EXPRESSIVE INTONATION AS RHETORIC IN THE PERFORMANCE PRACTICE OF INSTRUMENTAL ENSEMBLE MUSIC IN LONDON (1650 -1720)

by

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DISSERTATION ABSTRACT

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Descartes' *Compendium musicae* and Lamy's *La Rhétorique ou l'art de parler,* both published in English translation in London in the late seventeenth century, suggest approaches to period performance practice that support expressive intonation as a rhetorical device. Descartes' unique perspective on musical pitch and intervals provides a methodology for understanding inflected intonation in performance. Closely aligned with Descartes' epistemological perspective, Lamy's treatise provides an understanding of expressive intention as essential to effective rhetorical delivery. These approaches are applied to musical examples from trio sonatas of Arcangelo Corelli, John Ravenscroft and Henry Purcell, demonstrating that expressive intonation using subtle pitch inflection can be explained as a rhetorical practice. These subtle pitch inflections, related as they are to both rhetorical delivery and intonation systems, are not reflected in notation but realized only as music is heard in time. It is in performance contexts that pitch inflection can be realized as an expressive device. A supplemental audio file contains five short examples demonstrating pitch deviation applied to selected intervals.

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CHAPTER I

INTRODUCTION

> Musick in the Practice, hath been well pursued, and in good Variety; but in the Theory, and especially in the yielding of the Causes of the Practick, very weakly; being reduced into certain Mystical subtilties, and not much truth.[1]
>
> Francis Bacon, *Sylva sylvarum*, 1627

Cultural Context: Intonation at the Intersection of Science and Music

Even though he did not carry out any experiments about music, the "father" of experimental science Francis Bacon here gives voice to the English sympathy for an empirical approach to theories about music. Bacon's *Novum organum* (1620) signaled not only a new epistemology, but also an enthusiasm for rethinking questions that were at least two millennia old. Here in the *Sylva sylvarum* he cites the breakdown of the musical-cosmological assumptions of *musica mundana* and suggests that English natural philosophers focus on the nature of sound and sound production.[2] The majority of the seventeenth-century English music theorists were concerned with practical music, the rudiments of rhythm, pitch, and rules of composition, but not with the study of acoustics or intonation.[3] Those questions were the domain of the natural philosophers and

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[1] Francis Bacon, *Sylva sylvarum: or, a natural history in ten centuries; includes: History natural and experimental of life and death: or, of the prolongation of life (1669). Articles of enquiry, touching metals and minerals (1669). New Atlantis: a work unfinished***,** 1670 in the Max Planck Institute for the History of Science Digital Rare Book Library, http://echo.mpiwg berlin.mpg.de/ECHOdocuViewfull?mode=imagepath&url=/mpiwg/online/permanent/library/WX8HY2V2/pageimg&pn=63 (accessed May 24, 2011), 29.

[2] Andrea Luppi and Elizabeth Roche. "The Role of Music in Francis Bacon's Thought: A Survey," *International Review of the Aesthetics and Sociology of Music* 24 (December 1993): 100.

[3] The emphasis on *musica practica* in English theory is demonstrated in Rebecca Herissone's survey of music treatises written in England between the 1580s and the late 1720s. Over two-thirds were intended for the musical amateur and the rest for the student instrumentalist. Rebecca Herissone, *Music Theory in Seventeenth-Century England* (Oxford: Oxford University Press, 2000), 6-7.

mathematicians such as Simon Stevin, Christiaan Huygens and Marin Mersenne. Bacon's call for a new science based on the authority of experience was played out later in the century by the activities of the Royal Society, founded in 1660. The Society's motto "*nullius in verba*" was a codification of the new approach, a reliance on the authority of experience. The motto "on the word of no one" was a rejection of what Bacon called "mystical subtilties" that had dominated music theory for centuries. Many of the papers presented during the initial years of the Royal Society addressed musical topics, with one of their main concerns the problems with intonation and temperament. [4]

It is on the issues of intonation and temperament that the history of science and the history of music in England converge, a convergence that has suggested approaches that can be related to performance practice. As speculative theorists writing in the last half of the seventeenth century and the beginning of the eighteenth were describing intonation in precise mathematical terms, the practitioners of music were exploring stylistic changes. In England there was great enthusiasm for music in the Italian style, and for instrumental ensembles the trio sonatas of Corelli provided the model. Henry Purcell was referring to Corelli in his address "To the Reader" from the 1683 *Sonatas of Three Parts*:

> Instead of elaborate harangue on the beauty and the charms of Musick (which after all the learned Encomioms that words can contrive) comment itself best by the performances of a skilful hand, and an angelical voice: I shall say but a very few things by way of Preface, concerning the following Book, and its Author: for its

[4] Some publications by members of the Royal Society include the *Animadversions* appended to the English translation of Descartes' *Compendium musicae* (1653) by William Brouncker, first president of the Society; "An Account of Divers Particulars, Remarkable in my Book in which I will write of Music Philosophically, Mathematically and Practically" in the Royal Society Classified Papers 22 (1676) by John Birchensha; *A Philosophical Essay of Music Directed to a Friend* (1677) by Francis North; *A Proposal to Perform Musick in Perfect and Mathematical Proportions* (1688) by Thomas Salmon; *A Treatise on the Natural Grounds and Principles of Harmony* (1694) by William Holder; an entry in the Society's *Philosophical Transactions* 20 (1698) pages 249-256 showing his mathematical basis for tuning. These publications are discussed in Wardhaugh's examination of the sources for mathematical or mechanical study of music in England in the second half of the seventeenth century. Benjamin Wardhaugh, *Music, Experiment and Mathematics in England, 1653-1705*. Farnham, Surry: Ashgate Publishing Limited, 2008.

> Author, he has faithfully endeavour'd a just imitation of the most fam'd Italian Masters; principally, to bring that seriousness and gravity of that sort of Music into vogue...[5]

John Ravenscroft, not as well known nor as admired as Purcell, but representative of English amateur composers, referred to himself on the manuscript copy of his Op. 1 sonatas (1695) as "Inglese allievo d'Arcangelo Corelli."[6] Corelli's violin music, especially his trio sonatas, emulated by both the professional and the amateur in England such as Purcell and Ravenscroft, provide examples of music commonly heard by those natural philosophers of the Royal Society. Works by these three composers can serve as case studies for the application of scientific theory to contemporary practice. In fact, it was a trio sonata of this type that was the test case for Thomas Salmon's 1705 presentation for the Royal Society.[7] Salmon was trying to show how different sizes of major and minor seconds, derived from a mathematically precise theory of tuning, could be used to achieve pure harmonies. The report does not reveal anything about the success of his experiment, but it is clear that he was working with ways to keep most of the diatonic intervals pure and allow some dissonance for chromatic pitches. This represents not just a theory about the division of the octave, but also assumes a new perspective on dissonance.[8] These two elements, basic triadic harmony and the use of dissonance,

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[5] Peter Walls, "The Influence of the Italian violin school in 17th-century England," *Early Music* 18, no. 4 (November 1990): 575-587.

[6] Peter Allsop, "Ravenscroft, John (i)." In *Grove Music Online. Oxford Music Online,* http://www.oxfordmusiconline.com/subscriber/article/grove/music/22964 (accessed June 12, 2010).

[7] The details of Salmon's experiment are noted in Chapter Six. Of particular interest for the history of the relationships between music theory and musical performance is that there actually was an occasion in the seventeenth century where the judgment of the audience of Royal Society members was considered as an arbiter for a theory of tuning.

[8] Whether dissonance is defined according to usage or according to its disposition as an interval is the critical point here. With the harmonically driven music of this period, dissonance refers to the quality of a note, deriving its label according to its pitch distance from the triad. Figured bass treatises (e.g. by Morley

characterize the musical style of the late seventeenth and early eighteenth centuries. Music historians credit Corelli and his imitators with standardizing musical forms whose syntax was driven by functional harmony.[9] Francesco Gasparini, writing in 1708, suggested that it is the proper handling of dissonance that accounts for Corelli's eloquence, the "perfection of ravishing harmony."[10]

The relationship between stylistic changes in music and the developments in early modern science is complicated, not only because the science of music deals with a

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or Gasparini) emphasize the need to resolve dissonances to their consonant triads. For a history of the concept of dissonance and consonance, see James Tenney, *A History of 'Consonance' and 'Dissonance'* (New York: Excelsior Music Publishing Co. 1988) and for a survey of the inconsistent use of these terms in English music theories see Herissone, 114-120. Consonance and dissonance described mathematically, mechanically and acoustically was a concern of the natural philosophers of the seventeenth century, too. For a thorough discussion of the problem of consonance as viewed by the scientific community in the seventeenth century see H. Floris Cohen, *Quantifying Music: The Science of Music at the First Stage of the Scientific Revolution, 1580-1650* (Dordrecht: D. Reidel, 1984).

[9] Many music history texts used in American universities cite Corelli's sonatas as signaling the move from modal to tonal harmony in the years before and after the turn of the century. Not only were Corelli's sonatas expressive, they also represented a high point in the popularity of instrumental chamber music. *A History of Western Music* provides typical comments: "The trio and solo sonatas of Arcangelo Corelli (1653-1713) represent the crowning achievement in Italian chamber music of the late seventeenth century," and "His solo sonatas and concertos served as models that composers followed for the next half century." J. Peter Burkholder, Donald Jay Grout and Claude V. Palisca, *A History of Western Music* (New York: W. W. Norton, 2006), 393, 397. John Walter Hill in his more recent text notes that Corelli's trio sonatas were not only the most frequently published but also represented a normalization of harmonic practice. By merging modal melodic traditions with harmonic progressions based on circle of fifths chordal progression, he created a sense of movement through functional harmony. Hill emphasizes Corelli's skill in using compositional patterns already in use, but recasting them into musical segments that seemed to naturally culminate in a cadence. John Walter Hill, *Baroque Music: Music in Western Europe, 1580-1750* (New York: W. W. Norton, 2005), 328-343. Richard Taruskin cites Corelli as " 'the original classic,' playing a major role in standardizing genres and practices, and setting instrumental music on an epoch-making path of ascendency." Using his favorite instrumental combination of chamber music for strings, Corelli used the circle of fifths as a device to "drive a dynamically unfolding form-generating process." Taruskin continues: "It is certainly no accident, moreover, that 'tonality' as a fully elaborated system emerged first in the context of instrumental music. Instrumental music stood in far greater need of a potent tonal unifier like the circle of fifths than did vocal music, which can easily take its shape from its text as from any internal process." Richard Taruskin, *The Seventeenth and Eighteenth Centuries*, vol. 2 of *The Oxford History of Western Music* (Oxford: Oxford University Press, 2005), 177, 187-188.

[10] "This practice, followed by the better modern composers, is found particularly in the very charming *sinfonie* of Arcangelo Corelli…who, with so much artfulness, study and grace, moves and makes harmonies with those basses of his, with suspensions and dissonances so well regulated and resolved and so well interwoven with a variety of subjects, that it may well be said that he has discovered the perfection of ravishing harmony." Francesco Gasparini, *The Practical Harmonist at the Harpsichord*, trans. Frank S. Stillings (New Haven: Yale School of Music, 1963): 62.

changing subject, but also because in each of their histories dramatic changes seemed to occur at about the same time. The intersection of these histories provides a place from which one can discern contemporary understanding of intonation and temperament and form guidelines for performance practice. This is not to imply that the science of music can or should instruct performance issues, but only that the concerns of theorists of this time (e.g. revision of the division of the octave, reclassification of consonances and dissonances) had implications for the practice of music (e.g. limitations of tuning systems, modulations, incompatibility of various instruments in ensembles). This is also not to imply that the performance of music should instruct the science of music, although some have argued that the meeting of theory and practice in music has many factors in common with seventeenth-century science.[11]

For the mathematical musician interested in tuning in England the three most widely consulted authors were Marin Mersenne, Athanasius Kircher and René Descartes. Some of Mersenne's claims from the *Harmonicorum libri* and his *Harmonie universelle* (1636) were demonstrated for the Royal Society in the 1660s, and elements of his works surfaced in works of William Holder, John Pell, and Francis North. Kircher's *Musurgia universalis* (1650) was influential in the experiments of Robert Boyle and John

[11] While the relationship is close, it is neither causal nor originating from a common source. Some scholars suggest that music theorists such as Benedetti and Vincenzo Galilei served as models for the experimental attitude of the early Scientific Revolution. For more on this theory see Stillman Drake, "Renaissance Music and Experimental Science," *Journal of the History of Ideas* 31, no. 4 (Oct-Dec1970): 483. http://www.jstor.org/stable/2708256 (accessed October 14, 2008). H. Floris Cohen refutes Claude Palisca's claim that the empiricism that influenced both science and music came from a common 'humanistic ferment.' Cohen shows that the humanist movement is basically anti-scientific, that changes in the science of music did not result from increased empiricism, but from a new way of framing the data, and that stylistic changes came well before theories changed. Cohen, *Quantifying Music,* 253.

Birchensha, two of the Royal Society's most famous members.[12] The document that was continually cited throughout the century and shed the most practical understanding about intonation was the *Compendium musicae* by Descartes. Written in 1618 and published posthumously in 1650, the *Compendium* addresses issues of intonation from both a practical and a theoretical point of view. It was influential for the first members of the Royal Society and is foundational in Rameau's concept of chord inversions.[13] Only sixty pages long, it had been translated into English, French and Dutch. Benjamin Wardhaugh, in his 2008 study of texts written by mathematicians and natural philosophers between 1653 and 1705, calls it "the most important single point of reference for mathematical music theorists in the half century after its publication."[14] Mathematicians would have been interested in it because it presents such a clear demonstration of the continuous pitch spectrum, an element that could be demonstrated only by using logarithmic calculation. Practical musicians would have been interested because it describes the process of choosing pitch in performance, and could help explain why some choices are good and others are not acceptable.

Descartes' *Compendium* is not well known among scholars today and is practically invisible to musicians. The most recent English translation was published in 1961, and the most recent French translation in 1987. The *Compendium* is included in the

[12] Wardhaugh surveys the relevant material for the mathematical study of music available to a scholar in seventeenth-century England in chapter one "From Pythagoras to Kircher." An underlying theme throughout is the desire of theorists to reconcile ancient theories of intonation with modern musical practice, and to find mathematically elegant solutions to the problem of temperament. Wardhaugh, *Music, Experiment and Mathematics,* 5-27.

[13] Rameau had read the 1688 French translation by Poisson and took the concept of higher sounds being contained in lower ones. This formed one component of his *sons fondamental* theory. Thomas S. Christensen, *Rameau and Musical Thought in the Enlightenment* (Cambridge: Cambridge University Press, 1993), 90.

[14] Wardhaugh, *Music, Experiment and Mathematics*, 22.

1904 *Oeuvres de Descartes*, but not in the English language *Philosophical Writings of Descartes* (1984).[15] Because it is not concerned with music's meaning or value, his *Compendium* is rarely cited in philosophical writings on aesthetics.[16] Even though Descartes presents in it his recognition of the mental processes concerned with perception and performance of musical intervals, the *Compendium* has been generally ignored by researchers in cognitive science and psychology of music.[17] The *Compendium* does play a role in a cultural study of the senses by musicologist Kate van Orden. Her phenomenological interpretation of the *Compendium* emphasizes Descartes' epistemological position and his explanations of perception in terms of mechanical action. He begins his study of music with a focus on the essence of sound, not on theoretical aspects of ratio or proportion. When describing the nature of sound in his opening remarks Descartes acknowledges the actual physical sensation we feel when

[15] The *Compendium musicae* (a transcription of the Utrecht 1650 print) is included in volume ten of the 1904 authoritative *Oeuvres de Descartes* edited by Charles Adams and Paul Tannery, rev. ed. (Paris: J. Vrin, 1996), but not in the 1984 collection *The Philosophical Writings of Descartes* edited by John Cottingham, Robert Stoothoff and Dugald Murdoch (Cambridge: Cambridge University Press, 1984). A recent edition in French prepared by Frédéric de Buzon includes an account of the transmission of the text. René Descartes, *Abrégé de Musique* [*Musicae Compendium*] trans. Frédéric de Buzon (Paris: Presses Universitaires de France, 1987). For the most recent English translation see René Descartes, *Compendium of music* [*Compendium musicae*] trans. Walter Robert (Rome: American Institute of Musicology, 1961).

[16] An exception is the excerpt included in the second volume of source readings compiled and edited by Ruth Katz and Carl Dahlhaus. They included Descartes in their section on cognitive studies, with emphasis placed on the eight propositions listed at the beginning where he outlines his method. None of the chapters is reproduced in it entirety, and the section on the derivation of dissonant relationships is omitted entirely. Descartes, "Selections from *Compendium Musicae*," in *Contemplating Music: Source Readings in the Aesthetics of Music,* ed. by Ruth Katz and Carl Dahlhaus, vol. 2 (Pendragon Press, New York 1989): 506-524.

[17] For example, Carol L. Krumhansl notes in her summary of research of rhythm and pitch the importance of the study of intervals, yet there is no mention of Descartes' insights in this area. "Of all physical dimensions, pitch is perhaps the most differentiated perceptually, the most elaborated cognitively, and the most heavily theorized (in both music and language). One distinctive aspect of musical pitch is the special status of intervals.... At the core of theorizing about pitch is the belief that numbers provide a suitable vehicle to move between the realms of physics, psychology and music." Krumhansl does celebrate the achievements of Helmholtz in these areas, but does not acknowledge his debt to Descartes. Carol L. Krumhansl, "Rhythm and Pitch in Music Cognition," *Psychological Bulletin* 126 (2000): 165.

hearing a strong rhythm. It is through the senses that proportions are experienced (and with the active participation of the mind as an organizing force) are understood. With this approach to musical sound, Descartes presents what Kate van Orden calls an "embodied" analysis. With his mathematization of empirical knowledge, he takes one more step in the quantification of the world: "Measurement created new conditions of possibility of knowledge; it indeed forced intellectuals into a painful reevaluation of the universe."[18]

Jairo Moreno includes an analysis of Descartes' focus on perception in his 2004 book *Musical Representations, Subject and Objects: The Construction of Musical Thought in Zarlino, Descartes, Rameau, and Weber.*[19] Moreno, who uses the language of Foucault (the perceiver as a cognitive construction) and Barthes (listening as a creative endeavor), suggests that in the *Compendium* Descartes repositions the self as an object of knowledge. Because Moreno understands music to be more present empirically in the listener than anywhere else and because Descartes describes measurement of intervals in music as essentially a subjective activity, Moreno sees Descartes building the foundation for a dialectic between subjects and representations. For Moreno, Descartes' epistemological stance is about both sound perceived (*sens*) and sound understood (*ratio*). Both van Orden and Moreno are studying cultural contexts, and Descartes' *Compendium* offers an example of the paradigm shifts they explore.

A quite different approach is taken by music theorist Henry Klumpenhouwer who uses Descartes' model for establishing consonant and dissonant intervals as an analytical tool. He extends Descartes' procedures into a methodology for an analysis of the

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[18] Kate van Orden, "Descartes on Musical Training and the Body," in *Music, Sensation, and Sensuality,* ed. Linda Phyllis Austern (New York: Routledge, 2002): 24.

[19] Jairo Moreno, *Musical Representations, Subjects, and Objects: The Construction of Musical Thought in Zarlino, Descartes, Rameau, and Weber* (Bloomington: Indiana University Press, 2004).

Prologue from Lassus' *Prophetiae Sibyllarum.* In this case study, he compares Descartes' analytical model with analyses by William Mitchell and Karol Berger, and shows that Descartes' approach reveals particularly meaningful textual relationships revealed by the intonation placement in structural chords. These textual references are missed by the other analytical paradigms. Klumpenhouwer's approach is similar to mine in that he takes his methodology from the *Compendium* section on intervals and the *circulus* relationships, but differs in the goal. His focus is on how intonation within harmonic musical structures can be interpreted as meaningful. Mine is on the performer's procedures in establishing consonance and dissonance.[20] To my knowledge Descartes' *Compendium* has not been examined as a resource for intonation study. Descartes' presentation of pitch relationships, explaining them as measurable events existing on a continuum of sound, provides the mechanical model for describing and evaluating pitch inflections within musical contexts and can help musicians better understand their options for expressive performance. Finding meaning in music, analyzing the connection between quality of tone and beauty or showing what aspects of pitch or rhythm are instrumental in arousing emotions are all issues that Descartes avoids, saying these issues exceed the scope of his essay. But he does prepare the stage for new paradigms of meaning by showing the mechanism for understanding inflected pitch. I will suggest that with these tools, enhanced by an appreciation of rhetorical gestures, a performer can move an audience aesthetically.

In the seventeenth century the cultural move away from number mysticism required a new paradigm of meaning. With their attention to the use of melodic gestures to represent particular textual meanings, the composers of the new monodic style in the

[20] Henry Klumpenhouwer, "The Cartesian Choir," *Music Theory Spectrum* 14, no. 1 (Spring 1992): 15-37.

early seventeenth century emphasized expressiveness. This "rhetorical" role for music was now based not on revealing the truths of the cosmos by showing in sound the perfection of harmony, but on revealing the meaning of words. Music's main task was to be persuasive. With this "linguistic" function, it had been moved from the *quadrivium* to the *trivium*. The paradigm supplied by rhetoric is tenuous, based on the analogy between language and music, but nevertheless is often cited as an element of performance practice.[21] Classical rhetoric manuals cited the musician as providing the model for expressive delivery, with particular emphasis on understanding the power of sound and pitch as devices of persuasion. In late seventeenth-century England one of the most often reprinted resources was Bernard Lamy's *La Rhétorique ou l'art de parler*, issued in English in 1676 as *The Art of Speaking.* This was one of the most comprehensive resources for those who wanted their rhetoric with a modern view, based on Cartesian science but still couched in the humanist tradition. Analysis of the persuasive power of pitch inflection, volume, rhythm and phrasing all are demonstrations of a contemporary scientific approach to the art of speaking.

[21] Nikolaus Harnoncourt, a leader in period performance in the twentieth century, reflected on his work in a 1982 publication *Musik als Klangrede.* Despite the title, Harnoncourt does not explain his approach, except to say "it was clearly understood by instrumentalists in the 17th and much of the 18th Century that their music was always expected to 'speak.' " Nikolaus Harnoncourt, *Musik als Klangrede*, 1982, translated as *Baroque Music Today: Music as Speech* (Portland, Oregon: Amadeus Press, 1988): 66. An expanded assessment of rhetoric as an element of performance practice is given by Bruce Haynes in *The End of Early Music*. Haynes contends that Romanticism swept the assumptions of rhetoric away and what the early music movement needs now is a return to the use of rhetoric as an essential element of performance. "It was only in the early twentieth century that music historians rediscovered the importance of rhetoric as the basis of aesthetic and theoretical concepts in early music. An entire discipline that had once been the common property of every educated man has had to be rediscovered and reconstructed during the intervening decades, and only now is it beginning to be understood how much Western art music has depended on rhetorical concepts." Bruce Haynes, *The End of Early Music: A Period Performer's History of Music for the Twenty-First Century* (Oxford: Oxford University Press, 2007), 165.

Descartes and Lamy Provide Resources for Performance Practice

The focus of this study is an exploration of the relationships between theory and practice regarding intonation. I am using two theoretical sources from the late seventeenth century, one concerning intonation and one concerning rhetoric, as methodological guides for developing a theory of expressive intonation in the performance of instrumental ensemble music of that period. Descartes' *Compendium musicae* and Lamy's *The Art of Speaking* both represent the new approaches that describe mathematically and mechanically the possibilities of expressive intonation within musical contexts. There are two basic performance practice issues that can be addressed regarding ensemble music of the late seventeenth and early eighteenth centuries, both related to how and why a performer makes certain intonation choices. The first is about in-tune performance. This concerns intonation, not just about playing "in tune," but about performing within the parameters of consonance and dissonance. It also addresses how to evaluate and execute consonant and dissonant pitches within melodic and harmonic textures. Descartes' theory of intervallic intonation provided a new and ingenious way of describing the performer's intonation choices, and could be used to frame an analytical methodology. Central to this frame is the application of Descartes' approach to pitch as continuous, with intervallic size determined by melodic and harmonic contexts. In chapter two I provide a close reading of the *Compendium* and then give an assessment of this approach as an intonation strategy for the performance of instrumental ensemble music. In the *Compendium* Descartes studies the attributes of sound and the interaction between sounds, with specific attention to what is determined to be a consonance or a dissonance. His approach is not prescriptive, but rather is a clear description of what

musicians actually do in performance when ascertaining their pitch choices within a given harmonic matrix. Using visual metaphors to describe what the musicians' imagination projects when faced with intervallic constraints, Descartes' approach provides an analytical model for understanding the difference in size of harmonic consonances, melodic dissonances and the "commas" that influence their pitch classifications.

The second performance practice question is about creating a rhetorically effective performance. When harmony has been unhinged from cosmology, that is, when perfection and beauty are no longer associated with perfect numbers and Pythagorean tuning, what new paradigms were used to demonstrate expressiveness or even beauty in music? In cases where musical genres are not directly associated with textual meanings, can moments of tension and repose that result from the movement from dissonance to consonance be considered as meaningful? If so, what elements of intonation play into a performer's intention when delivering those meanings? For answers, I look to Bernard Lamy's *La Rhétorique ou l'art de parler* as a resource that carries the Cartesian methodology to broader rhetorical contexts. The identification of music with rhetoric is an idea that became more and more common during the seventeenth century, and Lamy's approach to the power of delivery provides a useful analogy to musical performance. Certainly some parallels with music do show the resemblance between rhetorical figures and musical figures, and these are achieved in the compositional process. A more performance-oriented element to be explored for my topic, however, is Lamy's attention to the qualities of sound and the way a speaker can use variations of pitch to excite or calm, to intensify or relax the delivery. This emphasis on delivery as a means of

persuasion, a move to the most practical level of rhetoric, provides the intersection where 'rhetorical music' becomes a potent tool for expression. Not only can sound move us to certain emotional states, it also has a connection to ideas. "It is not to be question'ed, but certain sounds, certain Numbers, and certain Cadences, do contribute to awake the images of things with which they have had alliance and connexion."[22] Lamy then presents examples from the *Aeneid* as demonstrations of different cadential types, some lowering the voice, some raising it up, some slowing and some abrupt. Each variation in pitch can have meaning because of its style of enunciation. Lamy also notes the variety of sounds available for vowels and how they can be used to prepare a cadence:

> Among the Vowels, some have a clear and strong sound; others are weak and obscure: and we may compose our Discourse as we please of such as are proper for our design, when we have a mind our Cadence should be weak or strong, clear or obscure.[23]

In my case studies of instrumental ensemble music, emphasis is placed on the similarity of the techniques of pronunciation between oratory and music. Depending on harmonic and melodic contexts, awareness of the power of pitch inflection as a technique of "pronunciation" can become a powerful tool for effective expression.

Various perspectives on my two questions will be demonstrated using movements of trio sonatas written in the style of Corelli as test cases. I have chosen the instrumental trio sonata, a genre of ensemble music for strings and continuo, for this study because its performance involves both the limitations of the fixed-pitch keyboard tuning and the variable tuning of two other instruments, either string or wind. Today's early music

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[22] Bernard Lamy, "The Art of Speaking," in *The Rhetorics of Thomas Hobbes and Bernard Lamy*, ed. John T. Harwood (Carbondale: Southern Illinois University Press, 1986): 293.

[23] Lamy, "The Art of Speaking" III.5.3, 296.

performer searches for the right instruments, reliable scores and appropriate sized venues for performance. As more and more techniques for effective period instrument performances are recovered, tuning and expressive issues become more apparent. For example, transparency of sound and lack of vibrato can reveal what is best (or worst) about ensemble intonation. Since both the *Compendium musicae* and *La Rhétorique ou l'art de parler* signify the epistemological shift of the late seventeenth century, the application of their methodologies to examples of music of the same period may result in perspectives that can inform current performance practices.

Current Literature on Intonation for Period Performance Ensembles

The instrumental ensemble repertoire of the late seventeenth and early eighteenth centuries has not been systematically analyzed for intonation practice. This is not because ensemble intonation is not an important topic, but because intonation for ensembles involves so many variables that are difficult to quantify. Intonation practice in this context addresses the ability to play 'in tune' with others in any ensemble, and while keyboard temperaments have been researched extensively, the intonation practice of singers and players of non-fixed-pitch instruments has received much less attention.[24] The reasons for this may include everything from the contextual specificity of the repertoire to the personalities associated with instrumental and vocal pedagogy. Yet for

[24] J. Murray Barbour and Mark Lindley have published the most influential monographs on tuning and temperament. J. Murray Barbour, *Tuning and Temperament: A Historical Survey* (East Lansing MI: Michigan State College Press, 1951). Lindley has authored many entries in *New Grove* concerning tuning, temperament and intonation topics, and published monographs on tuning and temperament for lutes, viols and keyboards. A summary of his approach is found in Mark Lindley, "Tuning and Intonation," in *Performance Practice: Music after 1600*, ed. Howard Mayer Brown and Stanley Sadie (New York: Norton, 1989), 169-185.

period performance study, tuning traditions would seem to be helpful to understanding the music. As Bruce Haynes has noted:

> Playing 'in tune' is a relative and very personal affair, and no set of rules or abstractions from practice can possibly encompass its complexities, or substitute for an alert ear and a willing spirit. Modern players schooled in equal temperament are conditioned to produce wide thirds and high leading tones. Yet, the basic assumptions of a singer or violinist in the 17th and 18th centuries concerning intonation were quite different from ours, and an understanding of them is not only useful in everyday ensemble work, but adds an unexplored expressive element to Baroque and Classical performance.[25]

Standard musical notation does not show possible variation in tuning. It is able to indicate the note names and relative pitch parameters, and because of this it is able to indicate the exact size in cents of intervals within the harmonic and melodic context, but only within an assumed system of tuning. Standard musical notation does not indicate the tension between melodic and harmonic intervals that pull intonation in opposite directions, as for example, when rising melodic lines suggesting narrow diatonic semitones (high sharps and low flats) and vertical sonorities suggesting the opposite (low sharps and high flats). Inflected intonation is a subtle art. Finding the solution to intonation questions in the music for instrumental ensemble is another aspect of the intonation challenge. The tension between melodic and harmonic intervals is addressed only as the music unfolds in time. That task is the purview of the early music performer, and as Haynes suggests, requires an "alert ear and a willing spirit." Furthermore, playing "in tune" assumes knowledge of what kind of intonation is appropriate for each musical context, what specific expressive purpose is desired and how that purpose may be realized in performance.

[25] Bruce Haynes, "Beyond temperament: non-keyboard intonation in the 17th and 18th centuries," *Early Music* 19, no. 3 (August 1991): 357.

Research in this area of performance practice is thin, perhaps because of what Haynes' describes as the "personal" nature of intonation practice. It also may be because intonation for any musical style is learned aurally, and musicians who have arrived at workable solutions would have little incentive to document their findings. Their performance would serve as their conclusions. I have found only two published sources that specifically address instrumental ensemble intonation as a performance practice issue in early music, and both are written by performers. In an article published in 1994, Holger Eichhorn, a cornettist based in Berlin, considers the intonation standards for seventeenth-century ensemble music and how performers today should approach them.[26] His sources for intonation standards of the seventeenth century include the *Syntagma musicum* (1619) of Michael Praetorius and *Musica modulatoria vocalis* (1678) of Wolfgang Caspar Printz.

The other monograph is by Paul Poletti, an American now living and teaching in Barcelona who builds and restores harpsichords and fortepianos.[27] Poletti surveys the changes in keyboard tuning systems from Schlick (1511) to D'Alembert (1762) and explains the categories of meantone, modified meantone and circulating temperaments.[28] Both Eichhorn and Poletti stress the importance of period performers understanding the theoretical criteria and the practical challenges of ensemble intonation. Both also come to

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[26] Holger Eichhorn, "*Ensemble-Intonation im 17. Jahrhundert,"* in *Stimmungen im 17. und 18. Jahrhundert. Vielfalt oder Konfusion?"* ed. Günter Fleishhauer et al. (Michaelstein: Kloster Michaelstein, 1997), 142-150.

[27] Paul Poletti, "Temperament and Intonation in Ensemble Music of the Late Eighteenth Century: Performance Problems Then and Now," in *Musique ancienne--instruments et imagination,* ed. Michael Latcham (Bern: Peter Lang, 2004), 109-132.

[28] Poletti not only discusses the relationship between temperament and the intonation practice available to other strings and winds in ensembles, but also tries to clarify the terminology and to correct bad grammar (e.g. "well-tempered" used for circulating temperament) for modern musicians involved in the 'historical performance practice' movement. Poletti, "Temperament and Intonation," 116.

the conclusion that performers in ensemble should use a flexible intonation approach, but neither provides guidelines for how to choose the degree or direction of inflection. Again, the question is how does one play "in tune"? And, even more specifically, how does one play in tune with a keyboard instrument that necessarily has several "out of tune" harmonies? Both Eichhorn and Poletti agree that there is no reason for all of the non-keyboard instruments in an ensemble to ever match the exact tuning system of the keyboard, no matter what its current temperament.

Eichhorn's suggestion for ensemble tuning is based on accommodating seventeenth-century standard keyboard tuning of quarter-comma meantone (eight pure major chords, where the fifths are tempered smaller by the same amount and the thirds are all close to pure, with those eight usable keys having identical consonances and dissonances). The bass instruments all must follow the intonation of the keyboard instrument. The string instruments with frets, members of the gamba family and the lutes, tune their open strings as close to keyboard pitches as possible. They should then adjust their frets to find sonorities that resonate with the chords on the keyboard. Those instruments that freely intone, including members of the violin family and the wind instruments, should adjust fingerings, use intensity of breath or vowel modifications in the oral cavity to achieve desired microtonal adjustments of pitch. With these suggestions, it is clear that the tuning of the fixed-pitch keyboard is simply a foundation that frames, but does not dictate all of the other intonational choices. Eichhorn suggests that because of the keyboard's compromised tuning system, the keyboard player should omit pitches that conflict with consonant intervals played by a melodic voice. The goal is to have "pure intonation" (beatless thirds and fifths for the triad) at the point of

consonance in the harmony. Eichhorn does not, however, extend his recommendations beyond these basic points.

Poletti's focus is on late eighteenth-century tuning systems, and he presents a summary of the characteristics of the major keyboard options.[29] Research into organ tunings reveals that one-quarter comma meantone tuning was standard for the seventeenth century and well into the eighteenth, and stylistic evidence suggests that the other keyboard instruments used the same system.[30] For the later eighteenth-century works, Poletti notes that many keyboard tunings systems coexisted well into the nineteenth century when equal temperament began to dominate. No matter what the keyboard temperament, freely intoning players in ensembles apparently still used both pure intonation for triads and inflected pitches for some dissonant notes. Poletti cites

[29] Poletti reviews the four categories of "temperament", those compromises that keyboard tuning technicians make, he explains "to accommodate the discrepancies which emerge when tuning using only pure intervals. If, for instance, a keyboard instrument were tuned using a succession of twelve pure fifths starting on a C, the last note tuned, B sharp, would be considerably higher than the appropriate C seven octaves higher than the starting point. The difference between the B sharp and the C is known as the Pythagorean comma. Similarly, a succession of four pure fifths starting on C will give a wide major third (C-E) two octaves higher. The difference between such a wide third and a pure one is known as the Syntonic comma. Many temperaments are aimed at creating acceptable thirds using the notion of the Syntonic comma. The small difference between the Pythagorean comma and the Syntonic comma is known as the Schisma." Paul Poletti, "Temperament and Intonation," 111 fn3. Translated into cents, the schisma is 1.954 cents and the syntonic comma is 21.51 cents. Poletti notes that meantone temperaments are designed to allow major thirds that are close to pure. Depending on how the syntonic is divided over the octave, these are designated as 1/4 comma, 1/3 comma, 2/7 comma, 1/5 comma meantone. What is characteristic of these regular meantone temperaments is that there is not any difference among the usable keys. In all of these there are no enharmonically usable pitches and the useable keys all have identical consonant and dissonant relationships. This is in contrast to circulating systems where divisions of the syntonic comma were distributed unevenly in the octave.

[30] Meantone (1/4 comma, 1/6 comma, 1/12 comma or equal temperament), modified meantone (those of Praetorius and D'Alembert) and circulating temperaments (Werkmeister III, Vallotti/Young) all provided different performance options in the eighteenth century, but as musical styles required more modulation the need for enharmonic pitches increased. Ibo Ortgies documented the temperament of north German organs in the seventeenth and eighteenth centuries, emphasizing the persistence of unmodified meantone tuning until at least the 1740s. He suggests that the shift away from meantone temperaments to circulating temperaments was made to accommodate the requirements of ensemble accompaniment. Ibo Ortgies, "Die Praxis der Orgelstimmung in Norddeutschland im 17. und 18. Jahrhundert und ihr Verhältnis zurzeitgenössischen Musikpraxis" (Ph.D. Dissertation, Göteborg University, 2004).

evidence from three eighteenth-century sources for this claim. The first is from Roger North in 1726:

> If the sounding part [of music] had been left to the voice, which conforms to all truth of accords whereof the ear is the judge, there never had been any suspicion of such major, minor, dieses, commas, and I know not what imaginary divisions of tones as some clumsy mechanical devices called instruments have given to speculate.[31]

That is, the human voice instinctively seeks pure intervals without any motivation to understand the mathematical formulae that describe pure, beatless consonances. The second directive, written from a practical musician's point of view, is from Quantz' *Versuch einer Anweisung die Flöte traversiere zu spielen* (1752):

> ...if a note lowered by a flat becomes transformed into the note just below it, the note with a sharp is a comma lower than the one with a flat. If these two notes are tied to each other, one must draw back one's finger a little [...] otherwise the third will be too high against the fundamental tone.[32]

Poletti's other source is a description by Charles Burney of the oboist Carlo Besozzi, who served at the Dresden court. Besozzi is praised for his skill in tempering his pitch to different basses. In other words, he was a sensitive and skilled musician who was able to

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[31] Roger North, *Theory of sounds shewing, the geneis, propagation, effects and augmentations of them reduced to a specifick inquiry into the cripticks of harmony and discord, with eikons annexed exposing them to occular inspection* (unpublished ms., British Library Add 32535, 1726), 1-73v. and quoted in Poletti, "Temperament and Intonation," 130.

