989: 132, 134). If Slavin's proposal that *B-Pp* and *B-Se* are contemporaneous with *M902* is considered with respect to the positions of the *M-M902* and *M-EscB* songs in Fig. 3, we can see that *B-Pp* (*M-EscB*) has a distance along the centroid progression very similar to *B-Hqp* (*M-M902*) and that *B-Cfd* and *B-Jnv* (*M-EscB*) have distances very similar to *B-Md*

(*M-M902*). Taken together, this strongly suggests that *M-M902* and *M-EscB* represent two separate parts of Binchois's Late style period, which is itself a development or refinement of his Middle style period.

These conclusions are supported by Fig. 5, where *M-M902* and *M-EscB* are merged into a new manuscript group and corresponding style period (Late). Here, not only is the Late centroid closer to the centroid progression than the *M902* and *M-EscB* centroids, indicating a better fit to the overall trend, but also the area of the configuration it occupies is smaller than that occupied by *M-EscA*, indicating less variability in the dyadic-melodic variables; i.e. a refinement or concentration of style compared to the Middle style period. Furthermore, any counterargument that the Late style period has a smaller area than the Middle style period in Fig. 5 because it covers a shorter time span is rendered invalid by their almost equivalent time spans: nine and ten years, respectively[24] (see above). These conclusions are also supported by Fig. 6, which shows that the trends exhibited during the Transitional style period from the Early to Middle songs remain in effect afterwards. That is, as we move from the Middle to Late style periods, we find a further increase in the proportion of superius-tenor sixths (*K6*) and the conjunctness of the contratenor voices ($ß_C$) and a further decrease in the proportion of superius-tenor fourths (*K4*); i.e. a refinement or concentration of style. Moreover, while Fig. 5 indicates that *M-M902* forms the earliest part of this Late style period, thereby supporting Slavin's (1989: 123) suggestion that some of the *M902* songs form a stylistic bridge from *EscA* to Binchois's latest songs, the position of *B-Cfd* and *B-Jnv* at the extreme left-hand end of the centroid progression strongly suggests that these were the last songs Binchois composed, which would imply that that their wide circulation, as shown by their survival in a large number of sources (Fallows 1999: 116, 215), may well be due to their being the swansongs of a famous composer.

The division of Binchois's songs into the four style periods proposed here is also supported by their broad agreement with the manuscript-group regions in Figs. 3 and 5. Here, the smaller areas occupied by *M-Ox1, M-EscA, M-M902, M-EscB* and the Late style period compared to *M-Ox2*, which indicate that they contain songs from approximately the same periods in Binchois's life due to their compact spreads of values for the dyadic-melodic variables, are explicable for various reasons. Firstly, *M-Ox1* is essentially a discrete collection of his earliest songs, four of the six being found in fascicle V of *Ox* (Fallows 1995: 45–7). Secondly, *EscA* and *M902* were compiled over a relatively short period of time in close proximity to the composer (Slavin 1989; 1992a). Finally, the merger of *M-M902* and *M-EscB* delineates a Late style period that is a refinement or concentration of his previous Middle style period (represented by *M-EscA*). Conversely, while it may contain batches[25] of Binchois's early songs, the broad spread of the values of the dyadic and melodic variables for *M-Ox2* and its resultant overlap with *M-Ox1* and *M-EscA* occurs because the eight-year time span, c.1428–1435, covered by the Transitional style period represented by *M-Ox2* means that it is effectively a snapshot of Binchois's output during a period of rapid stylistic change where he was making the transition from his ℂ idiom (*M-Ox1*) to the O-related style in favour at the Burgundian Court (*M-EscA*), as described above. Finally, as the style periods are closely associated with the centroid progression, these findings confirm not only the hypothesis that the *K6-K4/k9* vector reflects a chronological trend in Binchois's superius-tenor duets where his use of fourths and ninths decreased and his use of sixths increased over the course of his career, but also that this vector is itself closely associated with the centroid progression.

The Binchois Songs of *EscA*, *Tr87* and *St.Em*

The internal consistency of the findings described above and their remarkable degree of agreement with the musicological literature strongly suggest that the MDS configuration of Binchois's songs could be used as a basis for future research. To illustrate this, three examples are given to show how the manuscript groups, style periods and dispersion characteristics of the songs in the configuration can be used to confirm and clarify the findings of previous manuscript studies. More specifically, by distinguishing between separate scribes (*EscA*), determining relative stylistic dates for different manuscript layers (*Tr87*) and estimating the distance of a scribe from a composer (*EscA*, *Tr87*, *St.Em*).

Songs in *EscA*

It has long been recognised that the manuscript *EscA* is the work of two scribes, A and B (Slavin 1988; 1992a). Slavin concluded, on the basis of codicological and stemmatic evidence, that scribe A had a close working relationship with Binchois and access to authoritative versions and revisions of the songs he copied, whereas scribe B did not have a close connection to Binchois and the songs he copied were widely circulated versions (Slavin 1988: 189–90, 230; 1992a: 50). These conclusions are confirmed in Fig. 8, which shows the songs in *EscA* copied by both scribes. Here, the compact grouping of scribe A's songs, which more or less defines the area of the configuration delineated by *M-EscA*, indicates that they, like the songs in *M-Ox1*, are from the same period of Binchois's output, a situation that agrees

Figure 5. Figure 3 redrawn to show the four style periods based on the manuscript groups: Early (*M-Ox1* and *M-Reina*), Transitional (*M-Ox2*), Middle (*M-EscA*) and Late (*M-M902* and *M-EscB*). As in Fig. 3, the dotted line shows the centroid progression (the linear best fit to the manuscript-group centroids).

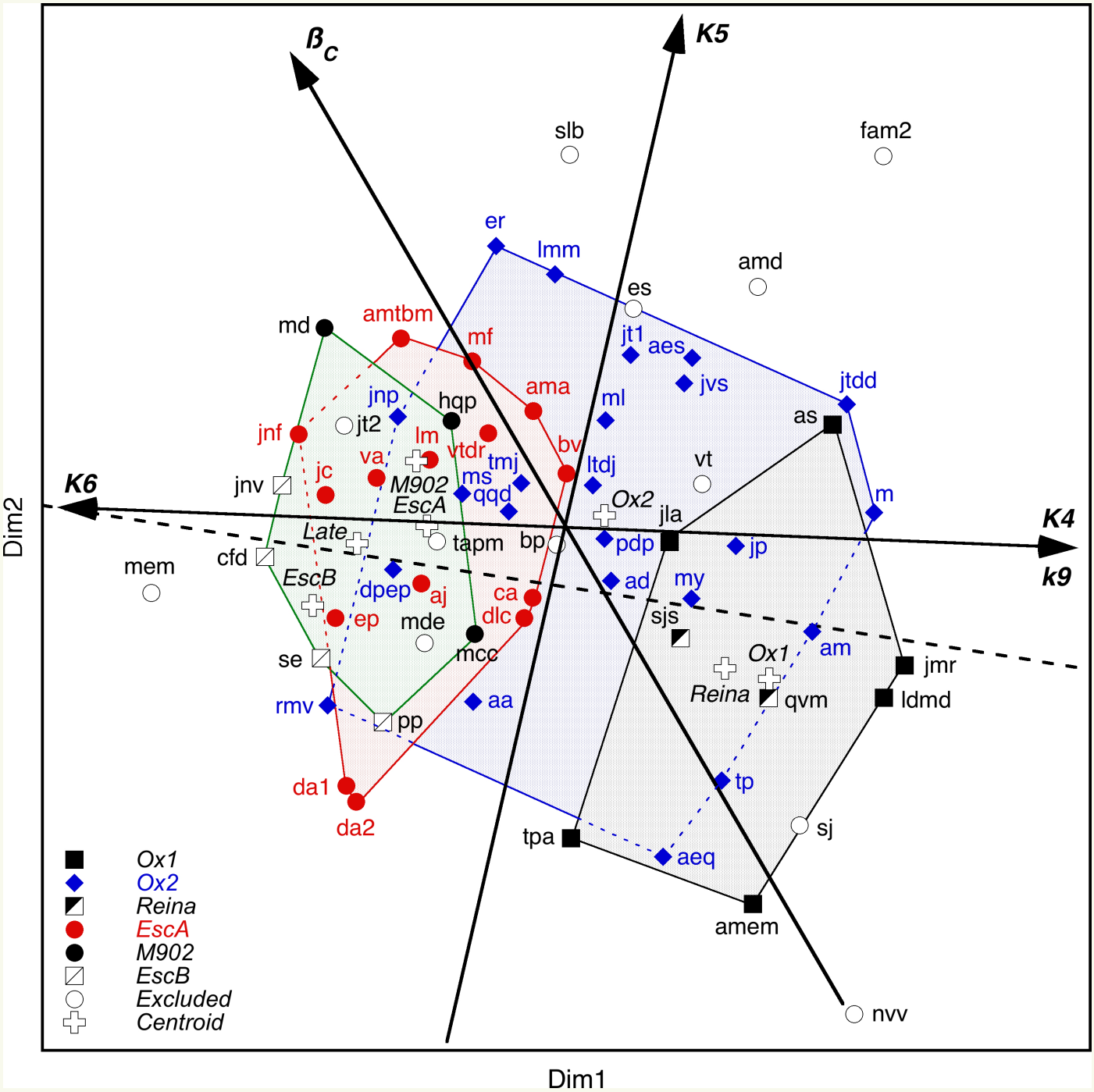
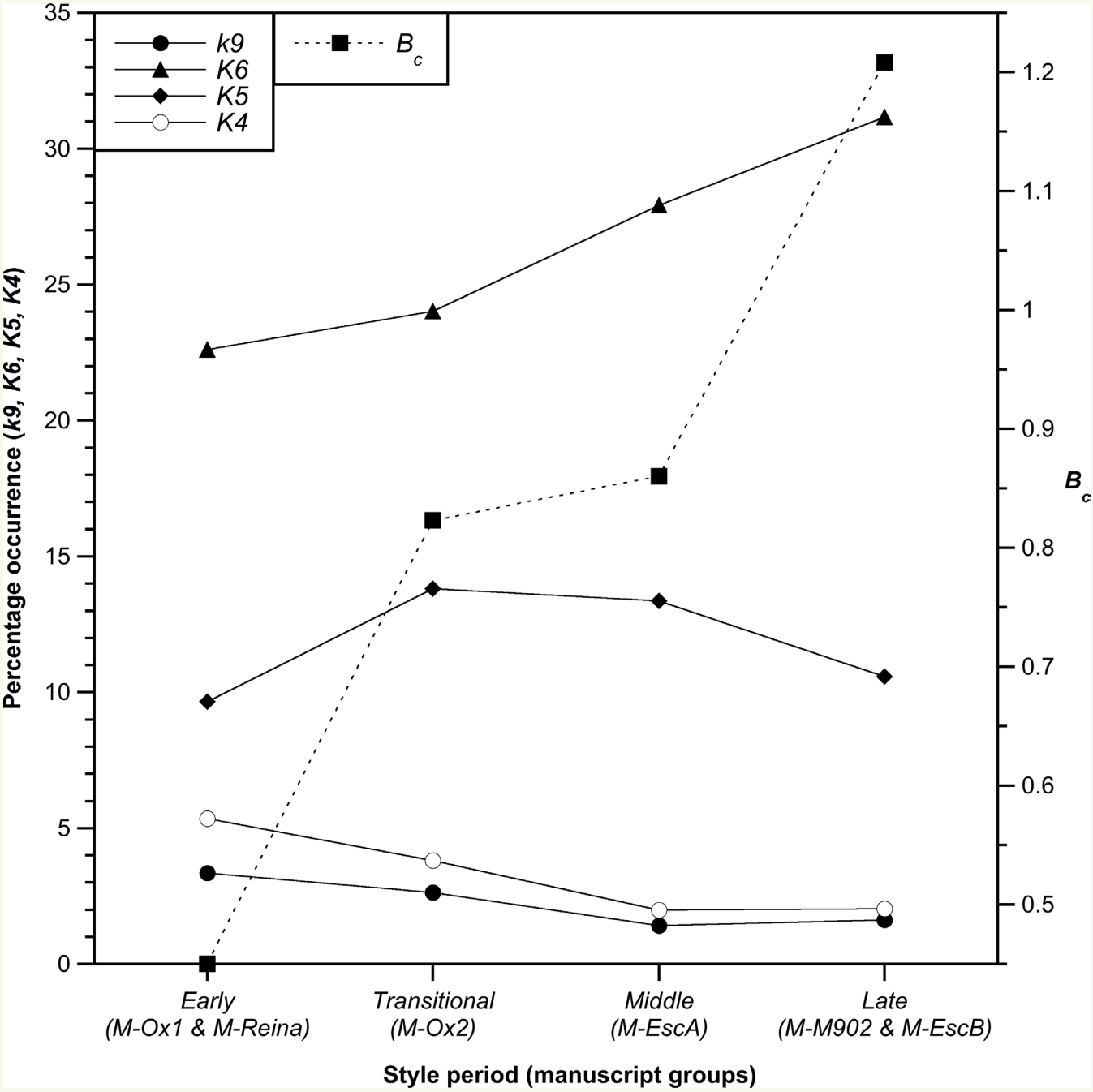
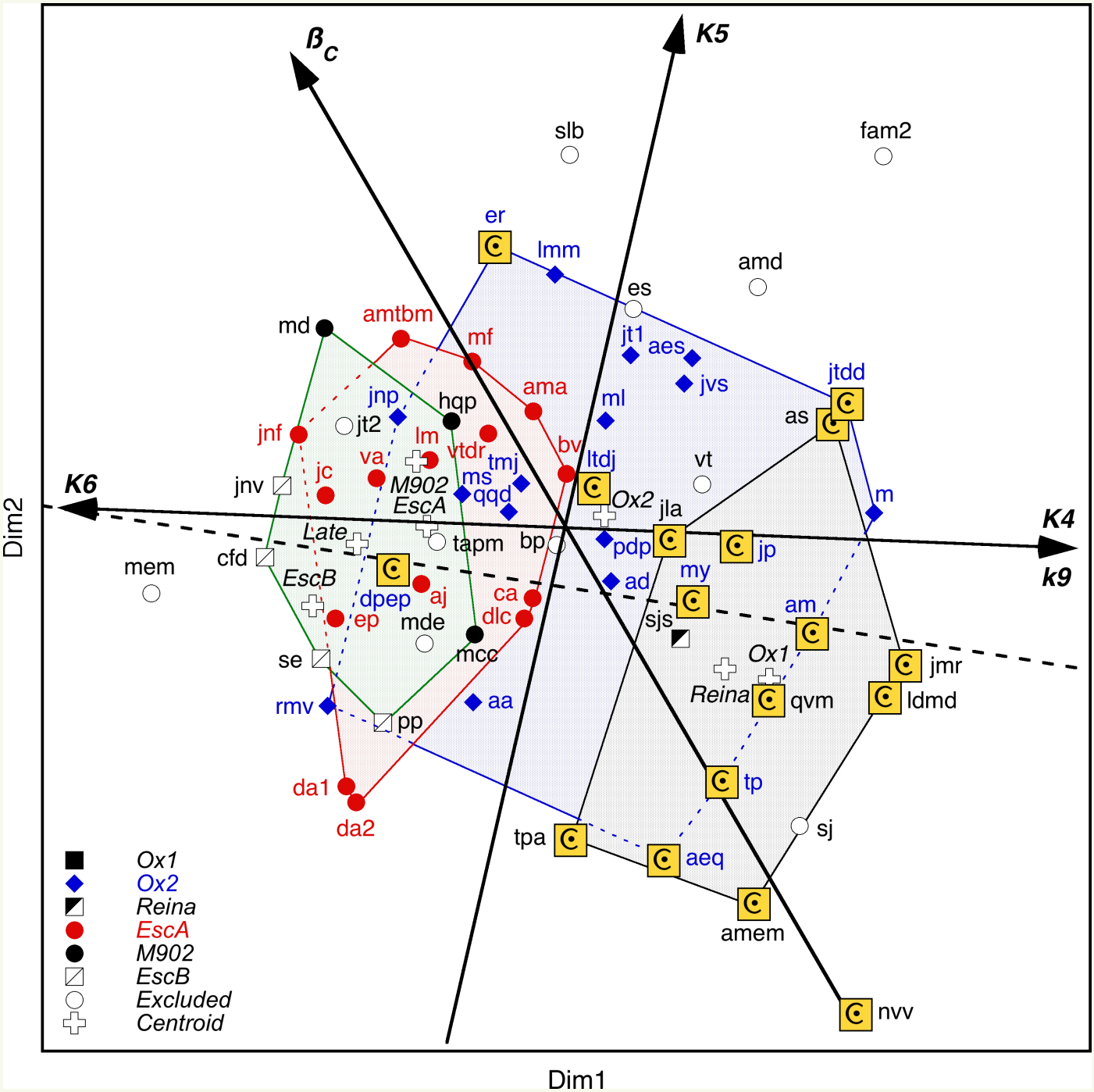


