Bach PitchTrak Program with Installation Instructions

Designed by Andy Reinke, the PitchTrak program was used to study pitch variety in the vocal lines of Bach's sacred cantata recitatives.

Introduction

　　　　To study pitch variety (especially chromatic completion) in Bach's sacred cantata recitatives, Melvin Unger and assistant Taylor Giacoma tabulated some 90,000 pitches in the vocal lines, identifying initial span lengths in which all twelve chromatic tones appear and deviations from equal pitch distribution, while also identifying recitative lengths, opening and closing keys, vocal instrumentation, chronological order numbers, and literary subjects. Results appeared in "Uncovering Text-Music Connections with a Relational Database: Towards an Objective Measurement of Pitch Diversity in Relation to Literary Themes in Bach's Church Cantata Recitatives" *Computers and the Humanities* 38/3 (August 2004): 271–97.

　　　　Our empirical approach to uncovering the connections between pitch diversity and Bach's textual themes required that all individual pitches be recorded, and the resulting pitch sets cross-referenced with generic text themes. To accomplish this enormous task, we commissioned the design of computer software,[1] which allowed pertinent information to be recorded and a number of quantitative operations to be carried out. The following data were recorded:[2]

　　　　• basic information about the recitative: movement identification, length in measures, opening and closing keys, scoring information (voice type, presence or absence of accompaniment), chronological position in Bach's sacred cantata output, date the work was composed or first performed,
　　　　• theological/literary themes including summaries found in Melvin Unger's *Handbook to Bach's Sacred Cantata Texts*,[1]
　　　　• general observations,
　　　　• pitches of the vocal part,
　　　　• number of measures in which the entire set of twelve pitch classes appeared (if at all).

Calculations for each recitative included the following:

　　　　• frequency of appearance of each notated pitch (without regard to register but preserving enharmonic differentiations), expressed as a percentage,
　　　　• pitch class distribution (expressed as a percentage of each pitch class present in the recitative),[2]
　　　　• total number of sharped notes and of flatted notes (inclusive of those signified by the key signature),[3]
　　　　• pitch diversity expressed as the average deviation from 8.3% (if all 12 pitch classes are represented equally, they each constitute 8.3% of the whole).[4]

---

[1]Thanks to Andy Reinke, who developed the software using Visual Basic.
[2]Microsoft Access.
[1]Melvin P. Unger, *Handbook to Bach's Sacred Cantata Texts, an Interlinear Translation with Reference Guide to Biblical Quotations and Allusions* (Lanham, Md: Scarecrow Press, 1996).
[2]Of course, all twelve pitch classes are not necessarily represented in every recitative.
[3]Counting sharped and flatted notes within a particular recitative without relation to key obviously tells one nothing about chromatic inflection (i.e., notes extraneous to the key) since most keys have sharped or flatted notes as part of their basic series. Furthermore, since recitatives often migrate from key to key, deciding which key should be used as the tonal point of reference at any given moment in a recitative is problematic. Rather, the significance of our totals is that they provide information useful for future inquiries about Bach's possible symbolic intention in using sharps or flats. For example, as numerous writers have suggested, Bach may have intentionally used sharps to denote suffering or "cross-bearing," since the German word for sharp (*Kreuz*) also means "cross."
[4]Average deviation scores can theoretically range from 0 (if all twelve pitch classes are each represented 8.3% of the time) to 15.25 (if a recitative had no pitch diversity at all: i.e., if it consisted of a single repeated pitch class). Of course the latter case is entirely hypothetical: one pitch class would appear 100% of the time (a deviation of from 8.3 of 91.7), the others 0% (a deviation of from 8.3 of 8.3). The calculation for average deviation would then be: $((8.3 \times 11) + 91.7) \div 12 = 15.25$.

Because the software developed for our study was capable of tracking not only the 90,000 pitches constituting the vocal lines of Bach's recitatives but also other attributes of these movements (as listed above), we entered more information than our immediate investigation required, recognizing that the resulting database could form the basis of several subsequent studies.[5] Furthermore, while the software was designed primarily to record hard data, it also included a field where we could enter observations regarding unusual structures or elements: bass pedals, alternation among voice types (S-A-T-B), intermingling of chorale and recitative sections, arioso segments, bass lines with infrequent notes, obvious scriptural quotations or allusions, and rhetorical figures (e.g., trembling figures). We took the cantatas in chronological order (as opposed to their catalog [*BWV*] order) so that we could incidentally observe any developmental trends. That Bach *did* change at least one aspect of his approach to recitative composition is documented in Robert Marshall's study.[6] However, our focus remained on answering the following empirically verifiable questions:

1) Did pitch diversity change with time?
2) In how many measures does a complete set of (all twelve) pitch classes occur? Are there any discernible patterns with regard to complete pitch sets and their textual settings?
3) What text themes appear most often and in what proportion?
4) Are there demonstrable relationships between text themes and pitch diversity?

Installing the Bach PitchTrak program:

-Move the zipped installation file into a temporary directory.
-Unzip (extract files).
-Click on setup.exe and follow through, answering queries about directories, etc.
-You will get an error message: "An error occurred while registering C:\Windows\System\msado15.tlb." Ignore it; it has something to do with making the installation procedure compatible with both Windows 98 and XP.
-Go to the Bach folder in Program Files and replace both the mdb file (Access database file has icon with purple key) and the Pitchtrak program itself (has icon with three little notes) with the newer version from the BACH PITCHTRAK folder.
-Pitches can be entered into the Access database by typing letters with the left hand and symbols for sharps and flats with the right hand (using the number pad): the slash on the number pad for flat(s) and the asterisk on the number pad for sharp(s).

---

[5]The program does *not* identify which pitches were stressed (presumably for rhetorical purposes) agogically or melodically. However it does have the potential to answer other questions regarding the relationships among pitch diversity, keys, number of sharped or flatted notes, chronology, voice types, accompaniment (accompanied vs. secco), and subject matter.
[6]After describing Bach's Leipzig practice of writing the text out in its entirety before beginning to compose the music (see quotations provided above) Marshall writes, "In the pre-Leipzig recitatives the music was usually written down before the words. (Marshall, *Compositional Process*, 1:92.) With regard to accompaniments Marshall notes, "Accompagnato [i.e., accompanying] parts were not composed until the vocal and continuo parts were already worked out. . . . The accompagnato parts themselves were filled in from top to bottom . . . . The autograph scores of the recitatives reveal, finally, that Bach often thought of the accompanying instruments and hence the basic harmonic rhythm as proceeding essentially in half-note values and consequently composed these parts one half-measure at a time." (Marshall, *Compositional Process*, vol 1, pp. 94–95.)