[32] Quantz addresses not only the general concept of pitch placement for violinists, but also the adjustments of pitch used by wind players. "If true subsemitones appear, that is, if a note lowered by a flat is transformed into the note immediately below it, raised by a sharp, or if a note raised by the sharp is transformed into one immediately above it that is lowered by a flat, it must be noted, as mentioned in the preceding paragraph, that the sharpened note must be a comma lower than the one with the flat. [....] The same rule must be observed on all instruments, with the exception of the keyboard, upon which the transformation of the subsemitone cannot be produced, and which must therefore be well tempered to sound endurable with both. Upon wind instruments this variation is accomplished through the embouchure. On the flute the pitch is raised by turning it outwards, and lowered by turning it inward. On the oboe and the bassoon the pitch is raised by pushing the reed further into the mouth and by pressing the lips more firmly together, and is lowered by withdrawing the reed, and relaxing the lips." Johann Joachim Quantz, *On Playing the Flute*, (*Versuch einer Anweisung die Flöte traversiere zu spielen*, 1752), trans. by Edward R. Reilly, 2nd ed. (New York: Schirmer, 1985), 269-270.

modify his pitch in performance.[33] Poletti's final assessment about performance is applicable to any time frame or genre:

> In other words, musicians used flexible intonation, sometimes called "just intonation" not the rigid system of keyboard tuning, but a system which is constantly shifting, changing like a harmonic chameleon, moulding to musical demands of each moment. Such intonation is often used by pop musicians and folk musicians today; they often sing or play melody instruments using pure intonation but are accompanied by players of keyboard instruments tuned in equal temperament. The secret lies in the skillful realization of the harmonic accompaniment in order to hide the bad thirds of the tempered instrument.[34]

Poletti's advice is for the musician to "strive to produce a more naturally inflected intonation (low sharps, high flats and pure consonances). The fact that this is often difficult and will undoubtedly require a significant amount of effort and experimentation is no reason not to do it."[35]

Two musicologists who have based their intonation studies on seventeenth- and eighteenth-century primary sources that address non-keyboard tuning issues are Patrizio Barbieri and Bruce Haynes.[36] Their studies, both published in 1991, discuss the specific challenges to instrumental intonation. Barbieri surveys violin intonation, using both pedagogical sources and rarely seen accounts of audience responses, demonstrating that

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[33] Charles Burney during a visit to the Dresden court in 1772 heard a very difficult oboe concerto played by Carlo Besozzi and commented on the subtle tuning he achieved: "...Besozzi's *messa di voce*, or swell, is prodigious; indeed, he continues to augment the force of a tone so much and so long that it is hardly possible not to fear for his lungs. His taste and ear are exceedingly delicate and refined; and he seems to possess a happy and peculiar faculty of tempering a continued tone to different basses, according to their several relations: upon the whole, his performance is so capital, that a hearer must be extremely fastidious not to receive from it a great deal of pleasure." *Charles Burney, An Eighteenth-century Musical Tour in Central Europe and the Netherlands being Dr. Charles Burney's account of his musical experience,* ed. Percy A. Scholes vol. 2 (London; Oxford University Press, 1959), 145.

[34] Poletti, "Temperament and Intonation," 131.

[35] Ibid, 132.

[36] Patrizio Barbieri, "Violin Intonation: A Historical Survey," trans. Sandra Mangsen, *Early Music* 19, no. 1 (Feb. 1991): 69-88, and Bruce Haynes, "Beyond temperament," 357-381.

violinists played in a kind of just harmonic intonation, with pure major thirds, lower sharps and higher flats. This practice changed towards the middle of the eighteenth century to accommodate the changing musical styles that employed enharmonic semitones. As the sharps began to be tuned higher to increase the tension of the leading tone of the tonal system, keyboard temperaments were modified accordingly. The move to Pythagorean intonation, introduced by virtuoso violinists who desired a more brilliant effect, pushed the leading tones even higher. Thus, the third of the dominant triad was moved to a position almost one fifth of a tone higher than a just third.[37] Barbieri also provides previously unpublished sources that document the performance history of violinists, showing the persistence of the use of just thirds well into the middle of the nineteenth century. Haynes also surveys the seventeenth- and eighteenth-century sources that address the subtleties of instrumental tunings. He includes a discussion of split keys for harpsichords and organs and the fingering charts for wind instruments that specify alternate fingerings, both indicating non-enharmonic tuning. These documents clearly show that musicians had options for pitch placement and were able to choose among them even when playing with fixed-pitch continuo instruments. The question for him is not whether to modify intervals within a fixed-pitch system, but how to relate non-keyboard intonation to a keyboard temperament that would serve the expressive needs of the repertoire performed. Barbieri explains the intonation challenges experienced by violinists, and includes some examples of the use of 'just' intervals.[38] Haynes expands his

[37] The Pythagorean interval of a major third has a ratio of 81:64 or 407.82 cents while the just major third interval has a ratio of 5:4 or 386.64 cents. The difference between them is 21.51 cents, a syntonic comma, also called a chromatic diesis or the comma of Didymus.

[38] Barbieri, "Violin Intonation," 69-72.

scope to include all non-keyboard instruments and brings in sources from the 1690s to the 1790s, but like Barbieri does not limit the discussion geographically or stylistically.[39]

My project should be considered an extension of their suggestions, one that provides the performer with both a practical understanding of possible solutions to intonation options and a rhetorical framework for expressive gesture. I consider my study to be an application of the sources cited by Barbieri and Haynes, worked out within a specific cultural place and time that was energized by Cartesian thought. My analytical methodology builds upon the conclusions of Barbieri and Haynes and provides an investigation of possible performance practices for a repertoire that fits neatly between the seventeenth-century traditions described by Eichhorn and Poletti's eighteenth-century focus. However, neither Eichhorn nor Poletti reach the level of specificity for inflected intonation that I wish to address.

To narrow the discussion and anchor it in a historical time and place, I will use as case studies selected slow movements from trio sonatas for two violins and continuo by Corelli, Ravenscroft and Purcell.[40] The two English composers were chosen because they intentionally wrote in the style of Corelli. The slow movement examples from these trio sonatas provide manifold opportunities for expressive playing, where a violinist is able to choose from a variety of pitch inflections that may increase or decrease harmonic or melodic intensity. In imagining performances of these works as heard in London at the turn of the century, one may reasonably hypothesize an ensemble of keyboard and two

[39] Haynes, "Beyond temperament," 356-381.

[40] Examples include the third movement of Corelli's G Minor sonata, op. 3 no. 11, from his *Sonate a tre, due violini, e violone, o Arcileuto, col basso per l'organo* (Rome 1689); the fifth movement of Purcell's G Minor sonata, no. 1 (Z 790) from his *Sonatas of 3 parts* (London, 1683); and the third movement of John Ravenscroft's G Minor sonata, op. 1, no 2, from his 12 *Sonate a 3* (Rome, 1695).

violins with gut strings using short bows and with vibrato used occasionally only for expressive purposes. The sound, heard in a moderately resonant room, would be clear and strong, allowing a distinct perception of consonance and dissonance. Expressive intonation, a component of successful performance practice in early music, requires a flexible approach to the inherent conflicts between just intervals and any fixed temperament.

Organization of the Study

Both Descartes and Lamy offer insights about how performance could be analyzed, and so the *Compendium musicae* and *The Art of Speaking* become foundational sources for my analysis of intonation options. In Chapter II the question of playing 'in tune' is discussed from two perspectives. First, from an audience perspective, I present a review of Bottrigari's complaint against ensemble intonation in his *Il Desiderio.* Second, from a performer's perspective, I present intonation choices as would be experienced by a hypothetical performer following Descartes' methodology. In the *Compendium* Descartes studies the attributes of sound and the interaction between sounds, with specific attention to what variations caused by slight pitch inflection can make an interval more or less consonant or dissonant. Descartes' approach is not prescriptive, but rather is a description of what musicians actually do in performance when considering their pitch choices within a given harmonic matrix. This awareness is developed into an analytical model for understanding the difference in size of harmonic consonances, melodic dissonances and the 'commas' that influence their pitch inflections. Using Descartes' methodology of calculating melodic dissonance, I describe several performance options for a two measure

musical example.

Chapter III begins with a detailed discussion of Descartes' analytical process, the reasons for his writing the *Compendium musicae*, and a summary of its contents. Descartes' use of *circulus* diagrams to show variation in pitch is unique, and is dependent not only on logarithmic calculation for continuous pitch but also on the power of the imagination to depict those calculations. Descartes' approach using the *circulus* diagram to show relationships between pitches in different tonal contexts is offered as an analytical model to address two problems related to intonation in performance. The first is the performance problem described by Bottrigari in Chapter II. The second is a performance problem associated with adherence to just intonation for all intervals, resulting in a downward or upward migration of the overall pitch from beginning to end. Descartes' use of *circulus* diagrams represents not only the result of logarithmic calculations for continuous pitch but also the power of the imagination to depict those calculations. His description of the proportionalizing imagination can be seen not only as an element in understanding rhythm and meter, but also as an influence on a musician's inflected pitch choices in performance. This description supports the musician's experience of performing with intonational flexibility.

Chapter IV addresses Descartes' view of rhetoric and musical expression as revealed in correspondence with Mersenne. In keeping with recent reassessments of Descartes' natural philosophy, his analysis of music is cast as functioning within the categories of representational cognition, intellectual cognition and perceptual cognition. Descartes' rationalistic and mechanistic perspectives are influential in the language arts as well as in science. Lamy's *La Rhétorique ou l'art de parler* is presented as an example

of Cartesian approaches influencing rhetoric. In Lamy's work the aesthetic of natural expression, derived from the rhetoric of Longinus, and the power of intention, derived from Augustine, are conflated with Descartes' imagery to create a system of expression that has parallels in music. Chapter IV concludes with a discussion of two perspectives derived from Lamy's rhetoric. The first is the idea that music is a kind of rhetoric, and that methods and meanings have parallel functions as types of discourse. The second topic addressed is how rhetorical skills, especially those about natural expression, could be understood as performance aids.

Chapter V explores the relationship between substance and style in discourse. For Lamy the most effective communication is that which is clear in expression and is based upon an awareness of the connection between what we feel and what we say. Extrapolating a descriptive language from Lamy and extending this paradigm for communication to music, the examples by Corelli, Purcell and Ravenscroft are presented as case studies. Using Lamy's understanding of the power of sound as an expressive device, several options for the placement of expressive pitches are given within the context of the melodic and harmonic frame. These options are then described both through pitch labeling and sound examples, providing the opportunity for evaluating the effectiveness of different rhetorical options. Approaching intonation as an element governed by rhetorical intent rather than by some abstract sense of pitch accuracy ties rhetorical theory to practical music making. My goal here is to try to capture the sense that music becomes meaningful only in performance and that is where the pitch inflection options are carried out. The late seventeenth century was a time when music's meaning became less identified with abstract number theory and cosmology. Theorists were

looking more to analogies with rhetoric to explain music's affective power. My approach considers the performance of music to be the last stage of composition, where all of the elements come together to serve a rhetorical goal. By working with these possibilities of expressive intonation as a performance practice, one can more intentionally approach the eloquence afforded by the "perfection of ravishing harmony" so celebrated in the music of Corelli and his imitators.

Chapter VI presents concepts of expressive intonation derived from Lamy's rhetorical guidelines and Descartes' pitch schematic as a performance practice, and explores possibilities for future research. Like many engaged in performance practice studies I have been approaching the experience of music with an attempt to replicate the eyes and ears of a late seventeenth-century musician. By using Descartes and Lamy as primary resources I have selected contemporary treatises as analytical aids, and have assumed that these are appropriate for understanding performance possibilities. Studies in music cognition and acoustics also support alternative strategies for evaluating affective and in-tune performance.[41] My position is that a focus on intonation from the performer's perspective transcends traditional tuning theories rooted in theories of number mysticism or in the unique problems of fixed-pitch keyboard systems. In establishing a connection between pitch inflection and rhetoric, I claim that intention for expression provides the foundation for understanding the syntax of musical delivery. It is not derived from rhetorical approaches, but follows parallel techniques using intonational inflection for effective expression.

[41] Some of the most thorough studies of violin intonation, for example, have been carried out by Janina Fyk at the Music Acoutics Laboratory Fryderyk Chopin Academy of Music in Warsaw. Janina Fyk, *Melodic Intonation, Psychoacoustics, and the Violin*, trans. by Joanna Ciecierska. (Zielona Góra, Poland: Organon, 1995).

The connections among Descartes, Lamy and current thought on intonation issues can also be explored within the context of performance. Carolyn Abbate suggests that what "counts" in a musical event is not the theoretical construct but the acoustical phenomenon, the real music in real time.[42] Paul Thom emphasizes the role of performance as a mode of interpretation that is equal to meanings found in music history and music theory.[43] Ingrid Monson emphasizes the role of active listening to performance as yet another mode of interpretation that also has meaning.[44] Monson calls this focus of attention on the experience of music itself a kind of "perceptual agency." While none of these scholars address intonation issues, they are all interested in the ways meaning can be found in the experience of listening. None of them address specifically what it is like to listen as a performer "from the inside" as music unfolds in time. It is this process that Descartes addresses, albeit in a mechanical way. Performing musicians may describe it in a personal way, and as Bruce Haynes noted, "there are no set of rules or abstractions from practice that can possibly encompass its complexities."[45]

Even though there has been ample scholarship addressing historical tuning and

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[42] Abbate labels 'drastic' that music which is real music in real time, and comes into being only when played or sung. A similar emphasis on the value of performance is presented by Vladimir Jankélévich in his *Music and the Ineffable* which Abbate had translated into English in 2003. Jankélévich raised the value of making music (and this includes recreating it in the listening process) over all other hermeneutical pursuits. Carolyn Abbate, "Music--Drastic or Gnostic?" *Critical Inquiry* 30 (Spring 2004), 505-536.

[43] Thom suggests three levels of musical interpretation: (1) editorial, where one figures out the meaning of the score, the context, the culture, the venue, the participants, (2) compositional, where musical ideas are translated into symbols so they can be understood by a community of performers, and (3) performance, where the musical score is realized in time. Paul Thom, *The Musician as Interpreter* (University Park, PA: Penn State University Press, 2007).

[44] Ingrid Monson presents a broad critique of the musicological community: she places the problem of meaning in music as being overly intellectualized, and presents a new term 'perceptual agency,' defined as a conscious focusing of sensory attention. This is a description of what our sensory apparatus naturally does when listening to music, and it is a habit that we should cultivate. In some ways, her position is remarkably similar to that of Descartes who also situates our understanding of music directly in our senses. Ingrid Monson, "Hearing, Seeing, and Perceptual Agency," *Critical Inquiry* 34 (Winter 2008): 536-558.

[45] Haynes, "Beyond temperament," 357.

temperament systems for fixed-pitch instruments, few scholars have ventured into the areas of explaining tuning changes as a performance unfolds or evaluating the reasons for making pitch inflections. This is not to say that musicologists are not interested in these questions, but only to note that their discussions rarely cite sources from seventeenth-century natural philosophy or rhetoric. Most are also not writing from the performer's perspective, that place where Descartes situates his discussion of intonation choice. This dissertation will have served as a step in that direction.

CHAPTER II

SEEKING GOOD INTONATION

> Where I had thought I would hear a celestial harmony I heard confusion rather than the contrary, accompanied by a discordance which has offended me rather than given me pleasure.[46] Bottrigari "Il Desiderio"

Desiderio's Complaint

Do audiences recognize good intonation when they hear it? Are musicians themselves able to explain how to achieve good intonation? Even in the mid-eighteenth century Quantz speaks bluntly about the intonation problems of musicians. "Many persons, through their natural ear, perceive whether others play falsely; but if they themselves commit the same error, they are either unaware of it, or do not know what to do about it."[47] This was most certainly the case in the report of the interlocutor described by Ercole Bottrigari in "Il Desiderio" (1599).[48] Written as a polemic against the conservative views of Giovanni Maria Artusi, this well-known dialogue is one of the few first-person accounts of the actual sound of instrumental ensembles and thus provides a place to begin the discussion of ensemble intonation issues. Desiderio had just attended a concert given by a large ensemble of about forty instrumentalists, and had left dismayed at the cacophony. He stopped at the home of his friend and music theorist Alemanno

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[46] Ercole Bottrigari, *Il Desiderio, or Concerning the Playing Together of Various Musical Instruments in which also is discussed the Tuning of these Instruments and many other things pertinent to Music,* trans. Carol MacClintock, Musicological Studies and Documents 9 (Rome: American Institute of Musicology, 1962), 13.

[47] Quantz, *On Playing the Flute*, 269.

[48] The names of the speakers are, of course, representative of real persons. 'Alemanno Benelli' is an anagram for Bottrigari's amanuensis Annibale Melone, who lived with Bottrigari in Bologna and studied Greek music theory there. Desiderio is the hypothetical character introduced in Zarlino's dialogues *Dimostrationi armoniche* as the one who always 'desires' to know about everything. This relationship allows for the conceit of explaining many theoretical issues.

Benelli to discuss why the musicians, all excellent artists who played so well individually, were unable to play in tune together:

> …having gone a number of times to hear various and diverse musical concerts by voices accompanied by different instruments, I have never experienced the great pleasure which I had imagined and supposed, and which, in fact I had hoped to experience. And today particularly, when I attended this one, such was the case; because, having seen a great apparatus of different kinds of instruments – among them a large Clavicembalo and a large Spinet, three Lutes of various forms, a great number of Viols and a similar large group of Trombones, two little Rebecs and as many large Flutes, straight and traverse, a large Double Harp and a Lyre – all for accompanying many good voices...there where I had thought I would hear a celestial harmony I heard confusion rather than the contrary, accompanied by a discordance, which has offended me rather than given me pleasure. Therefore I should like you to tell me if this comes from my sense of hearing, which may not be a good judge, or if what I thought I heard was music.[49]

Benelli's explanation for the cacophony was based on his awareness of the problems with tempered tuning practices, specifically the difficulty of combining the intonation of fixed-pitch instruments with those that have variable tuning. It was not that any of the players had bad intonation themselves, but that their instruments represented three distinctly different tuning systems, causing conflict in ensemble. He described these three categories of instruments and their characteristics. First there are the fixed-pitch or "stable" instruments such as organs, harpsichords and harps, tuned in a temperament before the concert. Next are the "stable but alterable instruments" such as the lute or the viol. These have stability because of the frets, but their pitches can be altered slightly by placing one's finger slightly above or below the fret. Other stable but alterable instruments are flutes and cornettos, where with breath, embouchure, and slight movements over the finger holes a pitch can be shaded slightly. Finally, there are the instruments whose pitch options are completely variable such as violins. These he calls the "*alterabili*." When these three kinds of instruments are combined they have the

[49] Bottrigari, *Il Desiderio*, 13.

potential, as the parts are performed within the intonation tendencies of the instruments, to clash on particular pitches.

Tuning Systems in Conflict

The theoretical foundations of the dialogue that follow are framed by two questions Desiderio asks of Benelli. The first is to explain what he means by "tempering" for those fixed-pitch instruments. The second is to explain why so many intelligent musicians seem unaware of the reasons for discord. In his answer to the first, Benelli launches into a history of music theory, most of which does not relate directly to the three kinds of instruments and their particular tuning parameters. He describes the three Greek genera and the microtonal inflections within each tetrachord, and complains that "modern" musicians mix these genera. He does not explain that tetrachord practice assumed a monophonic system, with interval shadings that served expressive goals. Benelli does imply that they can be reconciled to function within a polyphonic diatonic system. His dismay at the inability of "modern" musicians to understand tetrachord practice is grounded in his assumption that musicians could commit to and perform pitches according to some abstract system of tuning. His explanation of tempering is made from the same perspective. Benelli describes the impossibility of achieving all absolutely pure intervals within each octave of a keyboard. The task of fitting intervals with pure ratios within the boundaries of the octave is made workable by adjusting some intervals enough to compensate for the syntonic comma. For Benelli's experience some slightly altered fifths, widened or narrowed by a process he calls "blunting," no longer

function as true consonances but are acceptable as "tempered ones."[50] Desiderio has said that he does not understand the difference between true consonances and tempered ones, that is, if "true" consonances are beatless pure intervals how could there be any other kind. Benelli answers:

> So I will go back and tell you that tempering is nothing but avoiding the true plurality of strings...deceiving the sense of hearing.... I have said 'deceiving the sense of hearing' because one does not have that complete delight one would have on hearing the consonances in their perfect form. But mostly one hears them in this way, either widened or narrowed. The act of narrowing by the master-makers or tuners of such instruments is called 'blunting.'[51]

In response, Desiderio answers that he is aware that the opposite of "true" consonance is not "true" dissonance, but he has trouble with the concept of the imperfect consonance, achieved by "blunting." Benelli describes it as a deception in our sense of hearing. We hear these "blunted" notes neither pure nor as dissonance, but as acceptable substitutes for the pure consonance. For Desiderio, it seems that the descriptive language is just as confusing as the inability of musicians to fix these problems in performance. Benelli's attempts to explain do nothing to clarify the language issue. Speaking from the theorists' perspective, Benelli begins with two assumptions. One is that if musicians would only intellectually understand a system of temperament, they would be able to achieve it precisely in performance. The second is that good intonation in performance requires the adherence to one temperament to all of the lines within a polyphonic composition. This

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[50] Ibid, 46.

[51] Bottrigari was not writing this part of the dialogue in order to teach tuning, but rather to take a stand in favor of the "modern" style against the attacks by the conservative Giovanni Maria Artusi (Benelli's character). It is well known that Bottrigari, gentleman and humanist, and the critic Artusi were engaged in several public disputes about music. Artusi's manner has been described as pugilistic, conservative and satirical, and it is perhaps not surprising that he found reason to challenge Claudio Monteverdi, Nicola Vicentino and Vincenzo Galilei, all musicians who represented the changing music style, and with it changes in tuning requirements. Artusi's position on tuning for ensembles was to insist that all of the instruments should be tuned to the same temperament, and composers should use dissonance only according to Zarlino's rules. Bottrigari, *Il Desiderio*, 46.

means that his “stable but alterable” and his “alterable” instrument players might as well have fixed-pitch instruments that matched the keyboard. The skill to be developed is the ability to make their instruments sound like fixed-pitch instruments, consistent on all pitches with an objective standard. Both the intellectualization of sound and the call for consistency leads Benelli to understand the problem as one of misalignment of tuning systems.

Intervallic Size Matters

As an aid to understanding intervallic size and the relationship of just intervals to each other in a diatonic scale, I have provided three tables illustrating values in cents for intervals discussed in this chapter. The larger just intervals are listed in Table 2.1, first in their value in cents (rounded for calculation as typically indicated) in the first column, then the specific value in the second column and then as ratio in the third column.

Table 2.1. Size in cents for the octave and six beat-less intervals.

Interval	Size in Cents for Calculation	Actual size in Cents	Ratio
Octave	1200	1200	2:1
Major 6th	884	884.36	5:3
Minor 6th	813	813.69	8:5
Perfect 5th	702	701.96	3:2
Perfect 4th	498	498.04	4:3
Major 3rd	386	386.31	5:4
Minor 3rd	315	315.64	6:5

The intervals described below in Table 2.2 are those additional ones that can be combined with those above to form all of the pitches of just diatonic scale.

Table 2.2. Size in cents for the major and minor tones and semi-tones.

Interval	Size in Cents for Calculation	Actual Size in Cents	Ratio
Major tone	204	203.913	9:8
Minor tone	182	182.404	10:9
Major semi-tone	112	111.731	16:15
Minor semi-tone	92	92.179	135:128
Minimal semitone	71	70.67	25:24

Other intervallic relationships that figure in this analysis of intervals in diatonic just tunings include the syntonic comma (the difference between four pure fifths and two octaves plus a pure major third), the Pythagorean comma (the difference between twelve perfect fifths and seven octaves) and the schisma (the amount by which two Pythagorean thirds and one pure third exceeds an octave). These intervals are listed in Table 2.3.[52]

Table 2.3. Size in cents of intervals smaller than a minor semi-tone.

Interval	Cents	Ratio
Pythagorean comma	23.460	531441:524288
Syntonic comma	21.506	81:80
Schisma	1.954	32805:32768

[52] Charts and tables showing comparisons between most of the tuning systems discussed in Renaissance theory are included in Ross Duffin, "Just Intonation in Renaissance Theory and Practice," *Music Theory Online* 12.3 (October 2006) 1-16. An extensive mathematical analysis of all tuning systems is found in Easley Blackwood, *The Structure of Recognizable Diatonic Tunings* (Princeton, N. J.: Princeton University Press, 1985). Blackwood's comprehensive chart for comparison of all possible commas, minor seconds and chromatic semitones in just intonation is presented in Table 44, pages 116-117.

Because Just intonation is not a tuning system but rather a description of an intonational practice, the intervals in Table 2.3 can appear at any place in the diatonic scale. There is nothing fixed about the arrangement of the tones or steps within larger intervals. As Figure 2.1 shows, the just interval of a major third from C to E can be comprised of a minor tone and a major tone. C to D is a 10:9 minor tone of 182 cents and D to E is a 9:8 major tone of 204 cents. Similarly in the major third from E to G sharp, E to F sharp could be a 9:8 major tone of 204 cents and F sharp to G sharp a 10:9 minor tone of 182 cents.

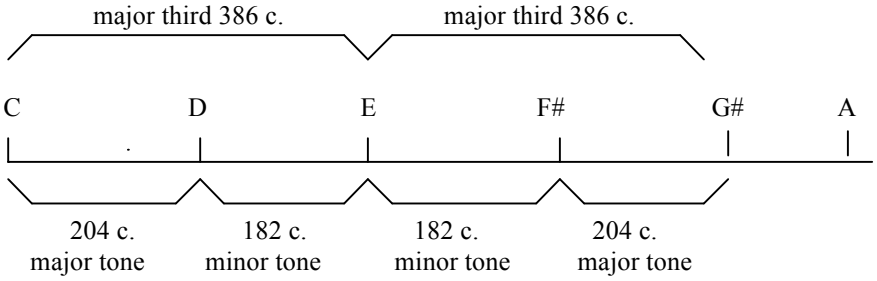


Figure 2.1. Variable positions of major and minor tones within major third.

The misalignment assumed in Benelli's commentary on tuning reflects the pitch variability possible with instruments, with a focus on the need for players to match the keyboard temperament. This would work well if the keyboard were tuned in something close to quarter-comma meantone, since most of the major thirds are Just intervals. Figure 2.2 indicates two just intervals of major thirds, each based on a different tonic pitch. The thirds do align well with quarter-comma meantone tuning, but not with equal temperament. The just interval of a fifth from D to A causes the A to sound five cents higher than in quarter-comma meantone tuning.

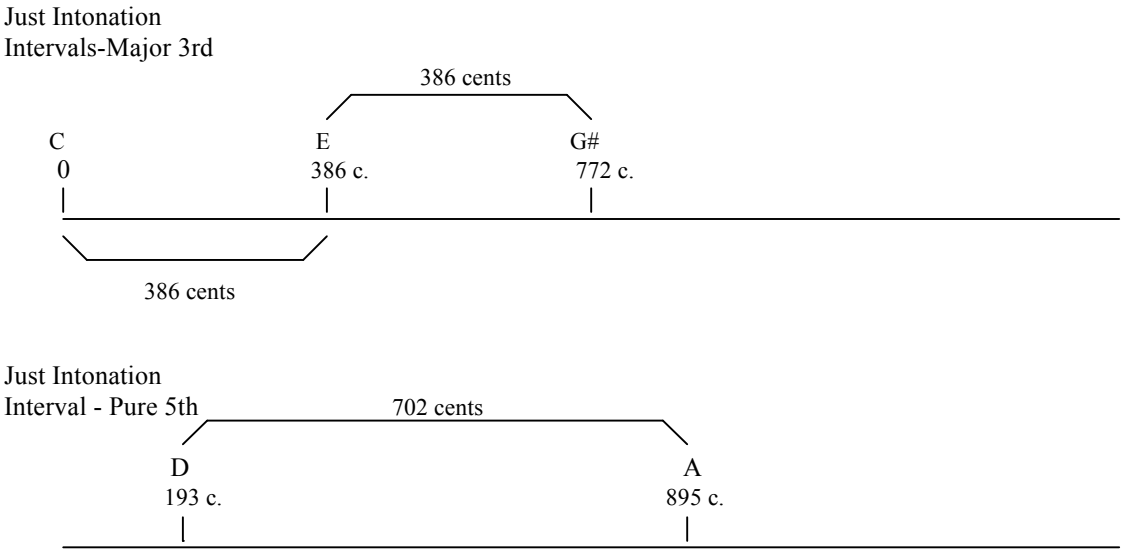
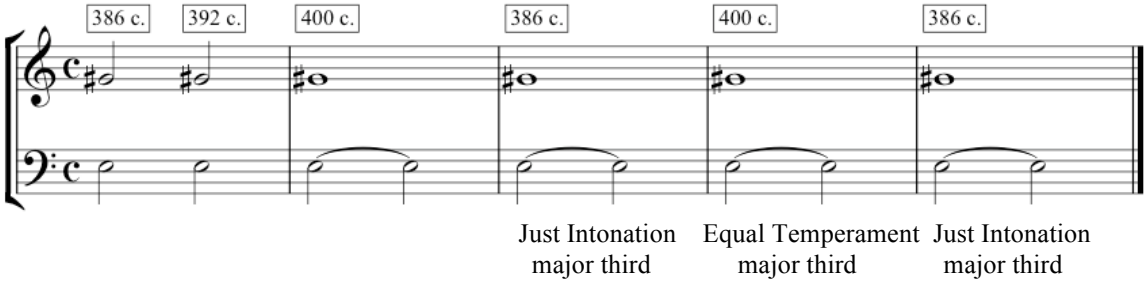


Figure 2.2. Comparison of pitch levels among equal temperament and meantone tuning systems for intervals of pure thirds and pure fifths.

Intervallic Size in Practice

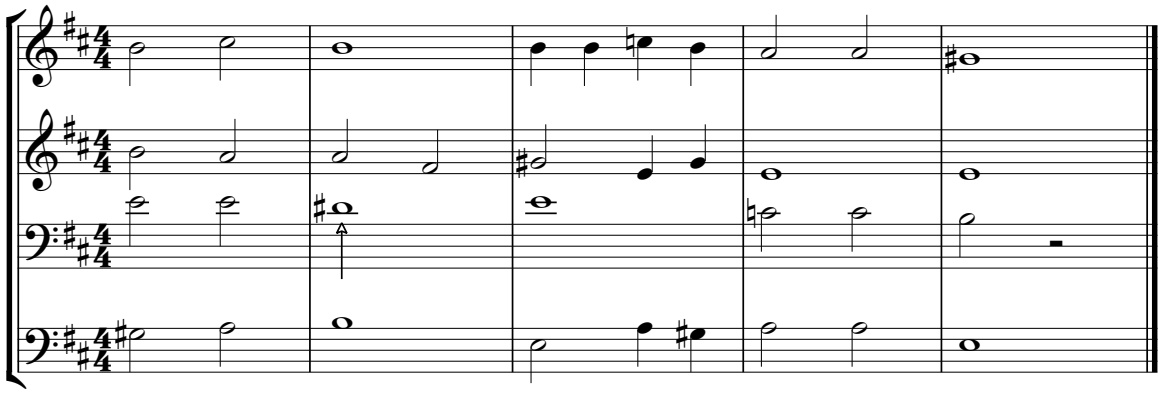
Two musicians could play the two notes of a major third anywhere from 386 to 412 cents wide and it would still be perceived as a major third. When played out of context, pitch deviations below 12 cents are barely noticeable to the human ear. But if the deviation is beyond 12 or if it is heard with other close pitches played successively, the discord is evident. These differences are clearly discernible if two different players play thirds at the same time over a unison bass note, e.g., one played as a justly tuned interval and one that is wider. The interval of a major third in just intonation is measured at 386 cents, 14 cents lower than an equal temperament major third at 400 cents. Example 2.1 provides an example in sound and notation with three different pitch levels for a major third. It begins with a "pure third" of 386 cents, then the upper note is raised to make the third 6 cents wider, then 14 cents wider to a 400 cent third and the pattern is repeated. Refer to Audio 1.1: Sound for Example 2.1 in the Supplemental File for an audio version of these variations in interval size.



Example 2.1. Pitch deviation by cents for intervals of a major third.

To situate the subtle pitch difference in a musical context, Example 2.2 presents a hypothetical four-part instrumental cadence in the style close to Bottrigari's time. There

are several opportunities for conflict; different players may choose different pitches according to their own perceptions and the limitations of their instruments.



Example 2.2. Four-part cadence to E Major.

For illustration of the intonation options, consider the bass line player having the organ (fixed-pitch instrument), the tenor line player a dulcian (stable, but alterable), the alto line player a cornetto (stable but alterable) and the top line a violin (alterable). In measure two, the player of the tenor line has the option of hearing the D sharp (indicated by the arrow) in several ways, and because he can inflect the pitch slightly with his instrument, he has choices. If he hears the D sharp as part of the vertical harmony, forming a consonant pure third with the fixed-pitch bass note, he will place it low. The interval between bass line B and tenor line D sharp would then be 386 cents, forming a just intonation relationship also with the B in the soprano line. The alto line player could then place his F sharp as a pure fifth of 702 cents with the bass line B. However, if the tenor line player thought of the D sharp as a leading tone to E, he could place it higher in relation to the bass line B. This would create a wide third of 400 cents or more between bass and tenor lines. If the wider third is his choice, then the alto line player could place

his F sharp higher to make an acceptable minor third with the D sharp. But that would produce an unacceptably wide fifth between the F sharp and the bass B. The violinist playing the top line sustains a B through this measure in octaves with the bass line B. Given these pitch options, the alto and tenor line players could produce uncomfortably dissonant intervals in the second measure.

Another opportunity for misalignment could happen if the organist and the tenor line player had D sharps that did not match. Assuming the organ is in the standard meantone tuning, there would be a pure 386-cent third between B and D sharp. If the tenor line player chose the higher leading tone D sharp option, then the difference between the two D sharps would be at least 14 cents, a discernible amount, particularly if the two D sharps are played simultaneously. Another opportunity for an uncomfortable interval would occur if the tenor line player chose the higher option for D sharp but the alto line player chose the lower F sharp to create a pure fourth down from the soprano line B. That would create an unacceptably small minor third between D sharp and F sharp of 302 cents, 13 cents smaller than a justly tuned minor third. These variations in interval size are relationships worked out in tuning systems for keyboards, but when they unfold in performance contexts, there is little opportunity to modify one's choice.

The most obvious situation that will result in intonation clashes from pitch alignment errors is whenever there is more than one player to a part. Desiderio reported that there were forty instrumentalists at the concert he heard, and that the instruments were mixed, so doubling would be very likely. Not only would there be the risk of players choosing different options for pitches such as the D sharp in the second measure of the example, but if they are tuned according to different systems the clashes will be

inevitable. For example, if the violinist tunes pure fifths between D and A and between A and E, the E string will be 10 cents higher than the organ's E. All of the possibilities for alignment clashes involve pitch adjustments of 14 cents or less, a small difference, yet clearly audible to the discerning listener.

The potential for conflict among instruments with different tuning systems described by Benelli hinges on the differently sized intervals that would be applied to the same two notes. Since the "stable" instruments are bound by their fixed pitches, the "stable but alterable" and the "alterable" instruments have in his view the obligation of matching the fixed-pitch instruments. According to Benelli, the musicians should all match the fixed-pitch instrument's tuning so that everyone essentially played only the notes of a temperament. But why does this not happen in performance? Because musicians without fixed-pitch restrictions most often choose the beatless 'Just' intervals, perceiving them to be the most "in-tune" option. This phenomenon has yet to be explained adequately, but it is seems to be at the heart of many intonation problems for ensembles. Working from the single line of his or her own parts, the performers do not have the knowledge of the whole or of any abstract organizing intonational system. But Benelli has little sympathy for the performers:

> It would perhaps be easy if this conversation should reach their ears, that, persuaded by the many good reasons contained in it, musicians should abstain from *concerti* and not try it in the future to make connoisseurs of music laugh at the great confusions of different instruments, by multiplying which they hope to work miracles, such as those they have read about as being accomplished by Orpheus and Amphion and all the other ancient Musicians. And as long as they so deceive themselves you cannot give them good advice.[53]

[53] Bottrigari, *Il Desiderio*, 45.