Figure 6. The mean values of the five significant MDS variables for the four style periods based on the manuscript groups shown in Fig. 5

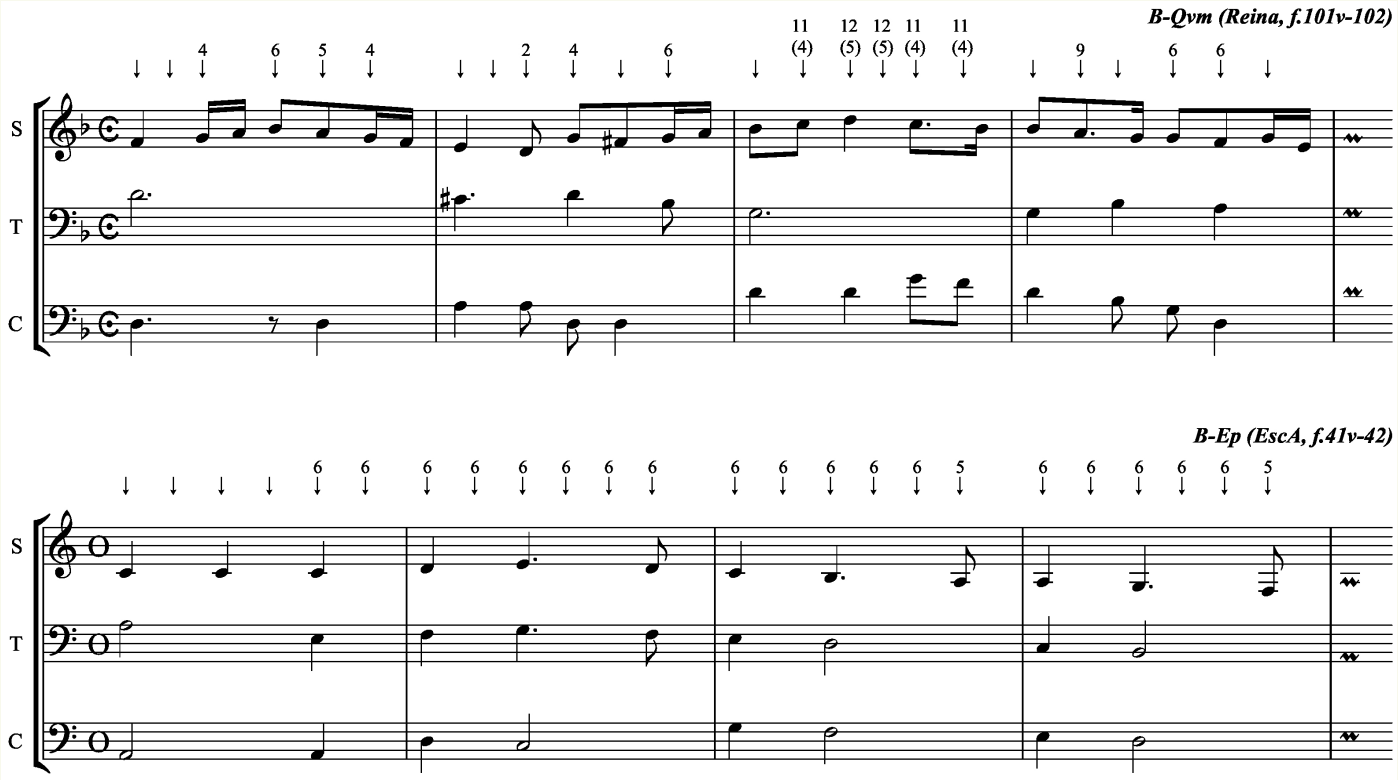


with scribe A having a close working relationship with Binchois over a period of time. Conversely, while five of the ten songs copied by scribe B form part of the *M-EscA* region, indicating that scribe B's activity was contemporary with that of scribe A, the broader overall spread of scribe B's songs indicates that they cover a longer time span than scribe A's (i.e. they are not from the same period of Binchois's output), a situation that agrees with scribe B being more distant from Binchois and the songs he copied being widely circulated. Finally, it should be noted here that the position in the MDS configuration and the EC date of the *M-EscA* centroid is almost certainly correct, as the four songs copied by scribe B that are distant from the *M-EscA* region were excluded from the *M-EscA* centroid calculation (*B-Jvs* and *B-Lmm* due to their assignation to *M-Ox2* and *B-Sj* and *B-Slb* due to their unrepresentative positions in the MDS configuration).

Figure 7. Figure 5 redrawn to show all the songs written in ☾. Here, apart from *B-Se* (written in ☿) and *B-Da* (written in ♁), the remaining songs are written in ○.



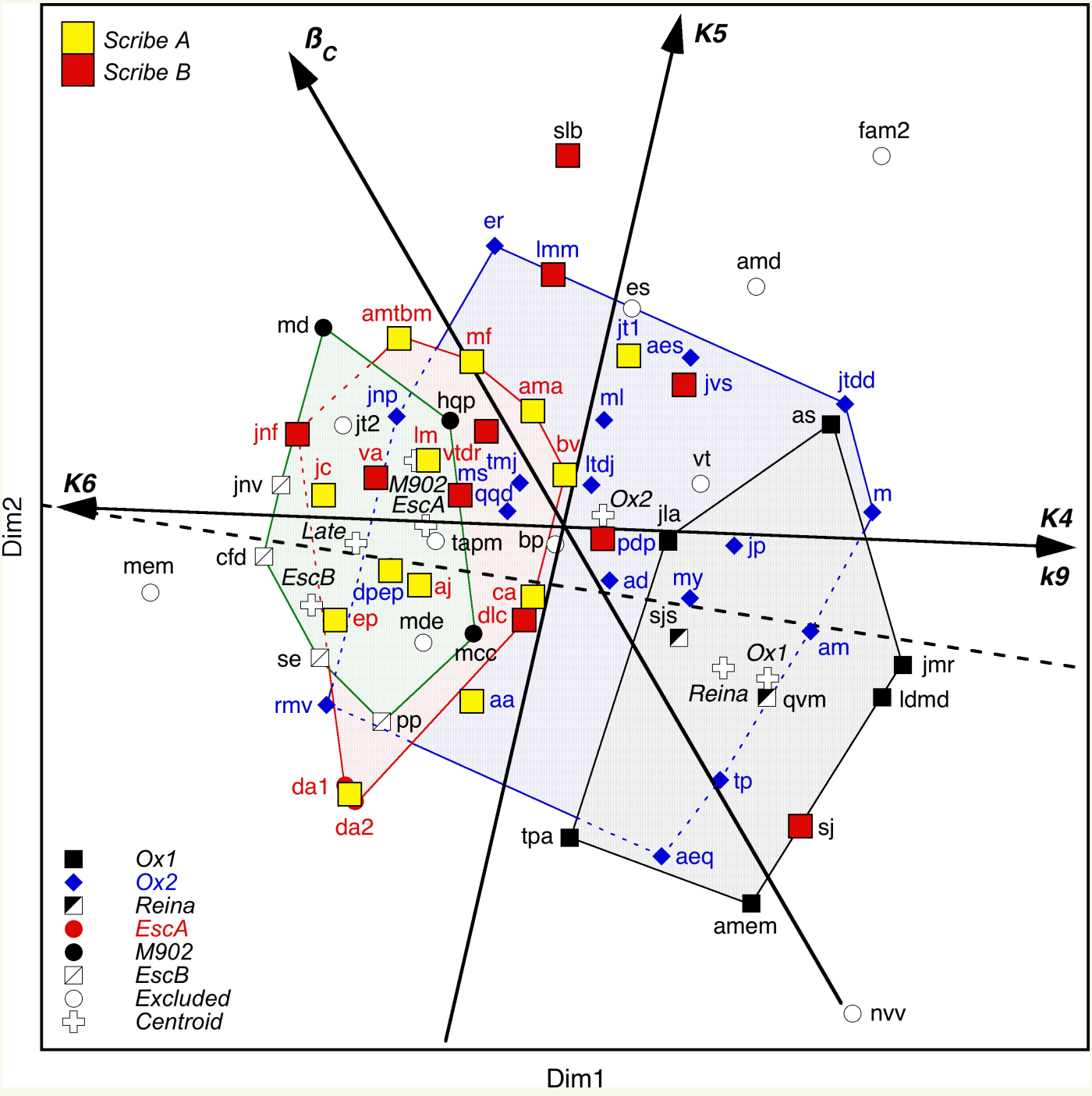
Example 2. Two extracts of equal length: one from the early song *B-Qvm*, the other from the later song *B-Ep*. Here, as in Ex. 1, the significant dyadic superius-tenor sonorities are indicated at the start of each quaver (minim), the text is omitted for clarity and the voices are presented in the order superius, tenor, contratenor.