As a theorist, Benelli has the typical low opinion of practicing musicians, but it is more than what is traditionally the hierarchical prejudice of the educated over the uneducated. In answering Desidero's second question in this way, Benelli is evading the real tuning issues.[54] Convinced that performers deceive themselves, he does not consider physiological or psychological bases for the tendency of musicians to gravitate toward just intonation. Musicians in performance more commonly trust their instincts, not the theories, and habitually play pure beatless intervals within the harmonic context they hear. Benelli would have them conform their intonation to the fixed-pitch keyboard, thus making the entire ensemble accept a compromised tuning system.[55] In effect he is asking

[54] As a champion of Zarlino's theory, Benelli carries forward Zarlino's inability to resolve the inherent conflict between pure intervals, mathematically and rationally justified, and the tuning of contemporary instruments. Zarlino's solution was to have two different tuning systems, one for vocal music with more consonances, and the other for instrumental music that followed the fixed-pitch limitations of the keyboard repertoire. Michael Fend summarizes Zarlino's dilemma: "First, he redefined the notion of consonance by enlarging the number which contained the proportions of all the traditional consonances so that the new number would also include the proportions of thirds and sixths. Instead of the traditional number four, the *quaternario*, which had served in the Pythagorean tradition to define consonance – since it comprised intervals analogous to the proportions 2:1, 3:2, 4:3, 3:1 and 4:1–Zarlino chose the number six, the *senario*, because it also included the proportions of the thirds (5:4, 6:5) and of the major sixth (5:3). Second, he admitted that a tuning system created out of these intervals would have certain musical deficiencies and that it did not, in fact, coincide with the tuning of contemporary instruments. The inevitable tempering affected the status of the pure intervals, which now seemed deprived of any musical reality; it was therefore inappropriate for them to be at the core of the notion of interval and consonance." Michael Fend, "The Changing Functions of *Senso* and *Ragione* in Italian Music Theory of the Late Sixteenth Century," in *The Second Sense: Studies in Hearing and Musical Judgment from Antiquity to the Seventeenth Century,* ed. Charles Burnett, Michael Fend and Penelope Gouk (London: The Warburg Institute of the University of London, 1991), 199-221.

[55] There were attempts to construct keyboards with tuning options that could accommodate just intonation intervals from any diatonic key. Bottrigari was impressed by the theories of Vicentino, although it is unlikely that he understood his work completely. From Vicentino's perspective, all pitches in the diatonic, chromatic and enharmonic genera should be available to the instrumentalist, including the keyboardist. In 1555 he even devised a microtonal keyboard instrument called an *archicembalo* that could produce pure intervals in all keys. With thirty-six keys for each octave, this was more of a theoretical option than a useful instrument. His goal was to provide the pure intervals of just intonation so every harmonic triad would be completely consonant, but the resulting number of extra keys and an extra keyboard to accommodate those pitches was a drawback for production and common use. Vicentino also developed a marking for inflected pitches in published madrigals, using one to three small dots above particular notes to indicate the desired degree of pitch inflection. Maria Rika Maniates, "The Cavalier Ercole Bottrigari and His Brickbats: Prolegomena to the Defense of Don Nicola Vicentino against Messer Gandolfo Sigonio," in *Music, Theory and the Exploration of the Past*, ed. by Christopher Hatch and David Bernstein (Chicago: University of Chicago Press, 1993), 137-188.

musicians to override their natural instinct in order to conform to a system of tuning based on theoretical constructs. Assuming that all of our hypothetical performers could accomplish this for our instrumental piece, would the intonation then be better? It would only be better in the way that solo keyboard music sounds in tune, even though that is always a compromised solution. But it would be more consistent. And would a cellist's placement of his finger on a string be affected by an understanding of the conflicts between different systems of temperament and ways to accommodate a series of super-particular ratios within a sounding octave? That is, if the theory could be understood, would our hypothetical cellist correct it? There is no clear answer to this in the dialogue.

Bottrigari, however, does present his model for good intonation. It is briefly described at the end of the dialogue, and essentially is an observation that performers trust their ears. To reach consensus in an ensemble, all of the musicians need to be trained to hear the same relationships. The model for this idea was formed when Benelli heard a performance of concerted music by the twenty-three nuns of St. Vito in Ferrara:

> When you watch them come in... to the place where a long table has been prepared, at the end of which is found a large clavicembalo, you would see them enter one by one, quietly bringing their instruments, either string or wind. They all enter quietly and approach the table without making the least noise and place themselves in their proper place, and some sit, who must do so in order to use their instruments, and others remain standing. Finally the Maestra of the concert sits down at one end of the table... with a long, slender and well-polished wand..., and when all the other sisters clearly are ready, gives them without noise signs to begin, and then continues by beating the measure of the time which they must obey in singing and playing. And at this point... you would certainly hear such harmony that it would seem to you either that you were carried off to Heliconia or that Heliconia together with all the chorus of the Muses singing and playing had been transplanted to that place.... They played cornetts and trombones which are the most difficult of musical instruments…with such grace, and with such a nice manner, and such sonorous and just intonation of the notes that even people who are esteemed most excellent in the profession confess that it is incredible to anyone who does not actually see and hear it. And their passagework is not of the kind that is chopped up, furious, and continuous, such that it spoils and distorts

> the principal air, which the skillful composer worked ingeniously to give to the *cantilena*; but at times and in certain places there are such light, vivacious embellishments that they enhance the music and give it the greatest spirit.[56]

Perhaps these musicians reached a consensus on intonation by always playing and singing with the same colleagues and working under the direction of the *maestra* Sister Rafaella. Perhaps the process of "trusting one's ears" at that time represented a practice that is the most natural, the most instinctive, giving the kind of resonance that makes concerted music so powerful. Benelli does not specify how this is done, only suggesting that the "perfection of consonances" was achieved in performance. He concedes that even if musicians intellectually understood all of the ratios of intervals, whether consonant or dissonant, that understanding would not guarantee correct execution of those ratios in practice. Rather it is primarily within the context of regular rehearsal that good intonation for concerted music is achievable. The challenge of reconciling the many possible aesthetic judgments about intonation would then have been solved by training all of the members of the consort to adhere to the tuning decisions dictated by the leader. Whether or not the *maestra* Sister Rafaella understood ratios and tuning systems, it is clear that she and the nuns did know how to fix tuning issues so the audience heard the perfection of consonances.

There also could be other factors that suggest that good intonation of the nuns was more than just the product of discipline and consistent practice. It may have also been influenced by the widespread use of meantone tuning for organs and harpsichords during

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[56] Bottrigari, *Il Desiderio*, 57-59. Confirmation that this ensemble was mixed vocal and instrumental is found in a discussion of these famous concerts. "Nothing was said about the repertoire, but Giovanni Maria Artusi also attended these concerts and noted that the ensemble included cornetti, trombones, violins, viole bastarde, double harps, lutes, cornamuses, flutes, harpsichords and singers." Karin Pendle, "Musical Women in Early Modern Europe," in *Women and Music: A History*, ed. Karin Pendle, 2nd ed. (Bloomington: Indiana University Press, 2001), 70.

this style period. Meantone tuning provides at least seven pure thirds for triadic harmonies, providing the most resonance in the vertical sonority of the major triad. If their consort compositions were harmonically conservative with the counterpoint emphasizing the triads of the meantone tuning, there would be fewer opportunities for disagreement.

Good intonational practice may have also been related to the vocal basis for instrumental polyphony in the sixteenth century. Since church musicians usually began their studies as singers and instrumental performance became a secondary mode of performance, the primary pitch placement ideal would have been vocal, with pure intervals. Although the repertoire for the performances of the St. Vito nuns was not recorded, it is likely that the polyphony was generally non-modulating, and this would have contributed to the stability of pitch choices. All of these factors hinge on the human desire for the sonority of the pure major third and the natural resonance of triads built upon that purity. That sonority is simply an acoustical fact of the just intervals of the harmonic series and I am suggesting that what Bottrigari recognized was not its mathematical purity, but its acoustical desirability. Even if one could have convinced musicians to match the objective standard of the stable fixed-pitch instruments, without pure thirds in their triads they still would not have given the pleasure of the "perfection of consonances" he so admired.

I am suggesting that Benelli's answers to Desiderio's questions would not have fully explained why the instrumental ensemble he had just heard was so out of tune, nor would have his proposd solutions actually made the ensemble sound better. Even if the musicians understood the mathematical elegance of beatless ratios, there is no reason that

knowledge would result in a different intonation scheme for the instrumental repertoire. Benelli's answers failed to recognize the factor of just intonation and the effect of pure intervals on one's perception of "in-tune-ness." The persistence of just intonation in musical practice extended well beyond the sixteenth century, and is the norm even today for many cultures. By no means of purely antiquarian interest, just intonation is a compositional factor for twentieth-century composers such as Harry Partch and Lou Harrison. Acceptance of tunings other than equal temperament is also a factor as non-Western music establishes a presence in European and American culture. In performance styles where vibrato is occasional, for example the jazz styles of *a capella* groups or popular and country music styles, intonational purity through just intonation intervals is the norm. Just intonation was the way musical intervals were tuned until the nineteenth century when other tuning options became more common. This was largely due to the ascendancy of the piano and a repertoire that was characterized by increased modulation. By the early twentieth century the "intonational panacea" of equal temperament had become standard.[57] As W. A. Mathieu describes it, the "obfuscation of resonance" is the steep price paid for the dominance of fixed-pitch tuning.[58] It is with re-examination of the

[57] "Intonational panacea" is a description offered by Douglas Leedy regarding the acceptance of equal temperament. He does trace resistance to equal through Western music history, citing the compositions of Harry Partch and Lou Harrison as champions of just intonation. Leedy also notes that directors of wind ensembles in America favor just intonation for all chords from simple triads to thirteenth chords. Douglas Leedy, "The Persistence of Just Intonation in Western Musical Practice: Part I: Just Intonation in Western Music History, Music Theory and Acoustics," *1/1 The Journal of the Just Intonation Network* vol. 11 (2004): 12-24 and "The Persistence of Just Intonation in Western Musical Practice: Part II: Just Intonation in the Teaching and Performance of Music,"*1/1 The Journal of the Just Intonation Network* vol. 12 (2005): 4-19.

[58] W. A. Mathieu, *Harmonic Experience: Tonal Harmony from its Natural Origins to its Modern Expression* (Rochester, VT: Inner Traditions International, 1997) 137.

early music repertoire and appropriate performance practice that a reconsideration of ubiquitous equal temperament has begun.

Even in the mid-eighteenth century, when stylistic changes had influenced keyboard tuning and the new circulating temperaments provided more usable keys, accurate ensemble intonation was still a challenge and pure intervals still desired. Examples of audience reaction to intonation are rare, and revealing comments, especially those about quality of sound or purity of intonation, are difficult to find. Yet the ones that are still available to us are compelling. Barbieri cites several unpublished sources in his 1991 article "Violin Intonation: a Historical Survey," including some that indicate that both audiences and performers expected pure intervals, especially at cadences. In this observation by the French physicist Charles Hébert, it is clear that the response to that final moment of pure intonation is visceral:[59]

> Italians are not so far removed from the use of enharmonic notes as the French; I have formed this opinion looking at the joy that suddenly appears on the face of a whole Italian audience, in a sinfonia or concerto, when one of these notes is played: in an instant all of them exclaim *Viva!*, even if they are in a church....[60]

Descartes' Perspective

The process of inflecting a pitch slightly more sharp or flat to cause a final consonant interval to be beatless (or "pure") is an example of choices the performer makes in performance and, if Hébert's observation is typical, one that is valued by the

[59] Citing the almost complete lack of published sources, Barbieri acknowledges the difficulty of documenting the history of performance practice. "In this article I shall therefore depend mainly upon unpublished sources of practical or experimental origin, including some that concern singing. Indeed, these are the only documents that provide a secure point of reference in so foggy an area. They show that violinists of all schools, at least until the middle of the 18th century, played in just or in meantone intonation; moreover, the Italians, especially during Corelli's time, enjoyed playing in quarter-tones." Barbieri, "Violin intonation," 76.

[60] Ibid, 76.

listener. But the process of choosing inflected pitches is rarely discussed in pedagogical literature or music theory. It is in the science of music, initiated in the seventeenth century by the natural philosophers like Bacon and Descartes with their new epistemological stance, that the realities of performance are addressed. As mathematicians developed logarithmic descriptions of the continuous pitch spectrum, the connection between the experience of performers and the calculation of accurate pitch placement was clarified, at least theoretically. In musical practice, inflected pitches may have reflected the artistry of the performer but in the music theories of the seventeenth century before Descartes, there was no method for describing the process. Descartes' description of choosing pitch for intervals provides an image of that process, supported by mathematical calculations that describe the continuous spectrum of pitches available.

Descartes' approach begins with an analysis of rhythm and pitch, two attributes of sound that are essential for music.[61] In studying pitch, he analyses intervals in context, assuming the point of view of the singer or player performing one line in a polyphonic composition. From this perspective he notes that to find one's next new pitch, one's ear is hearing its possibilities chiefly in relation to what is currently being sounded. This perspective was unique for its time, indeed, is new even today. In this way, Descartes' analysis of intervals becomes a kind of performance practice, not a formulation of a just diatonic scale or any of the temperaments related to just intervals. For him "just intonation" refers to a pure, beatless interval and can be formed between any two pitches of any two lines in a polyphonic composition, either harmonically or melodically.

[61] Descartes' approach is discussed and analyzed in detail in Chapter III. For the purposes of comparison to Bottrigari's analysis of intonation problems, the relevant points are the adherence to just intonation, the changing vertical relationships that result from choosing consonant relationships in context, and that the melodic intervals that result from this process will ultimately be of different sizes.

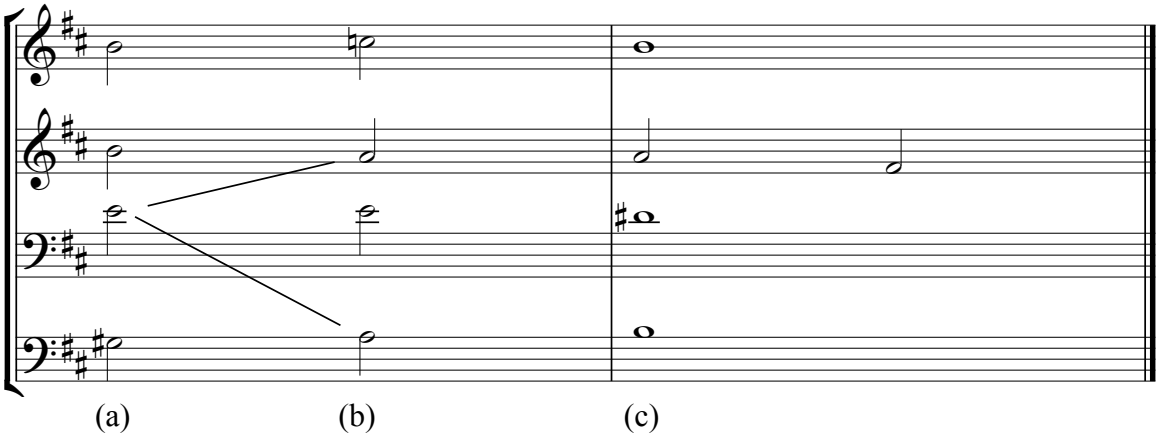
Descartes describes six consonant intervals, the *senario* of Zarlino, and reproduced in Table 2.4 below. These six pure, beatless intervals are described both as a ratio and in cents. A performer, however, would not describe them in these terms, but simply hear them as pure intervals.

Table 2.4. The Just Intonation intervals of Descartes' *senario.*

Senario interval	as ratio	in cents
--Major Sixth	10:6	884.36 cents
--Minor Sixth	8:5	813.69 cents
--Fifth	6:4	701.96 cents
--Fourth	4:3	498.04 cents
--Major Third	5:4	386.31 cents
--Minor Third	6:5	315.64 cents

If Descartes' methodology were applied to the D sharp-F sharp choices in the second measure of Example 2.2 above (page 38), the performers would need to focus on the harmonic character of the prevailing harmony they are hearing and then project from that the most probable placement of their next pitch. It is this process of finding and establishing consonance in horizontal relationships that distinguishes Descartes' approach. At a quick tempo the tenor line player could place his D sharp as a pure fifth above the G sharp in the bass line of the first measure. He would be following his "ears," finding the closest consonant relationship that would include the D sharp. This solution assumes a rapid tempo, one where the D sharp could still be heard as part of the G sharp harmonic frame. However if this composition is performed at a slower tempo, then other

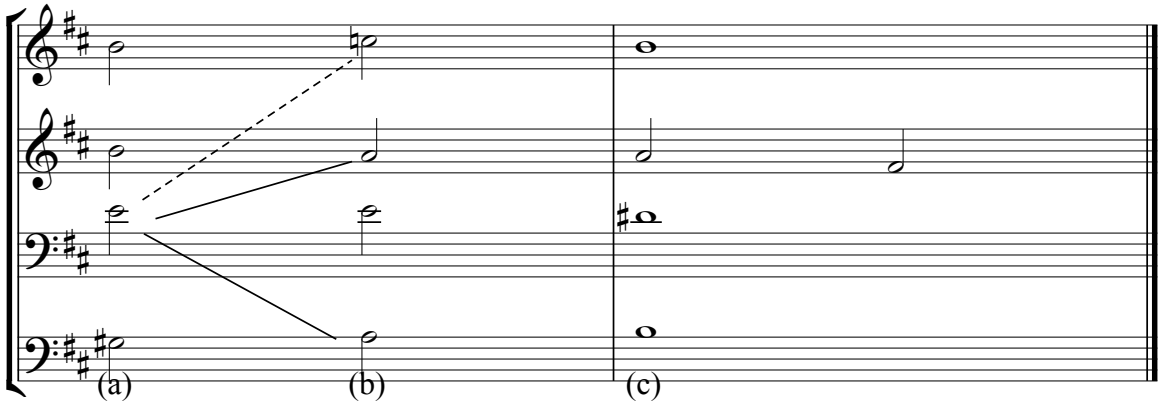
consonant relationships come into play and the placement of the D sharp against G sharp is less apparent because other consonant relationships are more apparent in the aural context. In Example 2.3 below, the alto line player situates his A on beat three of the first measure (chord b) as a pure interval of a fourth in melodic relationship to the E in the tenor part. Since chord b at a slow tempo will have obscured the sound of chord a, he cannot use the B of the soprano or alto lines or the G sharp of the bass line of chord "a" as reference pitches. Since the interval B to A in the alto line is a melodic second, the B is also precluded from being used as a reference pitch.[62]



Example 2.3. Reference pitch for octave As of second chord.

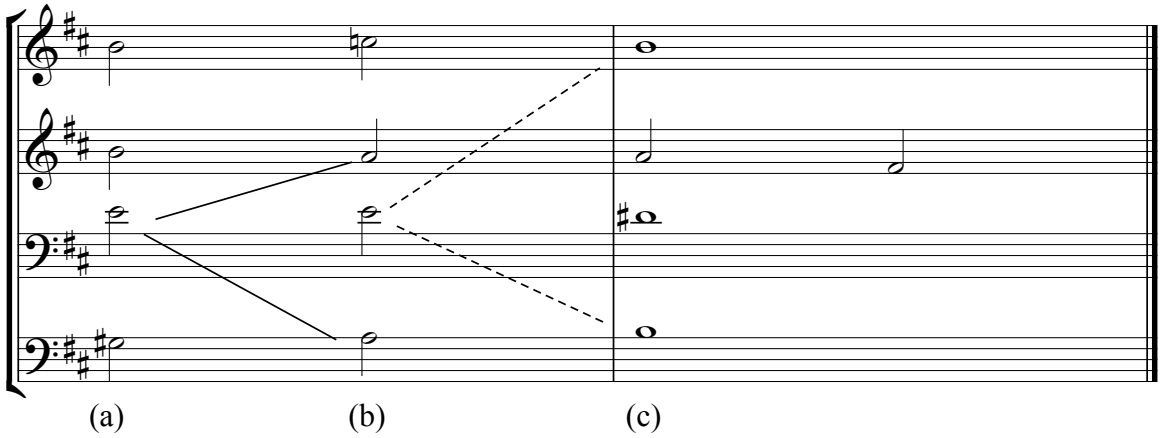
The soprano line player, a violinist in this hypothetical example, would then choose the pitch of the C (in chord b) as a pure, beatless minor sixth above the E in the tenor of chord a. Example 2.4 demonstrates this relationship.

[62] Descartes shows dissonance to be a melodic event, a result of the performer's pitch options after all of the consonant intervals have been chosen. Because the intervals of a second or a seventh are not in the consonant group, their sizes in cents are variable. This process is discussed fully in Chapter III. The various options for the intervallic size of a second are listed in footnote 81, page 66 below.



Example 2.4. Reference pitch for melodic C natural of second chord.

For chord c, the tenor E of chord b is the reference that controls the placement of the Bs in the soprano and bass lines of chord c. They each will form pure intervals in relation to the tenor E as indicated in Example 2.5 below.



Example 2.5. Reference pitches for octave Bs of second chord.

But, the D sharp of chord c does not have a consonant reference point in chord b. Forming an augmented second with the C in soprano, a tritone with the A in bass and alto and a half step with the previous E, it cannot refer back to a consonant relationship and

thus becomes one of those "variable" or wild card pitches. Descartes does not give a clear solution for placement of dissonances like this D sharp. He only notes that the pitch can be heard at many different points on the pitch spectrum. Leaving options open to the performer is one way that Descartes' mechanical understanding differs from that of the music theorists described in Bottrigari's dialogue. Working within a rational scale system, they would not have conceived of a dissonance as an expressive wild card.

These hypothetical examples serve to illustrate the performance model that Descartes suggested in the *Compendium*. His purpose in writing the *Compendium*, however, was not primarily to describe what a musician experiences but to use that experience as evidence of the sensory foundations of sound and intonation. His purpose also did not include making an investigation of acoustical phenomena, although his image of intervallic relationships did indicate an awareness of some aspects. For example, he noted that a lower pitch contains all of the higher pitches, just as a low string on a lute generates higher pitches that we identify as overtones. He left the explanation of this to the physicist. He also did not refer to a monochord for establishing ratio or finding the location of pitches. Rather, he formed the image of a circle (his *circulus*) with the outer circumference representing the acoustical space of an octave and the divisions within it representing various arrangements of the *senario* intervals listed above. The octave boundary created by the *circulus* image parallels the performer's own unison boundary. Whatever the harmonic or melodic structure in a composition, tonal practice relies on the primacy of the tonic and its octaves. Descartes acknowledged this when imagining the intervallic space occupied by a combination of consonant intervals and realized that within the octave boundary there will always be a very small interval

remaining. This he called a "schisma" and used it to explain the modifications of dissonant intervals that occur as melodic events in a performance within the *circulus.* [63]

Two figures from his *Compendium* illustrate this point. Figure 2.3 is Descartes' image of the octave and Figure 2.4 a reconstruction with intervals in cents added.[64] The numbers on the circumference (C at 360, D at 324, E at 288) are not pitch values in cents, but rather are arbitrary numbers that Descartes chose in order to avoid fractions in his calculations. The larger numbers represent lower pitches. The diagram shows all of

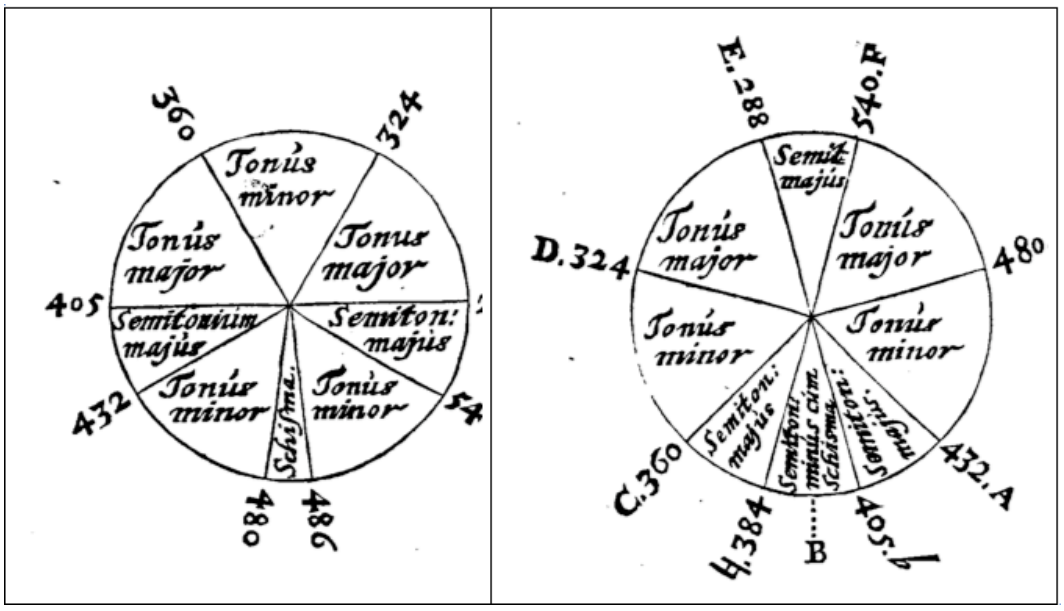


Figure 2.3. Descartes' division of the octave, *Compendium musicae* (1656), 18.

[63] Descartes is using "schisma" to literally mean "split." A schisma (1.9537 cents) today refers to the difference between a Pythagorean comma and a syntonic comma. Descartes' schisma of 21.51 cents is now called a syntonic comma.

[64] René Descartes, *Compendium musicae*, (Amsterdam: Joannem Janssonium juniorem, 1656) http://erato.uvt.nl/files/imglnks/usimg/e/e3/IMSLP73778-PMLP147962-Descartes_1656.pdf (accessed January 18, 2011), 18.

the diatonic pitches contained within the octave. By arranging the half-steps and whole-steps (semi-tones and tones) in different positions he is suggesting the "double function" of the movable schisma. It can be append to tones or semi-tones, inflecting the pitch of those intervals.

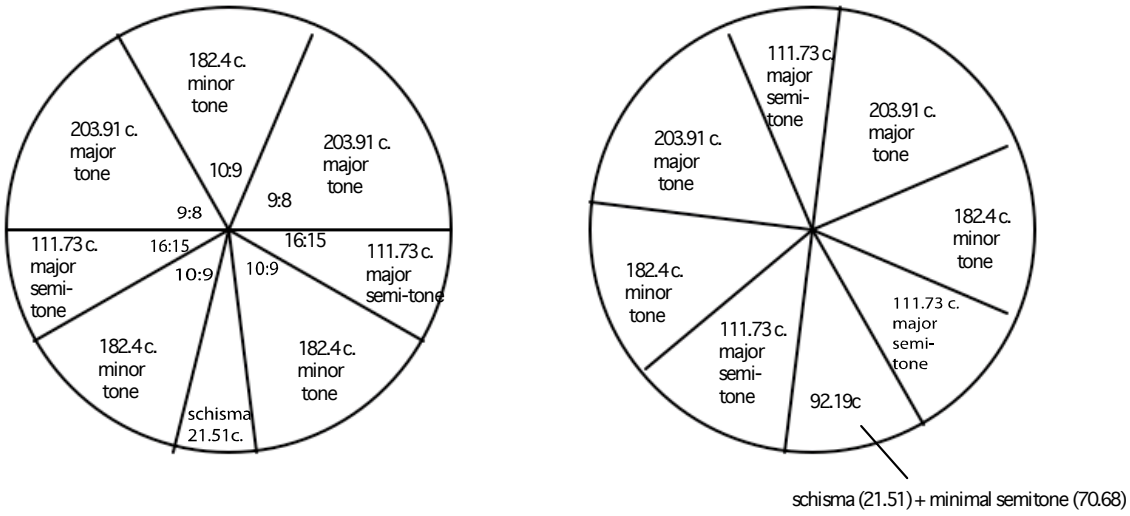


Figure 2.4. The same images as in Figure 2.3, with the addition of interval sizes in cents.

Descartes' explanation is as follows:

> since the octave contains two semitones and two minor whole-tones, it should also contain four major whole-tones in order to avoid fraction of intervals. But actually the octave contains only three major whole tones, and we are forced somewhere to use a fraction which equals the difference between a major whole-tone and a minor whole-tone. This difference we call a schisma, an interval also equal to the difference between a major whole-tone and a major semi-tone. The latter difference equals a minor semitone plus a schisma. With the help of these fractions the major whole-tone itself becomes, so to speak, somehow movable and capable of performing a double function. This can easily be seen in the illustration, where we have turned the space of a whole octave into a circle....[65]

[65] René Descartes, *Compendium musicae* [Amsterdam, 1656], trans. Walter Robert (n.p.: American Institute of Musicology, 1961), 32.

Descartes' imaginative representation of how performers in an ensemble actually move from one pitch to another is based on his sensory understanding of intervals and explained mathematically and geometrically in the *Compendium.* Descartes assumes that the natural inclination of the human ear is to hear, seek and perceive these pure consonances as a musician is playing. With this perceptual skill the performer is able to choose his next consonant pitch in relation to the one he currently hears, and he chooses those pitches according to the limits of the six pure intervals listed.

In Chapter III it will be clear that Descartes does not articulate the logarithmic calculations explaining this process, but his diagrams are clearly conceived from that mathematical description of a continuous pitch spectrum. The focus here is the experience of good intonation, and what a performer needs to know to achieve it. Descartes' approach begins with the senses and ends with a model of intonation practice that is different from anything that came before. His non-compositional, non-aesthetic and non-cosmological approach is the result of understanding musical intervals primarily in a 'scientific' way, as mathematically precise relationships within the octave. His perspective attempts to replicate the experience of the performer moving from one pitch to another, reacting to the tonal matrix of each phrase, and fitting his part into the web of harmonic and melodic movement. Playing from a part-book, the performer does not have or need a visual cue for knowing what precise pitches to play. The natural ability of the musician's hearing is the guide. Descartes' contribution to the question of good ensemble intonation is to provide a theoretical description of how intervals figure into the process of finding consonant pitches, and to account for the variations in pitch that occur in performance. He describes in a unique way the very issue that concerned Bottrigari,

showing how musicians in performance must rely on their ears, not on abstract theory. Intonation is experienced within the harmonic/melodic nexus, and as Descartes explains with his image of the intervals moving within a continuous pitch spectrum around the *circulus*, intonation can be varied according to the musical context. It is the decisions about these potential variations that are resolved in rehearsal and then presented in performance. If successful, the audience may even respond with "Viva!"

CHAPTER III

DESCARTES' DESCRIPTION OF INTONATION AS A PERFORMANCE PRACTICE

> Too much that has been written about temperaments and intonation, and is still being written about them is based on *a priori* theory instead of on the technique of composition and the performance of music to the satisfaction of the musical ear. The ear's estimate of intervals is at best an approximation, though in favourable circumstances it may be a very close approximation. This should be borne in mind in considering all that has been written above about mutable notes. In musical performance the comma must be thought of as a somewhat elastic interval, not as the problem it presents to the tuner of a keyboard instrument.[66]
>
> L. S. Lloyd, "Just Intonation" in *Grove's Dictionary of Music and Musicians,* 1954

The Comma as an Elastic Interval

The *Compendium musicae* presents an example of just what Lloyd had suggested, albeit three hundred years after the publication of the *Compendium* in English. Not only does Descartes in his images and commentary represent the comma as a "somewhat elastic interval," he also begins without reference to previous theories and appeals to the authority of the "musical ear" as the arbiter in questions of musical satisfaction. In this way Descartes signals a clear break from number mysticism and other *a priori* perspectives, and focuses only on sound and the attributes of musical intervals. He names duration and pitch as the essential elements of sound. He demonstrates both acoustically and geometrically that the octave contains all consonances within it. He also was the first to quantify musical pitch as existing on a continuous spectrum and to show how intervals

[66] Llewelyn S. Lloyd, "Just Intonation" in *Grove's Dictionary of Music and Musicians*, ed. Eric Blom, 5th ed. (London: MacMillan, 1954): 682.

were positioned along that continuum.[67] The comma functioned not as a problem to overcome in tuning, but as a moveable element that changed the size of intervals within the octave, treating intervals not as discrete, absolute entities, but as a series of relationships within a musical context. His circle diagrams of the pitch spectrum are images that synthesize and analogize the proportional relationships of intervals, depicting for the first time a means of accurately describing musical practice. Benjamin Wardhaugh notes the importance of Descartes' perspective in his study of mathematicians of the seventeenth century and their efforts to find a precise theory of musical tuning:

> René Descartes seems to have been the first person to assemble the necessary tools and solve this problem of the relative sizes of musical intervals, a problem which he approached through its implications for the visual representation of musical intervals in a precise and coherent diagram.[68]

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[67] Dutch mathematician Simon Stevin had described a continuous pitch spectrum in 1605, showing that the equal division of the octave was possible. However, his calculations were given as a demonstration of an abstract mathematical system that was not related to any particular musical practice or to any acoustical division of the octave. Cohen, *Quantifying Music,* 34-51.

[68] Wardhaugh reviews the issue of musical pitch as discrete or continuous: "...the 'Pythagorean' tradition in mathematical music theory identified musical intervals with mathematical ratios, and that identification became a foundation for the mathematical study of music in the Middle Ages and into the seventeenth century, finding renewed strength in the coincidence theory of consonance, which, though flawed, attempted to provide a mechanical rationale for such an identification. This quantification of pitch made it rather difficult to establish the relative sizes of different musical intervals, an operation which seems often to have been desired by mathematical music theorists. Of course, say, an octave is larger than a fifth, as 2:1 is larger than 3:2, and two fifths are larger than an octave, as $(3:2)^2$ is larger than 2:1. But what precise relationship do the octave and the fifth bear to one another? How much larger is one than the other? There must surely be some multiple of a fifth which is exactly equal to an octave, some power to which we can raise 3:2 to produce exactly 2:1. There is such a number–and it happens to be log (3/2)/log(2/1)–but finding it rested on two ideas which were unavailable to the ancient Greeks, or indeed to any musical theorist before the second decade of the seventeenth century. These were the logarithm, without which it was infeasible to compute the relative sizes of two ratios or musical intervals, and very hard in most cases to conceptualize quantity, and therefore that there was some meaning to be assigned to non-integer and indeed irrational multiples of the sizes of intervals. René Descartes seems to have been the first person to assemble the necessary tools and solve this problem of the relative sizes of musical intervals, a problem which he approached through its implications for the visual representation of musical intervals in a precise and coherent diagram." Benjamin Wardhaugh, *Music, Experiment and Mathematics in England, 1653-1705,* 36-37. The Greeks, according to Borzacchini, actually had considered the 'cognitively unnatural' concept of the continuum, but had never addressed it in musical contexts. See Luigi Borzacchini, "Incommensurability, music and continuum : a cognitive approach," *Archive for History of Exact Sciences* 61, no. 3 (2007), 273-202. http://www.metapress.com.libproxy.uoregon.edu/ content/k468056017l25637/ (accessed July 2, 2011).

Descartes also shows how musicians conceive of consonant relationships as they move from one harmonic point to the next. In his description of how intervals are created he describes a method that is not bound to any one diatonic scale pitch level, but instead shows pitches moving throughout a continuous pitch spectrum. He shows the *circulus* procedure by means of a diagram, where the circumference of a circle represents the octave and within that boundary musical pitch can become a continually moveable and measurable quantity. Descartes' unique perspective on intonation not only addresses the way performers manipulate pitch relationships, but also shows how melodic dissonances stand in relation to harmonic consonances. Following comments on the history of the *Compendium* and an overview of its contents, the rest of this chapter is an examination of the chapters of the *Compendium* that describe the *circulus* procedures and application of Descartes' analytical approach to musical examples.

The *Compendium musicae* in Context: Beeckman's Challenge

Remarkable as it is, establishing a new paradigm in music theory was not Descartes' ostensible goal in writing an essay on music. Describing the continuous pitch spectrum and showing how musicians work within it was merely one result of his conversations with Isaac Beeckman, who had challenged Descartes to develop explanations for how many things, including musical intervals, work. Beeckman had posed three challenges to Descartes: 1) to understand musical intervals in a scientific way, 2) to form a kinematic description of uniformly accelerated motion and 3) to explain problems in hydrostatics. The two men had met in November of 1618 in Breda, and

formed a friendship based on mutual interest in mechanics and music.[69] Beeckman's own approach to problems was inherently practical, with little regard for metaphysics or teleological explanations.[70]

Whether or not Descartes took his methodology from Beeckman or developed it on his own is the subject of recent scholarship on the early works of Descartes.[71] The *Compendium musicae* was not a polemic, but simply an essay concerning the first

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[69] On November 18, 1618 Descartes was in Breda on a family errand and was reading a placard about a mathematical problem. It was written in Flemish, and Descartes asked Beeckman, who was also standing there reading it, to help translate for him. In his diary Beeckman noted that Descartes impressed him as a rare find, someone who was a physico-mathematician and the only other person in Breda who spoke fluent Latin. Their conversation began with comment on the correct solution of the mathematical problem presented there. Beeckman was seven years older than Descartes, and had studied medicine and theology but made his living by making candles and supervising the installation of water conduits. He also had taught Latin in Utrecht, Rotterdam and Dordrecht. At the time of their November 1618 meeting, Descartes had completed his education at the French Jesuit school at La Flèche, had studied law at Portier, and was at the time serving in the army of Prince Maurice of Nassau as a gentleman soldier. Not happy in the Army because much of the time he was bored and surrounded by uneducated soldiers, the chance meeting with Beeckman and the intellectual stimulation of their friendship was a deciding factor in Descartes becoming a natural philosopher rather than a lawyer or a professional soldier. Gaukroger presents a detailed study of the influences of schooling at La Flèche and the experiences in the Army of Prince Maurice. Stephen Gaukroger, *Descartes: An Intellectual Biography* (Oxford: Oxford University Press, 1995).

[70]John Schuster sums up Beeckman's approach as moving from the macroscopic to the microscopic level. Quoting from his dissertation: "No mechanic would appeal to teleological processes, occult virtues or immaterial causes to account for the functioning of a simple mechanical device. Explanations in the mechanical arts rested on the appeal to a clear picture of the structure and interaction of the constitutive parts of the apparatus. His central contention was that there is no point in talking about effects if you cannot imagine how they are produced, and the exemplar of imaginatively controlled efficacy is the mechanical arts where men do command nature at the macroscopic level…." John A. Schuster, *Descartes and the Scientific Revolution, 1618-1634,* Princeton University Ph.D. Dissertation. University Microfilms reprint, 2 vol. Ann Arbor, 1977, 59.