Songs in *Tr87*

Five of the six songs attributed to Binchois in the manuscript *Tr87* by scribes A and B are found in three batches of pieces that were copied by scribe A (Johannes Lupi) at separate times (see Fig. 9, which shows the songs in *Tr87* copied by both scribes)[26]. If we make the reasonable assumption that *B-Sj* and *B-Slb* are stylistic experiments by Binchois that are contemporaneous with but unrepresentative of the other *M-EscA* songs, we arrive at the following copying order. The earliest batch (A1), copied separately from the rest of the main corpus, contains the isolated song *B-Lmm*, which is also found in *M-Ox2*. The second batch (A2) contains *B-Ama* and *B-Sj*, both of which are also found in *M-EscA*. The third batch (A3) contains *B-Ldmd* (unique to *Tr87*) and *B-Jmr* (also found in *M-Ox1*), the adjacency of which in the *M-Ox1* region of the configuration indicates that they are not only contemporaneous, but also two of Binchois's earliest songs. Finally, the remaining song, copied and attributed on the page immediately before *B-Jmr* in batch A3 by scribe B sometime between scribe A copying batches A2 and A3, is *B-Slb* (also found in *M-EscA*), as indicated by Wright's (1989: 59) statement that 'scribe B distributed his chansons in gathering 87.XII (ff. 133–142) [batch A3] in a manner which indicated his foreknowledge of scribe A's intention to follow this with a further layer of chansons'. In other words, Binchois's songs in *Tr87* were copied in the order A1 — A2 — *B-Slb* — A3. Here, the fact that the Binchois songs in each of scribe A's batches are all from different manuscript-groups/style-periods (A1 = *M-Ox2*/Transitional, A2 = *M-EscA*/Middle, A3 = *M-Ox1*/Early) and that *B-Slb* is from a later manuscript-group/style-period (*M-EscA*/Middle) than the other two songs in A3, which are chronologically and stylistically the earliest despite being copied last, strongly suggests that the *Tr87* scribes were at some distance from Binchois and that his songs reached them one or two at a time in exemplars containing songs from different periods of his output, a situation that agrees with Wright's (1982: 269) conclusion that scribe A 'recorded individual pieces and small groups of works as they came to hand'. Furthermore, these findings and Fig. 9 also make it clear that the calculation of the *Tr87* centroid will be skewed, and a disparity occur between the EC and proposed dates for *Tr87*, by the inclusion of the A3 songs, due to their being far earlier than the other *Tr87* songs, and the inclusion of *B-Sj* and *B-Slb*, due to their experimental and unrepresentative nature. If these songs are excluded, however, and the position of the *Tr87* centroid calculated on the basis of *B-Ama* and *B-Lmm*, the EC date of 1440 of the resulting centroid, despite being determined on the basis of only two songs, not only agrees with

Figure 8. Figure 5 redrawn to show the songs in *EscA* copied by scribes A and B. Here, for convenience, *B-Da1* and *B-Da2* are treated as a single data point.

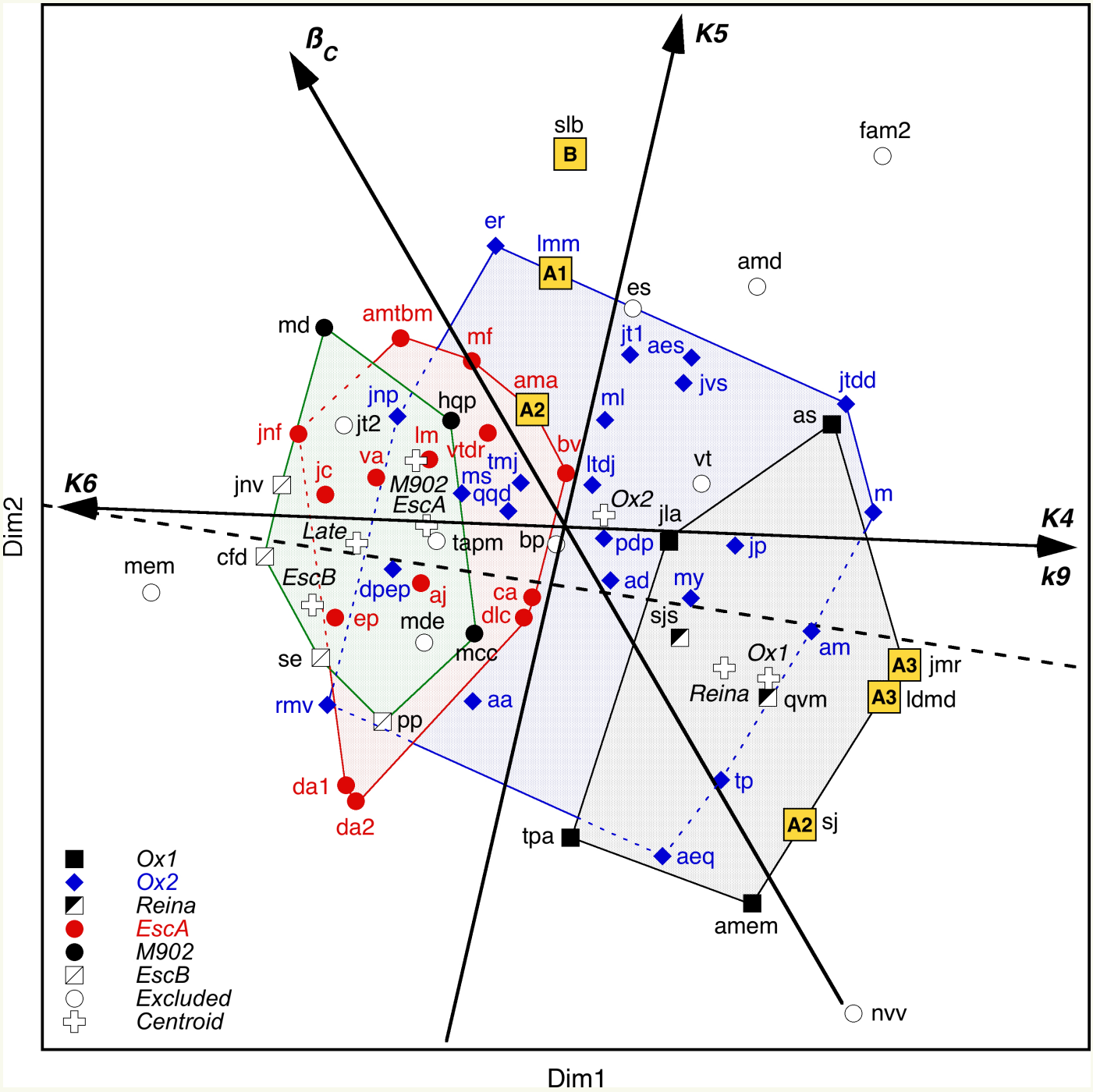


Wright's (1989: 106) conclusion that most of *Tr87* was copied c.1433–1445, but also with the watermark dates c.1433–1442 established by Saunders (1984: Vol. 1, 56 and Vol. 2, 164, 166, 169) for the six pages on which the Binchois songs are copied.

Songs in *St.Em*

With respect to the manuscript *St.Em,* Slavin (1988: 208) observed that 'with the exception of the two *unica* [*B-Amd* and *B-Mem*, both excluded from the analysis], there is a repertorial coherency to this collection [of Binchois's songs]. All of the songs are from approximately the same period in Binchois' life'. Figure 10, which shows the songs copied by the *St.Em* scribes, confirms Slavin's observation as it can

Figure 9. Figure 5 redrawn to show the batches of songs copied by scribes A and B in *Tr87*



be seen that the *St.Em* songs, like those copied by scribe A of *EscA* in Fig. 8, virtually define the area of the configuration delineated by *M-EscA*, indicating that they are from the same period of Binchois's output and contemporaneous with *EscA*. Furthermore, the close correspondence, with one exception, between the copying order of Binchois's songs in *St.Em* (Rumbold and Wright 2009: 108–10) and their stylistic dates (see Table 6, columns 1 and 5) strongly suggests that Binchois's songs reached the *St.Em* scribes more or less in the order, and possibly soon after, he composed them, a situation which agrees with Rumbold and Wright's (2009: 39 ff., 73) conclusions that the repertorial source for *St.Em* was the 'cultural nexus … [of] … Vienna, with its academic, diplomatic and ecclesiastical networks extending into both Western and Eastern Europe' and that the 'music was entered as it came to hand'.

Figure 10. Figure 5 redrawn to show the songs copied by the *St.Em* scribes. Here, for convenience, *B-Da1* and *B-Da2* are treated as a single data point.

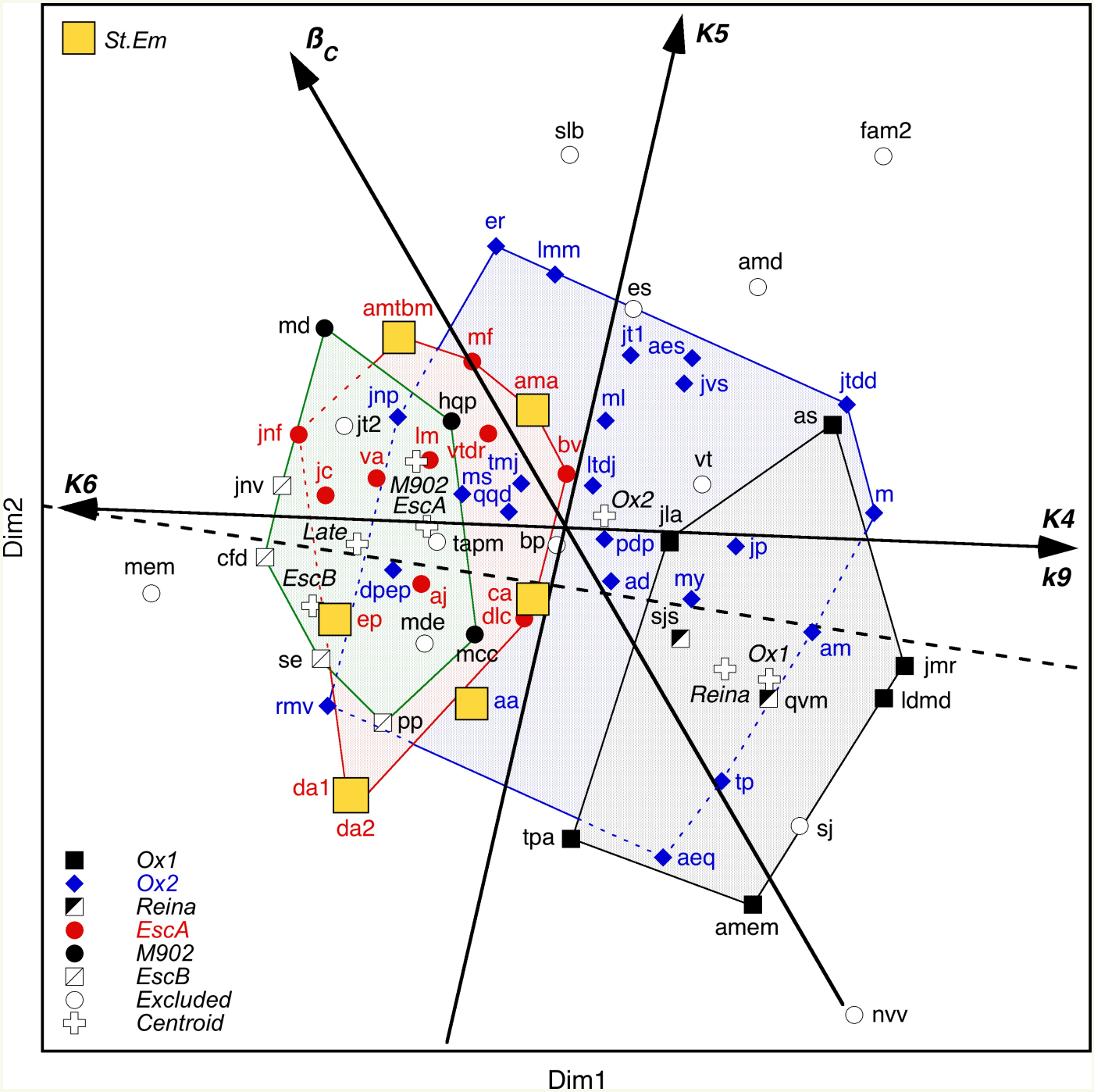


Table 6. The copying order of the songs in *St.Em,* along with their stylistic dates from Table 4, column 4

1 Copying order	2 Song	3 Gathering	4 Folio(s)	5 Stylistic date
1	*Aa*	IV	45v	1440
2	*Ama*	IV	45v-46r	1440
3	*Da*	IX	107r	1446
4	*Amtbm*	VIII	87r	1447
5	*Ep*	XI	126v-127r	1448
6	*Ca*	XI	127r, 129r	1438

General Conclusion

This article has shown how the analytical framework of Beauvois (2017) can not only resolve conflicting manuscript ascriptions, discover incorrect ones and verify scholarly attributions of songs to Binchois, but can also be used to divide the complete secular output of one composer into style periods, date individual songs and manuscripts by mapping biographical data onto the results and confirm and clarify the findings of previous manuscript studies. The analytical framework itself has some elements in common with the flexible and pragmatic approach to data analysis advocated by Everitt and Dunn (2001: 7–8) where (i) statistical methods are seen as tools to search for the underlying structure or pattern in a data set, (ii) the skilful interpretation of evidence is more important than a rigid adherence to a set of decision rules associated with significance tests or any other criteria and (iii) theories and conclusions derived from a particular data set should be validated using further data. When their approach is compared to the analytical framework, then it is clear that (i) the statistical and graphical techniques employed here (MDS, ProFit analysis) were used as tools to find the underlying structure or pattern (Binchois's stylistic development over time) in a data set of his songs, (ii) rather than rigidly adhering to a set of decision rules, one modest assumption was made concerning the underlying structure of the data (the *K6-K4/k9* vector taken to be the mean of the separate *K6*, *K4* and *k9* vectors) and the interpretation of the evidence was closely grounded in the historical reality of the manuscript transmission of the songs and (iii) not only were the findings internally consistent, but also their validity was clearly demonstrated by their remarkable degree of agreement with the musicological literature. This last point also strongly suggests that (i) for this particular data set of songs, the MDS configuration presented in this article provides an accurate representation of Binchois's stylistic development that could be used as a basis for future research, (ii) the analytical framework, in conjunction with biographical information, effectively provides a way to date the works in a musical repertory and (iii) the analytical framework could be applied to other repertories or composers whose works utilise a similar two-part contrapuntal core.

The findings described above indicate that the MDS configuration resulting from the dyadic-melodic analysis represents a stylistic continuum where (i) the centroid progression acts as a chronological gauge that runs from the earliest to the latest song, the distances along it closely corresponding to the relative lateness of style and the actual time elapsed and (ii) the gradual changes that occur in a composer's style over time are reflected by the changes in their treatment of the superius-tenor duet and the individual voices (as measured by the dyadic and melodic variables, respectively) and by the positions of the songs along the centroid progression. While this enabled us to map the stylistic changes that occurred in Binchois's songs over time and to link these changes with biographical events, thereby providing a basis for dividing the songs into style periods, there are, however, a number of caveats and issues that must be borne in mind for future studies using the analytical framework employed in this study. Firstly, while the EC dates of the songs at the beginning and end points of the centroid progression are likely to be accurate since they are based on biographical information and the EC dates for the manuscript and manuscript-group centroids are likely to be accurate due to the stylistic differences of the songs in each group cancelling each other out, songs with stylistic dates that are markedly later than the EC date of the centroid of the earliest manuscript in which they are found should be given the same EC date due to the manuscript effectively functioning as a *terminus ante quem* for that song. Secondly, as songs that are extremely short in length may have unusual positions in the MDS configuration due to their biased $ß_S$, $ß_C$ and $ß_T$ values, they should be examined closely and excluded from the analysis if they are unrepresentative. Thirdly, songs that are stylistic experiments may also occupy unusual positions in the MDS configuration, particularly if the experimental nature of the song is one that directly affects the dyadic and melodic variables. Here, the dyadic and melodic variables should be examined to clarify

the reasons why the song occupies its position in the configuration and, if the song is unrepresentative, it should be excluded from the analysis. Fourthly, while groups of songs composed over long time spans or from periods of rapid stylistic change in a composer's output will tend to occupy larger areas in the configuration than those composed over short time spans, external evidence should be adduced to decide between the longer-time-span or rapid-stylistic-change explanations for their larger areas. Finally, it should be noted that, when included in the data set on an individual basis, all of Kemp's (1990) anonymous Class I and Class II songs in *EscA* occupied positions in the *M-Ox2* and *M-EscA* regions of the central song cluster with no outliers. That is, they were all indistinguishable from Binchois's songs, a situation almost certainly due to Binchois and the anonymous composers in *EscA* sharing a common harmonic and melodic language that was in fashion at the Burgundian Court[27]. Therefore, while the only anonymous *EscA* songs examined here were those that were in Kemp's Class I category and included in the work list of songs in *Binchois Studies*, future researchers using the analytical framework employed in this study should not only screen the data set for problematic and misattributed songs, but also exercise caution in the initial selection of works and only include them in the analysis with good reason (e.g. on the basis of style, ascription, text etc.).

ENDNOTES

1. The value R^2 is the square of Pearson's correlation coefficient (R), which is an objective measure of how well the relationship between two variables can be described by a linear equation of the form y = ax + b. If the relationship is positive, R varies between 0 (no correlation) and 1 (perfect correlation).
2. This approach is similar to that taken by Kaye (1989: 41) who, while recognising the role of the *Gerüstsatz* — 'within any piece of the period there is a basic note-against-note consonant skeleton, which can be derived if the rhythmic and melodic ornamentation is cleared away' — also notes that 'whilst this type of reduction has its application in showing the substructure, it is the surface structure on which a piece's reputation for consonance or dissonance stands'. Here it should be noted that, as computational studies of music often run the risk of ending up with a complex set of data that is not amenable to interpretation or easy analysis, the analytical framework limits its focus to a carefully selected set of musical variables associated with the early fifteenth-century chanson rather than attempting to analyse every musical feature of the songs. Furthermore, while it might appear that the reductive nature of the analytical framework does not explicitly address finer details of the compositional process, such as the way composers of the period use techniques such as gestures, motives, rhythmic or melodic cells, non-imitative responses among the voices, etc., these factors are nonetheless included in the analysis as, due to their contribution to the surface structure of the music according to the individual predilections of each composer, they will result in specific distributions of (i) consonances and dissonances in the superius-tenor duet and (ii) conjunctness across the three voices, both of which are assessed by the dyadic-melodic analysis.
3. *B-Da1* can be found in Rehm (1957: 45–6). *B-Da2* is identical to *B-Da1*, but replaces the solus contratenor with Rehm's (1957: 73) contratenor primus. For details of the 3- and 4vv-versions of *B-Da*, see Fallows (1999: 137), Slavin (1992a: 37–40) and Strohm (1993: 193).
4. For *B-Amtbm*, see Kemp (1990: 60) and Slavin (1989: 133); for *B-Bv*, see Kemp (1990: 61) and Slavin (1989: 134–5); for *B-Dlc*, see Kemp (1990: 60) and Slavin (1989: 123–4); for *B-Jvs*, see Kemp (1990: 55–6) and Fallows (1987b: 132).
5. Apart from the four anonymous *EscA* songs, which were transcribed from Thomas McGary's (1973) edition of *EscA*, the songs were transcribed from Rehm's (1957) edition into notation software (ConcertWare, Great Wave Software) and any apparent oddities and transcription errors resolved by referring to the corrections given by Slavin (1988; 1992a) and a facsimile of *Ox* (Fallows: 1995). In addition, accidentals were only added when indicated by the manuscript in order to minimise editorial interference with the score (Beauvois: 2017, Technical Supplement: 6). While this procedure served to minimise the number of transcription errors in the data set of songs, some minor errors may still remain. However, these will have a minimal effect on the positions of the songs in the MDS configuration and, consequently, the overall results for two reasons: (i) the robustness of MDS as an analysis technique is such that, given a large number of data points (here 67 songs) relative to a small number of dimensions (here 2), it can uncover the underlying configuration even in the presence of substantial random error in the data and (ii) the pitfall that can occur of MDS adapting the configuration to this random error can be avoided by opting for an MDS solution with a low number of dimensions, as in the present analysis (Kruskal and Wish 1978: 77–8; Hout et al. 2018). After processing, the songs were converted into MIDI format and custom-written software used to carry out the dyadic analysis in Humdrum (www.humdrum.org) and the melodic analysis in MATLAB (www.mathworks.com).
6. The MDS analysis was carried out on the 11 dyadic-melodic variables using the PROXSCAL procedure in SPSS (www.spss.com). Here, the variables were standardised by converting them into z-scores and treating the z-scores as interval data. A dissimilarity matrix for the songs was then created and a metric Euclidean distance model, along with an initial simplex configuration, was specified for the MDS. The values of Stress-I (a badness-of-fit measure representing the difference between the mapped distances versus the original proximity matrix) were 0.469, 0.274, 0.172, 0.117 and 0.090 for the 1-, 2-, 3-, 4- and 5-dimensional solutions. Here, the improvement in fit as the number of dimensions increased from 1 to 2 and less so from 2 to 3 with the subsequent levelling-off from 3 upwards, indicated that the two-dimensional solution provided the best fit to the data due to a combination of a relatively low Stress-I value and its ease of interpretation (Kruskal and Wish 1978: 48–56).
7. The ProFit analysis, which was also carried out using SPSS, treated the song coordinates as the independent variables and the 11 standardised dyadic-melodic variables as the dependent variables. In Beauvois (2017: Technical Supplement: 7), an R^2 cutoff of 0.49 ($R < 0.7$) was used because a clear differentiation was expected between the two composers, as their markedly different style characteristics would result in different profiles for the musical variables being examined. This R^2 cutoff of 0.49 was taken from Rosenberg et al. (1968) who derived it from psychological-testing methodology where a correlation of $R = 0.7$ is considered an adequate measure of test-retest reliability as the R^2 value indicates that roughly half of the variability in the data has been accounted for. Here, however, a more relaxed R^2 cut-off of 0.333 ($R = 0.577$), which indicates

that a third of the variability in the data is accounted for, was used, as we would expect any differences that occurred to be less marked due to the works of only one composer being examined. This R^2 value not only resulted in a meaningful set of vectors, but also corresponded to a gap in the R^2 values between *K4* and $ß_T$ (see Table 2). Five variables were found to significantly increase in value over the configuration: *K5, K2,* $ß_C$*, K6* and *K4*. As the significant result for *K2* was an unusual finding, the ProFit analysis was repeated for the two dyadic sonorities that had been combined to form *K2, (k2* and *k9*, where the lower-case '*k*' indicates a raw, uncombined sonority) to see whether it was the proportion of seconds or ninths in the superius-tenor duet that significantly changed across the configuration. When the R^2 values were compared, it was found that R^2 (*K2*) = 0.648, R^2 (*k9*) = 0.603 and R^2 (*k2*) = 0.047. Here, the negligible R^2 value for *k2* and the comparable R^2 values for *K2* and k9 indicate that the significant result for *K2* is mainly due to a significant change occurring over the configuration in the proportion of ninths in the superius-tenor duet, rather than the proportion of seconds.