[71] There is some evidence that Beeckman did more than challenge Descartes. Basing his study on Beeckman's own journal entries and on correspondence with Mersenne, Klaas van Berkel shows Descartes' indebtedness to Beeckman for his mechanical approach to addressing philosophical questions. Klaas van Berkel, "Descartes' debt to Beeckman: inspiration, cooperation, conflict," in *Descartes' Natural Philosophy*, ed. Stephen Gaukroger, John Schuster and John Sutton (London: Routledge, 2000), 46-59. This collection of essays reflects new studies of Descartes' natural philosophy, placing his work in relation to his immediate predecessors and his contemporaries, and showing how his perspective evolved in response to achievements by both his supporters and detractors. These essays also address the subsequent misunderstanding of natural philosophy as a method of inquiry in the seventeenth century. Looking at Descartes' early work in context, one must consider his interest in anatomy, in mechanics and studies of motion, in physiology, psychology, ethics and the management of the passions, and in the rhetorical nature of his presentations. It is especially in the area of cognition and the nature of mind that Descartes' earlier work reflects a natural philosopher's perspective, rather than the dualism that dominates his later publications and commentaries on them.

challenge. It was sent to Isaac Beeckman in January 1619 as a token of friendship and as a response to Beeckman's suggestion that mathematics combined with natural philosophy could provide a better way to show how things worked. Such a response could have been expected, given the relationship that had developed between the two men around this time.[72] Notes in Beeckman's diary indicate that the challenges regarding falling bodies and hydrostatics were also answered, but never published. The *Compendium musicae*, however, was known to Marin Mersenne and copied before Beeckman's death by Constantijn Huygens and at least three others. It was eventually published in 1650 in Brussels, and it is from this source that all extant copies are derived.[73]

The *Compendium musicae,* a slim volume of only fifty-eight pages, is not a comprehensive work of music theory. Rather, it is presented as an inquiry, a process of discovering through descriptive analysis the claims that can be made about musical intervals. Regarding method, Descartes moves from the general to the specific, first stating the essential characteristics of music and then the conditions for his discussion of intervals. In scope it addresses Beeckman's question about musical intervals with

[72] "Between November 1618 and early 1619, Descartes served what was effectively an apprenticeship with Beeckman. The routine seems to have been that, more often than not, Beeckman would set Descartes specific problems in mechanics and related areas, problems to which Beeckman himself knew the solution, and sometimes did not. But it was not just a teacher/pupil relationship. Beeckman was not an especially good mathematician, and he was keen to exploit Descartes' mathematical skills. Nevertheless, his contribution to the exercise was the more crucial, for he presented Descartes with a way of thinking about physical problems that was to form the basis for his own subsequent work in this area." Gaukroger, *Descartes: An Intellectul Biography,* 69.

[73] The original of the *Compendium musicae* has been lost, but there seem to have been at least four copies made before Beeckman's death in 1637, and two more before Descartes' death in 1650. Beeckman's journal from 1627 contains a rough copy with no diagrams. In 1635 Constantijn Huygens made a fair copy that included the diagrams, and this is the probable source for van Schooten's copy. Seventeenth-century sources available today include five in Latin, one in French and one in English. Most authorities suggest that the source for the first printing in 1650 is the 1641 copy made by Frans van Schooten. Facsimile sources for this paper include the 1650 Utrecht print, the 1656 Amsterdam print, the 1692 Frankfurt print, and the 1653 English print with animadversions. Modern translations available in English by Walter Robert (1961) and in French by Frédéric de Buzon (1987). The history of the document and its transmission is available in the preface to the French translation by Frédéric de Buzon.

definitions and detailed diagrammatic descriptions of how intervals are formed as contrapuntal events, with both melodic and harmonic function. His analysis of intervals is presented with both mathematical and diagrammatical descriptions as the first step in the process of understanding consonance and dissonance. Some other aspects of sound are cited but not addressed. The task of analyzing quality of tone and the acoustical principles involved in creating and sustaining sound is, according to Descartes, the "domain of the physicist." Assessing the emotional effect, the meaning or value of intervals is, as Descartes clearly states, beyond the scope of his "small volume." He does not deny that there are emotional effects or that they could be addressed, but he chooses not to address them here. In the final paragraph of the *Compendium* Descartes indicates the limits of his inquiry:

> Should I be forced to deal in detail with the various emotions which music can arouse, it would be necessary to show which steps, consonances, meters, etc. are instrumental in arousing these emotions. But this would exceed the scope of this small volume.[74]

Descartes never does return to this topic in his later writings.[75]

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[74] René Descartes, *Compendium musicae* (Amsterdam, 1656), trans. Walter Robert (Rome: American Institute of Musicology, 1961), 52. Robert's source is: "...et iam quidem sequeretur ut de singulis animi motibus, qui à Musica possunt excitari, separatim agerem, ostenderemque per quos gradus, consonantias, tempora, et similia debeant illi excitari, sed excederem compendii institutum" *Renati Des-Cartes Musicae Compendium* (Amsterdam: Joannem Janssonium juniorem 1656), 34. IMSLP73778-PMLP147962-Descartes_1656.pdfAmsterdam, under http://imslp.org/wiki/Musicae_compendium_%28Descartes,_Ren%C3%A9%29 (accessed Sept 10, 2010). The Utrecht printing, representing the first transmission for the general public and the source for the Amsterdam print, has identical wording and is used as the primary source for this dissertation. *Renati Des-Cartes Musicae Compendium* (Utrecht: Gisberto à Zÿll and Theodori ab Ackersdÿck, 1650), 57. ISLP109391-PMLP147962-Trajectum_ad_Rhenum.pdf, under http://imslp.org/wiki/Musicae_compendium_%28Descartes,_Ren%C3%A9%29 (accessed August 8, 2011).

[75] There are several places in the *Compendium* where the effects of music are referenced. In the discussion of meter he notes that tempo is a factor in evoking emotional response, but that a thorough discussion of this depends on a study of the "motions of the soul" and this is beyond the scope of this discussion. Again, in the final paragraph of his discussion of the consonant intervals of sixths and thirds, he notes the emotional effects of certain intervals, but says this topic exceeds the limits of the *Compendium*. Again, at the very end of the book in the penultimate paragraph, he notes that "to show which steps, consonances, meters, etc. are instrumental in arousing emotions" exceeds the scope of his work.

Descartes' Topics

The *Compendium* is organized according to topic, with brief titles heading each of the thirteen sections.[76] He begins with the nature of musical sound, then examines how sounds are organized in time, and finally discusses sound as heard in two-voice intervals or dyads. The first topic is presented under the heading "*Hujus objectum est Sonus"* with three paragraphs defining music both in substance and in quality:[77]

> The basis of music is sound; its aim is to please and to arouse various emotions in us. Melodies can be at the same time sad and enjoyable; nor is this so unique, for in the same way writers of elegies and tragedies please us most the more sorrow they awaken in us.

This is followed directly by a statement of means, then limitations:

> The means to the end, i.e. the attributes of sound, are principally two: namely, its differences of duration or time, and its differences from high to low. The quality of tone (from what body and by what means it emanates in the most pleasing manner) is in the domain of the physicist.

In the third paragraph he ventures into more evaluation of the qualities and effects of sound:

> The human voice seems most pleasing to us because it is most directly attuned to our souls. By the same token, the voice of a close friend is more agreeable than the voice of an enemy because of sympathy or antipathy or feelings–just as it is

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[76] It is impossible to know whether the autograph of the *Compendium* was organized in chapters with headings, or whether these were added either by a later copyist or by the printer in 1650.

[77] Placing this statement as a chapter heading, signals Descartes' approach as a natural philosopher. The word *objectum*, usually translated into English as 'object' or 'basis', has in Latin the additional and specific connotation of an object presented to the senses. This choice of a specific term reflects that aspect of seventeenth-century natural philosophy emphasizing both external empirical phenomena and the function of the senses as organizing and interpreting those phenomena. An analysis of common misinterpretations of the term natural philosophy and of Descartes' role as a natural philosopher is given in the introduction to *Descartes' Natural Philosophy,* ed. Stephen Gaukroger, John Schuster and John Sutton (London: Routledge, 2000), 1-25. Using theories of sound as examples, H. Floris Cohen presents a more broadly contextual interpretation, articulating three ways that natural philosophy was developed in the early seventeenth century. H. Floris Cohen, "The Onset of the Scientific Revolution: Three Near-Simultaneous Transformations," in *The Science of Nature in the Seventeenth Century: Patterns of Change in Early Modern Natural Philosophy,* ed. Peter R. Anstey and John A. Schuster (Dordrecht: Springer, 2005), 9-33.

> said that a sheep skin stretched over a drum will not give any sound when struck if a wolf's hide on another drum is sounding at the same time.[78]

The second topic consists of procedures to be followed in the inquiry. Under the title "Praenotanda," Descartes lists eight numbered statements as prolegomena, stating his premises that will allow the logical connections to be made between the conditions of music he finds most perceptible "to the senses" and his conclusions based on the principles that govern that perception. First he states that it is through our senses that pleasure is experienced, and that in music that degree of pleasure is related to how easily sounds are understood. We experience more pleasure when the sound is easily grasped, being not too complicated but also not too simple. We also have more pleasure when there is variety in the presentation and when relationships are clearly understood. Descartes acknowledges that all sounds are not music, and that some sounds are too extreme and hurtful to be considered as music.

The next three topics cover the aspect of musical sounds in context, first as sound in time (meter and rhythm), then sounds in combination (high pitches and low pitches) and finally sounds in ratio (as consonances or dissonances). Descartes' observations on meter and rhythm, under the heading *De numero vel tempore in sonis observando,* are summarized in just three pages. Here he emphasizes principles of proportionality. Based

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[78] These three paragraphs are from the English translation, René Descartes, *Compendium musicae* (Amsterdam, 1656), trans. Walter Robert (Rome: American Institute of Musicology, 1961), 11. The Utrecht source (with italics for certain phrases) reads:

"Finis ut delectet, variosque in nobis moveat affectus, fieri autem possunt cantilenae simul tristes et delectabiles, nec mirum tam diversa. Ita enim elegiographi et tragoedi eo magis placent, quo majorem in nobis luctum excitant.

Media ad finem, vel *Soni affections duae* sunt praecipuae, nempe *hujus differentiae* in ratione durationis vel temporis, et in ratione intensionis circa acutum aut grave, nam de ipsius soni qualitate, ex quo corpore et quo pacto gratior exeat, agunt Physici.

Id tantum videtur vocem humanam nobis gratissimam reddere, quia omnium maxime conformis est nostris spiritibus. Ita forte etiam amicissimi gratior est quam inimici ex sympathia et dispathia affectuum, eadem ratione qua ajunt ovis pellem tensam in tympano obmutescere si feriatur, lupinâ in alio tympano resonante. *Renati Des-Cartes Musicae Compendium* (Utrecht, 1650).

on his claim that the senses are most pleased when ratios are easily perceived, he observes that time is organized into measures of either two or three units. In practice, rhythms are perceived only when there is an understandable proportion from which the entire rhythmic framework is extrapolated.

The topics of sounds in combination and sounds in ratio comprise the remaining forty pages of the book, beginning with "sounds high and low," then addressing consonance in octaves, fifths, fourths, thirds and sixths, and finally, summarizing movement from one interval to another. Descartes concludes the *Compendium* with a paragraph stating that these are not all of his ideas on the topic of intervals, but that he is forced to finish quickly and send it off so he can attend to his duties in the army.[79]

In describing dyads as the high and low sounds heard as a unit, Descartes summarizes in one paragraph the three ways intervals can be delineated:

> This may be considered chiefly in three manners, or wayes: either in sounds which are emitted at once and together from divers bodies; or in those which are emitted successively from the same voyce; or lastly, in those which are emitted successively from divers voyces, or sonorous bodies. From the first manner, arise

[79] The tone of Descartes' admiration of Beeckman is evident in this final paragraph. "iamque terram video, festino ad littus, multaque brevitatis studio, multa oblivione, sed plura certe ignorantia hic omitto, patior tamen hunc ingenii mei partum, ita informem, et quasi ursae foetum nuper editum, ad te exire, ut sit familiaritatis nostrae mnemosynum et certissimum mei in te amoris monimentum, hac tamen, si placet, conditione, ut perpetuo in scriniorum vel musaei tuo umbraculis delitescens aliorum judicia non perferat, quo, sicut te facturum mihi policeor, ab huius truncis partibus benevolos oculos non averterent ad illas, in quibus non nulla certe ingenii mei lineamenta ad vivum expressa non inficior, nec scirent hic, inter ignorantium militarem ab homine desidioso et libero, penitusque diversa cogitanti et agenti, tumultuose tui solius gratia esse compositum." *Renati Des-Cartes Musicae Compendium* (Utrecht, 1650), 57-58. Robert's translation reads: "I am already close to land and hurrying to the shore; I have omitted a great deal in an endeavor to be concise—much because I have forgotten, but most, without doubt, because of ignorance. Yet I permit the immature offspring of my mind to reach you although it is an uncouth as a new-born baby bear, to serve as a token of our friendship and as unmistakable proof of my love for you. I beg of you, however, that it remain forever hidden in the privacy of your desk or your library: it should not be submitted to the judgment of others. For they might not, as I trust you will, turn from these fragments and look with good will at those writings in which I can say that at least some characteristics of my talent find accurate expression. They would not know that this booklet was hastily written for your sake only, in the midst of turmoil and uneducated soldiers, by a man without occupation or office, busy with entirely different thoughts and activities." René Descartes, *Compendium musicae* (Amsterdam, 1656), trans. Walter Robert (Rome: American Institute of Musicology, 1961), 52-53.

> consonancies: from the second, Degrees: from the third, Dissonancies, which come nearer to Consonancies. Where it is manifest that in Consonancies the Diversity of sounds ought to be lesse, than in Degrees; because that would more tire, and disgust the Hearing in sounds, which are together emitted, then in those that are emitted successively. The same also, in proportion, may be affirmed concerning the Difference of Degrees from such Dissonancies, as are tolerated in relation.[80]

The first relationship is illustrated as A_1 (Figure 3.1 below) as an interval from sounds produced at the same time by two different sources. The second relationship, illustrated as A_2, is melodic, describing sounds produced successively by a single voice. The third relationship shown as A_3 is both harmonic and melodic; it describes sounds produced successively by two voices. In this description of pitch relationships for intervals, Descartes initiates the parameters of his tuning theory, claiming that the size and quality of dissonant relationships is dependent upon the stability of pure consonant intervals. Since harmonic intervals (those of type A_1) are to be made more consonant than melodic intervals, a result of performers moving naturally as much as possible from consonance to consonance, the resulting step-wise intervals are of variable size. Melodic intervals or "degrees" (those illustrated as type A_2) could be consonant if they were based on *circulus*

[80] This excerpt is from the first English translation of 1656, and exaggerates the negative effects of dissonance. *Renatus Des-Cartes Excellent Compendium of Music,* 7-8. Descartes does emphasize the relationship between dissonance and consonance, noting that too much dissonance can tire the ear. This slight distortion of the psychological effect is important for discussion of the reception of the *Compendium* in England. What is of importance here is Descartes' articulation of placement and levels of dissonance, noting that harmonic intervals should be set as primary consonances and that dissonant intervals in melodies are less offensive. It may be possible even to interpret Descartes' position as a foreshadowing of tonal theories, with primacy given to pure consonances to harmonic intervals of dominant and tonic triads. The complete paragraph from the Utrecht print reads "Haec tribus maxime modis potest spectari, vel scilicet in sonis, qui simul emittuntur à diversis corporibus, vel in illis qui successive ab eadem voce, vel denique in illis qui successive à diversis vocibus vel corporibus sonoris: ex primo mode consonantie oriuntur, ex 2º gradus, ex 3º dissonantie, que magis ad consonantias accedunt, ubi patet in consonantiis minorem esse debere sonorum diversitatem quam in gradibus; quia scilicet illa magis auditum fatigaret in sonis qui simul emittuntur, quam in illis qui successive. Idem etiam in proportione dicendum de differentia graduum ab illis dissonantiis que in relatione tolerantur." *Renati Des-Cartes Musicae Compendium* (Utrecht, 1650) 11.

relationships or less consonant if resulting from what remains in the division of the octave after the consonant relationship is established.

A_1	A_2	A_3
Pitch x_1 | | | Pitch x_2	Pitch x_1 - - - - - - -Pitch y_1	Pitch x_1 - - - - - - -- Pitch y_1 | | | | | | Pitch x_2 - - - - - - -Pitch y_2
The two pitches depicted are from different sound sources. The distance between x_1 and x_2 is that which 'creates' consonances, which Descartes later classifies as only those just intervals of the octave (4:2), the fifth(3:2), the fourth (4:3), the major third (5:4), the minor sixth (8:5), the minor third (6:5) and the major sixth (5:3).	The distance between x_1 and y_1 represents various possible "steps" from a single sound source. The line of dashes indicate a melodic whole step or half step.	The sound producing sources x_1 and x_2 are shown moving from one interval to another. Vertical lines again represent consonant intervals. Horizontal dashes represent melodic steps that, because of the restriction of vertical consonance, will necessarily result in 'commas' that are associated with consonances.

Figure 3.1. Three possible pitch relationships for intervals.

The melodic intervals (those of type A_3) could vary for a whole tone between 182 and 204 cents for a major tone and for a semi-tone between 92 and 112 cents, and these non-consonant variations (dissonances) are tolerated if they are heard "in relation."[81] That is, too much dissonance would "tire the ear" but some degree of dissonance would provide variety.[82] This desire to not "tire the ear" is based on the seventh of the eight

[81] The differences between the two extremes in the sizes of whole tones and semitones give rise to the concept of major and minor whole tones and major and minor semitones. See Tables 2.2 and 2.3 on page 34.

[82] "It is clear then that in consonances the diversity of sound must be less than in steps, for this diversity would tire the ear more in sounds produced simultaneously than in sounds produced successively. The same holds true, to an extent, in regard to the difference between steps and those dissonances which are

prolegomena, where Descartes states that the most pleasure is possible when the listener is stimulated but not overly stressed by complicated sensations. Describing consonance and dissonance as aspects of the division of the octave is the result of Descartes' observation of instrumental acoustics:

> Let no one think that is mere fancy when we say that by the division of the octave we generate properly only the fifth and the major third, and the other consonances only secondarily. I have proved this by experimenting with the strings of the lute (any other instrument whatsoever will do equally well). If we pluck one of its strings, the force of its sound will set in vibration all the strings which are higher by any type of fifth or major third, but nothing will happen to those strings which are at the distance of a fourth or any other consonance. This power of the consonances can derive only from their relative perfection or imperfection. The former are, so to speak, primary consonances, the others only secondary, for they result necessarily from the former.[83]

This conviction is based on his observation of the sympathetic vibration of lute strings and on the assumption that a more powerful sound is somehow more perfect. Descartes gives two other experiences that support his claim that the octave contains the other consonant intervals and those more resonant intervals have primacy over other less resonant intervals. The first is again related to a plucked string:

> ....of the two pitches which are required to form a consonance, the lower is far more powerful and somehow includes the upper ones; this is manifest on the strings of the lute, for when one of these is being plucked, the ones which are an octave or a fifth higher vibrate and sound audibly of their own accord....Pitch is related to pitch as string to string. Each string includes all strings that are shorter than itself, but not longer ones. Each pitch contains all higher pitches, but lower

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permissible between different voices." *Compendium musicae* (Amsterdam, 1656), trans. Walter Robert (Rome: American Institute of Musicology, 1961), 16.

[83] Ibid, 21. The original reads: "Neque quis putet imaginarium illud, quod dicimus proprie tantum ex divisione octavae quintam generari et ditonum, caeteras per accidens, id enim etiam experientia compertum habeo in nervis testudinis vel alterius cuiuslibet instrumenti, quorum unus si pulsetur, vis ipsius soni concutiet omnes nervos qui aliquo genere quintae vel ditoni erunt acutiores, in iis autem qui quarta, vel alia consonantia distabunt, id non siet: quae certe vis consonantiarum non nisi ex illarum perfectione potest oriri vel imperfectione, quae scilicet primae per se consonantiae sint, aliae autem per accidens, quia ex aliis necessario fluunt." *Musicae Compendium* (Utrecht, 1650), 18.

pitches are not contained in a high pitch. It is therefore clear that the higher pitch of a consonance must be found by the division of the lower one.[84]

Descartes' second example is the experience of over-blowing a length of pipe, where with a stronger breath the pitch leaps up an octave. Although not described as specifically overtones or partials, it is the upper octave that "contains" the fifth (second overtone) and major third (fifth overtone), as indicated in Figure 3.2 below.[85] This is not a string length divided in the tradition of medieval centonics, but one based on acoustical properties. In this figure, AC represents a sounding octave, with CB representing overtones produced by the octave AC; AB describes the pitch matrix produced by the octave AC.

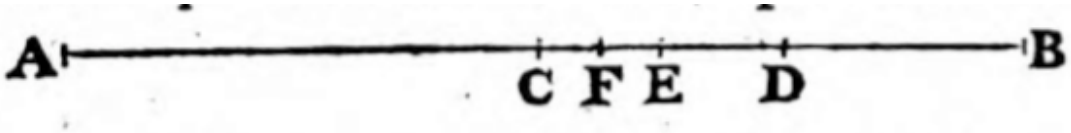

Figure 3.2. The octave contains all of the other consonances, *Compendium musicae* (1650), 12.

[84] Ibid, 17. The Latin reads "Secondo ex duobus terminis, qui in consonantia requiruntur, illum, qui gravior est, longe esse potentiorem, atque alium quodammodo in se continere: ut patet in nervis testudinis, ex quibus dum aliquis pulsatur, quo illo 8[a] vel quinta acutiores sunt, sponte tremunt et resonant, graviores autem non ita, saltem apparenter: cujus ratio sic demonstratur. Sonus se habet ad Sonum ut nervus ad nervum, atqui in quolibet nervo omnes illo minores continentur, non autem longiores, ergo etiam in quolibet sono omnes acutiores continentur, non autem contra graviores in acuto, unde patet acutiorem terminum esse inveniendum per divisionem gravioris." *Musicae Compendium* (Utrecht, 1650), 12.

[85] Thomas Christensen writes that although he was heavily indebted to Zarlino (whose works were available to the students at Le Flèche) for his basic music theory, Descartes had a unique approach to the monochord. "Descartes treated the monochord in a critically different way: the string divisions he plotted were for Descartes real physical entities. Zarlino had considered these string division only images of the numerical ratios he believed to be the cause of musical consonance. Descartes turned this ontology around: the consonance of the octave was the true foundation of sounds; numbers served only a descriptions. Essentially, Descartes was substituting a mechanical (acoustical) model of music for the older Pythagorean (numerical) model. In crucial ways, this anticipates the analogous mechanistic explanations he would propose for the entire cosmos some years later." Thomas Christensen, *Rameau and musical thought in the Enlightenment* (Cambridge: Cambridge University Press, 1993), 77. The source of the figure is *Musicae Compendium* (Utrecht, 1650), 17.

By dividing CB (the first series of overtones) into equal parts at D, the resulting interval CD is a fifth. By dividing CD into equal parts at E, the resulting interval CE is a major third. Descartes claims to have produced all consonances by these basic divisions, claiming that further division would not yield any more simple consonances. His example is that if one divided CE at F, the result would be not a consonance, because it does not produce a clear and strong sympathetic vibration. The interval CF would consist of the "remainder," a major whole tone, a minor whole tone and a semitone. Secondary consonances are those "imperfect" consonances that result from the placement of perfect simple consonances within the octave. So, because the fifth is a perfect simple consonance, the fourth is a secondary imperfect consonance.

Similarly, because the major third is a perfect simple consonance, its complementary interval within the octave, the minor sixth, is a secondary imperfect consonance. The perfect simple consonances are contained within the octave and the remaining interval is thus an imperfect secondary consonance. This is diagrammed within a circle in Figure 3.3 below.[86] The circumference represents the upper octave CB of Figure 3.2. Within it the fifth and the fourth, the major third and minor sixth, and minor third and major sixth are all positioned as complementary intervals. Descartes describes the relationship between these pairs of complementary intervals as having three categories: the first, represented by the inner circle, is the octave itself resulting from the unison; the second shown as the *diapente* and *diatessaron* or consonant intervals of the

[86] *Musicae Compendium* (Utrecht, 1650), 19.

second division; the third circle shows the major third (ditone) and the minor sixth and the outside circle contains the minor third and major sixth.[87]

Figure 3.3. The division of the octave showing relationship of primary and secondary consonances, *Compendium musicae* (1650), 19.

[87] "We have further made a distinction between those consonances which result immediately from these divisions and those which result only secondarily; we have, therefore, stated that there are [only] three consonances per se. This can be proved by the first figure, in which we have derived the consonances from the numbers themselves. It must be noted that there are only three interval-numbers, to wit: 2, 3, and 5. 4 and 6 are multiples of these, and are therefore only secondarily interval-numbers. This is clearly the case also because they do not inherently and straightway form new consonances, only composites of the existing ones." *Compendium musicae* (Amsterdam, 1656), trans. Walter Robert, 22. The source reads: "Ex iam dictis elicimus omnes consonantias ad tria genera posse referri: vel enim oruntur ex prima divisione unisoni, illae qua octavae appellantur, et hoc est primum genus: vel 2^{o} oruntur ex ipsius octave divisione in aequalia, quae sund quintae et quarte, quas idcirco consonantias 2^{x} divisionis vocare possumus: vel denique ex ipsius quinte divisione, quae consonantiae sunt tertiae et ultimate divisionis: rursum divisimus in illas quae per se ex illis divisionibus oriuntur, et in illas quae per accidens, tresque duntaxat per se consonantias esse diximus, quod etiam potest confirmari ex prima figura, in qua consonantias ex numeris ipsis elicuimus: in ella enim advertendum est 3^{es} esse duntaxat numeros sonoros 2. 3. Et 5. Numerus enim 4. Et numerus 6. Ex illis componuntur, atque ideo tantum per accidens numeri sunt sonori, ut ibi etiam patet ubi in recto ordine et recta linea non generant novas consonantias, sed duntaxat illas quae ex prioribus componuntur:" *Musicae Compendium* (Utrecht, 1650), 20.

Descartes' Circle Images

His is not a theory of acoustics or a presentation of the overtone series, but an imaginative projection of relationships. This is even more evident in the *circulus* image in Figure 3.4 below.[88] This diagram shows various options for intervallic size and the way a

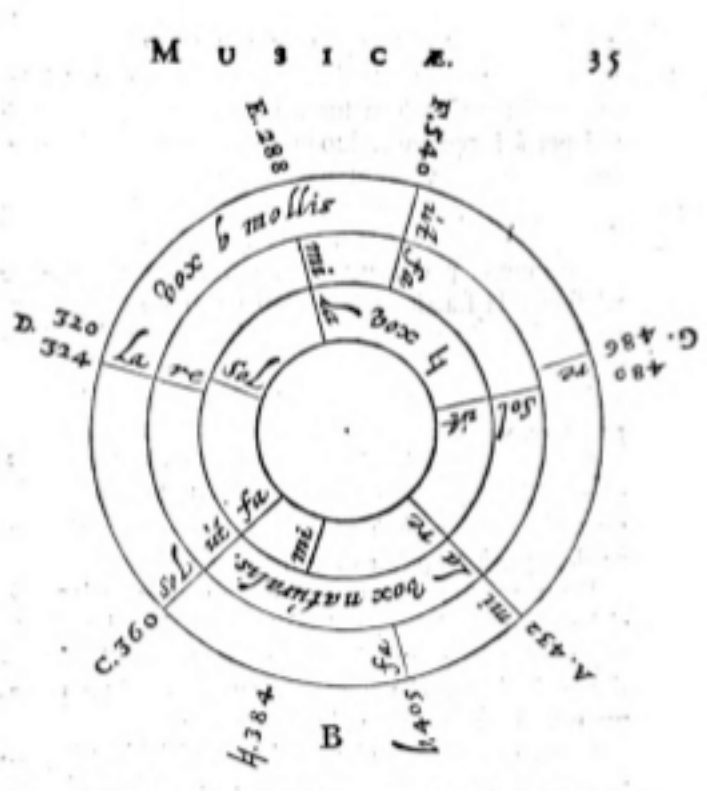

Figure 3.4. Descartes' *circulus* figure showing five perfect intervals and their adjacent moveable pitches, *Compendium musicae* (1650), 35.

very small interval, labeled "schisma" by Descartes and called a "comma" by later writers, could be attached to perfect consonances forming secondary or imperfect consonances.[89] Descartes presents this figure in the context of explaining the musical

[88] *Musicae Compendium* (Utrecht, 1650), 35.

[89] As Walter Robert explains, the numbers here do not indicate pitch in cents, but rather numbers that could be used to avoid fractions in the calculations. Descartes wrote his ratios with the lower number as the numerator (representing string length proportions), thus the larger numbers represent lower pitches. For

"steps," and is illustrating possible variations in placement of particular pitches. Unlike other circle diagrams depicting tuning systems, this is not a fixed-pitch system but reflects the variability of pitch levels in relation to interval placement.[90] For example, the G on the right side of the diagram could be a few cents higher or lower, depending on whether it was heard in relation below B-flat (re to fa) or above E (mi to sol). The *circulus* shows these divisions geometrically, showing the relative sizes of intervals with slightly different locations for certain pitches; Wardhaugh suggests that Descartes could not have made such an accurate diagram without the use of logarithms.[91]

Descartes' approach using the *circulus* diagram to show relationships between pitches in different tonal relationships is unique and can be used as an analytical model to address two problems related to intonation in performance. The first is the performance problem described by Bottrigari. As long as the explanations for bad intonation were explained against the standard of a fixed tuning system, the situational experience of the performing musician would not be addressed. Descartes' appreciation of the resonance and power of primary consonances as the reference point for pitch choice informs his

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example the calculation to find the ratio of the major whole tone D up to E, the fraction would be 288/324 and the ratio 8:9. In footnote 42 on page 34 of his translation Robert explains further how the diagram is to be interpreted. "Ascending [from pitch 'A'] = 288, 540, 486 or 480, 432, 405 (E, F, G, A, B-flat). If E-G is to be a pure minor third (5/6) F-G must be a major whole-tone (8/9).; therefore, the schisma must be added to the minor whole-tone 540-486, and we must ascend 288, 540, 480, 432, 405. If, however, we wish the minor third G-B flat to be pure ("in regard to 405"), the schisma must be added below the minor whole-tone 480-432 to form the minor third 486-405." René Descartes, *Compendium musicae* (Amsterdam, 1656), trans. Walter Robert (Rome: American Institute of Musicology, 1961), 34.

[90] Circle diagrams were not new with Descartes, and began to appear more often with explanations of tonality in the eighteenth century as images of circular modulation and circulating temperaments. In the seventeenth century circle diagrams more often had correspondence with the zodiac, the orbits of the planets, or other cosmological references. Zarlino's diagram, page 26 of *Istitutioni harmoniche* (1558), is one of the earliest that refers specifically to fixed pitches of the "sonorous numbers" of his *senario.*

[91] According to Wardhaugh, this is a very early application of logarithmic calculation to a function, as a way to transform one line into another. Wardhaugh, *Music, Experiment and Mathematics,* 45. See also his "Musical logarithms in the seventeenth century: Descartes, Mercator, Newton," *Historia Mathematica* 35 (2008): 19-36.

claims for the possibility of variation in pitch levels. As for the deviations in intervallic size among the three classifications of instruments in *Il Desiderio*, the fixed-pitch instruments, the stable but alterable and the alterable-pitch instruments, Descartes' analysis provides the larger context for understanding ways to manipulate pitches toward concord. He understands that vertical relationships in performance are not always going to be consonant and that dissonances resulting from the changing consonant relationships can be heard as melodic elements that provide variety.[92] His model of the moveable comma describes ways to make the necessary pitch compromises, with the possibility of providing the accommodation needed in the fixed-pitch category as well as the freedom for inflection with the other instrumental types.

The second is a performance problem associated with adherence to just intonation for all intervals, resulting in a downward or upward migration of the overall pitch from beginning to end. This is sometimes called "pitch drift" or "the singer's dilemma," and was addressed at length by Benedetti in the mid-sixteenth century.[93] Descartes accepts

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[92] This attribute is consistent with the eighth point in his prolegomena, where Descartes states that variety in all things is most pleasing to our senses.

[93] G. B. Benedetti was physicist and mathematician who challenged Zarlino's syntonic diatonic tuning scheme as unsupportable for performance, and suggested that in fact singers use some kind of tempered intervals to preserve the pitch level of the opening and closing harmonies. He does not, however, describe exactly how this is accomplished, except to say that good singers seem to divide the comma and add a fraction to each of the consonances, resulting to something that might approach meantone tuning. Benedetti's position on the relationship between vibration, resonance and just intervals is similar to that of Descartes. What Descartes had accomplished with his model is a description of the way good singers could manipulate pitch levels using the moveable comma to maintain a stable 'tonic' pitch. A good summary of Benedetti's early work in acoustics and the physical theories of sound is found in Stillman Drake, "Renaissance Music and Experimental Science," *Journal of the History of Ideas* 31, no. 4 (October-December 1970), http://www.jstor.org/stable/2708256 (accessed October 14, 2008). The historian of early modern science H. Floris Cohen contrasts the work of Benedetti and Vicenzo Galilei in addressing pitch drift in chapter three of his survey of the experimental approach to the science of music. But Cohen's central issue is an exploration of the relationship between the simple ratios of consonant intervals and the human sensation of musical beauty, and he notes that Benedetti finds the answer in the sensation of 'softness' that is felt with vibrations of consonant intervals and the 'sharpness' caused by vibrations in dissonant intervals. H. Floris Cohen, *Quantifying Music: The Science of Music at the First Stage of the Scientific Revolution,1580-1650* (Dordrecht: D. Reidel, 1984). A cogent analysis of the problem of pitch

pitch drift as a given, at least in theory, but suggests that this problem is worthy of study and could be solved.[94] Though not overtly presented in the *Compendium*, his delineation of the relationship between consonance and dissonance within the pitch boundary of the primary octave provides some tools for addressing pitch migration. Descartes' model already shows how a musician could move from one pitch to the next, maintaining pure beat-less intervals for the six perfect consonances, and still maintain the same beginning and ending pitch. He does this from both an "outside" perspective, describing the three ways (shown in Figure 3.1) that intervals are formed, and from an "inside" perspective, describing intervallic choices from the perspective of the participating musician. The formula for this process is again consistent with the primacy of consonant moves, with dissonance occurring as a melodic event and produced as the result of those changing consonant moves. As an exploration of the science and mechanics of intervals, the *Compendium* does not mention any musical styles, and aside from Descartes' mention of his experience with strings of the lute there is no documentation of his being a musician. However, the concepts of a continuous pitch spectrum and the moveable comma within the *circulus* corresponds well with the use of dissonance as an expressive device in music of the *seconda pratica.*

Descartes' examples of motion from one interval to another begins in the section of the *Compendium* titled *De Gradibus sive Tonis Musicis*. This is where he gives the

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drift and an analysis of Benedetti's "Puzzle" appears as part of Ross Duffin's article on the use of just intonation as a performance practice. Ross W. Duffin, "Just Intonation in Renaissance Theory and Practice," *Music Theory Online* 12, no. 3 (October 2006), http://www.mtosmt.org/issues/mto.06.12.3/mto.06.12.3.duffin.html (accessed January 2, 2008).

[94] This is not an issue restricted to a particular repertoire or time period in the history of music. In the process of recording performances, whether for classical or popular genre, for commercial issue, many recording engineers routinely use software programs such as Auto-tune™ to address pitch drift and other discrepancies in intonation.

most extensive analysis of the way dissonance and consonance are related.[95] His claim that stepwise motion in one voice must be consonant with the pitch of another voice in the first interval is a radical departure from most current discussions of intonation. This subtle change of pitch, sometimes representing a move up or down of only a few cents, is not controlled by an abstract and fixed system, but rather by the process of moving from interval to interval. First he notes that there are only four possible kinds of "steps," the major and minor whole tones and the major and minor semi-tones. The exact sizes of these whole tones and semi-tones are determined by the movement of consonant intervals, and they are necessary to provide variety and to effect smooth movement from one consonance to another.[96] Descartes presents two examples, the first a movement from

[95]"Est autem probanum gradus sic spectatos ex inequalitate consonantiarum generari; quod sic ago, quotiescunque sit transitus ab una consonatia ad aliam, vel unus terminus tantum movetur vel uterque simul, sed neutro modo potest fieri talis transitus, nisi per intervalla, quae inaequalitatem, quae est inter consonantias, designent, ergo, minoris prior pars sic demonstratur. Si verbi gr. ab A ad B sit quinta et velim ab A ad C esse sextam minorem, necessario à B ad C erit differentia, quae est inter quintam et sextam minorem nempe 16. ut patet: posterior autem pars minoris ut probetur, notandum, non solum spectandam esses in sonis proportionen dum simul emittuntur, sed etiam dum successive, adeo ut, quantum fieri potest sonus unius vocis cum proxime praecedenti alterius debeat consonare, quod nunquam accidet nisi gradus ex inaequalitate consonantiarum oriantur; verbi gratia D E sig quinta et moveatur uterque terminus motibus contrariis ut fiat tertia minor, so D F sit intervallum quod non oriatur ex inaequalitate quarte à quinta, non poterit F cum E per relationem consonare, si vero inde oriatur potest; et ita in ceteris ut facile est experiri: ubi notandum est, quod ad illam relationem attinet, nos dixisse illam debere consonare quantum fieri potest; non enim semper potest, ut apparebit in sequentibus." *Musicae Compendium* (Utrecht, 1650), 27-28. Now it remains to be proved that the steps considered in this way are produced by the differences between the consonances. I do this as follows: whenever there is a transition from one consonance to another, either one or both tones must move, or both move at the same time, but neither can be made unless by means of the interval that corresponds to the differences between consonances. If, for example, A to B is a fifth and that A to C is a minor sixth, not only should one look at the proportion of sound heard at the same time but also the next sound that is to be approached, and as much as possible move as a consonance with the nearest preceding sound. Take for example D to E as a fifth and both voices moving in contrary motion, so that a minor third results. If D to E is interval that did not originate from the inequality between the fourth and the fifth, then F cannot be in a consonant relationship with E; but if it did originate [in that inequality], then it can be.

[96] "Duabus maxime de causis requiruntur gradus in Musica, nempe ut illorum adjumento ab una consonantia ad aliam fiat transitus, quod tam commodè per ipsas consonantias cum varietatè, quae in Musica jucundissima est, fieri non posset; deinde ut in certa quaedam intervalla omne spatium, quod sonus decurrit, ita dividant, ut per illa semper et commodius, quam per consonantias, cantus incedat." *Musicae Compendium* (Utrecht, 1650), 26. There are principally two reasons why the steps are needed in music; first, to make a transition, by their help, from one consonance to another; this cannot be achieved so conveniently, and with that measure of variety which is most pleasing in music, by the consonances alone;

a fifth to a minor sixth, and then from a fifth to a minor third. Figure 3.5 is from the Utrecht 1650 printing.[97] Although the placement of the staves suggests specific pitches, there are no clefs or key signatures given, and the notes are labeled only as points in a diagram.

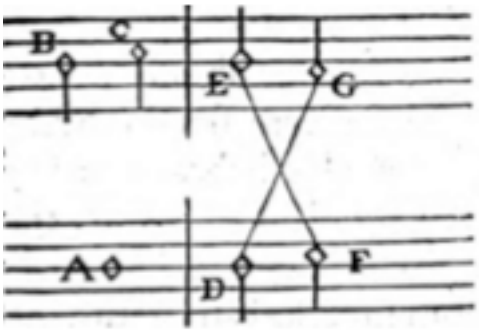


Figure 3.5. Illustration indicating movement from one consonant relationship to the next, *Compendium musicae* (1650), 27.

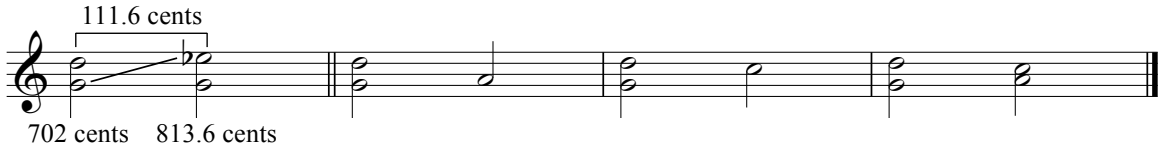
For these examples Descartes explains that as the performer moves from one consonance to the next, there will be (as a result of the irregularity of divisions within the octave) some melodic interval that is not consonant.[98] For example, the non-consonant interval in first example in Figure 3.5 is the semi-tone between note B and note C in the move from a fifth to a minor sixth. Descartes' claim is that the musician's reference point for intonation is the consonance of the nearest preceding pitch in the other voice, in this case the note labeled A. Arbitrarily assigning pitch names to Descartes' example, the

secondly, to divide the whole gamut which sound traverses into fixed intervals, so that melody can always proceed through them more smoothly than would be possible if it moved only through consonances." *Compendium musicae* (Amsterdam, 1656), trans. Walter Robert, 28.

[97] *Musicae Compendium* (Utrecht, 1650), 27.

[98] It is theoretically possible to have all motion from consonance to consonance, for example a composition that had only octaves, fifths and fourths. But Descartes suggests that the reason that half steps and whole steps were invented was to add variety. It would tire the ears of both the musicians and the listeners if there was not a balance between dissonance and consonance.

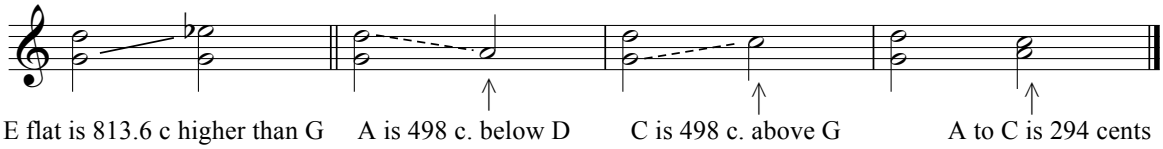
harmonic fifth as G and D and the next pitch in the upper voice as E flat (Example 3.1 below), the non-consonant move would be from D to E flat, indicated by the bracket. Following the requirement of placing pitches according to the consonant relationships of the *circulus,* the performer places the E flat as a pure minor sixth to the G in the lower voice. The resulting interval from D to E flat is a major semi-tone (in cents this would be about 111.6) rather than a minor semi-tone (92.18 cents), based on the difference between a pure fifth (702 cents) and a pure minor sixth (813.6). This procedure is described in the first measure of Example 3.1, the bracketed interval between D and E as the major semi-tone.



Example 3.1. Consonant relationship between interval of a fifth to interval of a sixth.

The second pair of intervals in Descartes' example represents the move from a fifth to a minor third, and its intonation scheme could be realized in at least two ways. The first, following the prescriptive rule of always making a consonant move using a pitch in the previous interval as reference, the performer of the top voice must make the choice for the non-*circulus* interval from D to C in relation to G. The perfect consonance from G to C (498 cents) means that the C is placed as a major whole tone (204 cents) below D. In the same manner the pitch for the A in the second interval is chosen by reference to the D of the first interval. This is also a *circulus* relationship of a perfect fourth and results in creating a major whole tone step of 204 cents from G up to A. Arriving at both pitches in this way for the second interval results in a very narrow minor

third of 294 cents, shown in the vertical relationship between A and C in Example 3.2 below. In some contexts, for example at a place of faster harmonic motion, this minor third of 294 cents, a full 21.6 cents narrower than a perfect consonant third of 315.6 cents would be acceptable. This narrow minor third from the example below can be heard in the Supplmenetal Audio File as Audio 1.2: Sound for Example 3.2.



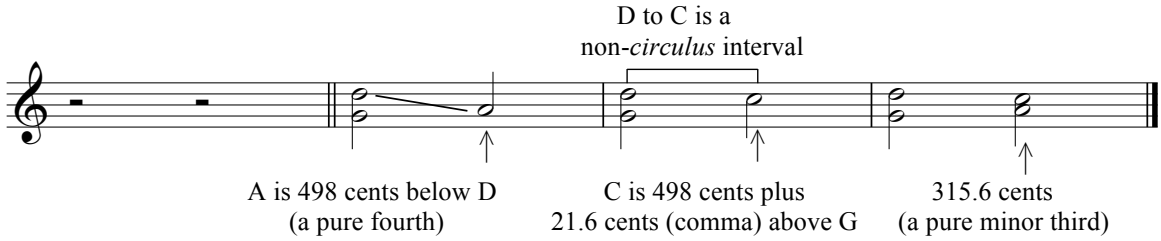
Example 3.2. Consonant relationship between interval of a fifth to interval of a minor third with both voices following *circulus* consonances.

In other performance situations, one may wish for a point of less tension. This is where Descartes suggests that the "schisma" (comma) be added to the *circulus* interval, creating a "secondary consonance." In this second option one chooses a consonant relationship for only one of the steps, and adding the cents in a moveable comma to the other. "Here it should be noted, in regard to this relation, that it must as far as possible be consonant; however, it cannot always be so, as will later become evident."[99]

Again assigning pitch names to Descartes' example as presented in Example 3.2, these options are illustrated below in measures 2-4 of Example 3.3. Here the *circulus* relationship is used in the first notated measure for the A, but not for the C in the next measure. The C is understood to be moveable, making it a slightly higher pitch and allowing the final interval to be in just intonation. In this example the D to E interval is a melodic dissonance, with its moveable comma indicated in brackets. Refer to Audio

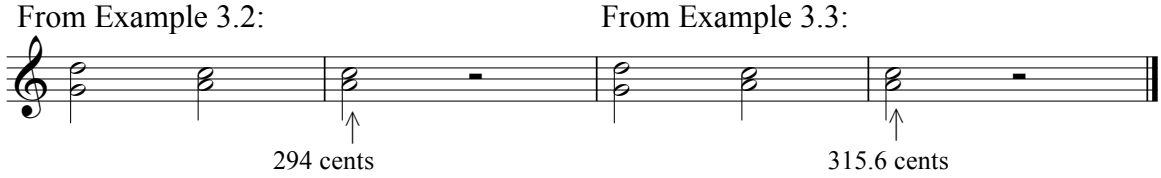
[99] "Ubi notandum est, quod ad illam relationem attinet, nos dixisse illam debere consonare quantum fieri potest; non enim semper potest, up apparebit in sequentibus." *Musicae Compendium* (Utrecht, 1650), 28.

1.3: Sound for Example 3.3 in the Supplemental File for an audio version of this example.



Example 3.3. Consonant relationship between interval of a fifth to interval of a minor third with only one voice following *circulus* consonances.

The comparison between the sizes of the minor third A to C in both examples is given in Example 3.4 below, and the audio version is available in the Supplemental File as Audio 1.4: Sound Example 3.4.



Example 3.4. Comparison of final minor third from examples 3.2 and 3.3.

The size of melodic dissonances can be varied according to musical context. Using Descartes' calculations these could be either the difference between major and minor whole tones (about 21.6 cents) as in example 3.3 or between the major whole tone and the major semi-tone (92 cents) in the same example. When pitches are inflected a few cents upward or downward, of course the sizes of the harmonic interval changes as well. Harmonic dissonances include not only intervals of a seventh and ninth, but also the intervals formed by numbers larger than the six intervals of the *senario* as well as those

formed from consonant movement described in Example 3.2. Extending Descartes' model to instrumental music of three or more parts would involve complexities beyond the scope of this paper. However, the principles for intonation choice in intervals still apply, with the moveable comma providing the means for smooth transitions between harmonic intervals.

The Power of Imagination

Descartes' use of *circulus* diagrams to show variation in pitch is unique, and is dependent not only on his logarithmic calculations, but also on the power of the imagination to envision the implication of those calculations. The first evidence of the function of the imagination in comprehending a complex of sounds is provided in the discussion of rhythm. It is not just the process of hearing proportion in time, but more essentially an act of the understanding that creates rhythmic coherence for the listener. Descartes observes that it is specifically the function of the imagination to collate perceived sounds into recognizable patterns and to organize smaller patterns into larger units that define the entire composition:

> ...there arise two kinds of Measures in Musick: namely by a Division into Three in time, or into Two. But, this Division is noted by a percussion, or stroke, as they call it; which is ordained to assist our Imagination, that so we may the more easily perceive all the members of the Tune, and be delighted with the proportion, which ought to be in them. Now, this proportion is most frequently kept in the members of the Tune, in order to the helping of our Imagination, so that while we yet heare the last of the time, we may remember what was in the first and what was in the rest of the Tune. Which is effected, if the whole Tune be composed of 8, or 16, or 32, or 64 etc. members: so that all Divisions may proceed from a double proportion. For them, when we have heard the Two first members, we apprehend them as one, while yet wee conjoyn the Third member with the First, so that the proportion becomes triple: afterward, when we have heard the Fourth, we conjoin it with the Third, and so apprehend it as one and the same. Then we again conjoin the Two First with the Two Last, so apprehend those Four together as One. And

> thus doth our Imagination proceed even to the end: where at length it conceives the whole Tune, as one intire thing composed of many equall members.[100]

From this description of meter as heard, one can understand Descartes' general natural-philosophical method as a theory of proportions, where sensation is based in some kind of natural geometry. The listener is grounded in a process of organization, and only by using his imagination, can he or she connect rhythmic events first heard with those anticipated to continue to the end. Dennis Sepper has emphasized the importance of understanding the imagination as a key to understanding Descartes' early writings, asserting that there are both sense-based and thought-based components involved.[101] Imagination functions as an analogical model for thinking, and Sepper describes how it relates to perceiving meter and rhythm, as described in the *Compendium musicae*:

> Imagination is portrayed here as an extraordinarily active power that is responsible for the ability to perceive the complex unity of sounds as a whole rather than as simply a congeries of unconnected tones. In the passage it is also the primary agent of cognition, of the grasping by mind (apprehension). It is an agent: that is, imagination does the work of conceiving/synthesizing; an agent of cognition: that is, the imagination is not simply projecting visual (or auditory) images but recognizing something not directly perceived by the sense, the proportions in the song taken as an entirety. Moreover, the memory required for this synthesis and cognition appears to be a by-product of the process as it takes place from moment to moment, from musical part to musical part.... Here we might remark that imagination comes up first not in the visual realm but in the auditory, which suggests that Descartes was already thinking of the power of imagination as transcending the specific character of any single sense. It is precisely imagination's character of being presentative, synthetic, and

[100] *Renatus Des-cartes Excellent Compendium of Music: with Necessary and Judicious Animadversions Thereupon.* (London: Thomas Harper, 1653) IMSLP73876-PMLP147962-English.pdf under http://imslp.org/wiki/Musicae_compendium_%28Descartes,_Ren%C3%A9%29 (accessed Jan. 21, 2011), 4-5.

[101] Dennis L. Sepper has emphasized Descartes' concept of imagination as a central technique involved in his early writings, used as a way to represent relationships in geometry as well as in sound. Sepper's original research and analysis was presented in *Descartes's Imagination: Proportion, Images and the Activity of Thinking* (Berkeley: University of California Press, 1996) and expanded for the chapter "Figuring things out: figurate problem-solving in the early Descartes" in *Descartes's Natural Philosophy*, edited by Stephen Gaukroger, John Schuster and John Sutton, 228-248 (London: Routledge, 2002).

> memorative that seems to interest him, rather than any merely representational use. This character rests on proportionality, or, to use the Greek equivalent, analogy.[102]

The proportionalizing imagination as here described can be seen not only as an element in understanding rhythm and meter, but can also be understood as functioning in the musicians' pitch choices in performance. Descartes' imagination depicts the possibility of the moveable pitches in the *circulus* diagram. His description of the performer's task of choosing pitches in reference to resonant consonances is another act of the proportionalizing imagination, a key to understanding how music is heard "from the inside" in the context of performance. Sepper does not extend his analysis of the proportionalizing imagination to concepts of pitch:

> Rhythm ordinarily extends in an equable way throughout an entire song (or throughout each of its major units), so that the synthetic activity of conceiving rhythm creates a complex unity by iteration and temporal projection/retention, a complex that nevertheless falls into one of two classes, either double or triple time. With tone there is less need for an extended synthesis (putting aside the loose regularity determined by the key or mode of a passage), since the relationships of primary importance exist between tones sounded in immediate succession or even simultaneously. These immediate relationships are already proportioned to the sense of hearing and its pleasures so the synthetic functioning of imagination is less urgent for properly appreciating them. Moreover, there is a greater variety of melodic effects than two, and to explain all of them would require a greater complication in the investigation both of the ways in which the soul is moved and of how the proportions expressed in one harmony or phrase are related backward and forward to the other parts of the song.[103]

From the position of auditor Sepper's observations are plausible, but from the position of performer the imagination is as much at work in pitch choices as in perceiving rhythmic coherence. In practice, it is precisely those "relationships of primary importance [that] exist between tones sounded in immediate succession or even simultaneously" that are of concern in pitch choices. A musician playing one of three musical lines and having

[102] Sepper, *Descartes's Imagination,* 45.

[103] Ibid, 46.

options for creating either pure, beat-less intervals with another part or for moving the pitch level slightly higher or lower, makes that choice using what he is hearing as the current tonal and what he remembers as the general tonal frame of the composition. In all three elements the musician's proportionalizing imagination is at work in conceiving the possibilities, in synthesizing information about the immediate pitch matrix, and in placing his/her next pitch choices within the larger tonal framework of the composition.

By creating the *circulus* model that describes pitch options in diatonic tonal music, and by identifying the imagination as the agent of perception and judgment, Descartes presents the tools for describing the actual process of performing music with intonation flexibility. The construct for this is not adherence to an absolute and objective pitch structure but is a dynamic process, where the "comma" is moved around the *circulus* according to the performer's choices. Other elements that can influence a performer's intonational choices are explored in the next chapter. The value of Descartes' analytical approach to intervals from the performer's view "on the inside" addresses the decision making process at the sensory level. Descartes' model for understanding musical sound is a mechanical one, where acoustical reality trumps Pythagorean numerical models, and where numbers do not reveal ontological truths but merely describe relationships between sounds.

CHAPTER IV

LAMY'S MODEL OF EFFECTIVE PERSUASION

> ...Not only this effect of repose but a full cadence is necessary at the end of a composition. During the course of a composition the avoidance of such a cadence has a charming effect. This occurs when, so to speak, one voice seems to wish to rest while another voice proceeds further. This is a type of figure of speech in music, just as there are figures of speech in Rhetoric. Sequence, imitation, etc. also belong to this category; they occur when two voices sing successively, that is, at different times, either the same [melody] or its opposite. The latter they can also perform simultaneously. [Other] elaborate contrapuntal devices, as they are called, also can contribute a great deal when they occur in parts of compositions. Such tricks, however, when they are used from beginning to end of a composition, have as little to do with music, I believe, as acrostics or palindromes with poetry; poetry is supposed to arouse the emotions in the same manner as music.[104]
>
> --Descartes, *Compendium musicae*

[104] The full excerpt is given here from the Utrecht print and from the English translation by Robert. Praeterea advertendum, auditui magis satisfieri in fine per octavam, quàm per quintam, et omnium optime per vnisonum. Non quia quinta illi non sit gratissima in ratione consonandi; sed quia in fine spectare debemus ad quietem, quae major reperitur in illis sonis inter quos est minor differentia, vel nulla omnino vt in vnisono. Non solùm autem haec quies sive cadentia juvat in fine; sed etiam in medio cantilenae, huius cadentiae fuga non parvam affert delectationem, cùm scilicet vna pars velle videtur quiescere, alia autem vlterius procedit. Atque hoc est genus figurae in Musicâ, quales sunt figurae Rhetoricae in oratione; cujus generis etiam sunt consequentia, imitatio, et similia, quae fiunt cùm vel duae partes successive, hoc est diversis temporibus, plane idem canunt, vel plane contrarium. Quod vltimum etiam simul facere possunt, et quidem id in certis cantilenae partibus aliquando multum iuvat. Quod autem attinet ad contrapuncta illa artificiosa, vt vocant, in quibus tale artificium ab initio ad finem perpetuò servatur, illa non magis arbitror ad Musicam pertinere, quàm Acrostica aut retrograda carmina ad Poeticam, quae ad motus animi etiam excitandos est inventa, vt nostra Musica. *Musicae Compendium* (Utrecht, 1650) 55-56. "It is noteworthy, too, that the ear is more satisfied by an octave than by a fifth as final concord, and is satisfied most of all by the unison. Not that the fifth is very unpleasing as a consonance, but at the end we demand repose, and that is found to a higher degree between those pitches between which there is the smallest difference or none at all, as in the unison. Not only this effect of repose but a full cadence is necessary at the end of a composition. During the course of a composition the avoidance of such a cadence has a charming effect. This occurs when, so to speak, one voice seems to wish to rest while another voice proceeds further. This is a type of figure of speech in music, just as there are figures of speech in Rhetoric. Sequence, imitation, etc. also belong to this category; they occur when two voices sing successively, that is, at different times, either the same [melody] or its opposite. The latter they can also perform simultaneously. [Other] elaborate contrapuntal devices, as they are called, also can contribute a great deal when they occur in parts of compositions. Such tricks, however, when they are used from beginning to end of a composition, have as little to do with music, I believe, as acrostics or palindromes with poetry; poetry is supposed to arouse the emotions in the same manner as music." *Compendium musicae* (Amsterdam, 1656), trans. Walter Robert (Rome: American Institute of Musicology, 1961), 51.

Intonation as an Expressive Device

Descartes illustrates in Figure 4.1 below a musical suspension, a figure of delayed resolution commonly used at cadences.

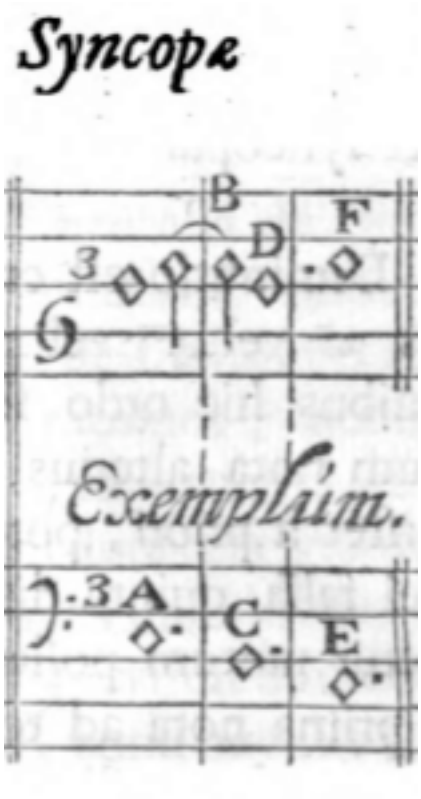


Figure 4.1. Descartes' illustration of suspension, *Compendium musicae* (1650), 54. [105]

He notes that figures like this have analogues in rhetoric, and that their overuse can be detrimental to the art of music. It is in his final comment on the likeness of music to poetry that Descartes makes this reference to music as an art form. Does this suggest something about his position on meaning in music? Is there anything in his descriptions of music as relationships between sounds that could support a rhetorical paradigm for music composition, analysis or performance? Considering Descartes' rationalist agenda and the way he develops his analysis of rhythm and pitch in the *Compendium*, as well as

[105] *Musicae Compendium* (Utrecht, 1650), 54.

the complete lack of reference to music as a language, there seems to be little support from him for imposing a rhetorical scheme on music.

Descartes' evaluation of musical-rhetorical figures as artifice rather than substance reflects an attitude not uncommon in the seventeenth century. Patrick McCreless summarizes the consequence of emphasis on figures:

> Over the course of the Renaissance and into the seventeenth century a growing interest in the passions and their representation and expression in rhetoric and poetics led to an elevation of *movere* over *docere* and *delectare,* and a corresponding elevation of *elocutio* at the expense of *inventio* and *dispositio.* This concern with *elocutio* entailed an increasingly frenzied obsession with the centerpiece of *elocutio*–the figures.... It was in fact an overemphasis on the figures that eventually led to the death of rhetoric. The once vital tradition of civic rhetoric had given way to the dry recitation and identification of figures with strange-sounding names in Greek and Latin. By the early eighteenth century, even though rhetoric remained at the center of most European educational systems, it had hardened into an oppressive orthodoxy and had lost its vitality.[106]

But other elements in Descartes' writings suggest two approaches in which expressiveness can be understood. The first links the qualities of sound with our visceral response to it. The third paragraph of the *Compendium* attests to this:

> The human voice seems most pleasing to us because it is most directly attuned to our souls. By the same token, the voice of a close friend is more agreeable than the voice of an enemy because of sympathy or antipathy of feelings – just as it is said that a sheep-skin stretched over a drum will not give forth any sound when struck if a wolf's hide on another drum is sounding at the same time.[107]

Other phrases from the *Compendium* reveal Descartes' physical appreciation of sound,

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[106] Patrick McCreless, "Music and rhetoric," in *The Cambridge History of Western Music Theory*, ed. Thomas Christensen (Cambridge: Cambridge University Press, 2002), 851.

[107] Descartes, *Compendium musicae* (Amsterdam, 1656), trans. Walter Robert (Rome: American Institute of Musicology, 1961), 11. Kate van Orden in her monograph "Descartes on Musical Training and the Body" argues that Descartes emphasizes the value of sensory data to confirm relationships formed in the mind. She notes that his chapter on rhythm in the *Compendium* is the most "embodied" analysis of how proportional relationships are judged. Van Orden sees the *Compendium* as an example of how Descartes "interrogated" the world through bodily perception and rational inquiry, using the senses as "arbiters of proportion." Her observations support the Cartesian elements in the phenomenology of expressiveness developed by Lamy. Kate van Orden, "Descartes on Musical Training and the Body," in *Music, Sensation, and Sensuality,* ed. Linda Phyllis Austern (New York: Routledge, 2002), 78-95.

such as hearing the bass line leaping, feeling delight in an evaded cadence or describing the tenor voice of a composition as being "like a sinew in the midst of a composer's body which sustains and connects all the other members."[108] These physical references to sound rest on Descartes' epistemological position and are closely related to the approach of natural philosophy, especially those aspects concerning the relationships among perceptual cognition, intellectual cognition and imagination outlined in the *Compendium*. The second approach links various rhetorical gestures to the taxonomy of the passions described in his last work, *Les Passions de Âme* (1649). Both approaches can be extended as ways to address expressivity in music, and can be cited in support of using intonational inflection as a rhetorical element in performance.

Several sources from antiquity acknowledge the power of musical expression and suggest it as a model for the orator. Quintilian, for example, writes about the "advantages a future orator may reasonably expect to derive from the study of music:"

> Music has two modes of expression in the voice and in the body; for both voice and body require to be controlled by appropriate rules. Aristoxenus divides music, in so far as it concerns the voice, into rhythm and melody, the one consisting in measure, the latter in sound and song. Now I ask you whether it is not absolutely necessary for the orator to be acquainted with all these methods of expression which are concerned firstly with gesture, secondly with the arrangement of words and thirdly with the inflexions of the voice.... It is by the raising, lowering or inflexion of the voice that the orator stirs the emotions of his hearers, and the measure, if I may repeat the term, of voice or phrase differs according as we wish to rouse the indignation or the pity of the judge. For, as we know, different emotions are roused even by the various musical instruments, which are incapable of reproducing speech.[109]

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[108] Descartes, *Compendium musicae* (Amsterdam, 1656), trans. Walter Robert (Rome: American Institute of Musicology, 1961), 48-49. Secundam, que Basso proxima est, tenorem vocant, haec etiamin suo genere precipua est, continet enim subjectum totius modulationis, et est veluti nervus in medio totius cantilene corpore, qui reliqua eius membra sustinet et coniungit. *Musicae Compendium* (Utrecht, 1650), 51.

[109] The excerpt in its entirety reads: "Music has two modes of expression in the voice and in the body; for both voice and body require to be controlled by appropriate rules. Aristoxenus divides music in so far as it concerns the voice, into rhythm and melody, the one consisting in measure, the latter in sound and song. Now I ask you whether it is not absolutely necessary for the orator to be acquainted with all these methods

Quintilian cites Aristoxenus' division of the basic musical elements into rhythm and melody, and says that the orator must master the rules of both. This division of musical elements is similar to Descartes' division of sound into rhythm (duration or time) and pitch (differences of tension, high to low). Quintilian then considers vocal inflections as those expressive variations of pitch that result from raising or lowering the voice. Descartes also suggests that pitch variation is an expressive device, noting that "a variety of melodies...affect us in different ways according to the characteristics of the mode."[110] But Descartes does not indicate what the varieties of melodies are expressive of, or how expressiveness is achieved. He neither acknowledges the ancient paradigm that the orator

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of expression which are concerned firstly with gesture, secondly with the arrangement of words and thirdly with the inflexions of the voice, of which a great variety are required in pleading. Otherwise we must assume that structure and the euphonious combination of sounds are necessary only for poetry, lyric and otherwise, but superfluous in pleading, or that unlike music, oratory has no interest in the variation of arrangement and sound to suit the demands of the case. But eloquence does vary both tone and rhythm, expressing sublime thoughts with elevation, pleasing thoughts with sweetness, and ordinary with gentle utterance, and in every expression of its art is in sympathy with the emotions of which it is the mouthpiece. It is by the raising, lowering or inflexion of the voice that the orator stirs the emotions of his hearers, and the measure, if I may repeat the term, of voice or phrase differs according as we wish to rouse the indignation or the pity of the judge. For, as we know, different emotions are roused even by the various musical instruments, which are incapable of reproducing speech. Book i. x. 21-26. Quintilian, *Institutio oratoria,* trans. H. E. Butler (Cambridge, MA: Harvard University Press, 1920): 171.

[110] Tres in quolibet modo sunt termini principales, à quibus incipiendum et maxime finiendum, vt omnes norunt. Vocantur autem Modi, tum ex eo quòd cantilenam cohibent, ne vltra modum hujus partes divagentur, tum etiam praecipue quia illi apti sunt ad continendum varias cantilenas, quae diversimode nos afficiant pro modorum varietate, de quibus multa Practici, verùm solâ experientiâ docti. Quorum rationes multae deduci possunt ex supra dictis. Certum enim est, in quibusdam plures ditonos et tertias minores, et in magis vel minus principalibus locis inveniri, ex quibus pene omnem Musicae varietatem oriri supra ostendimus. *Musicae Compendium* (Utrecht:1650) 56-57. As everyone knows, there are three degrees in each mode on which one must begin and, which is even more important, end. The modes owe their name to their ability to prevent tones of a melody from wandering in all directions. Furthermore, the modes allow for a variety of melodies which affect us in different ways according to the characteristics of the mode. Composers employ them in many ways based on practical experience. Many reasons for this variety can be deduced, however, from what we have already stated. It is clear, for example that in some modes major rather than minor thirds will be found occupying the more prominent positions in other modes the opposite will be true. We have shown that all variety in music is dependent upon these conditions. *Compendium musicae* (Amsterdam, 1656), trans. Walter Robert (Rome: American Institute of Musicology, 1961), 52.

be like a musician, nor the view of Mersenne and his imitators that the musician emulate the orator.

The Harmonic Orator

The seventeenth-century theorist Marin Mersenne tried to explain in detail his view of the relationship between music and rhetoric, recognizing both the aesthetic aspects and the technical elements of rhetorical performance. In *Traité de l'harmonie universelle* (1627) he begins the comprehensive task of describing his 'harmonic orator," combining the philosophical scheme of late sixteenth-century Neoplatonism with the principles of rhetoric and the mechanical science of the seventeenth century.[111] Mersenne made it the responsibility of the musician to master *musique accentuelle*, the "natural and universal language of the passions."[112] He said musicians must study grammar, rhetoric, history, poetry, philosophical dialectics, moral philosophy and theology. He must know how to build and repair his own instruments, and also be an historian of music. He must study physics and architecture so he could locate the best acoustical venues.

More than twenty years before Descartes wrote about the passions, Mersenne attempted a mechanistic description of how the passions function in relation to music. For him the passions were actual physical states that are influenced by sound. Of the eleven passions he discussed, five were located in the right ventricle of the heart and the rest in

[111] Contextual studies of Mersenne's ideas as they relate to rhetoric include Dean T. Mace, "Marin Mersenne on Language and Music," *Journal of Music Theory* 14, no. 1 (Spring 1970): 2-34, and David Allen Duncan, "Persuading the Affections: Rhetorical Theory and Mersenne's Advice to Harmonic Orators," in *French Musical Thought, 1600-1800*, ed. Georgia Cowart (Ann Arbor: UMI Research Press, 1989), 149-175.

[112] Duncan, "Persuading the Affections," 162.

the left.[113] Music, especially its rhythmic elements, could physically alter the physical processes in the listener's body. The effects of having one's passion of "joy" excited could include feeling one's blood moving faster, feeling the heart enlarge, and having a flushed face because "of the vital spirits the heart sends up." If there is a passion of "despair" then the face becomes pale and "melancholy corrupts the little blood that remains in the veins."[114] The linguistic orator may be better at communicating rational ideas, but the harmonic orator is the one who can arouse passions by organizing sounds within a rhetorical paradigm.

For Mersenne it was not just vocal music that provided these opportunities for expressiveness. He also viewed instrumental music as oratory, and suggested composers use the conventions of texted music as meaningful organizational elements. He suggested ways in which instrumental phrases could be punctuated with analogues to commas, colons and periods. He thought composers should write instrumental music with phrases that would not exceed what a vocalist could sing in one breath. Phrasing was to be modeled after speech. Falling intervals of thirds or fourths could simulate despair or sighs, while rising or falling half steps indicate feeling some kind of weeping or groaning.

A prolific correspondent with other early modern thinkers, Mersenne looked for support of his program in the works of his colleagues. Descartes and Mersenne had both attended the Jesuit college of La Flèche, and were lifelong correspondents. Having read Beeckman's copy of the *Compendium* and positioning himself as a fellow natural philosopher, Mersenne corresponded with Descartes about intervals and how they could

[113] In 1601 Thomas Wright's *The Passions of the Minde* also listed eleven passions. This was more than twenty years before Descartes published his theory of the passions.

[114] A more complete account of the passions as they relate to Mersenne's view of hydrostatics and pneumatics is summarized in Duncan, "Persuading the Affections," 160.

be described as expressive or as having aesthetic value. Although Mersenne's letters have been lost, Descartes' answers suggest that Mersenne was asking specifically how to support the claim that consonant intervals are more pleasant than dissonant ones. Descartes' responses were unambiguous; qualitative concepts of pleasure are simply not subject to rational analysis. In a letter of January 1630 Descartes wrote "In order to determine what is more agreeable, it is necessary to assume the capacity of the auditor, which like taste varies from person to person."[115] And in March 1630 the position is even more directly stated:

> In answer to your query as to whether the reason for *beauty* can be established, it is just like what you asked previously concerning why one sound is more agreeable than another, except that the word *beauty* seems to relate more particularly to the sense of sight. Generally, neither the beautiful nor the agreeable signifies anything except a connection between our judgment and the object, and because the judgments of men are so different, one can only say that neither beauty nor the agreeable has any determined measure.[116]

Again, in 1630 he writes: "What will please the most people will simply be named most *beautiful*, though this cannot be determined."[117] Descartes further refines his response about consonances in an undated letter:[118]

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[115] Mais, pour determiner ce qui est plus agréable, il faut supposer la capacité de l'auditeur, laquelle change comme le goust, selon les personnes; in Charles Dill, "Music, Beauty and the Paradox of Rationalism," in *French Musical Thought, 1600-1800,* ed. Georgia Cowart (Ann Arbor, MI: UMI Research Press, 1989), 199n9.

[116] Pour vostre question, sçavoir si on peut establir la raison du *beau*, c'est tout de mesme que ce que vous demandiez auparauant, pourquoy vn son est plus agreeable que l'autre, sinon que le mot de *beau* semble particulierement se rapporter au sens de la veuë. Mais generalement ny le beau, ny l'agreable, ne signifie rien qu'vn rapport de nostre iugement à l'objet; & pource que les iugemens des homes sont si differens, on ne peut dire que le beau, ny l'agreable, ayent aucune mesure determinée, in Dill, "Music, Beauty and the Paradox of Rationalism," 199n10.

[117] Mais ce que plaira à plus de gens, pourra estre nommé simplement le plus *beau*, ce qui ne sçauroit estre determine." Ibid, 199n12.

[118] Charles Dill suggests this was written around October 1631.

> Touching on the sweetness of consonances, there are two things to distinguish: to know what renders them more simple and concordant and what renders them more agreeable to the ear. Now, rendering them more agreeable depends on the places where they are employed, and there are some places where diminished fifths and other dissonances are more agreeable than consonances, so that one cannot determine absolutely whether one consonance is more agreeable than another.... But one can say absolutely which consonances are more simple and more concordant.[119]

His rationalism is clear and even a decade after the writing of the *Compendium*, his comments on meaning in music go back to the principles he established in his examination of intervals. Discussions of aesthetic qualities are outside of his rationalistic system and they were not ever again mentioned in publications of known correspondence.

Music and Perceptual Cognition

Like Francis Bacon, Descartes was a natural philosopher whose method eventually precluded alignment with most humanist thinkers who looked for meaning in music. In his prolegomena, in the analysis of rhythm and meter, and in a less overt way in his analysis of pitch for intervals, the outline of what became his epistemology is revealed. The first component is the emphasis on the role of the senses. For example in the third and seventh items of his eight "praenotanda," he says that whatever object is known by the senses must be neither too complex nor too simple. The reason for this is that the senses become confused when a design is too complex, and they become

[119] In the history of the aesthetics of music, the tension between our understanding of the acoustic realities of sound and the desire to use sound as an expressive art has resulted in an extensive literature on meaning in music. Mersenne's advocacy of beauty in music and Descartes' refusal to validate his position is discussed at length in Charles Dill's monograph on the paradox of rationalism. Descartes' final statement to Mersenne on this subject was written in November 1631, clearly intended as a signal to close the discussion with "I know nothing more to respond with concerning all that you have proposed reading this science, except what I have written to you on diverse occasion." (Je ne sçache rien de plus à vous réspondre, touchant tout ce que vous me proposez de cette science, que ce que ie vous en ay écrit a diverses fois.) Dill, "Music, Beauty and the Paradox of Rationalism," 209n16.

dissatisfied when it is too easy. The second component emphasizes the abstracting practices of the intellect. In items five and six Descartes addresses the way that relationships among the parts of an object are sensed, stating that the mind is less perplexed when the patterns are arithmetic rather than geometric. The third component builds upon both knowledge from senses and knowledge from the intellect in order to gather the necessary components for creating meaning. In his discussion of rhythm and meter he evokes this third level of knowledge, maintaining that it is the product of a proportionalizing imagination. The imagination serves as the locus for synthesizing information from the senses and from one's rational mind.