8. A preliminary examination of the final set of vectors found that the angle between *K6* and *K4* was 169° (equivalent to R = -0.98) and the angle between *K6* and *k9* was 177° (equivalent to R = -0.99), indicating that *K4* and *k9* are almost perfectly inversely correlated to *K6* and can therefore be combined into a single mean vector where *K6* increases and *K4* and *k9* decrease as one goes towards the *K6* end and *K6* decreases and *K4* and *k9* increase as one goes towards the *K4/k9* end.
9. Concerning the date of *EscB*, see also Southern (1969: 50–1) and Elmi (2019: 107).
10. The division of *Ox* into *M-Ox1* and *M-Ox2* is also supported by the seven-stage chronological order of fascicle rulings based on rastrum size for this manuscript (Fallows 1995: 13, Table 1). Here, both fascicles of *M-Ox1* are in stage 2 and, while fascicles IIIx, IIIz, IIy, IV and I of *M-Ox2* are spread across stages 5–7, fascicles X and IX (stages 3 and 4) create a chronological gap between *M-Ox1* and *M-Ox2*.
11. It should be noted that while this study offers no evidence to contradict the ascription of *B-Jnv* to Binchois in *Niv*, a more definitive answer to the attribution of this song would require the complete secular outputs of Binchois and Du Fay to be compared using the analytical framework, something that lies outside the scope of the present study but will form part of a future one.
12. Further support for this conclusion also appears when the procedure used to compare Grossin's songs with Binchois's in the section entitled **Discussion of the Authorship of *B-Lmm*** of the Appendix, including them in the data set on an individual basis, is used to compare Binchois's songs with the two other 3vv songs (*Alas, alas* and *Ave regina celorum*) attributed to Frye by Fallows (2014) and another 3vv work, perhaps a contrafactum of a rondeau (Kenney 1955: 193, 199), ascribed to him in the Schedel songbook (*Trinitatis dies*). When this is done, all three are found to have positions in the same region of the MDS configuration as *B-Tapm*: the bottom left-hand area of the configuration delineated by the *K6* and *K5* vectors (not shown). Here, the relative proximity of all four works attributed to Frye compared with the wide degree of separation of Grossin's songs in Fig. A1 of the Appendix suggests that all four are by the same composer and that the ascriptions of *B-Tapm* to Frye in *Lab* and *Mel* are correct.
13. The eight concordances, noted by Kemp (1966), are three Binchois songs and two others in fascicle V, two in fascicle VI and one in fascicle VIII. As Boone (1987: 113) has dated these fascicles to 1426, 1426–1427 and 1428–1429, respectively, a time span c.1426–1429 is indicated for *Pz*.
14. Songs used for centroid calculation = *B-Amem, B-As, B-Jla* (none excluded).
15. Songs used for centroid calculation = *B-Qvm, B-Sjs* (*B-Jt2* excluded).
16. Songs used for centroid calculation = *B-Aa, B-Amem, B-Jmr, B-Rmv* (none excluded).
17. Songs used for centroid calculation = *B-Ama, B-Jmr, B-Ldmd, B-Lmm* (*B-Sj* and *B-Slb* excluded).
18. Songs used for centroid calculation = *B-Bp, B-Ep, B-Jla, B-Lm* (none excluded). Stoessel (2017: 214) also notes that the completion date of 1411 in the colophon to the *Libellus or Flores musicae* music treatise at the end of this manuscript would suggest that *Stras* was compiled over a longer timespan than that proposed by Staehelin (1989).
19. Songs used for centroid calculation = *B-Aa, B-Ama, B-Amtbm, B-Ca, B-Da* (the mean position of *B-Da1* and *B-Da2*), *B-Ep* (*B-Amd* and *B-Mem* excluded).
20. Songs used for centroid calculation = *B-Aa, B-Da* (the mean position of *B-Da1* and *B-Da2*), *B-Ep, B-Es, B-Fam2, B-Jnf, B-Mcc, B-Mde, B-Mf, B-Pp, B-Se, B-Vtdr*. As Fig. 3 indicates that *B-Fam2* is clearly an outlier and that a case could be made for *B-Es* being an outlier too, two centroids were calculated for *R1411*, one excluding *B-Fam2* (*R1411a*) and the other excluding both *B-Fam2* and *B-Es* (*R1411b*).
21. It should be noted that none of these style periods are to be associated with period definitions such as Medieval or Renaissance and that no Medieval-Renaissance boundary is implied by Binchois's Transitional style period. Furthermore, no qualitative assessment of the songs is implied by the use of the words Early, Middle and Late to describe the style periods; they are used purely in a chronological sense. Finally, it should be noted that the boundaries between the style periods are porous with no abrupt changes in style, as shown by the gradual changes in the dyadic-melodic variables that occur over time and style period in Fig. 6 and the marked degree of overlap between the manuscript-group regions in the MDS configuration in Figs. 5 and 7.
22. Fallows (2000: 202) notes that, compared with the songs, 'the sacred music ... is infinitely more varied, in style, in notational techniques, in textures, in musical ideas. Against this backdrop, the restrained style of his chansons looks even more restrained and it is an urgent task to explain why that should be.' Kirkman and Slavin (2000a: 7) also note that 'the narrower [stylistic] approach [for the songs] must have been intentional.'
23. This figure is the mean of the transition points derived from (i) the ☾/○ percentages, which indicate the transition point between the two mensurations occurred between the *M-Reina* (1428) and *M-Ox2* (1435) centroids (i.e. 1432) and (ii) Fig. 5, which indicates the transition point between *M-Ox1* and *M-EscA* is close to the *M-Ox2* centroid near the song *B-Ad* (i.e. 1434).
24. Late manuscript-group and style period = *B-Hqp, B-Mcc, B-Md* and *B-Cfd, B-Jnv, B-Pp, B-Se*. The distance of the Late centroid along the centroid progression established by the linear fit to the *M-Ox1, M-Ox2, M-EscA* and *M-EscB* centroids is 1.389, which corresponds to an EC date of 1447.

25. Of the seven *M-Ox2* songs in ☾ that are either in or close to the *M-Ox1* region of the configuration, five are found in fascicles IIIz (*B-Am, B-Jp, B-Jtdd*) and IIy (*B-Aeq, B-Nvv*) of *Ox*, the exceptions being *B-My* and *B-Tp* (see Fallows 1995).

26. The following information concerning *Tr87* is taken from Wright (1982: especially 258, 262) and Wright (1989: especially 34–6, 41–2, 46–7, 372–3).

27. This common harmonic and melodic language may be a consequence of the use of compositional models, stock phrases and previously memorised melodic formulae in written composition (see Berger 2005: 127–30, 156–7; Canguilhem 2015: 155–6; Rossi 2005).

APPENDIX

Table A1. Column 1 = Binchois's songs ordered by song code (prefixed by *B-* throughout the main body of the text); column 2 = song title; column 3 = number in Rehm's (1957) edition; column 4 = mensuration of each song; column 5 = selected sources for each song, the first being the earliest according to Slavin's manuscript chronology; columns 6 and 7 = initial and final assignations to the chronological manuscript groups (prefixed by *M-* throughout the main body of the text); columns 8 and 9 = x–y coordinates in the MDS configuration; column 10 = remarks on each song (S = superius, T = tenor, C = contratenor)

1 Song code	2 Song	3 Rehm No.	4 Mens	5 Selected Sources	6 Initial MS-group	7 Final MS-group	8 MDS Dim1	9 MDS Dim2	10 Remarks
Aa	Adieu adieu	1	○	*Ox, EscA, St.Em, R1411*	*Ox2*	*Ox2*	-0.231	-0.433	*EscA* (scribe A)
Ad	Ay douloureux	9	○	*Ox*	*Ox2*	*Ox2*	0.111	-0.133	*Unicum*
Aeq	Amours et qu'as tu	7	☾	*Ox*	*Ox2*	*Ox2*	0.241	-0.819	*Unicum*
Aes	Amours et souvenir	8	○	*Ox*	*Ox2*	*Ox2*	0.313	0.422	*Unicum*
Aj	Adieu jusques	2	○	*EscA*	*EscA*	*EscA*	-0.360	-0.139	*EscA* (scribe A)
Am	Amours merchi	49	☾	*Ox*	*Ox2*	*Ox2*	0.610	-0.259	Ballade
Ama	Adieu mon amoureuse joye	48	○	*EscA, St.Em, Tr87*	*EscA*	*EscA*	-0.082	0.290	Ballade *EscA* (scribe A)
Amd	Adieu ma dulce	4	○	*St.Em*	—	—	0.475	0.599	*Unicum*
Amem	Adieu m'amour et ma maistresse	3	☾	*Ox*	*Ox1*	*Ox1*	0.463	-0.936	
Amt	Adieu mes tres belles amours	5	○	*EscA, St.Em, Stras, Tr92*	—	—	—	—	*EscA* (scribe A)
Amtbm	Adieu ma tresbelle maistresse	—	○	*EscA, St.Em, Tr92*	*EscA*	*EscA*	-0.411	0.471	*EscA* (scribe A)
As	Amoreux suy	6	☾	*Ox*	*Ox1*	*Ox1*	0.661	0.256	
Bp	Bien puist	10	○	*Stras*	—	—	-0.024	-0.042	*Unicum*
Bv	Bien viengnant ma tresredoubtee	—	○	*EscA*	*EscA*	*EscA*	0.000	0.135	*EscA* (scribe A)
Ca	C'est assez	11	○	*EscA, St.Em*	*EscA*	*EscA*	0.084	-0.174	*EscA* (scribe A)
Cfd	Comme femme desconfortee	56	○	*EscB, Mel*	*EscB*	*EscB*	-0.747	-0.073	Late song
Da1	Dueil angoisseux	50	⌽	*EscA*	*EscA*	*EscA*	-0.546	-0.641	Ballade *EscA* (scribe A) 3vv: S, T, solus C

Da2	Dueil angoisseux	50	⌽	*St.Em, Tr88, M902, EscB, R1411*	*EscA*	*EscA*	-0.522	-0.681	Ballade *EscA* (scribe A) 3vv: S, T, C primus
Dlc	Depuis le congié	—	○	*EscA*	*EscA*	*EscA*	-0.104	-0.225	*EscA* (scribe B)
Dpep	De plus en plus	12	⊂	*Ox, EscA*	*Ox2*	*Ox2*	-0.430	-0.105	*EscA* (scribe A)
Ep	Esclave puist yl	15	○	*EscA, St.Em, Stras, R1411*	*EscA*	*EscA*	-0.573	-0.225	*EscA* (scribe A)
Er	En regardant	13	⊂	*Ox*	*Ox2*	*Ox2*	-0.174	0.700	*Unicum*
Es	En sera il mieulx	14	○	*R1411*	*R1411*	—	0.166	0.545	*Unicum* Late song
Fam1	Filles a marier	55	○	*R1411*	*R1411*	—	0.408	1.403	*Unicum* 3vv: S1, S2, T
Fam2	Filles a marier	55	○	*R1411*	*R1411*	—	0.786	0.924	*Unicum* 3vv: S1, C, T
Fam3	Filles a marier	55	○	*R1411*	*R1411*	—	1.617	0.184	*Unicum* 3vv: S2, C, T
Hqp	Helas que poray je	16	○	*M902*	*M902*	*M902*	-0.285	0.265	*Unicum*
Jc	Je cuidoye	60	○	*EscA*	*EscA*	*EscA*	-0.597	0.081	*Unicum* *EscA* (scribe A)
Jla	Je loe amours	52	⊂	*Ox, Stras*	*Ox1*	*Ox1*	0.257	-0.036	Ballade
Jmr	Je me recommande	18	⊂	*Ox, Tr87*	*Ox1*	*Ox1*	0.840	-0.343	
Jnf	Je ne fai tousjours	19	○	*EscA, R1411*	*EscA*	*EscA*	-0.664	0.232	*EscA* (scribe B)
Jnp	Je ne pouroye	20	○	*Ox*	*Ox2*	*Ox2*	-0.417	0.276	*Unicum*
Jnv	Je ne vis oncques	57	○	*Niv*	*EscB*	*EscB*	-0.705	0.105	Late song
Jp	Joyeux penser	21	⊂	*Ox*	*Ox2*	*Ox2*	0.421	-0.046	*Unicum*
Jt1	Jamais tant 1	17	○	*Ox, EscA*	*Ox2*	*Ox2*	0.160	0.429	*EscA* (scribe A)
Jt2	Jamais tant 2	17a	⊂	*Reina*	*Reina*	—	-0.551	0.254	*Unicum*
Jtdd	J'ay tant de deul	51	⊂	*Ox*	*Ox2*	*Ox2*	0.696	0.306	*Unicum* Ballade
Jvs	Je vous salue	—	○	*EscA*	*EscA*	*Ox2*	0.292	0.359	*Unicum* *EscA* (scribe B)
Ldmd	L'amy de ma dame	23	⊂	*Tr87*	—	*Ox1*	0.789	-0.423	*Unicum*
Lm	La merchi	22	○	*EscA, Stras*	*EscA*	*EscA*	-0.339	0.169	*EscA* (scribe A)
Lmm	Liesse m'a mande	25	○	*Ox, BU, EscA, Tr87*	*Ox2*	*Ox2*	-0.027	0.630	*EscA* (scribe B)
Ltdj	Les tres doulx jeux	24	⊂	*Ox*	*Ox2*	*Ox2*	0.066	0.105	*Unicum*
M	Mesdisans	54	○	*Ox*	*Ox2*	*Ox2*	0.764	0.037	*Unicum* Ballade
Mcc	Mon cuer chante	29	○	*M902, R1411*	*M902*	*M902*	-0.227	-0.264	
Md	Ma dame que j'ayme	53	○	*M902*	*M902*	*M902*	-0.601	0.497	*Unicum* Ballade
Mde	Mon doulx espoir	30	○	*R1411*	*R1411*	—	-0.352	-0.287	*Unicum* Late song
Mem	Mort en merchy	32	○	*St.Em*	—	—	-1.030	-0.163	*Unicum*
Mf	Margarite fleur	27	○	*EscA, R1411*	*EscA*	*EscA*	-0.233	0.414	*EscA* (scribe A)
Ml	Ma leesse	26	○	*Ox*	*Ox2*	*Ox2*	0.098	0.266	*Unicum*

Ms	Mon seul et souverain desir	31	○	*Ox, EscA*	*Ox2*	*Ox2*	-0.258	0.084	*EscA* (scribe B)
My	Mes yeulx	28	☾	*Ox*	*Ox2*	*Ox2*	0.311	-0.177	*Unicum*
Nvv	Nous vous verens	33	☾	*Ox*	*Ox2*	—	0.715	-1.209	*Unicum*
Pdp	Plains de plours	34	○	*Ox, EscA*	*Ox2*	*Ox2*	0.095	-0.028	*EscA* (scribe B)
Pp	Pour prison	35	○	*EscB, R1411*	*EscB*	*EscB*	-0.455	-0.483	Late song
Qqd	Quoy que dangier	37	○	*Ox*	*Ox2*	*Ox2*	-0.142	0.040	*Unicum*
Qvm	Qui veut mesdire	36	☾	*Reina*	*Reina*	*Reina*	0.503	-0.424	*Unicum*
Rmv	Rendre me vieng	38	○	*Ox*	*Ox2*	*Ox2*	-0.592	-0.442	Acrostic: ROBIN HOQVEREL
Se	Seule esgaree	42	¢	*EscB, R1411*	*EscB*	*EscB*	-0.608	-0.324	Late song
Sj	Se j'eusse	40	○	*EscA, Tr87*	*EscA*	—	0.578	-0.740	*EscA* (scribe B)
Sjs	Se je souspire	39	○	*Reina*	*Reina*	*Reina*	0.284	-0.275	*Unicum*
Slb	Se la belle	41	○	*EscA, Tr87*	*EscA*	—	0.009	0.927	*EscA* (scribe B)
Tapm	Tout a par moy	58	○	*Niv*	*EscB*	—	-0.321	-0.034	Late song
Tmj	Toutes mes joyes	44	○	*Ox*	*Ox2*	*Ox2*	-0.111	0.111	*Unicum*
Tp	Tristre plaisir	45	☾	*Ox*	*Ox2*	*Ox2*	0.386	-0.629	*Unicum*
Tpa	Tant plus ayme	43	☾	*Ox*	*Ox1*	*Ox1*	0.012	-0.773	*Unicum*
Va	Vostre alee	46	○	*EscA*	*EscA*	*EscA*	-0.471	0.124	*EscA* (scribe B)
Vt	Va tost mon amoureux desir	59	○	*EscB*	*EscB*	—	0.337	0.109	
Vtdr	Vostre tres doulx regart	47	○	*EscA, R1411*	*EscA*	*EscA*	-0.193	0.236	*EscA* (scribe B)

Table A2. Manuscript sigla

1 Siglum	2 Manuscript
BU	Bologna, Biblioteca Universitaria, MS 2216
EscA	El Escorial, Real Monasterio de San Lorenzo del Escorial, Biblioteca y Archivo de Música, MS V.III.24
EscB	El Escorial, Real Monasterio de San Lorenzo del Escorial, Biblioteca y Archivo de Música, MS IV.a.24
Lab	Washington DC, Library of Congress, Music Division, MS M2.1.L25 Case ('Laborde Chansonnier')
Mel	New Haven, Yale University, Beinecke Rare Book and Manuscript Library, MS 91 ('Mellon Chansonnier')
M902	Munich, Bayerische Staatsbibliothek, MS Cod. gall. 902
MC	Montecassino, Biblioteca dell'Abbazia, MS 871
Niv	Paris, Bibliothèque Nationale de France, Département de Musique, Rés. Vmc 57 ('Nivelle de la Chaussée Chansonnier')
Ox	Oxford, Bodleian Library, MS Canonici Misc. 213
PC2	Paris, Bibliothèque Nationale de France, nouv. acq. fr. MS 4379, second layer, ff.43–60
PC3	Paris, Bibliothèque Nationale de France, nouv. acq. fr. MS 4379, third layer, ff.61–68
Pz	Paris, Bibliothèque Nationale de France, nouv. acq. fr. MS 4917
Q15	Bologna, Museo e Biblioteca Internazionale della Musica, MS Q15 (*olim* 37)
R1411	Rome, Vatican City, Biblioteca Apostolica Vaticana, MS Urb. lat. 1411
Reina	Paris, Bibliothèque Nationale de France, nouv. acq. fr. MS 6771, third layer, ff.89–119 ('Reina Codex')
St.Em	Munich, Bayerische Staatsbibliothek, MS Clm 14274 (*olim* Mus. MS 3232a) ('St.Emmeram Codex')
Stras	Strasbourg, *olim* Bibliothèque de la Ville, MS 222 C.22 (destroyed in 1870)
Tr87	Trento, Castello del Buonconsiglio, Monumenti e Collezioni Provinciali MS 1374 (*olim* 87)
Tr88	Trento, Castello del Buonconsiglio, Monumenti e Collezioni Provinciali MS 1375 (*olim* 88)
Tr92	Trento, Castello del Buonconsiglio, Monumenti e Collezioni Provinciali MS 1379 (*olim* 92)

Discussion of the Authorship of *B-Lmm*

This song is ascribed to Binchois in *Ox* over an erased ascription to Du Fay and to Grossin in *Tr87* by a different hand from the music. Slavin (1988: 164–8), in his study of Binchois's songs, made a case for Grossin's authorship, arguing that while it is 'not far removed from Binchois' musical style', his authorship is questionable, as three musical features of the superius voice, the first two of which prominently appear in Grossin's *Tres douchement*, are 'without counterpart' in and 'outside Binchois's usual practice'. These are (i) an ascending leap of a fourth between the first two notes, (ii) a rest that interrupts the cadence at the end of the first phrase and (iii) the cadential figure in the penultimate bar. Because these three features are uncharacteristic of Binchois's usual practice and the appearance of the first two in *B-Lmm* and Grossin's *Tres douchement* seems more than coincidental, Slavin (1988: 167–8) concluded that Grossin is more likely to be the composer of *B-Lmm* and that this song should be removed from Binchois's oeuvre. He noted, furthermore, that '[Grossin's] apparent willingness to experiment — witnessed to by the strong differences between the two attributed songs [*Tres douchement* and *Va t'ant souspier*] … is significant, for it might have allowed him to write in the very different style of [*B-Lmm*]' (Slavin 1988: 167). However, there is evidence to suggest that Slavin's attribution to Grossin may be incorrect.

- Firstly, as can be seen in Ex. A1, with respect to the three musical features highlighted by Slavin (1988: 164–8), while the first two appear at the beginning and end of the first phrases of *Tres douchement* (bb.1-2) and *B-Lmm* (bb.1–3), the second feature also appears at the end of the first phrase of *B-Sjs* (b.4).

- Secondly, with respect to the third musical feature, the cadential figure in the penultimate bar of *B-Lmm* is extremely similar to the cadential figure in the penultimate bar of *B-Sjs* (a similarity also noted by Kemp 1990: 14–16).