As part of a recent reassessment of Descartes' system of natural philosophy, Stephen Gaukroger labels each of these categories of perception as a type of cognition.[120] The sensory process is representational cognition, the rational is called intellectual cognition and the powers of imagination result in perceptual cognition. In representational cognition the sense organs receive impressions. With intellectual cognition the mind reflects upon the sensory impressions, applying reasoning and

[120] Scholars such as Jamie Kassler, John Schuster, John Sutton and Stephen Gaukroger have been publishing studies that reassess Descartes' early works, studying them in context. They contend that much of his writing has been distorted because interpretations, especially those by Gilbert Ryle and Richard Rorty who ignored the fact that Descartes formed his positions in response to very practical questions. These scholars contend that there has also been a general misunderstanding of the approach of natural philosophers and of the irrelevance of metaphysical foundations to their projects. Stephen Gaukroger has also suggested that the way that current academic categories are organized (psychology vs. neurophysiology or philosophy vs. science) makes matters worse. "The result is the carving up of questions and domains which, for Descartes and other seventeenth-century thinkers were part of an integrated project, so that something that made perfectly good sense and had a clear rationale now becomes at best problematic and at worst indefensible." Stephen Gaukroger, John Schuster and John Sutton, eds., introduction to *Descartes' Natural Philosophy* (London: Routledge, 2000), 4-5.

organizational faculties to the data. Perceptual cognition resides in the imagination, where meanings, relationships and truth claims are established.[121]

All three faculties are involved in the process of understanding the rhythmic frame of a musical composition. In Descartes' description of rhythm it is the perception of sound as a rhythmic unit that engages representational cognition. Intellectual cognition is responsible for perceiving the proportions of meter being either duple or triple, as proportions more simple or more complex than this would tax the mind. And it is the function of perceptual cognition to integrate both of these for the purpose of comprehending the rhythmic frame of the entire composition, both in terms of what has been experienced and what is anticipated as the conclusion:

> The division is indicated by the bar or measure, as it is called, to aid our imagination, so that we can more easily apprehend all the parts of a composition and enjoy the proportions that must prevail therein. This proportion is often stressed so strongly among the components of a composition that it aids our understanding to such an extent that while hearing the end of one time unit, we will remember what occurred at the beginning and during the remainder of the composition. This happens when the entire melody consists of 8 or 16 or 32 or 64 units, etc. i.e. all divisions result from a 1:2 proportion. For then we hear the first two units as one, then we add a third unit to the first two, so that the proportion is 1:3; on hearing unit 4 we connect it with the third, so that we apprehend them together; then we connect the first two with the last two, so that we grasp those four as a unit; and so our imagination proceeds to the end, when the whole melody is finally understood as the sum of many equal parts.[122]

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[121] Stephen Gaukroger, *Descartes' System of Natural Philosophy* (Cambridge: Cambridge University Press, 2002), 216-222.

[122] Haec autem divisio notatur percussione, vel battutâ, vt vocant, quod fit ad juvandam imaginationem nostram; quâ possimus facilius omnia cantilenae membra percipere, et proportione quae in illis esse debet delectari. Haec autem proportio talis servatur saepissime in membris cantilenae, vt possit apprehensionem nostram ita juvare, vt dum vltimum audimus, adhuc temporis, quod in primo fuit et quod in reliquâ cantilenâ, recordemur; quod fit, si tota cantilena vel 8, vel 16, vel 32, vel 64, et caetera, membris constet, vt scilicet omnes divisiones a proportione duplâ procedant. Tunc enim, dum duo prima membra audimus, illa instar vnius concipimus; dum tertium membrum, adhuc illud cum primis coniungimus, ita vt sit proportio tripla; postea, dum audimus quartum, illud cum tertio iungimus, ita vt instar vnius concipiamus; deinde duo prima cum duobus vltimis iterum coniungimus, ita vt instar vnius illa quatuor concipiamus simul. Et sic ad finem vsque nostra imaginatio procedit, vbi tandem omnem cantilenam vt vnum quid ex multis aequalibus membris conflatum concipit. *Musicae Compendium* (Utrecht, 1650) 8-9. *Compendium musicae* (Amsterdam, 1656), trans. Walter Robert (Rome: American Institute of Musicology, 1961), 14.

Here Descartes presents in essence a description of the process of establishing musical coherence through the faculty of perceptual cognition. This cognitive process is first described in the *Compendium* and then explored more systematically in later works. His description of the faculty of perceptual cognition can also serve as an explanatory tool in music, not only to explain how rhythmic structures are understood but also to explain how pitch relationships are perceived and manipulated in performance. It is this aspect of his epistemology that supports my claim that intonational inflection can transmit meaningful rhetorical gestures.

Placing Descartes' epistemology in an historical context, Gaukroger compares Descartes' position on perceptual cognition with that of Aquinas, emphasizing the unique role of imagination:

> The imagination represents to itself the contents of the world and it represents to itself the contents of the intellect, and perceptual cognition takes place when it maps these on to one other.... the imagination, which draws on both the intellect and the information gleaned from the sense organs, that is the site of perceptual cognition, just as it is in mindless animals. The difference is that, whereas the imagination in the mindless animal has only one input, a sensory one, that in the human being has a sensory and an intellectual input. This intellectual input has been widely misunderstood, and the kind of account that we find in Aquinas, for example, whereby the perceptual process culminates in the intellect, has been read into Descartes' account, where the perceptual process, even when engaging the intellect, culminates in the imagination. The misreading has the effect of making perceptual cognition into a form of intellectual cognition.[123]

It is important to understand Descartes' delineation of perceptual cognition as a synthesizing and proportionalizing faculty because of the implications for explaining musical meaning within the context of natural philosophy. This distinguishes Descartes' approach from approaches to music theories that were associated with scholasticism. For

[123] Gaukroger, *Descartes' System*, 220-221.

Aquinas the imagination as a corporeal entity presents sensory information to the incorporeal intellect, and then it is no longer needed for knowledge. For Descartes the imagination is a place where sensory representations and intellectual abstraction come together to be formed into ideas. In that space, concepts such as number and proportion can have breadth and depth. Imagination is essential for knowledge. In music, imagination is a factor in creating coherence.[124]

The utilization of the imagination clarifies the means by which music can be expressive of particular sensations without specifically representing them. Perceptual cognition could, for example, recognize a musical phrase as building in intensity. The notes of the musical phrase are not in themselves tense objects. Neither can the sensory faculties of representational cognition be described as "feeling" tense. All that one can learn from representational cognition is something about the arrangement of notes, whether pitches are high or low, loud or soft, simple or complex, more or less concordant. One also does not describe the faculty of hearing as "intense." Just as in the argument for not ascribing the quality of beauty to an interval, Descartes' perspective would not allow the designation of intensity to the object of hearing or to something experienced within the hearing mechanism. The musical phrase is only understood as a phrase by the intellectual cognition, and can only be evaluated as being "intense" by the faculty of perceptual cognition. That is the place where the "truth claim" about intensity can be made. With these clear parameters, Descartes' epistemological position addresses Francis Bacon's call for a theory of music that abandons mystical subtlety and describes the musical practices concerning intervals accurately.

[124] Ibid, 218-219.

The Passions Engaged

This distinction between the sensory function of perception and the abstracting functions of the intellect and the imagination is important when addressing the way music is described as engaging the passions. Mersenne tried to develop a description of how music and the passions are related, referencing a mechanistic model of pneumatic forces. For him it is the accents in music that cause special physical responses in the body. The vibrations of music strike the air in the ear, which "imprints an emotion in the nerve of the ear canal."[125] From here the imprinted emotion is transferred as a passionate impression on the static matrices of the mind. Using the phrase "accents of the passions" he refers to a mechanism common to all people. Yet, he disregards or ignores the fact that the same passionate impression can create a variety of responses.

Mersenne's concern was not with consistency of argument, but with discovering a physical basis for his universal language theory. Realizing that the sounds of words and their meanings vary from culture to culture, Mersenne had asked Descartes whether he had any insight on the relationship between sounds and their meaning. This was not a discussion about musical sound, but about sound in general. Yet, Descartes' answer provided Mersenne with the link to join his own theory of the motions of the passions with an observation about the universality of some sounds, to arrive at the concept of music as a universal language of the passions. Descartes' contribution was simply to observe that there is one kind of "natural" sound that both men and animals make, and that is the inarticulate sounds that express the passions.[126] Mersenne reasoned that if this expressive sound was a universal natural phenomenon, and if motions of passions were

[125] Duncan, "Persuading the Affections," 160.

[126] Ibid, 161.

generated by vibrations, that is, of the same substance as music, then music was the language of the passions. From this deduction Mersenne also claimed that the music was superior to speech because it was a universal expressive language. His educational agenda for the musician, the *musique accentuelle,* is derived from this mechanistic concept of the "accents of the passions."

By contrast, Descartes never discusses music in relation to the passions, and if musical meaning and Descartes' theory of the passions were to be linked, it would most likely not be achieved in the way Mersenne had envisioned. Given Descartes' position as a natural philosopher and his objection to any claim of meaning in musical elements, it is unlikely that he would support the kinds of connections made to his own theory of passions. Writing to Mersenne specifically not about sound and language but about music, Descartes is unwilling to draw connections between musical elements and specific meanings, so would certainly not extend the connection to linguistic processes. This is not to claim that Descartes denies that music is expressive, but only that its specific meaning is unclear. It was Bernard Lamy who first saw the possibilities of a Cartesian approach to rhetoric by exploring expression in ways more directly aligned with ideas in the *Compendium* as well as with *Les Passions de l'Âme*.[127]

[127] Thomas Conley's survey of the influence of Descartes on rhetoric in Europe emphasizes the impact on the Jesuits (his most severe critics) and on the writing of Bernard Lamy in particular. "The 'rationalism' and, so to speak, 'applied dualism' in *L'Art de parler* are fairly representative of what happened to rhetorics all over Europe after 1660 or so. The implications of Cartesianism for rhetoric of course go far beyond mere alterations in the formats of those rhetorics and involve some fundamental revisions in the conception of human nature." Thomas M. Conley, *Rhetoric in the European Tradition* (Chicago: University of Chicago Press, 1994), 176.

Lamy's *L'Art de Parler*

Lamy first published his book on rhetoric, *L'Art de Parler,* anonymously in 1675. Anonymity was in order since his Cartesian leanings made him a target. The Jesuits were suspicious of followers of Descartes, whom they labeled a skeptic if not an atheist, and so placed his writings on the index in 1665. Lamy was also a member of the rival order, the Congregation of the Oratory of Jesus. He became an instructor in philosophy at Anjou, but as his teachings became known his superiors moved him to a position at the Convent of Saint-Martin-de-Misère near Grenoble in order to reduce his visibility to Jesuit critics. But as Cartesian ideas eventually became more widely accepted on the Continent and Descartes' mechanistic psychology influenced thinking in all fields, a Cartesian rhetoric like Lamy's began to have a wider appeal. It was not the first vernacular text in France, but was widely read and highly influential.[128] By the third edition in 1688, Lamy was identified as the author and the title changed to *La Rhétorique, ou l'art de Parler.*

La Rhétorique ou l'art de parler is a comprehensive text, organized into five large sections covering nature of the voice, the figurative use of language, the acoustical elements in delivery, the divisions of style and their uses, and finally, the power of persuasion as the fundamental value in rhetorical theory. Besides the Cartesian method, Lamy incorporates aspects of Ciceronian, Quintilian and Augustinian texts. He also was strongly influenced by Longinus' rhetoric book *On the Sublime*, translated and published

[128] Conely notes that Lamy's *Art de parler* was reprinted often, both in France and abroad, and that his influence went well beyond traditional rhetorical texts. "He explicitly revises the whole notion of rhetoric, transforming a means for handling *controversia* into a unilateral process of influence. If the old rhetoric was a way of managing uncertainty, the new is, by contrast, a way of managing the uncertain by shaping the "movements of their souls" to conform to the proposition advanced by the orator." Ibid, 177.

in French just a year earlier than *L'Art de Parler*.[129] He addresses the structural aspects of rhetoric from a mechanistic point of view, showing the means for achieving an expressive and eloquent oration. He also addresses the performative aspect of rhetoric through his examination of non-verbal elements in the communication of ideas and relationships. It is this emphasis on delivery and the expressive qualities of sound that distinguishes his text from previous approaches and also provides the connection to musical performance.

The opening paragraph of *La Rhétorique ou l'art de parler* signals a departure from traditional texts on rhetoric.[130] Just as Descartes affirmed the authority of experience by beginning his treatise on music with a recognition of the power of sound, Lamy begins with the power of the voice:

> We may speak with our eyes, and our fingers, and make use of the motions of those parts to express the ideas which are present in our minds, and the affections of our wills. But this way of speaking is not only imperfect, but troublesome.... Nature has disposed man to make use of the organs of the voice to give sensible signs of what he wills and conceives.[131]

Lamy's subsequent description of the physical process of vocalization reveals his interest in the empirical connection between thoughts and their expression. He emphasizes the distinction between the body that forms these sounds as the "body of our words" and the mind that creates them:

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[129] Longinus' *On the Sublime* (*Peri Hupsous),* a small book of rhetoric from the first century C. E., was translated into French by Nicholas Boileau in 1674 as "*Traité du Sublime ou du Merveilleux dans le Discours Traduit du Grec de Longin."*

[130] Cicero begins his rhetoric by stating his goal of bringing to the contemporary reader the great wisdom of Aristotle and Isocrates. "...the recollection of an old tradition must be revived in my mind...that you may understand what opinions the most famous and eloquent men entertained respecting the whole art of oratory." Cicero, I.ii. J. S. Watson, trans. and ed., *Cicero on Oratory and Orators* (Carbondale, IL: Southern Illinois University Press, 1970), 7. Quintilian in his survey of how to become a great orator cites Cicero as the authority. As they introduce their topics, neither Descartes nor Lamy mention any authority but their own experience.

[131]Lamy, I.1.1. John T. Harwood, ed., *The Rhetorics of Thomas Hobbes and Bernard Lamy*, (Carbondale, IL: Southern Illinois University Press, 1986), 180.

> And here it is of importance to observe the distinction betwixt the *soul* of words and the *body*; betwixt that in them which is corporeal, and that in them which is spiritual; betwixt that which is common to us with birds, and that which is peculiar to our selves. The ideas present to our mind (when it commands the organs of the voice to form such sounds as are the signs of those ideas) are the soul of our words: the sounds formed by the organs of our voice (which, though of themselves they have nothing resembling those ideas, do notwithstanding represent them) are the material part, and may be called the body of our words.[132]

He then separates the processes of speech into the physical, phonetic and syntactic elements associated with vocalizations. Thoughts in sound are those clear and distinct self-evident elements of speech. Describing the need for clarity in discourse and in the understanding of the expressive process, Lamy turns to a mechanistic explanation of the connection between thought and delivery. It is in this context that the passions are first mentioned:

> All that passes in our minds is either action or passion. We have seen already which way we may express our actions. Let us now see what nature dictates to signify our passions, that is, to signify the esteem, contempt, love or hatred we bear to things which should be the objects of our thoughts and our affections. Our discourse is imperfect unless it carry with it the marks of the motions of our will…. When we speak in passion, the air of our looks, the tone of our voice and several other circumstances, are sufficient to signify our commotion.[133]

In section two Lamy argues that figures are not expendable elements in rhetoric, but are basic as ways to express feelings that will engage the auditor. Close connections to Descartes' rationalistic and mechanistic perspectives provide the framework for Lamy's explanation of how rhetorical figures work as accessories to communication. Figures are more than formulae. They are active agents that are necessary to the goals of rhetoric. They are the "instruments used to shake and agitate the minds of those to whom we

[132] Ibid I.1.2, 181-182.

[133] Ibid I.3.3, 201.

speak."[134] If passions are the springs of the soul, then rhetorical figures are the triggers of those springs:

> Eloquence therefore would have but little authority over our hearts, and would indeed find strong resistance, did she not attach them with other arms besides truth. The passions are the springs of the soul. It is they which cause it to act. It is either love or hatred, or fear, or hope, which counsels and determines us. We pursue what we love, we avoid what we hate. He that holds the springs of a machine is not so much master of all the effects of the machine as he is of a person whose inclination he knows and is able to inspire with hatred or love, according as either is necessary to make him advance or to remove him from an object.[135]

The relationship between the passions and the figures is described as follows:

> We have seen how figures do imprint strongly, how they illustrate, and how they explain. We must use them in the same manner to discover the object of the passion which we have a mind to inspire and to make a lively picture that expresses all the features and lineaments of the said object.... Figures, as we have seen, being the characters of our passions, when those passions are irregular, serve only to describe those irregularities. They are instruments used to shake and agitate the minds of those to whom we speak.[136]

Section three is the longest of the five divisions and provides a clarification of the difference between sense and sentiment. Here Lamy is careful not to fall into the trap of turning structure into content. The substance of effective speech is clear and distinct thought; the style that accompanies transmission to an auditor is an accessory to that thought. Both elements are grounded in physicality and neither are meaningful in themselves. Meaning is located in the mind of the rhetor and is transmitted to the listener by a kind of vicarious experience of empathy. But this can only happen when the sounds are clear and well presented. One's performance of the oration must not be confusing, but

[134] Ibid II.4.4, 247.

[135] Ibid II.4.4, 246.

[136] Ibid II.4.4 and II.4.5, 246-247.

have an easily comprehended arrangement, an appropriate length, well-placed cadences and pauses to clarify organization. In addressing the acoustical elements of effective delivery Lamy develops his concept of natural expression and the need for understanding the techniques of sound manipulation even further. For example, when delivering a phrase we begin with a lift of the voice. "The ear judges the length of a phrase by the elevation of the voice."[137] In a subsequent description of a sentence, Lamy describes the importance of a clear shape:

> To compose a period, or [which is the same thing] to express a sentence that is composed of two or more several senses, with such art that the expressions in the said sentence my have the conditions necessary to please the ear; we must first provide that the expressions be not too long, and that the whole period be proportioned to the breath of him who is to pronounce it.... The members of a period ought to be joined close, that the ear may perceive the equality of the intervals of respiration.... A period, like a circle, encompasses and encloses the whole sense of a sentence, and causes the ear with ease to perceive the distinction or union of its members. In pronouncing an entire period, we raise our voice to the middle of the sentence and let if fall gradually afterward.[138]

Lamy's goal here is to show how pitch is used to organize and define the shape of a phrase. He also addresses aspects of tone and tempo, and the intention of the speaker:

> So the cadence of words is many times of more force than the words themselves. In short, we cannot doubt of the efficacy of the tone. A bold tone begets an impression of fear. A sorrowful tone disposes to compassion. Discourse loses much of its force when not sustained with advantages of action and voice: it is an instrument that receives its virtue from the hand that manages it. Words upon paper are like a dead body upon the ground.[139]

Lamy also explains how rhythm can be expressive:

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[137] "In beginning a sentence, when we lift up our voice insensibly, the Greeks call it TASIS and at the end of a sentence when we depress it, it is called THESIS. The ear judges of the length of a phrase by the elevation of the voice, if that be loud, It makes us expect many words; if the expected words do not follow, the defect deceived them, and is uneasy as well to the speaker as to the hearer." Lamy, III.1.3; Harwood, *The Rhetorics*, 259.

[138] Ibid III.3.3, 271-272.

[139] Ibid III.5.2, 294.

> Particular regard must be had to the measures of time. Among those measures the *spondeus* marches gravely, the *dactylus* rolls off something faster, the *iambus* goes faster from that, and the *trochaeus* seems to run, and takes it name from a Greek word of that signification. The *anapaestus*, in opposition to the *dactylus* rolling on pretty fast in the beginning, at the latter end, seems to knock or dash against something that repells it, from whence that also has its name, as is as much as *repercussion*. The effects of these measures are all different. He who would accommodate the cadence of his words to the things of which he treats, ought to select those feet which are most comfortable to them.[140]

Good discourse employs patterns and proportions that are connected both physiologically to breathing and psychologically to the mind. Like Descartes, Lamy often refers to "the ear" as the arbiter, and he addresses "what the ear distinguishes in the sounds of words, and what it may perceive with delight":[141]

> These conditions are necessary to all sounds to make them agreeable, whether it be to the sounds of the voice or of instruments.... Let us see now how we may make the sounds have such conditions as may render them agreeable to the ear.... We may without much difficulty range our discourse in such manner that the pronunciation be neither too violent nor faith; that it be moderate and distinct. The ear perceives several things: In pronunciation: ...it judges the measure of time in which each letter, each syllable, each word, each expression is pronounced. Next it judges of the elevations and depressions of the voice, by which in speaking each word, each expression is distinguished. In the third place the ear observes the silence or repose of the voice at the end of words or sentences when we join or separate words... and [the fourth] is accents, the knowledge of which is absolutely necessary for pronunciation.[142]

Lamy's explanations of how variations in sound can articulate phrase structures, organize rhythms and "please the ear" can be applied as easily to instrumental sounds as to vocal

[140] Ibid III.5.3, 296-297.

[141] Ibid III.2.7, 266.

[142] The voice is to be raised on the *sharp* (´), depressed on the *grave* (`), raised and then lowered for the *circumflex* (ˆ). Ibid III.2, 267.

sounds. As he wrote, "these conditions are necessary to all sounds...whether it be to the sounds of the voice or of instruments."[143]

Section four is a short survey of style, with attention to fitting appropriate style to the abilities of the speaker and to the situation in which he is speaking. Like Mersenne's requirements for the "harmonic orator," Lamy lists the things required of the eloquent orator. Having good style is dependent on the orator having a good imagination, a good memory and the "qualities of mind" that makes one eloquent. Lamy describes these qualities of mind:

> What we have hitherto said relates only to the corporal organs. The qualities of the mind are more considerable and important. Reason must regulate the advantages of nature, which are rather defects than advantages when we understand not how to use them....To enjoy the sovereign perfection of eloquence the mind must be adorned with these three qualities: first a capacity to discover abundantly all that may be said upon any proposed subject. A narrow apprehension is incapable of giving things their just latitude and extent. The second quality consists in a certain sagacious vivacity that strikes immediately into things, rummages them to the bottom, and cleanses every corner. Those whose minds are heavy and dull, do not penetrate into the folds or intricacies of an affair, and therefore can only skim off what they find at the top. The third quality is exactness of judgment, and that regulates both the other qualities. A good judgment chooses and picks, it stops not at every thing presented by the imagination, but discerns and discriminates betwixt what is fit to be said and what is fit to be passed. It dilates not on things according to the bigness of their images, but amplifies discourse or contracts it, as the thing and reason require....[144]

The final section of *L'Art de Parler* has a separate designation as "A Discourse in which is given an Idea of the Art of Persuasion." In describing the process of persuasion Lamy emphasizes the need to move beyond abstract concepts to something more visceral. His is a call to action:

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[143] Ibid III.2.7, 266.

[144] Ibid IV.1.6, 308-309.

> The common way of affecting the heart of man is to give him a lively sense and impression of the object of that passion wherewith we desire he should be moved. Love is an affection excited in the soul by the sight of a present good. To kindle this affection in a heart capable of loving, we must present him with an object of amiable qualities. Fear has for its object not only certain evil but evil contingent. To fright a timorous person, we need no more than to make him sensible of the evils that threaten him. It is not without reason that the arts of persuading and well-speaking are not separated, for the one serves for little without the other. To stir and affect the soul of a man, it suffices not to give him a bare representation of the object of that passion wherewith we would animate him; we must display all the riches of our eloquence to give him an ample and sensible delineation that may strike it home, and leave an impression.... 'Tis not enough therefore to produce good arguments, to deliver them with clearness and perspicuity; but we must use them with extraordinary address, that may surprise the hearer, make him admire and draw the eyes of the whole world upon us.[145]

How does one get the attention of the "heart of man" in order to "stir and affect the soul"? Lamy says it is necessary to first excite the element of "admiration":

> Admiration is a motion of the mind that converts it upon some extraordinary object, and inclines it to consider whether the said object be good or bad, that it may either pursue or avoid it. It is of importance to an orator to excite the passion in the mind of his auditory.[146]

The orator must therefore convey some quality in his presentation that sets this process of admiration in motion. Descartes describes admiration as a sudden surprise of the soul, a response to something extraordinary. The resulting strong impression made on the brain causes another mechanism to begin strengthening this passion, and to remember it.[147] Lamy's mechanistic account of admiration is similar to Descartes' in that there is both a

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[145] Ibid V.3.2, 364-365.

[146] Ibid V.3.2, 365.

[147] Descartes, *Passions* 2:70 about *L'admiration*: "Wonder is a sudden surprise of the soul which causes it to apply itself to consider with attention the objects which seem to it rare and extraordinary. It is thus primarily caused by the impression we have in the brain which represents the object as rare, and as consequently worthy of much consideration; then afterwards by the movement of the spirits, which are disposed by this impression to tend with great force towards the part of the brain where it is, in order to fortify and conserve it there; as they are also disposed by it to pass thence into the muscles which serve to retain the organs of the senses in the same situation in which they are, so that it is still maintained by them, if it is by them that it has been formed." In *The Philosophical Works of Descartes*, Vol. 1, trans. Elizabeth S. Haldane and G. R. T. Ross, 362.

place and a process to explain the auditor's reaction. The place is the soul, that locus of perceptual cognition where the act of recognizing something extraordinary occurs, and the process is the orator's act of communicating both verbally and non-verbally something of extraordinary power.

For Lamy the most effective discourse is that which is clear in expression and is based upon an awareness of the connection between what we feel and what we say. With this he establishes the foundation for a rhetoric based more on natural expression than on artifice. The suggestion that there is a natural inclination for expression that is rhetorically powerful and full of truth and feeling is also found in part one of Descartes' *Discourse on Method:*

> I esteemed eloquence highly, and was enamored of poetry. Both, however, I regarded as being natural gifts rather than fruits of study. Those in whom the gift of reasoning is strongest and who are careful to render their thoughts clear and intelligible, are always the best able to convert others to what they propose, even if they speak Breton and are ignorant of rhetoric.[148]

The suggestion that the power of "clear and intelligible" expression is a kind of natural persuasion supports Lamy's development of the tools of rhetoric, but does not take the place of evidence of truth. Thomas M. Carr, Jr. clarifies the relationship between Lamy's rhetoric and Descartes' philosophy:

> Lamy's tendency is to stretch to their limits fundamental Cartesian positions in order to allow for traditional rhetorical practices. He pays homage to *évidence* and the linear chains of proof exemplified by geometry, yet he also makes room

[148] Descartes, *Discourse on Method*, trans. Norman Kemp Smith (New York: Random House, 1958), 97. Although skilled as a rhetorician, Descartes did not celebrate rhetorical prowess. Rhetoric was not a tool for finding the truth, but only for the illustration and transmission of knowledge. "Although in the *Discours* Descartes had rejected rhetoric as an art of persuasion, he subsequently came to admit that clear and distinct ideas were not always sufficient to persuade and recognized a rhetoric of philosophical discourse, leaving to his successors definition of the precise role of rhetoric, description of its psychological processes, and analysis of the functions of language." George A. Kennedy, "The contributions of rhetoric to literary criticism," in *The Eighteenth Century*, ed. H. B. Nisbet and Claude Rawson, vol. 4 of *The Cambridge History of Literary Criticism* (Cambridge: Cambridge University Press, 1997), 350.

> alongside them for a rhetoric that deals with contested issues where certainty comes from an accumulation of interlocking arguments, just as Descartes had allowed for moral certainty rather than self-evidence in the realm of action. When *évidence* cannot be reached, or when an audience refuses to attend to it rhetorical stealth must be invoked.[149]

Lamy's focus on vividness of sense-impression and the power of precise words to express the orator's thoughts reflects not just his appreciation of Descartes but also his deep knowledge of rhetoric, gained in part from his acquaintance with Quintilian. Quintilian in the *Institutio oratoria* (6.2.32) emphasized the requirement of vividness in providing *evidentia*, the narration that describes events for the listener. This is a rhetorical figure of clear and distinct sensation and comes very close to what Descartes demanded in the first step of his method, to accept nothing as true that was not clearly recognized as such, and to avoid prejudiced judgments by accepting nothing beyond what was presented to the mind so clearly and distinctly that it could not be doubted. The idea that effective persuasion relies as much on non-verbal elements as on words themselves provides the link to the expressive possibilities of music.

Music as a Model for Rhetoric

While *L'Art de Parler* is not about music, Lamy does reference music as a model for rhetorical expressiveness. His authority for this position was the recently discovered rhetorician Longinus.[150] Lamy's appropriation of the aesthetic views of Longinus brings

[149] Thomas M. Carr, Jr., *Descartes and the Resilience of Rhetoric: Varieties of Cartesian Rhetorical Theory* (Carbondale, Ill.: Southern Illinois University Press, 1990), 165.

[150] Lamy's interest in Descartes, Cicero, Quintilian and Augustine is overt, but a close reading shows that he was also familiar with the works of Dionysius of Halicarnassus, Lucian, Plato, Aristotle, St. Chrysostom, Livy, Virgil, Florus, Ulpianus of Ascalon and Servius Honoratus.

the value of "sublime" expression into the vocabulary of rhetoric, making the association between the power of vivid ideas in language and power of sound in music.[151]

Longinus discusses the issue of our human attraction to great ideas from a less mechanistic point of view than Lamy. Longinus enumerates the five elements needed for an orator to achieve the ability to cast a spell over an audience. These include great ideas, inspired passions, the ability to create effective figures of thought, the ability to choose good words and the ability to form an effective arrangement. Here is Longinus' view of the limitations of the typical handbooks on technique. Once again, the appeal to the power of natural expression is clear:

> We are to investigate at the beginning whether there is a technique for sublimity or profundity, for some think that those who reduce such matters to handbooks of technical pronouncement are on the whole misled. You see, they say that things great in nature are innate and not teachable; that nature is the only technique for getting them: the workings of nature are made worse and more wretched when reduced to the barebones by technical handbooks.[152]

Here again he elevates "the natural" as a mode of persuasion.[153] Longinus also uses the metaphor of music to describe specific characteristics of effective communication:

> …harmonious arrangement is not only a natural source of persuasion and pleasure among men but also a wonderful instrument of lofty utterance and of passion. For does not the flute instill certain emotions into its hearers and as it were make them beside themselves and full of frenzy, and supplying a rhythmical movement constrain the listener to move rhythmically in accordance therewith and to conform himself to the melody, although he may be utterly ignorant of music? Yes, and the tones of the harp, although in themselves they signify nothing at all,

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[151] Boileau's translation of Longinus' *On the Sublime* was read widely read in France and England, influencing writers such as Alexander Pope and John Dryden. Lamy's references to Longinus reinforced the interest of English poets in theories of the sublime, and may account for the popularity of the English translations of his rhetoric.

[152] Longinus, *On the Sublime* trans. James A. Arieti and John M. Crossett (Lewiston, NY: Mellen Press, 1985), 2.1.

[153]Longinus influenced Lamy as much as Descartes, and his references to him are overt. While Descartes is never mentioned by name, Lamy does cite Longinus in several passages.

> often cast a wonderful spell, as you know, over an audience by means of the variations of sounds, by their pulsation against one another, and by their mingling in concert.[154]

With music used as model for rhetoric, Longinus and Lamy both present narratives that shadow Descartes' position as well. They acknowledge some relationship of music to language, but are clear that the tones of music "signify nothing at all." Contrary to Mersenne's claim and in line with Descartes, Lamy does not look for meaning in the sounds themselves, while still acknowledging that the tones of music do have immense power over human passions and they affect us deeply. Lamy's exploration of the close connection between mind and body, between reason and sense, rests on this acknowledgment of how non-verbal expressions of sound affects us. This is clear from his insistence that orators should learn from musicians how to manipulate the senses with an effective arrangement of sound.

In his discussion of the effects of music, Lamy also aligns music with numerical patterns, acknowledging the power these proportions have over the soul. Lamy cites Longinus again as "that excellent critic in his description of the soul who tells us that these numbers are instruments very proper to provoke or agitate our passions:"

> Every motion that is made in the organs of sense, and communicated to the animal spirits is connected by the God of Nature to some certain motion of the Soul. Sound can excite passions and we may say, that every passion answers to some sound or other...This connection is the cause of our sympathy with numbers and that naturally according to the tone of the speaker, our resentment is different. If a tone be languishing and doleful, it inspires sadness; if it be loud and brisk it begets vivacity and courage; some airs are gay and others melancholy.[155]

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[154] Longinus, *On the Sublime*, 39.1.

[155] Lamy, III.5.1; Harwood, *The Rhetorics*, 292.

In this section on the sympathy between the soul and number, Lamy refers to Augustine's idea of transmission of sympathetic concordances:

> We have seen that a discourse is agreeable when the times of the pronunciation of syllables which comes it are measured by exact measures; that the time (for example) of a syllable is exactly either the double or treble time of another syllable. The exactest measures are those which are expressed by numbers. In geometry all exact reasons are called *rationed numeri ad numerum*, and therefore the masters of the *Art of Speaking* have thought good to call *numeros* whatever the ear perceives of proportion in the pronunciation of a sentence, whether it be the proportion of the measure of time or a just distribution of the intervals of respiration.... Saint Augustine observes that our souls have a sympathy and alliance with these numbers, and that the different motions of the mind do correspond and follow certain tones of the voice to which the soul has a secret inclination.[156]

Longinus was another who also recognized that these numbers (rhythms) can be used to agitate, provoke or soothe us. Sounds are significative and can affect our moods:

> ...what we have said ought not to seem strange, especially if we reflect upon what has been derived to us from many eminent authors [Longinus], relating to the strange effects of music. Some have affirmed there were persons who played so excellently upon the flute, that they knew how to accommodate their airs to all kinds of maladies, how to ease those who were in pain, delight those who were sad, and recover those who were sick.[157]

In all of these examples there is correspondence between the substance of the sound and the effect that sound has on the auditor, whether because of its proportion, tessitura, representations, tone or some other factor. Whatever the specific characteristic, it is the performance of the music itself that is the affective agent.

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[156] Ibid III.5.1, 291.

[157] Lamy, III.5.1; Harwood, *The Rhetorics*, 293.

For Lamy, music remains the primary model for the orator. Figures and tropes are manipulations of sound in music, but are not meaningful in themselves. Neither Longinus nor Lamy mistake a metaphorical image for an ontological position. They do not present the arrangement of sound as a substitute for text, or as having any kind of semantic content. But their recognition of the affective power of sound, the syntax of its presentation in time and the response of "the ear" or of "the soul" is important and is linked to delivery. Lamy's emphasis on the primacy of sound, the necessity of vivid images in presenting patterns in sound and its power to access the passions directly are the core ideas that support expressive performance of music.

Rhetoric as a Model for Music

While Lamy and Longinus both suggest that orators study music as a model for non-verbal expression, the converse relationship between these sister arts is not so easily substantiated. Skepticism about the application of rhetorical paradigms to musical examples has been expressed, particularly by scholars who have studied seventeenth-century French sources.[158] Outside of German-speaking areas, the study of rhetoric and its application to music did not dominate the discourse, and seemed not as forceful an analytical tool as some find it today. Jonathan Gibson has shown that seventeenth-century French rhetoric treatises not only lack support for the doctrine of figures, but actually

[158] Jonathan Gibson, "'A Kind of Eloquence Even in Music': Embracing Different Rhetorics in Late Seventeenth-Century France," *The Journal of Musicology* 25, no. 4 (Fall 2008): 394-433. Others who have questioned rhetorical analysis of music include Brian Vickers, "Figures of Rhetoric/Figures of Music?" *Rhetorica: A Journal of the History of Rhetoric* 2, no. 1 (Spring, 1984): 1-44; Jasmin Cameron, "Rhetoric and Music: The Influence of a Linguistic Art," in *Words and Music*, ed. John Williamson (Liverpool: Liverpool University Press, 2005), 28-72; and Douglas Dempster, "Is there Even a Grammar of Music?" in *Musicae Scientiae: The Journal of the European Society for the Cognitive Science of Music* 2, no. 1 (1998): 55-65.

suggest a conscious reaction against those models.[159] This is not to say that rhetorical schemes were unknown to musicians, or that thinking in rhetorical terms was uncommon, but only that theorists of that time avoided the claim that rhetoric functioned through music. Gibson concludes that studying the rhetorical theories is useful as a key to understanding the aesthetics of the period, but not as revealing as guides to analysis or performance practice. Even today the usefulness of the *musica poetica* theories of German writers has been questioned. Patrick McCreless notes:

> It has now become fashionable, even among the most sympathetic scholars, to question whether Burmeister was a brilliant innovator or an obsessive pedant: was the invention of the musical figures a great conceptual leap forward? Or did it represent the imposition of a once vital but now petrified and repressive discipline on a newly developing art that deserved better, and that has ever since had difficulty relieving itself of the ballast thereby imposed upon it?[160]

Others have effectively drawn reasonable connections between rhetorical theories and the French repertoire with studies of vocal music.

In her study of the French seventeenth-century air, Catherine Gordon-Seifert has demonstrated through stylistic analysis how composers such as St. Lambert, Bacilly, La Barre and Le Camus established connections between texts and their musical settings. For example, composers often would set the exclamation "*hélas*" for a female voice as an ascending or descending fourth in an upper register.[161] The example cited refers to the rhetorical figure *exclamation* and signals a change of passion. But if one hears that same interval in a high register in instrumental music, there is no inherent reference to the meanings associated with the word "*hélas*." While some of the musical gestures

[159] Gibson, "A Kind of Eloquence," 397.

[160] Patrick McCreless, "Music and Rhetoric," 859.

[161] Catherine Gordon-Seifert, *Music and the Language of Love: Seventeenth-Century French Airs* (Bloomington: Indiana University Press, 2011), 170.

associated with text settings do become conventions in instrumental music, Gordon-Seifert does not claim direct correspondence of expressive meaning between vocal and instrumental genre.

The relationship between verbal meanings and non-verbal gestures in sound is tenuous at best. Don Harrán in his monograph "Toward a Rhetorical Code of Early Music Performance" outlines the way that rhetorical traditions have influenced composition up until the seventeenth century.[162] Like Gordon-Seifert, his analysis focuses on vocal repertoire and emphasizes the need for musical delivery to reflect the rules of speech. These rules include accuracy, clarity, elegance and compatibility.[163] But when Harrán considers the problems inherent in applying rhetorical directives to instrumental genre he equivocates. It is not so easy to support analogous approaches to delivery when text is not present:

> If one considers Ganassi's remark that the ideal instrumental performer is one who looks to the singer for a model, then the potential of rhetorical influence looms large. If, however, instrumental music was subject to a grammar and rhetoric of its own, then a different approach will have to be taken. Clearly, the instrumental repertory, to the extent that it deprives us of textual aids as a directive to its performance, poses special semantic problems with noticeable ramifications on the way music is executed.[164]

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[162] Don Harrán, "Toward a Rhetorical Code of Early Music Performance," *The Journal of Musicology* 15, no. 1 (Winter 1997): 19-42.