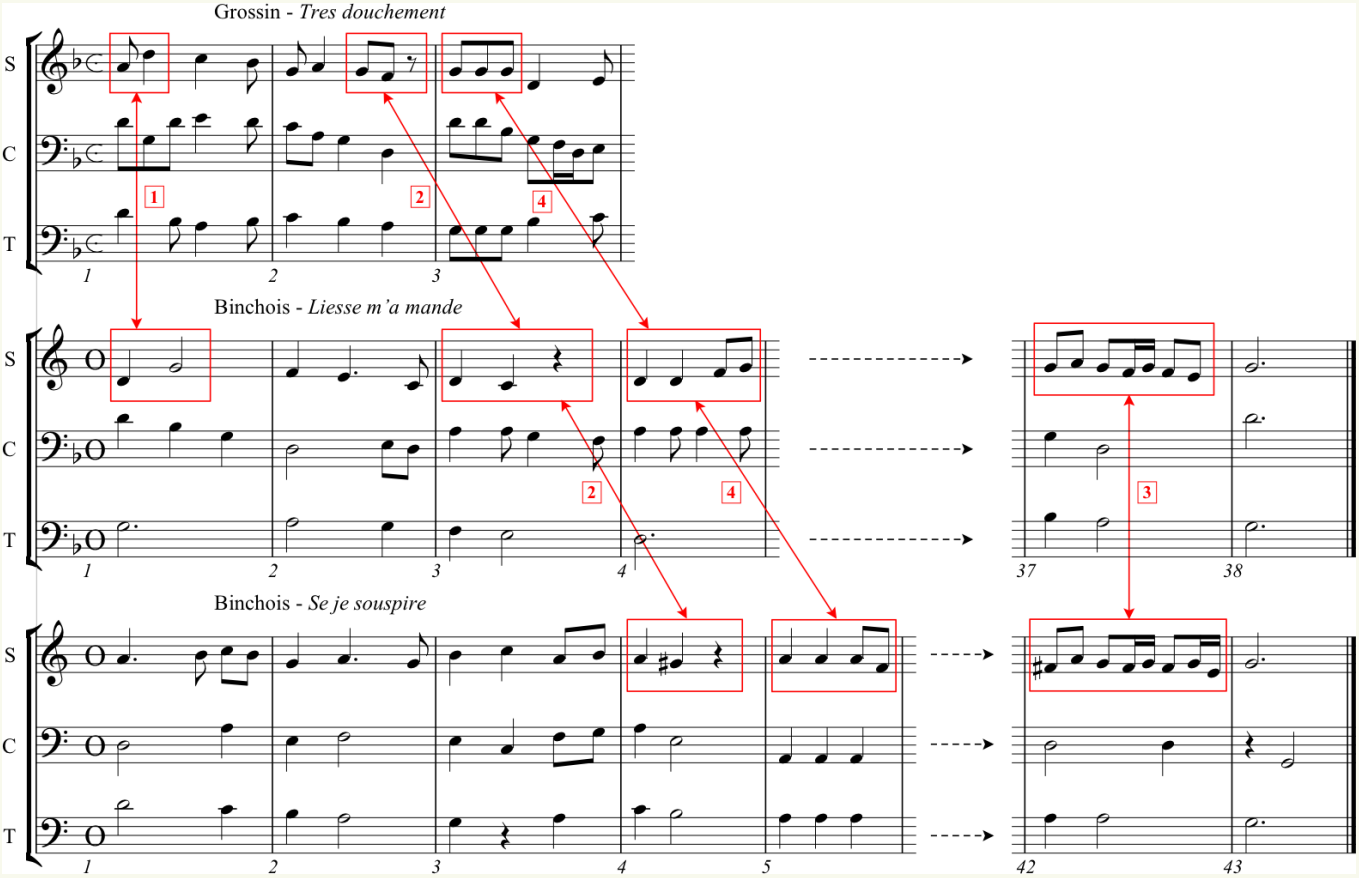
- Thirdly, all three songs have a fourth musical feature in common: their second phrases start with repeated pitches in all three voices (*Tres douchement*, b.3; *B-Lmm*, b.4; *B-Sjs*, b.5). Here, the exceptionally close correspondence between *B-Lmm* and *B-Sjs* due to their rhythmically-identical superius voices and the static sonorities formed by the repeated pitches in their contratenor and tenor voices, in conjunction with the presence of the second and third of Slavin's musical features in identical positions in both songs, strongly suggests that the three musical features *Tres douchement* has in common with *B-Lmm* were lifted by Grossin from the opening of *B-Lmm* and incorporated into the opening of *Tres douchement*.

- Fourthly, Slavin's (1988: 167) observation that Grossin's 'apparent willingness to experiment … [that] … might have allowed him to write in the very different style of [*B-Lmm*]' is matched by Binchois's own willingness to experiment, as shown by those songs that occupy unusual positions in the MDS configuration as a consequence of being stylistic experiments (see the discussion of *B-Sj* and *B-Slb* in the section entitled **Data Screening of Problematic Songs**). Here, the position of *B-Lmm* on the periphery of the central song cluster raises the possibility that it is another stylistic experiment and that its contrapuntal crudities and peculiarities such as those found on the downbeats of b.17 and b.29, the latter of which would suggest Grossin's authorship as it is also found in *Va t'ant souspier* (b.9), may have been a deliberate choice by Binchois. Alternatively, they may be due to the surviving copies of the song being made from erroneous exemplars (Slavin 1988: 168–71) or the song as we have it being an initial version that Binchois never revised, unlike *B-Jt2* which appears to be a preliminary or draft version of *B-Jt1* that he later revised to bring it in line with his current harmonic and melodic practice (see the section entitled **Data Screening of Problematic Songs**).

- Finally, when Grossin's *Tres douchement* and *Va t'ant souspier* are included in the data set on an individual basis, the MDS configuration shown in Fig. A1 results. Here, the position of *Va t'ant souspier* at the edge of the configuration at the low end of the $ß_C$ vector is almost certainly due to its extreme shortness in length, which, like *B-Nvv*, results in biased $ß_S$, $ß_C$ and $ß_T$ values and an unusual position in the configuration. However, while the wide degree of separation of *B-Lmm*, *Tres douchement* and *Va t'ant souspier* in the configuration might be the result of the very different styles of the three songs, one might have expected them to be closer to each other if they were by the same composer.

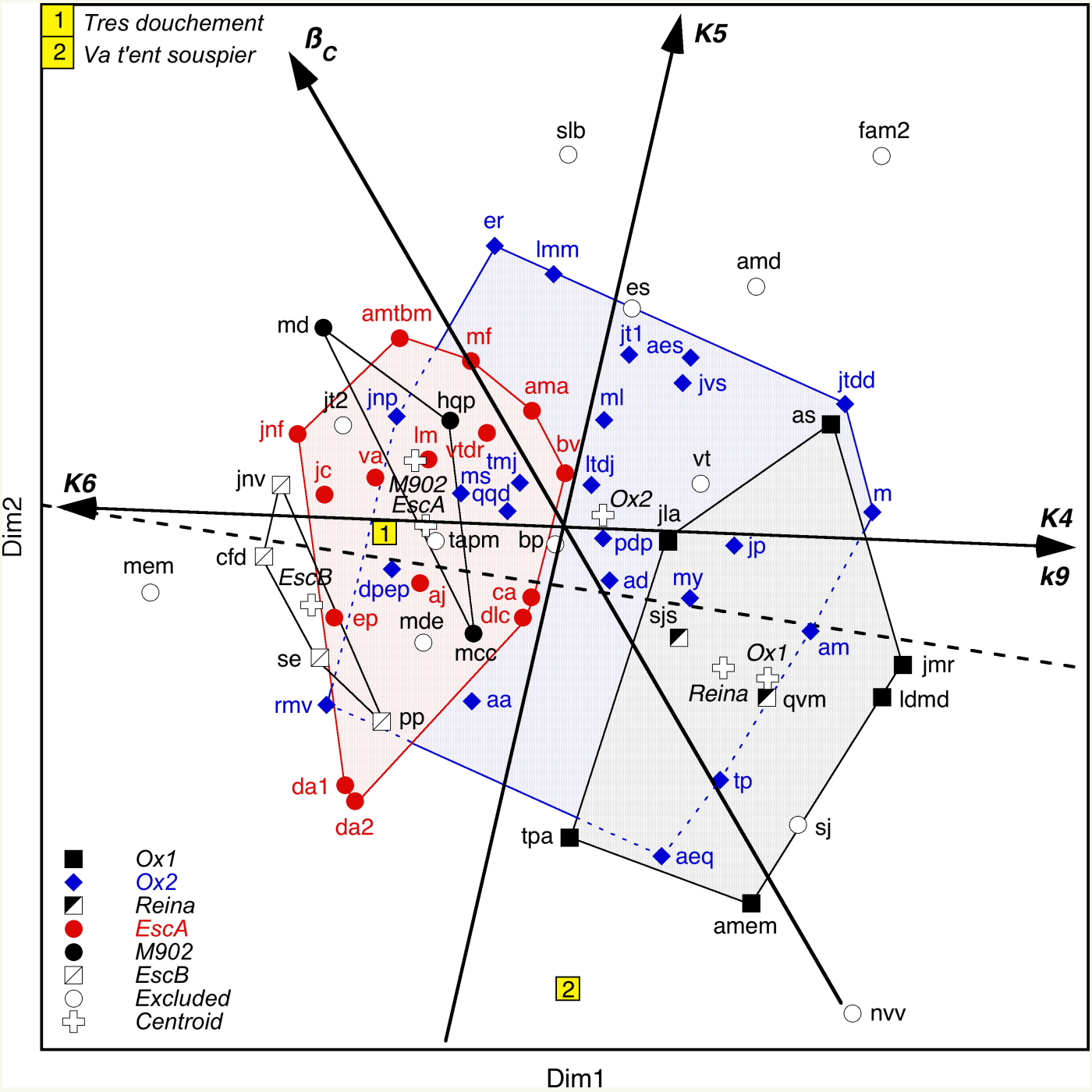
Therefore, given that (i) two of the three musical features Slavin (1988: 164–8) describes as 'without counterpart' in and 'outside Binchois's usual practice' appear in identical positions in *B-Lmm* and *B-Sjs*, (ii) the exceptionally close correspondence between *B-Lmm* and *B-Sjs* with respect to the fourth musical feature and the presence of two of Slavin's musical features in identical positions in both songs strongly

Example A1. The occurrence in Grossin's *Tres douchement*, *B-Lmm* and *B-Sjs* of three musical features described by Slavin (1988: 164–8) as 'without counterpart' in and 'outside Binchois's usual practice': an ascending leap of a fourth between the first two notes (1), a rest that interrupts the cadence at the end of the first phrase (2) and the cadential figure in the penultimate bar (3). Also highlighted is a fourth musical feature (4) that all three songs have in common. For clarity, bar numbers are below the staves and texts are omitted.



suggests that Grossin took the three musical features *Tres douchement* has in common with *B-Lmm* from Binchois, (iii) the contrapuntal crudities and peculiarities of *B-Lmm* can be accounted for by it being a stylistic experiment by Binchois or an initial version that he never revised and (iv) the wide degree of separation of *B-Lmm* from Grossin's other songs shown in Fig. A1 offers no support for his authorship, we can see that Slavin's case for Grossin's authorship of *B-Lmm* is not as watertight as might first appear. Consequently, as the evidence reviewed here not only weakens Slavin's case for Grossin's authorship, but also offers no evidence to contradict and, in fact, supports its ascription to Binchois in *Ox*, *B-Lmm* is provisionally assigned to Binchois and included in *M-Ox2* and its centroid calculation until further evidence appears to decide the issue.

Figure A1. Figure 3 redrawn to show the position of Grossin's songs (in yellow) when included in the data set on an individual basis



POSTSCRIPT

Se mesdisans, an *unicum* copied immediately before *B-Slb* in *Tr87* by Scribe B, has a number of characteristics that indicate Binchois as its composer. This can be seen in Ex. P1, which shows the occurrence of four common musical features (2, 4, 5 and 6) in *B-Lmm, B-Sjs* and *Se mesdisans*.

In all three songs, the cadence at the end of the first phrase is interrupted by a rest (2) and the second phrase starts with repeated pitches in all three voices (4). Moreover, in the latter feature, the superius voices of *B-Lmm* and *B-Sjs* are rhythmically identical, those of *B-Sjs* and *Se mesdisans* have identical pitches and all three songs have static sonorities formed by repeated pitches in their contratenor and tenor voices. Furthermore, a superius rhythm (5) identified by Kemp (1990, 30–2) as one of Binchois's stylistic characteristics (crotchet, dotted-crotchet, semiquaver) is not only found in b.2 of all three songs, but is also present in *Se mesdisans* to a far greater degree (30%) than in *B-Lmm* and *B-Sjs* (≤18.4%). In addition, the midpoint cadences of *B-Sjs* and *Se mesdisans* (bb.15–18 and 16–18, respectively) are extremely similar, both songs having almost identical figurations in their superius voices (6) in the lead-up to cadences on A using staggered fermatas where one voice comes to rest after the other two. Finally, not only is another of Binchois's stylistic characteristics (a triadic motive identified by Kemp (1990, 20–2) and discussed by Slavin (1988: 9, 160–1) that occurs in *B-Aa, B-Jt1, B-Jt2, B-Qqd* and *B-Va*) found in b.10 of the tenor voice of *Se mesdisans*, but also the superius rhythms of bb.1–3 of *B-Aa* that precede its two consecutive appearances in bb.4–6 of the same song are identical to bb.1–3 of *Se mesdisans* (not shown).