[163] Harrán's source is Quintilian's *Institutio oratoria*, XI.iii, 30-65. Harrán continues: "So far we have proposed the idea that composition depends on performance. Yet we still do not know how. It is here that the rhetoricians come to our aid with the notion of delivery as meant to reflect the content of the speech, which cannot be done unless the two are homologically related. It follows, then, to quote them, that the rules for delivery are identical with those for speech itself. The end in both is to achieve accuracy, clarity, elegance, and compatibility. Suffice it to say, for the time being, that, as regards *pronuntiatio*, the rhetoricians mean, by accuracy, a faultless pronunciation; by clarity, proper enunciation (of words) and punctuation (of sentence members); by elegance, the natural inflexion and modulation of the voice (which, itself, should be strong, sweet, and resonant); and by compatibility, the appropriate expression of ideas and emotions (*prepon, decorum)*." Harrán, "Toward a Rhetorical Code," 25.

[164] Ganassi, writing in the early sixteenth century, had comments appropriate for instrumental music extracted from vocal models. Ibid, 40.

What could be the unique grammar and rhetoric of the instrumental repertory, and how could that be known? Harrán does not suggest answers to this, but his overall view is that the rules for rhetorical delivery are applicable to performances at large:

> ...it seems to me that what has emerged is a code for music performance that inheres in the ontological unities of speech and music and thus can claim to some sort of universalist validity in Western music a large. The code does not supplant the particularities of performance in different periods. Rather it provides a skeletal frame to be filled out by myriad changes in the style of performance from the Middle Ages to, at least, the end of the nineteenth century, for as long, that is, as textual considerations ruled composition.[165]

The dynamic of the relationship between rhetoric and music seems to have moved from rhetoric modeling music to music modeling rhetoric. Harrán suggests that performers today recover this rhetorical code in their performances, and yet its application to instrumental music is still questionable.

Francis Bacon's call for explanation of a theory of performance that is clear and true could be seen as a challenge to the mystical subtitles of Pythagorean number theory, and also to assumptions about a rhetorical performance style. Descartes and other natural scientists of the seventeenth century addressed questions of tuning and intonation, providing, eventually, a new scheme for pitch options based on a perspective that includes a continuum. These methods also suggest an approach to rhetoric that is based on qualities of sound. The connection between the effect of consonance and dissonance, as well as other elements such as tempo, rhythm, tessitura, volume and arrangement, or the syntax of sound in time, is part of what Descartes refers to as the satisfaction of "the ear." Treatises on rhetoric that have used music as a model do not address the question of how sounds can be expressive. They merely describe the ways that sound affects the

[165] Ibid, 41.

auditor, and their model is the expressivity of music. Thus, the musician who looks to treatises on rhetoric for the answer to this question finds a tautology. He is looking to rhetoric for rules about expressivity, but those rules are based on the expressivity of musical practice.

Because his focus is on the mechanics of sound, Descartes avoids this conundrum entirely. Music expresses sensations of motion that can only be understood during the time of performance itself. Variety is achieved by moving from points of tension to moments of repose. The rhythmic framework and its relationship to harmonic and melodic shapes are primarily experiential. Among the elements that signify tension, the use of dissonance is basic. In his youthful analysis of intervals, Descartes presents a foundation for this position on musical expression. As it is extended to a position from which an analytical framework such as rhetorical organization can be developed, it still supports an explanation of performance practice. But organizing musical meaning around rhetorical terms can obscure a more basic reference to meaning that is based in a more primary relationship to sound.

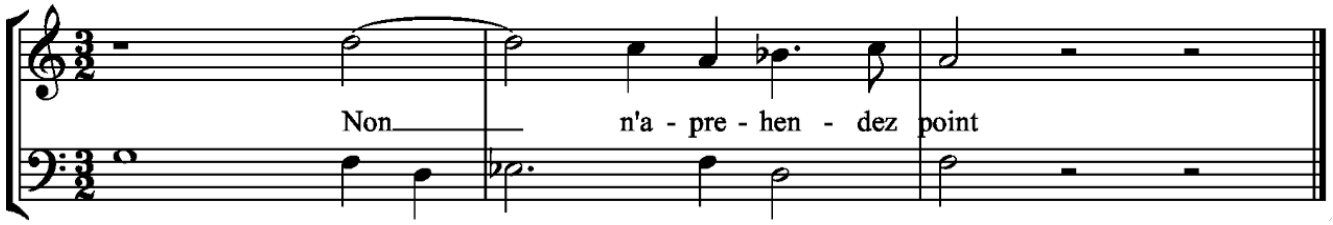
Gordon-Seifert assumes those sound-based meanings when she describes the effects of certain harmonic relationships:

> Seventeenth-century theorists considered musical composition as a sequence of consonant intervals that embodied different degrees of tension and relaxation. The ear demanded that there be progress from an interval of more complexity (an imperfect consonance) to one of less complexity (a perfect consonance).[166]

Here she describes the use of suspension in one of St. Lambert's airs, *"Non n'aprehendez point*." In her comprehensive analysis of the primary passions represented in this genre,

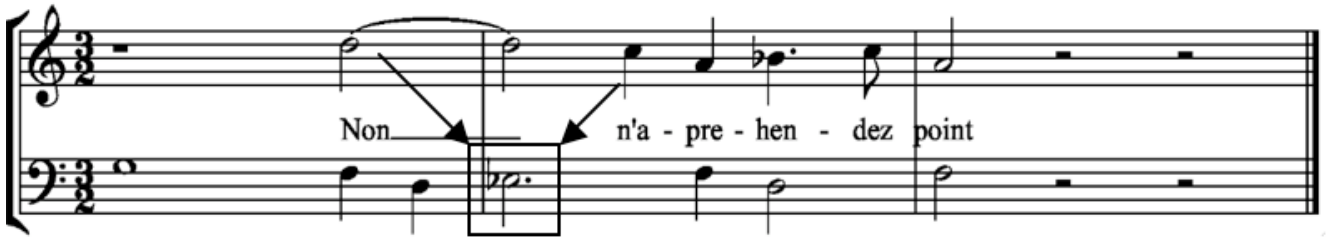
[166] Gordon-Seifert, *Language of Love*, 70.

she says that this air expresses an agitated passion of courage. The opening statement is given in example 4.1.



Example 4.1. Lambert, "*Non n'aprehendez point*," mm. 1-3.[167]

The dissonance created with the movement of the bass line pitch D to E flat initiates tension at the beginning of measure two, indicated by the first arrow in Example 4.2 below.



Example 4.2. Lambert, "*Non n'aprehendez point*," mm. 1-3, with indication of dissonance between E flat and D, and reference pitch for C.

This tension of this dissonant seventh is resolved to the consonant sixth (E flat to C), the beginning of a descending series of embellished parallel sixths, culminating in the F-A third in the cadence where it achieves its repose. It is not only the use of dissonance which is expressive, but also the harmonic context in which it appears. Being placed at the beginning of the text, in a high register, and on the fifth scale step in the key of g

[167] From *Les Airs de Monsieur Lambert*, p. 24 in Gordon-Seifert *Language of Love*, 71.

minor gives impact to the text. Gordon-Seifert explains how devices associated with power are clear in the text and in its musical setting:

> This example embodies all of the devices associated with *le pouvoir*, yet it also demonstrates how Lambert intensifies and diminishes affect in response to the text. He divides line one (mm. 1-5) into two verbal units of six syllables each, typical of bold statements. The air begins with a forceful "no," which is sustained for the value of a whole note and is placed on one of the highest pitches of the piece. The air is in minor mode on G; thus, one might expect the strength of a G-minor sonority to accompany this negative expression. Instead, Lambert starts with a D-minor chord in first inversion under the "No" (m. 1) to weaken the affect. The D-minor sonority then changes to E flat major...the kind of dissonance caused by the D in the melody and the E flat in the bass was known as *la supposition,* or controlled dissonance.... Although dissonance functions as an ornament, adding variety, grace, and charm to the harmony, theorists emphasize that it was especially useful in association with impassioned expressions, as in this example. This example, then, shows an intensification of affect on the word "No" from apprehension (the D-minor sonority, a perfect consonance, and a point of relaxation) to aggression (the imperfect consonance on the suspension and a point of tension).[168]

The descriptions here are referencing the qualities of sound as the effects of meter, tessitura and intervallic tension combine to reflect the dramatic connotations of text. Whether or not these elements are meaningful for non-texted music is the next topic.

Expressive Intonation

Using Descartes' *syncope* as an example of the cadential suspension and applying the pitch directives from his *circulus* procedures, several options for instrumental performance are possible.[169] The figure called a *syncope* is pictured as figure 4.1, and represents a "cutting up" of text in rhetoric as in *dixti* being substituted for *dixisti*.

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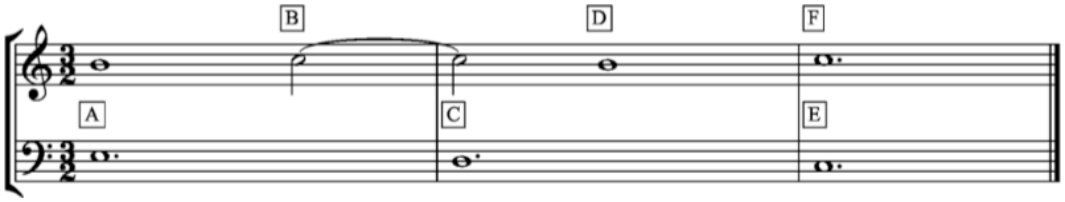
[168] Gordon-Seifert, *Language of Love*, 69-70.

[169] In the German *musica poetica* tradition it is described as a dissonance at the beginning of a tactus which continues the pitch of the preceding tactus. As a syncopation, it creates a whole gesture. Burmeister writes that "no cadence merits the name unless it is endowed with this ornament." Joachim Burmeister, *Musical Poetics,* trans. Benito V. Rivera (New Haven: Yale University Press, 1993), 171.

Descartes does not name the feeling of dissonance as being related to any feeling of power, love, sorrow, tenderness or happiness. However, in describing the effect of a suspension he evokes the descriptive language of "anticipation", "tension" and "satisfaction in the sweetness of resolution." In the *Compendium*, he offers his notation of a cadential suspension, and an explanation of relationships between various pitches. Transcribed here in modern notation as Example 4.3, the notes are given Descartes' letter designations for easy reference in his explanatory paragraph below.



Example 4.3. Example of suspension from *Compendium musicae.* [170]

His explanation follows:

> A suspension occurs when one hears the end of a note in one voice together with the beginning of a note in the opposing voice; one can see this in the example above, where the last beat of the note labeled B is dissonant with the beginning of the note labeled C. This can be tolerated because the member of the note labeled A, with which it was consonant, is still in one's ear. The same relationship and dependent state exists between B and C, a situation in which dissonances are tolerable. Their variety even has the effect of making the consonances between which they are located sound better and more eagerly anticipated. For while the dissonance BC is being heard, our anticipation is increased, and our judgment about the sweetness of the harmony is suspended until we come to the note D. The end of note D holds our attention and the note F now following produces a perfect consonance, an octave. These suspensions are, therefore, usually used in cadences, for that which is long awaited pleases all the more when it finally comes about.[171]

[170] Descartes, *Musicae Compendium* (Utrecht, 1650) 55.

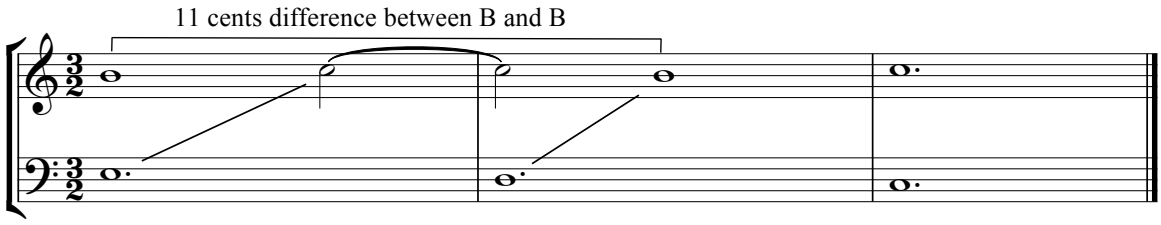
[171] Syncopa fit, cùm finis notae in vnâ voce auditur eodem tempore cum principio vnius notae adversae partis. Vt videre est in exemplo posito, vbi vltimum tempus notae B dissonat cum initio notae C; quod ideo fertur, quia manet adhuc in auribus recordatio notae A, cum quâ consonabat; et ita se habet tantùm B ad C instar vocis relativae, in quâ dissonantiae perferuntur. Immo etiam harum varietas efficit, vt consonantiae, inter quas sunt sitae, melius audiantur, atque etiam attentionem excitent: cùm enim auditur dissonantia BC, augetur expectatio, et iudicium de suavitate symphoniae quodammodo suspenditur, donec ad notam D sit

Both Descartes' and Gordon-Seifert's descriptions of suspensions emphasize the delayed satisfaction of the final consonance that is possible because of the tension-repose relationship presented by the dissonant event. And considering the expressive options available to each performer, the degree of dissonance and the intensity of the expression could vary. All performances of suspensions such as those described by Descartes or Gordon-Seifert need not be the same. In Bottrigari's discussion of intonation in ensembles, he implied that all musicians did not perform within a uniform tuning system. In the present argument we could say that they did not have the same parameters for expressive intonation. Lamy's observations about delivery and the primacy of individual expression justify different interpretations, which include the possibility of diverse pitch parameters. But his specific suggestions are more appropriate to analyses of entire pieces, and some of these will be explored in the next chapter. However, using the short example of suspension (Example 4.3 above), one can at least experiment with ways to increase or decrease intervallic tension through subtle pitch inflections.

Following Descartes' explanation of consonant relationships and using his *circulus* procedures, there seems initially only one way to perform the pitch relationships in the three measures of Example 4.4. Calculations are made assuming a fixed-pitch instrument for the bass line. In keeping with the instrumental practice of the seventeenth century, this instrument would be set in quarter-comma meantone tuning. In this case the note B (pitch C in the treble line) must be a perfect consonance (beat-less interval) with

perventum, in quâ magis auditui satisfit, et adhuc perfectius in notâ E, cum quâ, postquam finis notae D attentionem sustinuit, nota Fillico superveniens optime consonat: est enim octava. Et quidem hae syncopae idcirco in cadentijs solent adhiberi, quia magis placet, quod diutius expectatum tandem accedit; ideoque sonus post auditam dissonantiam in perfectissimâ consonantiâ vel vnisono melius quiescit. Hîc autem gradus etiam inter dissonantias sunt reponendi; quicquid enim consonantia non est, debet dici dissonantia. *Musicae Compendium* (Utrecht:1650) 55-56. English version from *Compendium musicae* (Amsterdam, 1656), trans. Walter Robert (Rome: American Institute of Musicology, 1961), 50.

note A (pitch E in the bass line). When the dissonance is resolved with the second B of the treble line, it is placed as a perfect consonance with the D in the bass line. The first B is in a perfect consonance relationship with the bass E. The pitch drift from this procedure is then about eleven cents flatter between the first B and the second B in the treble line, enough to be easily perceived by the discerning ear.

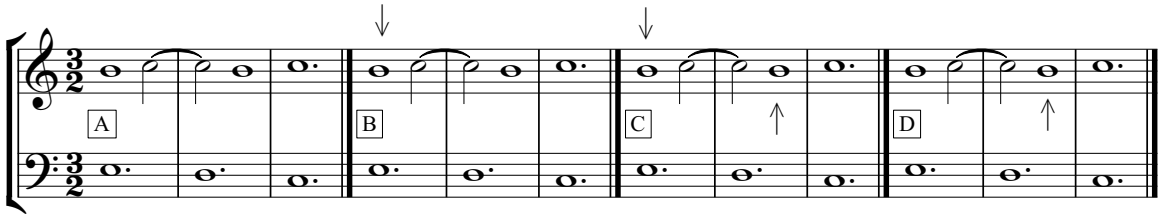


Example 4.4. Descartes' suspension example with reference relationships indicated.

If the musicians placed every interval according to Descartes' *circulus* plan, that is, by gauging relationships according to the most recently sounded perfect consonance, then the following interval sizes would occur: assuming the first interval E (bass) to B (treble) is 702 cents at 1088 Hz, then the interval from C (treble) referring to E (bass) as 813.6 cents because the treble line player hears that pitch as pure to the bass E; the second measure D in the bass is a fixed pitch, and creates the 1076-cent dissonance with the tied over C 1076; the interval B (treble) in second measure to D (bass) is pure at 884.4 cents, causing the B to sound at 1077 Hz. The greatest point of tension, the seventh at the beginning of the second measure, moves to the moment of greatest repose, the octaves in the third measure. This "rhetorical" figure suggests the delay of movement to the final consonance through the focus of energy caused by the dissonance. The move to the final repose thus produces the charming effect Descartes describes.

But other effects are possible, especially if one uses the pitch inflections allowed in Descartes' *circulus* in other ways. Nothing in the *Compendium* denies the possibility of

applying the continuous pitch options expressively, and much of what he indicates about continuous pitch and the moveable *schisma* supports this. The places for pitch inflection are indicated by arrows in each of three possibilities indicated in Example 4.5 below.



Example 4.5. Descartes' example of suspension with four possible points of pitch alteration indicated by arrows.

Example 4.5 illustrates Descartes' three-measure *syncope* three times, each of which can be heard in Audio 1.5: Sound for Example 4.5 in the Supplemental File. The pitches indicated by arrows are altered to show inflected pitches. Option A is the one described in Example 4.4 above, with the first treble B sounding eleven cents higher than the second. Option B has the first B sounding eleven cents lower than pure so it matches the second B. Option C is the opposite of Option A, with the first B low and the second B in the higher position. Option D has both of the Bs sounding in the higher position. All of these options involve moving the *schisma* interval around the *circulus* and when heard in the context of a composition could have quite different effects. Options A and B with the penultimate treble note quite low emphasizes the harmonic purity with the bass D, making the repose of the final octave less abrupt. Having a variance of the B pitches could be an advantage or a disadvantage, depending on the overall context. Option D raises both Bs higher than pure, observing Lamy's suggestion to take care to end a phrase with a clear indication of the point of repose, that is, the B could be viewed as a less

extreme dissonance than the C but still striving for resolution.[172] And by choosing to raise the penultimate B even more than eleven cents, the performer could be placing the B a minor semi-tone below the final C. This is still in keeping with the schisma options in Descartes' *circulus*, but serves to increase intensity at an expressive point.

The decision to employ any of these options should also be related to the placement of this cadential figure in the larger structure of the composition. The overall effect of tension and repose suggested by these options for instrumental music can be described as rhetorical, or as an expression of motion. Whatever the metaphorical frame, the focus on pitch inflection provides the possibility of several different degrees of tension and repose that fit within any intonation system. Because the performer is working the sound "from the inside," the choices for expressing dynamic processes, syntax and other representations can constantly be adjusted within the context of each performing experience. This is what is meant by the term "expressive intonation." It is accomplished by inflecting the pitch of a particular note by adding to its "perfect" size (its beat-less, just intonation) a *schisma* (a small amount, that can vary between just a few cents and the full 21.5 cents of a comma) that increases its size and also makes it slightly dissonant.

In this chapter, two topics concerning rhetoric have been considered. The first is the idea that linguistic practices directly informed the way composers and performers of the seventeenth and eighteenth centuries thought about music. The musician was a kind of orator, using notes instead of words to communicate ideas and feelings. This idea was championed by Mersenne, but disregarded by most other French music theorists of the

[172] Lamy, III.1.3; Harwood, *The Rhetorics,* 258-259. This is an extrapolation and exaggeration of Lamy's point about gauging points of repose, part of his discussion of voice placement.

later seventeenth century. There are still those who support this view, citing specific rhetorical elements in musical compositions, but in general the idea that music is a species of rhetoric dominates the discourse of our current century more than it did in the seventeenth.

The second topic is how the techniques of delivery outlined by Lamy, especially those concerned with natural expression, could be understood as aids to the performance of music. Musical settings of text offer the clearest examples of the correspondence between music and text, and suggest that there is meaning inherent in the music itself. These references do not seem to apply in non-texted instrumental music, yet instrumental music seems to be expressive of something. Addressing the question of expression from a late seventeenth-century perspective, one could at least claim that instrumental music is expressive of motion. For a natural philosopher like Descartes, nothing more about meaning can be substantiated. His reluctance to support Mersenne's humanistic agenda attests to this. But, his analysis of the intonation of intervals does show his unique understanding of dissonance and consonance as markers of motion and repose. Musical "motion" is a concept that refers to the dynamic processes that are basic to performance.

While Descartes' analysis is concerned with non-verbal elements in music, Lamy's analysis of syntax also addresses aspects of expressive delivery that are common to both rhetoric and music. He holds that syntax is part of the natural expression of man, related not only to the physical way sound is formed by the speech organs but also by mental processes of intention. Lamy's reference to the "motions of the mind" is his mechanical description of intention, a concept that refers both to expression itself and to the way expression is communicated.

Using musical examples by Purcell, Ravenscroft and Corelli, I will apply these concepts of motion derived from Descartes' intonation relationships and Lamy's focus on syntax. These are the substantive elements of expression that the musician 'delivers' in performance. On the surface level, stylistic elements (those culturally derived expressions of meaning) are also part of musical performances that have a rhetorical analogue in the "figures" of rhetoric. Performance involves both levels of expression, delivering the substance and the style of the musical material.

Of the many elements that performers use for expression, inflected intonation is one of the most subtle. Experienced musicians use expressive intonation naturally, responding perhaps as much to their instinctive sense of pure harmonies as to the feedback from colleagues and audiences. But many performers today still attempt to match an inflexible arbitrary external intonational paradigm, most often that of the equally tempered piano. When performing music of the late seventeenth and early eighteenth centuries, a time when justly tuned intervals were the norm and both harmonic and melodic dissonances were of variable sizes, the expressive possibilities of using inflected intonation are much greater. Performers today who are interested in period-specific techniques could explore inflected intonation as a performance technique. Sorting out how intonation is related to rhetorical substance and rhetorical style in musical discourse is the next topic to be addressed.

CHAPTER V

EXPRESSIVE INTONATION AS A RHETORICAL TOOL IN PERFORMANCE PRACTICE

> Our discourse is imperfect, unless it carry with it the marks of the motions of our mind; [173]
>
> Among the vowels, some have a clear and strong sound; others are weak and obscure: and we may compose our Discourse as we please of such as are proper for our design, when we have a mind our Cadence should be weak or strong, clear or obscure.[174]
>
> Bernard Lamy, *The Art of Speaking*

Motions of the Mind #1: Syntax

What Lamy is addressing here is how we make sense of sounds in time, specifically how units of organization or patterns of construction successfully carry images from the speaker's mind to the audience. Extending this perspective to music, one can envision the analogous process whereby the patterns of music, those organizational units called phrases, are carried from performer to listener and understood clearly because of the syntactical elements embedded in the phrases. These "marks of the motions of the mind" could be labeled merely as units of arrangement, but in music they are also related to other elements that serve to organize a composition. Phrases, for example, have many, including length, tessitura, melodic shape, harmonic succession, voicing, rhythmic gestures and cadential type.

To place the issue in the context of the late seventeenth-century culture of scientific analysis, I am setting aside for the moment the larger issue of the analogies between music and language discussed by humanists. Addressing Lamy's concern with

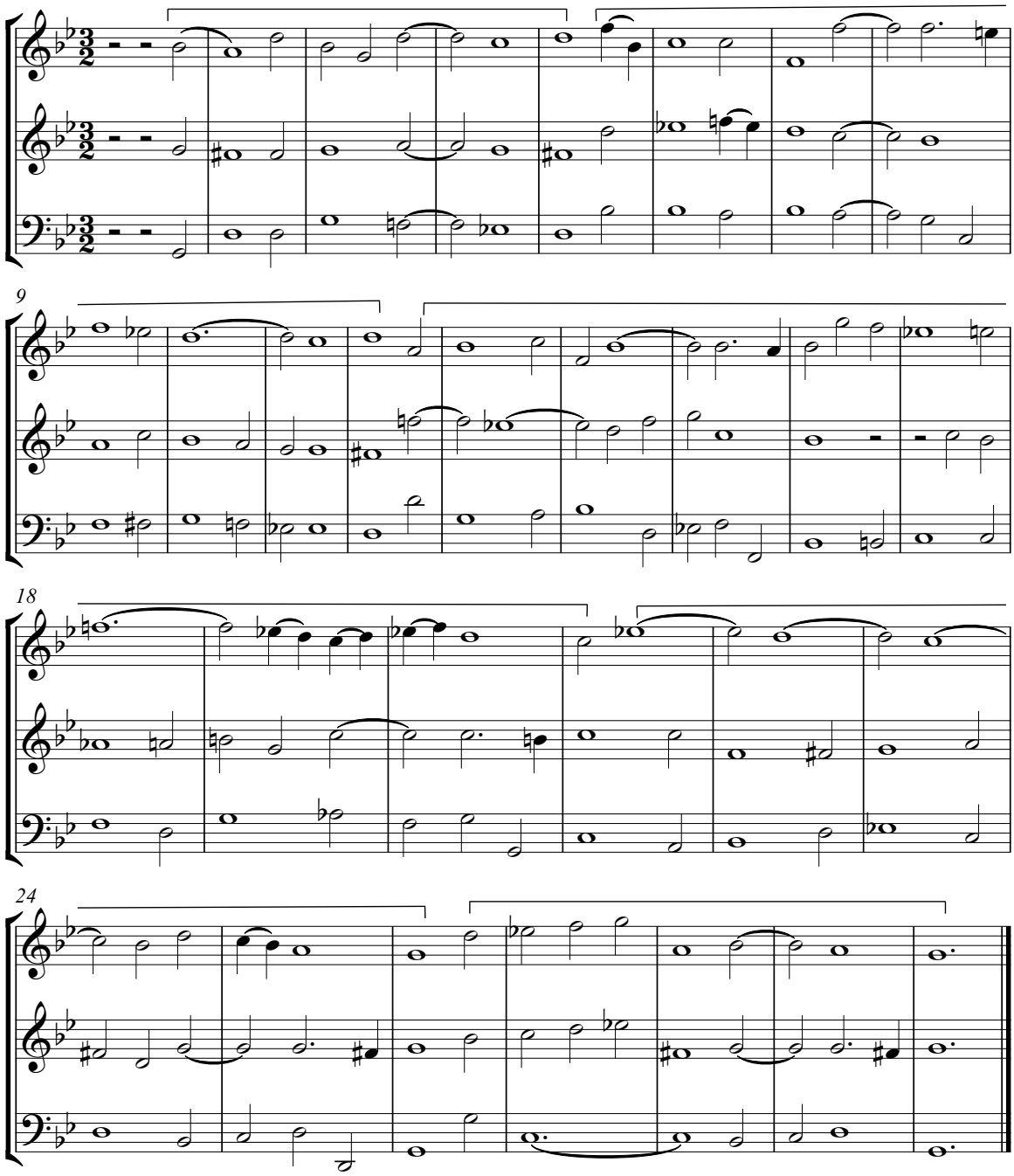
[173] Lamy, I.3.3; Harwood, *The Rhetorics,* 201.

[174] Ibid III.5.3, 296.

intonation contours to see how they function as clear and distinct markers of structural organization in music, I have provided brief examples from three composers whose music was well-known in that late seventeenth-century culture. I have also chosen a repertoire that would have been performed on organ and violins, those instruments that were classified by Bottrigari as "stable" and "*alterabili*" respectively. To provide examples in which comparatively slight deviations of interval sizes would most easily be heard, they are all adagio movements. The standard tuning for the fixed-pitch organ would have been quarter-comma mean tuning, the performance occuring in a comparatively small resonant room where the gut strings and early bowing technique would result in strong fundamental tones. Given these parameters for sound and a concern for expressiveness, the adagios from trio sonatas for two violins and continuo by Ravenscroft, Corelli and Purcell should provide appropriate material for a discussion of what a musician could do with intonational inflection to support a "rhetorical" performance.

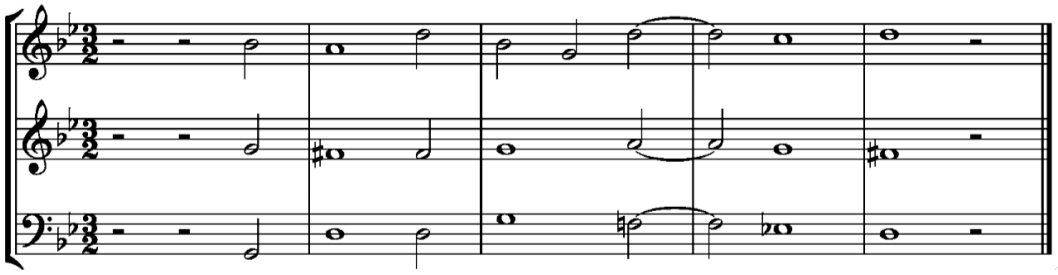
The first example is the third movement from John Ravenscroft's second sonata, Opus 1 (1695), a thirty-measure Adagio.[175] Each of the five phrases represents a structural event that involves both melodic and harmonic movement toward a cadence. Cadences are either perfect authentic or Phrygian. The perfect authentic cadences all employ a 4/3 suspension either in an inner voice (measures 21-22, 25-26, 29-30) or in the top voice (measures 8-9 and 16-17). The two Phrygian cadences utilize standard voicing, i.e., the top voice ascends by a whole step and the bass voice descends by a half-step (as in measures 4-5 and 11-12). Each cadence point is signaled by a hemiola.

[175] John Ravenscroft, *Sonate a tré, doi violini, e violone ò arcileuto col basso per l'organo*, ed. Richard Gwilt (Hungerford, England: RG Editions, 1999), 8.



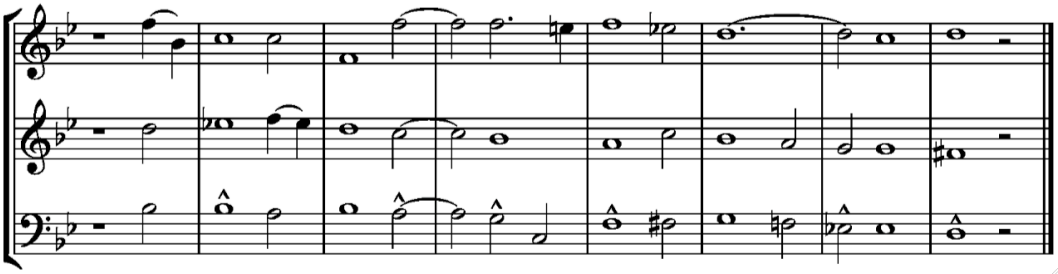
Example 5.1. Ravenscroft, Op. 1, Sonata Seconda: Adagio (1695).

The first phrase establishes the key by means of a Phrygian cadence on V, the overall harmonic motion moving from G minor to D major (Example 5.2).



Example 5.2. Ravenscroft, Op. 1, Sonata Seconda: Adagio (1695), mm. 1-5.

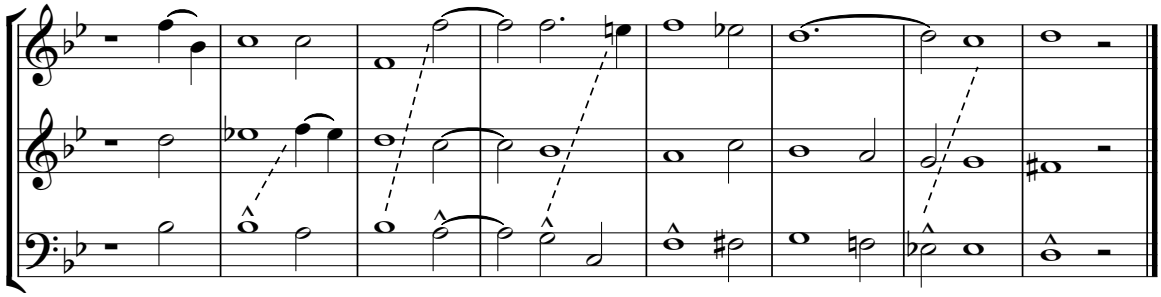
The slightly longer second phrase (measures 5-12) has three segments, the first establishing B flat with a hint of an imperfect authentic cadence, the next moving through a 4/3 suspension toward an F Major cadence and continuing with the descent of the top voice down to the D, using a 7/6 suspension over the passing E flat in the bass, echoing the previous Phrygian cadence, thus extending the D major (V) first established in measure five. Moving from B flat through F to D, Ravenscroft uses stepwise motion in the bass line to stabilize the harmonic frame. These structural bass line scale steps are each indicated with a circumflex, in Example 5.3 below.[176]



Example 5.3. Ravenscroft, Op. 1, Sonata Seconda: Adagio (1695), mm. 5-12.

[176] In calling these structural scale steps I am not intending to infer a Schenkerian analysis. However, it is obvious that Schenker's linear approach to harmonic analysis appears well suited to Corelli's music. Nicholas Cook suggests that theorist Christopher Wintle is right in showing that Schenker's most important concepts are derived from seventeenth-century Italian musical practice. "Wintle is not simply showing that Corelli's music, almost completely ignored in Schenker's writings, is nonetheless susceptible to Schenkerian analysis. He is showing that it is quite explicitly and even obviously constructed out of a limited range of linear-harmonic formulae of 'models', which correspond more or less directly to the Schenkerian *Ursatz* and are transformed in very much the manner of Schenkerian theory; you cannot help wondering whether it might not have been from Corelli's music that Schenker derived his idiosyncratic but central idea of the tonal archetype." Nicholas Cook, "At the Borders of Musical Identity: Schenker, Corelli and the Graces," *Music Analysis* 18, no. 2 (July 1999): 180.

In reference to Descartes' *circulus* procedures illustrated in Chapter IV, the performer's reference points for pitch choices in these measures can be easily aligned with these descending structural pitches. Example 5.4 illustrates some of the possible intervallic relationships, with arrows indicating the pitches that can serve as reference points for establishing pure, consonant intervals.



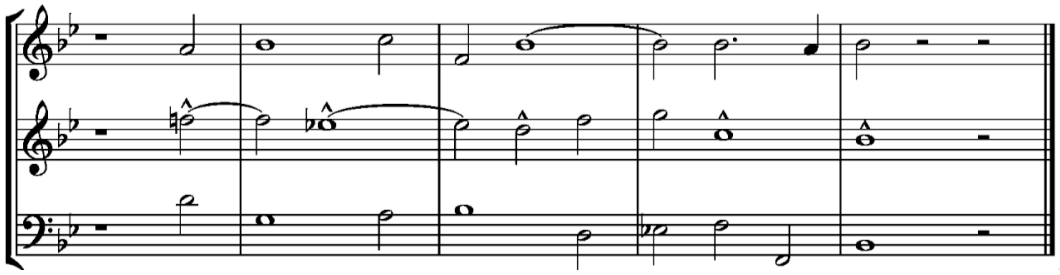
Example 5.4. Ravenscroft, Op. 1, Sonata Seconda: Adagio (1695), mm. 5-12 showing reference pitches for interval intonation.

Both the E natural in the top voice of measure four of this example and the C in the top voice of the penultimate measure would sound "low" compared to the modern performance practice today of making every leading tone high. A typical pedagogical formula for melodic leading-tone pitches is to place them high, especially in fast tempi.[177] But, considering the rhetorical options for expressiveness one could choose a more harmonically pure lower pitch for the C to enhance a sense of repose at the D major triad. This tonality represents not only the dominant harmony, but is the second time a cadence

[177] In fact, some teachers advocate pushing the leading tone even higher, to enhance the arrival of the tonic tonality. For example, Theodor Podnos, writing in 1981, understands well the many possible intervallic sizes for half steps, major thirds and sevenths. He surveys all of the possible inflections used by modern violinists in their teaching and performance, and has counted at least thirty intonation alterations used by the finest violinists of the twentieth century. Yet, he consistently links the experience of good intonation with leading tones that are as high a possible, no matter whether the context is minor or major, an interior cadence or a final cadence. "Also, F# is the leading tone of both G minor and G major; you contribute to the G tonality by raising the intonation of the leading tone, F#. And, of course, you should raise this intonation still further as the tempo increases." Theodor Podnos, *Intonation for Strings, Winds and Singers: A Six-Month Course* (Metuchen, N.J.: The Scarecrow Press, 1981), 64.

with hemiola arrives at D major. If, however, the performer wanted to increase tension to emphasize the second D major arrival point, the C could be raised a few cents, also allowable within Descartes' *circulus* system as a move of the comma. The other pitch in this cadence that has expressive possibilities is the F sharp of the D major triad. If it is placed as a pure third with the bass D, then it will transmit a stronger sense of repose; if placed higher than pure, making the D to F sharp more dissonant, then a sense of restlessness is possible, guiding the ear onward to the next phrase.

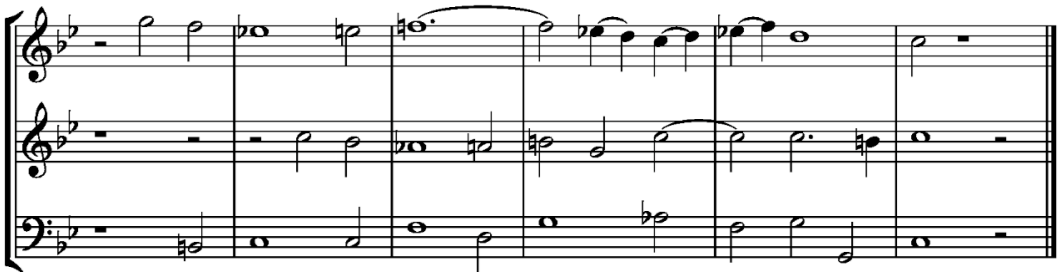
Example 5.5 shows that the third phrase (measures 12-16) contains several suspensions: the first a 7/6 suspension in the first two measures, then a 4/3 suspension in the third measure and finally a cadential 4/3 suspension in the last two measures.