While these shared characteristics offer strong support for Binchois as the composer of *Se mesdisans*, it was also included in the data set on an individual basis, like the Grossin songs in the section entitled **Discussion of the Authorship of *B-Lmm*** of the Appendix, to see if its position in relation to the other *Tr87* songs was consistent with this attribution. Figure P1, which shows the resulting MDS configuration, indicates that it is found in the *M-EscA* region of the central song cluster to the left of another song in *Tr87*: *B-Ama*. Furthermore, like *B-Ama*, its distance along the centroid progression (1.405), which yields a stylistic date of 1448, places it in Binchois's Middle style period. These findings, along with the exceptionally close correspondence between the three songs shown above, form a marked contrast to the position of *B-Slb* outside the central song cluster and it being unlike Binchois's other songs in having the highest proportion of fifths in its superius-tenor duet and being the most conjunct song overall. Taken together, this evidence strongly suggests that the hypothesis advanced in the main body of the article that *B-Slb* is not by Binchois is correct and that either Scribe B or his exemplars erroneously placed the ascription in *Tr87* above it instead of the previous work copied in the manuscript: *Se mesdisans*. Furthermore, it also confirms that songs that are outliers or occupy unusual positions in the MDS configuration are anomalous works that are either incorrectly attributed or stylistic experiments that should be excluded from the analysis for being unrepresentative. However, in this instance, it should be noted that Binchois's non-authorship of *B-Slb* would have no effect on the other findings reported in this article as its outlier status resulted in its exclusion from the *M-EscA* group and the *M-EscA* and *Tr87* centroid calculations.

Finally, Binchois's possible authorship of *Se mesdisans* also has ramifications for the EC date of *Tr87*. It was established in the section entitled **Songs in *Tr87*** that Binchois's songs in this manuscript were copied in the order A1 – A2 – *B-Slb* – A3. However, it became apparent that if all the songs were included in the *Tr87* centroid calculation, the result would be skewed and a disparity occur between its EC and proposed dates as the A3 songs were far earlier than the other *Tr87* songs and *B-Sj* and *B-Slb* occupied unusual positions in the MDS configuration. This left only two songs for inclusion in the calculation: *B-Ama* and *B-Lmm*. Therefore, as the position of *Se mesdisans* in the MDS configuration makes it suitable for inclusion in the centroid calculation and increasing the number of songs will increase the probability of a more accurate result, the position of the *Tr87* centroid was recalculated on the basis of *B-Ama, B-Lmm* and *Se mesdisans*. Here, the distance along the centroid progression of the resulting *Tr87* centroid (1.252) yielded an EC date of 1445, a result later than the previous estimate of 1440, but one that still agrees with Wright's (1989: 106) conclusion that most of *Tr87* was copied c.1433–1445 and also with the watermark dates c.1433–1442 established by Saunders (1984: Vol. 1, 56 and Vol. 2, 164, 166, 169) for the six pages on which the Binchois songs are copied.

Example P1. Example A1 from the Appendix redrawn to show the occurrence in *B-Lmm, B-Sjs* and *Se mesdisans* of four common musical features (see text). For clarity, bar numbers are below the staves and texts are omitted.

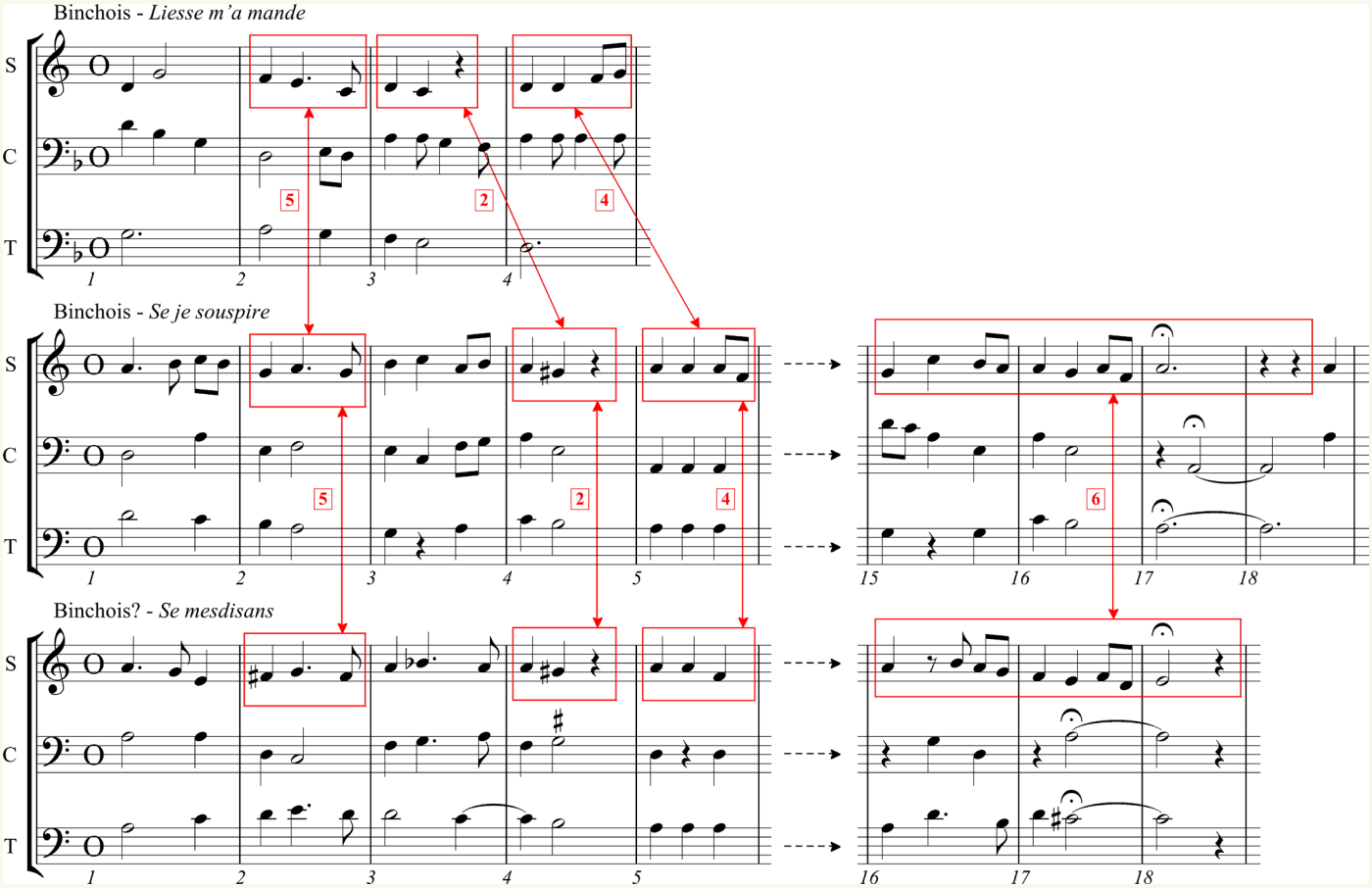
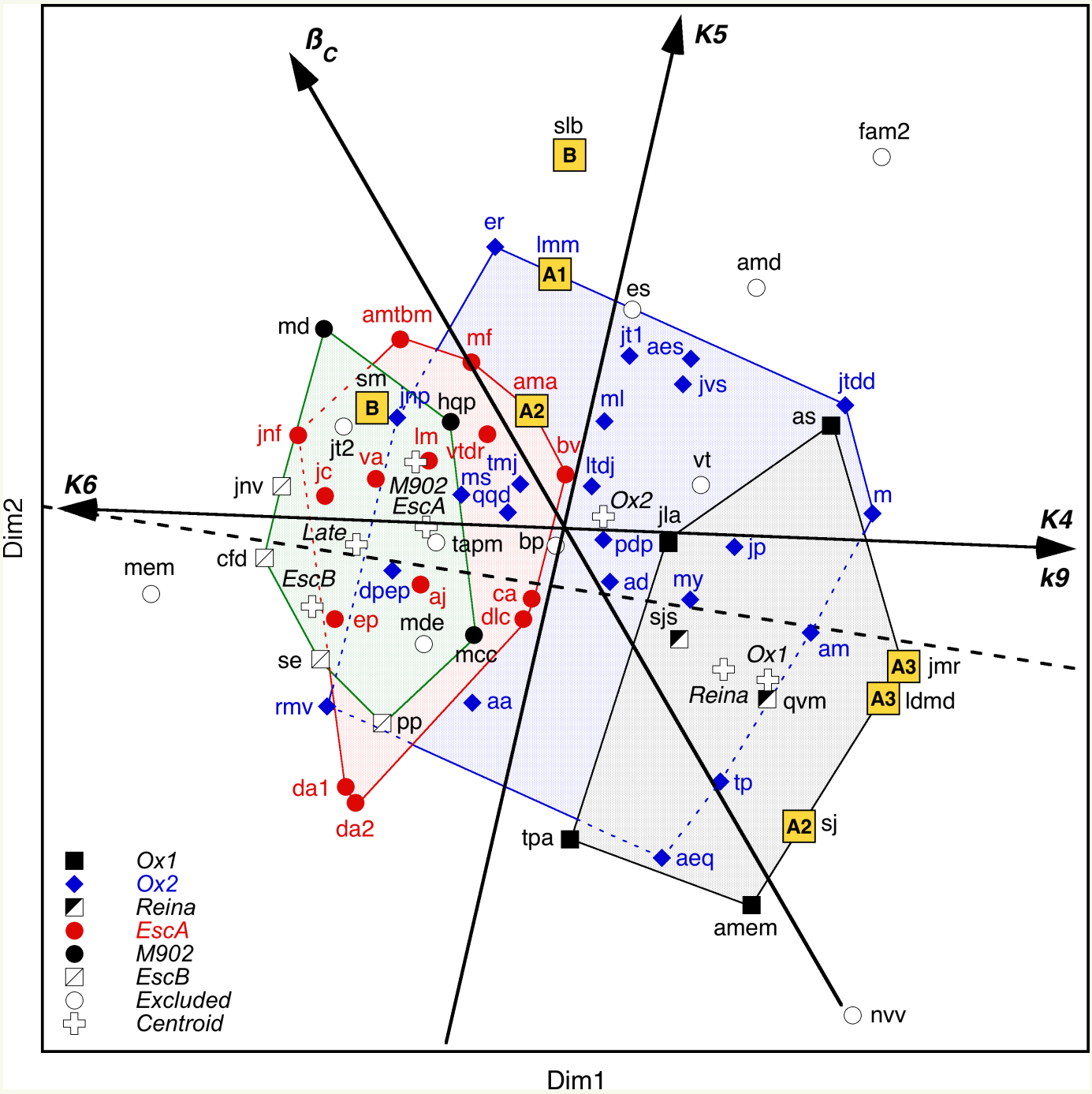


Figure P1. Figure 9 redrawn to show the batches of songs copied by scribes A and B in *Tr87* and the position of *Se mesdisans* (sm) when included in the data set on an individual basis



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ABSTRACT

An analysis of the chansons of Gilles Binchois used the graphical multivariate statistical technique of multidimensional scaling to quantitatively evaluate a carefully selected set of musical variables associated with the early fifteenth-century chanson repertory. The variables used in the analysis acknowledged that the superius and tenor voices of an early fifteenth-century chanson create a self-sufficient duet that forms the contrapuntal and harmonic core of the work and that this two-part contrapuntal framework (the *Gerüstsatz*) is enriched by a subordinate contratenor voice that makes an essential contribution to the overall musical texture. The findings indicated that this analytical framework was able to (i) resolve conflicting manuscript ascriptions, discover incorrect ones, and verify scholarly attributions of songs to Binchois, (ii) divide his complete secular output into four style periods approximately 8 to 10 years in length, (iii) date individual songs and manuscripts to within an accuracy of approximately plus or minus two years by mapping biographical data onto the results, and (iv) confirm and clarify the findings of previous manuscript studies. The internal consistency of the findings and their remarkable degree of agreement with the musicological literature strongly suggests that they could be used as a basis for future research and that the analytical framework could be applied to other repertories or composers whose works utilise a similar two-part contrapuntal core.

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Keywords. Gilles Binchois, statistics, multidimensional scaling, chanson, Medieval, Renaissance, *Gerüstsatz*

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