Example 5.5. Ravenscroft, Op. 1, Sonata Seconda: Adagio (1695), mm. 12-16.

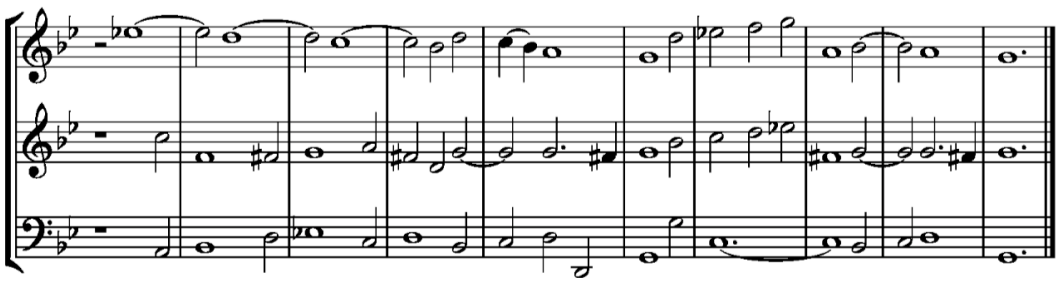
The dissonance on beat one of the second measure, between the bass line G and highest pitch F, is prominent because of the tessitura. The overall intonational descent of the highest sounding pitches directs the ear to divide this phrase into two parts, with the first tracing tension to repose: F-E flat-D. The second part of the phrase interrupts the descent with the embellishing move up to G, but ultimately completes it through C down to B flat. Each significant pitch is indicated by a circumflex.

The fourth phrase (measures 16-21) with its multiple use of chromatic leading tones affords even more options for inflected pitch choice. Example 5.6 shows a chromatic ascent in measures 2-3 in the top voice that is motivically echoed in the middle voice in measures 3-4. These gestures represent interesting possibilties for intonational inflection: one could either match the organ tuning (with the very low minor third between C and E flat in measure 2, and the F to A flat in measure three) or pull the pitch up against the organ tuning. The latter would create very strong, expressive dissonances in each instance, dissonances satisfied by the resolutions to the following major third between C and E natural and the perfect fifth between D and A natural. What one chooses is dependent on the overall rhetorical intention of the musician, whether the desire is to obfuscate or clarify the musical motion. Parallel rhetorical devices are available to the orator who, as Lamy notes, delivers his discourse according to an overall design.



Example 5.6. Ravenscroft, Op. 1, Sonata Seconda: Adagio (1695), mm. 16-21.

In the last phrase, Example 5.7 below, Ravenscroft returns to a chain of suspensions, 4/3 in the second measure, 7/6 in the third, 7/6 in the fourth and 4/3 to the G minor cadence in the sixth measure. This is followed by a four-measure coda with hemiola that reiterates the harmonic motion of the cadence of the previous phrase.



Example 5.7. Ravenscroft, Op. 1, Sonata Seconda: Adagio (1695), mm. 22-30.

This series of phrases from a typical Corelli-style trio sonata shows a syntactic organization characterized by clear melodic direction, harmonic tension and cadence points. On the macro level the obvious constructs and contrapuntal relationships are revealed through notation. On a more subtle level, these elements can be enhanced or diminished by intonational inflection revealed only in performance. There is no notation that can account for the expressive inflection options available to the performer, since only the performing musician is in the position to react to the acoustic reality of the moment.

The parameters influencing performance include not only the resonance of the performance space and the fixed-pitch continuo instruments, but also the choices made by one's colleagues. The two violinists playing this Ravenscroft composition in 1695 would have been viewing not a full score but only their part book. With seeing just one line of notation and gleaning all of the other information from what they heard as the composition was played, the process of finding their exact pitch relationships with their partners was not a visual, but an aural exercise. Furthermore, the dialogue that is possible between the two treble parts could have taken on conversational attributes as each player responds to the intentions of the other.

Other elements to consider in performance include the spaces between phrases, periods or movements. The space required for breath and for reflection is also part of performance not indicated by written notation. Lamy also considers these elements of speech and notes the need for repose. "We are obliged to take breath from time to time; the necessity of being understood, makes us stop commonly at the end of every expression to respire...the voice does not repose equally at the end of every sense; in a sentence where there is much comprised, we repose a little at the end of every comma."[178] Those spaces needed for breath, the change of focus that results from having a "conversation" with one's performance colleagues and the expressive options through refinements in pitch, volume and tone are all inflection, volume and tone are all more closely aligned with performance practice than with written notation.

I am suggesting that presenting these intentions in a clear way, as one's "marks of the motions of the mind," function in a similar way for both the musician and the orator. The seventeenth-century perspective of natural philosophy as claimed by Descartes and the re-articulation of that perspective in a rhetoric text by Lamy both point to that position as well. However, it is not until the developments in cognitive neuroscience address the question of the correspondence between music and language that experiments confirm that hypothesis. Aniruddh Patel has published research showing that music and language share neural resources that act upon what she calls "domain-specific representations" such as pitch and timbre. Her conclusion is that both language and music share the same organizational model, the syntax that is needed to process and make sense of sound. If this is true and if there is a physiological basis for the connection between language and music, then attempts at describing music "as language" or "as rhetoric"

[178] Lamy, III.3.2; Harwood, *The Rhetorics,* 269-270.

seem to have scientific support. However, the commonalities of music and language seem confined to organizational syntax: there is in this research no suggestion that music has a semantic value or a particular grammar. There is also no support for concepts like those of Mersenne, where he suggests that music functions as a universal language. This research is much more in line with Descartes' initial claims and observations in his introduction to the *Compendium*: music is about sound; we are affected by its ability to move us, its essential attributes are duration and pitch, our understanding of it is gained directly through sensory experience of sound and we find our pleasure in it through its design (its variety and proportional aspects).

In modern cognitive neuroscience the descriptive language is different, but that to which it points is the same. Elements that contribute to understanding in music at the subcortical level include pitch patterns and melodic contours. Elements that contribute to understanding at the same neurological level for language are also pitch patterns and melodic contours. It is clear in both language and music that some pitches in the hierarchy of tones are perceived as being stable more than others. This phenomenon leads to their function as points of syntactic organization.[179] While these conclusions have not lead music theorists or cognitive scientists back to Pythagorean number mysticism, they do seem to support what Descartes and Lamy have to offer as part of a theory of sound and syntax. The "motions of our minds" may now be labeled "syntactic processing." Many current studies of how a musician accesses and communicates these organizational

[179] Aniruddh D. Patel, "Music and the brain: three links to language," in *The Oxford Handbook of Music Psychology*, ed. Susan Hallam, Ian Cross and Michael Thaut, 208-216 (Oxford: Oxford University Press, 2009).

frameworks have resonance with the *Compendium musicae* of Descartes and the questions of the natural philosophers of the seventeenth century.

What this means for the performer is that understanding the function of the syntactic markers as aids to coherence supports effective expression. The expressive intonation options, when chosen in acknowledgement of the overall syntactic organization, can be used to support that organization. Each of the third, fourth and fifth cadences of the Ravenscroft Adagio have 4/3 suspensions (see measures 15, 20, and 25). The performer could emphasize the finality of the last one in measure 25 by pushing that leading tone pitch (the F sharp in the second treble voice) higher. The leading tone B natural of the previous cadence in measure 20 could be slightly lower and the leading tone A natural in measure 15 could be placed as a perfect, beat-less consonance with the C in the other voice. Each of these options assumes intonational inflection for intervals to be acting as an expressive aspect of counterpoint, adding a bit of intensity to some dissonances and de-emphasizing the impact of others. Many expressive options are possible, and all are dependent on the interactions with the other performers. If there is a biological basis for our desire for consonance, and if some pitches are perceived as being more stable than others, then the syntactic elements in musical performance should be good indicators of the "marks" of the mind.

Motions of the Mind #2: Dissonance

Descartes introduces the concept that consonance and dissonance are on a continuum related to intervals, measured both vertically and horizontally. That is, the space between pitches has various degrees of consonance or dissonance as they are

perceived in context that includes a succession of events that are related to each other only in the aural memory of the auditor. Since in this repertoire each bass line note is a fixed pitch determined by a tempered tuning, other pitches are evaluated in terms of their relationship to that lower voice. If dissonant, they are usually perceived as harmonic points of tension, if consonant, as points of rest or stability. But there is also the horizontal or linear perspective where intervals are perceived as melodic events that seem to express either action or repose. Thus a sense of motion in a composition is the result of the building up of tension in dissonance and the release of tension as the melodic and harmonic elements achieve consonance. This motion is perceived on a continuum that reveals the inherent tension or lack of tension between tones heard as part of both harmonic and melodic textures.

Unique features of Descartes is his analysis of intervals from the performer's perspective and his reference to *motus,* a word that could be translated as "motion" or as "emotion." He used the word *motus* twice in the *Compendium*, both times in the context of the effects of music. Descartes never attempted to draw a connection between music and emotion either in private correspondence or published works, but assuming that he meant "motion" instead of "emotion" in regards to the effects of music, two avenues of inquiry could be pursued. The first relates to his three laws of bodily motion and the claim that even when stimulated by an outside force, our bodies have a tendency toward repose. This could be linked to his reference to "satisfying the ear," since that satisfaction could be understood not as pleasure, but as the kind of repose that is welcomed after activity. For Descartes it is that repose, the result of motion, that is the source of pleasure, not anything inherent in specific harmonies.

The second avenue of inquiry is suggested by a recent hypothesis put forward by neuroscientist Daniel Wolpert of Cambridge University. Wolpert's claim is that the brain evolved to its present size specifically to be able to navigate successfully in order to thrive. Brain function is basically about motion, and the reason we have well-developed brains is that survival in our environment assumes physical agility, and agility requires extremely complex neurological functions.[180] Extrapolating from this thesis, one could explore the possibility that the brain learns these skills by doing them either in action or in thought. Both kinds of learning are based on motion, actual or imagined. Using this model, one could say that musical motion presents a vicarious experience of those same neurological functions.

Emphasizing the concept of a vicarious experience of motion towards a cadential goal, John Walter Hill describes the elements of musical motion in his analysis of the "normalized harmonic style" that became a signature of ensemble music in the late seventeenth century:

> Corelli's repeated use of sequences to focus directional musical processes toward cadences is the culmination of a progressive tendency that can be traced over a period of many decades in the Italian ensemble sonata. To the inherent features of sequences that generate motion – pattern and single-directional contour – Corelli adds suspensions and forward-pressing rhythmic figures far more than any predecessor. More than anyone before him, Corelli consistently introduces, toward the beginning of his sequences, the accidentals that belong to the scale or mode based on the upcoming cadential pitch, thus evoking a specific expectation of the goal....
>
> Corelli's non-sequential and non-cadential harmonies also contribute to the impression of directed motion. His ever greater concentration on harmonic progression based on the cadence and on descending sequences is part of the

[180] Daniel M. Wolpert and J. Randall Flanagan, "Motor learning," *Current Biology* 20 (2010): 467-472. The more recent phase in the development of his thesis is presented in a lecture given in July 2011, Edinburgh, Scotland as part of TED Global. Posted November 2011. http://www.ted.com/talks/daniel_ wolpert_the_real_reason_for_brains.html. (accessed November 4, 2011).

> explanation, but not all of it. Corelli also uses chordal motion by step and by third, although in far more restricted contexts than his predecessors.[181]

An example of this harmonic style, with the motion-generating features that Hill describes, is the third movement Adagio from Corelli's trio sonata in G minor, Opus 3 No. 11 (1689).[182]

Like the example from Ravenscroft's Opus 1, this movement is in 3/2. But while Ravenscroft's Adagio has five relatively short phrases, Corelli's Adagio has just three, plus a short reprise, and they exemplify the kind of motion to the cadence associated with his compositional style. The movement is reproduced in its entirety in Example 5.8, with the major phrases delineated by brackets. As in the Ravenscroft, each cadence is signaled by a hemiola. Both movements are in G minor and the first cadence in each (a Phrygian half cadence) is identical, even to the notes employed in all three voices (Ravenscroft measures 3-5 and Corelli measures 5-7). However, the subsequent phrases in Corelli example are more intense. In the second phrase the falling fifth in the top voice and the rearticulated quarters in both upper voices at the end of the measure fifteen strengthen the harmonic move to B flat major, III of the tonic (the "relative major"). In the last phrase the tessitura reaches up to high C in measure eighteen, falling immediately down an octave. This dramatic register change then sets up the long downward move to the final cadence.

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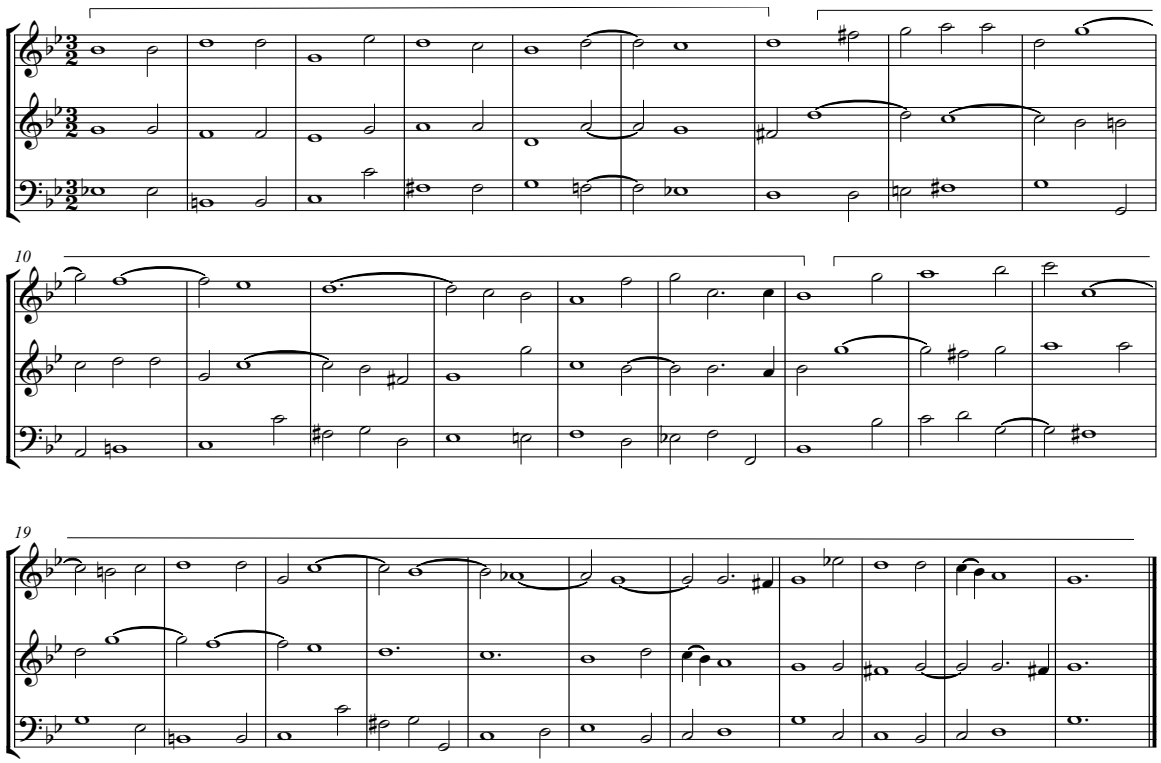
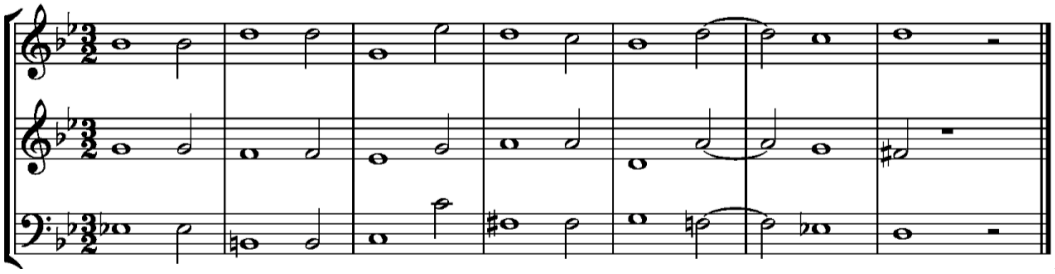
[181] Hill, *Baroque Music,* 338.

[182] Arcangelo Corelli, *Sonate da chiesa a trè* (London: Augener, 1886), 180.



Example 5.8. Corelli, Op. 3, No. 11, Adagio (1689).

As mentioned above, the first phrase of Corelli's Adagio ends in a Phrygian cadence, shown in Example 5.9 below. Unlike Ravenscroft, who begins his Adagio on the tonic, moves directly to the dominant and then to the Phrygian cadence, Corelli is more subtle in his establishment of the tonic.



Example 5.9. Corelli, Op. 3, No. 11, Adagio (1689), mm. 1-7.

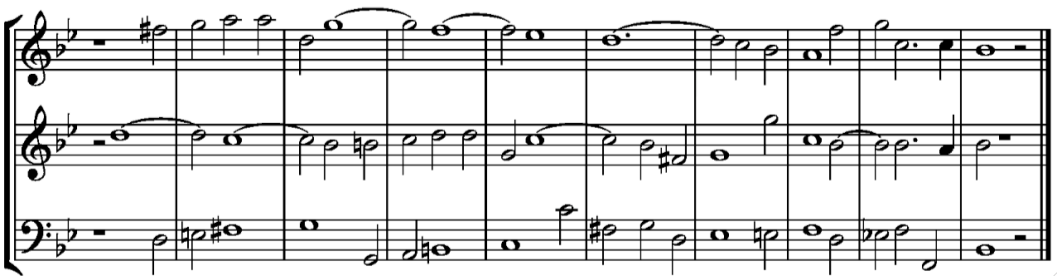
Corelli begins with an E flat major triad, inretrospect the flat II of the dominant D major. This E flat tonality proceeds to C major through its leading tone B natural (E flat to B

natural!), then repeating the dissonant tritone move (C to F sharp) to the leading tone of the tonic G. This tonic initiates the hemiola that establishes the Phrygian cadence in measure seven. Dissonances in measures two and four that generate instability are resolved in measures three and five, and the hemiola over the descending tetrachord to the D major serves to dissipate motion generated in the first half of the phrase.

The next two phrases are both longer, each with a series of suspensions over a bass line that creates points of tension between melodic lines and the harmonies of the bass lines. In the first of these phrases (shown in Example 5.10 below) there is in every measure either a seventh or a second placed on the first beat: a seventh between the bass and middle line of the second measure of the phrase, a second between the two treble lines of the third measure, a seventh between outer voices of the fourth measure, a seventh between the two treble lines of the fifth measure, a second between the two treble voices of the sixth measure, and a seventh between the outside voices of the seventh measure. In the eighth measure the tension of the suspensions and their dissonant intervals is finally released with the dominant F major triad, the first chords of the hemiola signaling the arrival at a cadence in B flat, the III relative major.[183] Bass lines that ascend or descend by step or even those with a series of leaps that move through the circle of fifths create a tension between the melodic pattern and the harmony.[184]

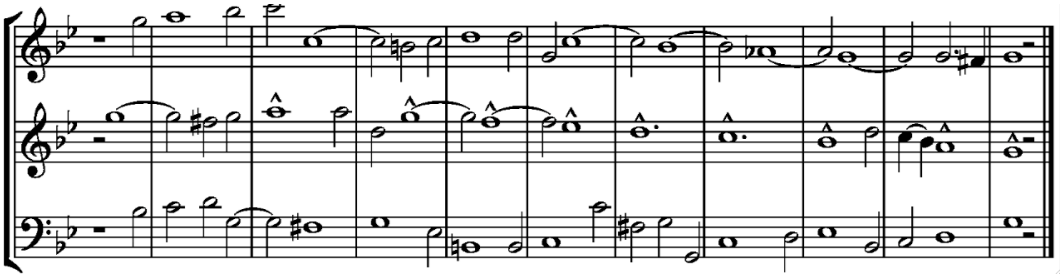
[183] Gasparini, in writing *L'armonico pratico al cimbalo* (1708) was attempting to help the beginning basso continuo player find correct pitches in an unfigured bass part. But a side effect of his examination of bass line patterns, especially those in the Corelli sonatas, was to be able to generalize about those elements that allow for dissonances in both the melodic and the harmonic spheres. Garparini concluded that is the elegantly controlled use of dissonance that creates a feeling of satisfaction in instrumental music.

[184] A survey of many of Gasparini's descriptions of sequences is presented in Hill's chapter on the Sonata and Concerto in Late Seventeenth-Century Italy. John Walter Hill, *Baroque Music: Music in Western Europe, 1580-1750* (New York: W. W. Norton, 2005), 330-343.



Example 5.10. Corelli, Op. 3, No. 11, Adagio (1689), mm. 7-16.

In the second of the two long phrases, the use of dissonance is similar. Here the middle melodic line traces a descending step-wise minor scale, G to G. Each note of the descending scale is marked in Example 5.11 below with a circumflex.

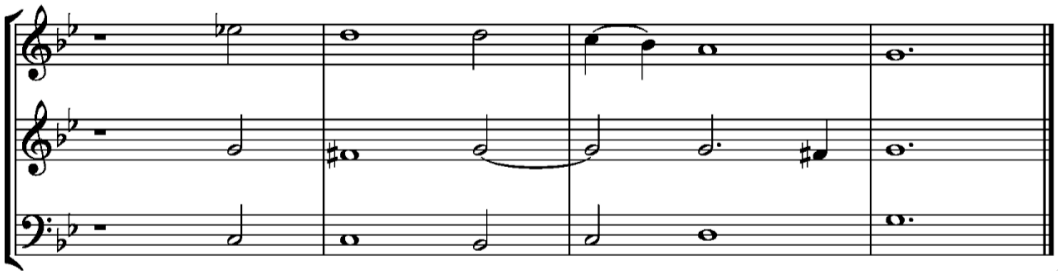


Example 5.11. Corelli, Op. 3, No. 11, Adagio (1689), mm. 16-26.

The upper melodic line has two expressive pitches that provide variety and increased tension, delaying the expected pattern of the descent. The first occurs in the third measure where the tessitura is extended to a high C, the highest note in the entire Adagio. It forms the fourth of a 4/2 chord which is partially resolved (to a tritone) with the movement of the bass note down to F sharp. This high C is followed immediately by a C an octave lower, and this pitch becomes the preparation for a 4-3 suspension. This completes the resolution before the chain of suspensions leading to the cadence. The second expressive pitch is heard in the upper voice in the eighth measure of this phrase within the pattern of suspensions that begins on C and then moves down to B flat as a seventh over the bass C.

The expectation is for the next pitch in this chain to be an A natural. Corelli instead substitutes an A flat, the flat supertonic, creating a minor sixth with the bass C. The expressiveness of this interval, called a Neapolitan sixth in later musical traditions, is caused not only by the surprise of hearing a pitch that is out of the scale, but also by the sense of calm that this interval generates. It provides an opportunity for the performer to form a pure beat-less interval, one that emphasizes sonorities we might describe in this context as dark, close or low. Whatever the emotional connotations, the intonation for the flat second scale step tends to lean towards the tonic pitch, even in music that assumes Pythagorean or equal tempered tuning. With inflected intonation choices, the A flat could be placed a few cents lower than normal in order to enhance its gravitation towards the tonic.

Example 5.12, the final phrase, shows the more typical sharp 4/2 above the subdominant bass note C and then the 6/5 and 5/4 suspensions in the cadence. In the repetition of the cadential gesture, Corelli returns to a more conventional formula without the flat II, reiterating the bass line using his typical compound diminished cadence.



Example 5.12. Corelli, Op. 3, No. 11, Adagio (1689), mm. 26-29.

Richard Taruskin also discusses the normalization of harmonic style as exemplified in Corelli's trio sonatas, emphasizing movement around a circle of fifths as

setting the standard for tonal music. Like Hill, he uses images of motion as essential to this music's expressivity. In his analysis of the Presto of Op. 3 no. 11 that precedes the Adagio discussed above, he comments:

> Not only does Corelli use the circle [of fifths] here in its complete form, he also manages to enhance its propulsive force in two distinct ways: first, by doubling the rate of chord change (what is now often called the "harmonic rhythm") in the second half of the progression; and second, by adding sevenths to most of the constituent chords, especially in the latter (faster, more emphatic) portion. These sevenths, being dissonances, create the need for resolution, thus turning each progression of the circle into a simultaneous reliever and restimulator of harmonic tension. In this intensified form, the circle of fifths becomes more than just a conveyor belt, so to speak; it becomes, at least potentially, a channeler of harmonic tension and a regulator of harmonic pressure – phenomena that can be easily associated or analogized with emotional tensions and pressures, hence harnessed for expressive purposes.[185]

From these descriptions, it is clear that the tension between dissonance and consonance is one way of objectively describing motion toward a cadence. In performance, the musician understands the tension between dissonance and consonance subjectively, and can manipulate pitch levels subtly to emphasize directional movement. Both from the objective and subjective perspectives, motion toward cadences enhances the syntactic points of organization in the musical discourse.

Motions of the Mind #3: Dance as Rhetoric of the Body

Intonation is essential to realizing both clear syntax and motion, and as such maintains an analogous relationship to gesture. Working from an evolutionary point of view, Elizabeth Tolbert suggests that music developed as an embodied gesture, rooted in preverbal spatio-temporal activity. Music and language may have both originated from the same need for motor modeling, but music retained the primary link to symbolic

[185] Richard Taruskin, *The Seventeenth and Eighteenth* Centuries, vol. 2 of *The Oxford History of Western Music* (Oxford: Oxford University Press, 2005), 188.

thought.[186] Tolbert initiated her research as an effort to address musical meaning, trying to avoid the many contradictory conclusions of those who study music as a language. Her conclusions, based on studies of the evolution of human cognitive abilities, suggest that musical performance has a specific meaning as a kind of embodied gesture.

> ...music is grounded in a capacity for "mimesis," or motor modeling, and has a social ontology rooted in gesture and preverbal spatio-temporal concepts. Although both music and language evolved from a mimetic capacity, musical meaning retains a distinct link to vocal mimesis through sonic representations of bodily movement and emotional states. This work challenges both structural and cultural accounts of musical meaning by suggesting that music's power is not derived solely from syntactical or semantic referents, arousals and expectancies, or from its indexical relationships to a particular cultural context, but rather through its immediacy as a performance of socio-emotional essence and embodied gesture.[187]

Understanding the process of imagining musical shapes and representing them corporeally as symbolic thought, a culturally advantageous skill, is supported by anthropological studies. Tolbert's claim that meaning resides in the shapes and movements represented by music suggests a close connection to dance. A similar understanding of the communicative goals of gesture is referenced in the early eighteenth-century writings of John Weaver. In his introduction to his 1707 English translation of Feuillet's *Choréographie*, Weaver describes dance as the rhetoric of the body, and gives some indication of the kind of representation that dancers can present in their movements:

> Stage-Dancing was at first designed for *Imitation*; to explain things conceived in the Mind, by *Gestures and Motions* of the Body, and plainly and intelligibly representing *Actions, Manners* and *Passions*; so that the Spectator might perfectly understand the Performer by these his *Motions*, tho' he say not a

[186] Elizabeth Tolbert, "Music and Meaning: An Evolutionary Story," *Psychology of Music* 29 (2001): 84-94.

[187] Ibid, 84.

> word. Thus far the excellence of the *Art* appears: but its Beauties consist in the regulated Motion of all parts, by forming the Body, Head, Arms and Feet into such *Positions, Gestures,* and *Movements*, as represent the aforesaid *Passions, Manners,* and *Actions*... so that the Spectator will not only be pleased and diverted with the Beauty of the *Performance* but will also be instructed so as to judge the *Design* of the performer. And without the help of an Interpreter, a Spectator shall at a distance, by the lively representation of a just Character, be capable of understanding the *Subject* of the Story represented, and be able to distinguish the several *Passions, Manners,* and *Actions*; as of *Love, Anger*, and the like.[188]

Referencing movement as a way to explain, communicate and represent is also what musicians mean when they refer to gesture in music. Bruce Haynes identifies a musical gesture as a "short sequence of notes, a musical building block; a segment or division of a phrase; the smallest unit of musical meaning into which a melodic line can be divided."[189] As a foundation for his call for period performance musicians today to return to a "rhetorical style," understanding the meaning of gestures is important and he aligns them with rhetorical figures:

> The original writers on Rhetoric considered figures exceptions, something "other than the obvious and ordinary." In that case, the other "ordinary" melodic units comparable in size to figures must have had a separate identity. I call these generic units of meaning, of which phrases are made up, *gestures* (or more properly, *audible expressive phrasing gestures*). Baroque melodies consist of a continual series of gestures: brief melodic events, structural cells of one to several notes in length. Each gesture expresses or emphasizes a single independent idea, sentiment or attitude. The characteristic that defines a gesture is meaning, however slight.[190]

Identifying gestures in an instrumental trio sonata may become an exercise in searching for a sliver of meaning, "however slight." The slow movement of the G minor trio sonata

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[188] Quoted in John Spiegel and Pavel Machotka. *Messages of the Body*. (New York: The Free press, division of Macmillan Pub, 1974), 31.

[189] Haynes, *The End of Early Music,*14.

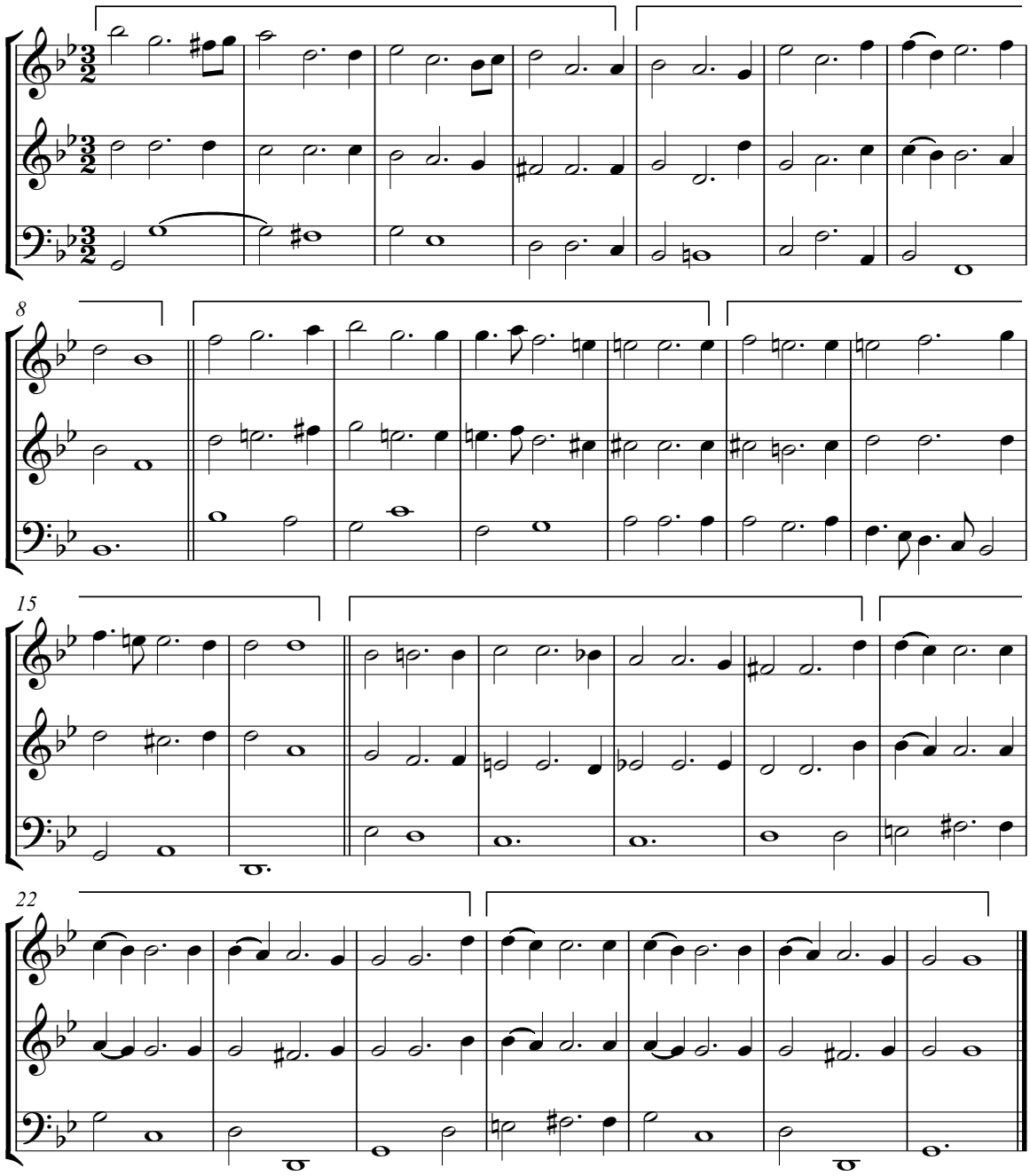
[190] Ibid, 191.

by Purcell can serve as a musical example.[191] This movement is clearly in a dance style. Its primary organizing feature is the regular rhythmic pattern of two long notes per measure, occupying the first two beats of a 3/2 meter, the sole exception being the final cadence of the middle section, where a hemiola interrupts the regularity of the two long notes. Cadence endings arrive on the second beat without exception. These rhythmic features correspond to the well-known dance pattern of the Sarabande.

Two other factors confirm its relationship to the dance: first, unlike the examples from Ravenscroft and Corelli, the two treble lines of the Purcell example move together homophonically for the entire movement. Second, Purcell's three eight-measure phrases (although the third phrase is extended by a *petit reprise*) are exceptionally symmetrical, each with two subsets of four measures; even the four measure units are organized into two measure gestures, with the exception of the passage containing the hemiola.

Like the examples from Ravenscroft and Corelli, Purcell's slow movement (Example 5.13 below) has a clear syntactical arrangement. The harmonic frame is similar in all three examples, with cadences most frequently arriving on the dominant D major or the relative major B flat chords. Purcell's movement also has clear harmonic motion, and although he does not use suspensions as often as Ravenscroft or Corelli, Purcell does include some dissonant harmonies that create points of tension that are resolved at cadential points.

[191] Purcell's models for this style include those of Corelli, whose first book of trio sonatas circulated in manuscript in London at this time, as well as those of Lelio Colista and Carlo Ambrogio Lonati. Hill suggests that Purcell knew Lonati's music well. In his preface to the twelfth edition (1694) of *A Brief Introduction to the Skill of Musick*, Purcell quoted a passage from one of Lonati's sonatas. Hill, *Baroque Music*, 369.

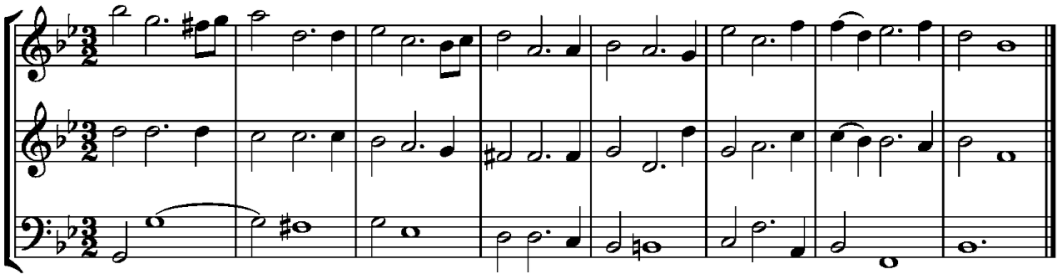


Example 5.13. Purcell, Sonata in G minor, Adagio (1683).[192]

The brackets indicate the phrase grouping. The melodic units seem to conform to what Haynes identifies as gesture, those short "structural cells" heard in the opening phrase as

[192] Henry Purcell, Sonatas of Three Parts (London: E. Eulenburg, 1975): 7-8. These twelve sonatas were issued in four part books, one each for violino primo, violino secondo, basso and basso continuo.

descending intervals. The first eight measures shown in Example 5.14 below move from G minor to D major through a Phrygian cadence in the first four measures and then to a B flat major perfect authentic cadence in measures seven and eight. In the first four-measure phrase, the dissonant harmony occurs on the strong second beat of the second measure. In performance the dissonant clash between the D of the upper part and the C of the second part could, according to Descartes' *circulus* procedures be made even more dramatic by moving the pitch of the D a few cents higher to accentuate the tension with the C. This application of inflected pitch could be repeated in each of the places where a similar dissonance is found.

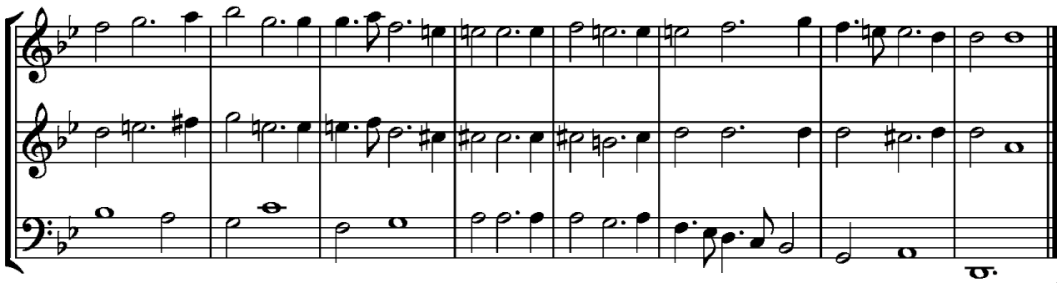


Example 5.14. Purcell, Sonata in G minor, Adagio (1683), mm. 1-8.

In terms of the melodic contours in this phrase, the second treble line moves downward generally by step, while the top treble line has melodic downward skips of a third, a fifth or a fourth before reaching the final B flat of the phrase.

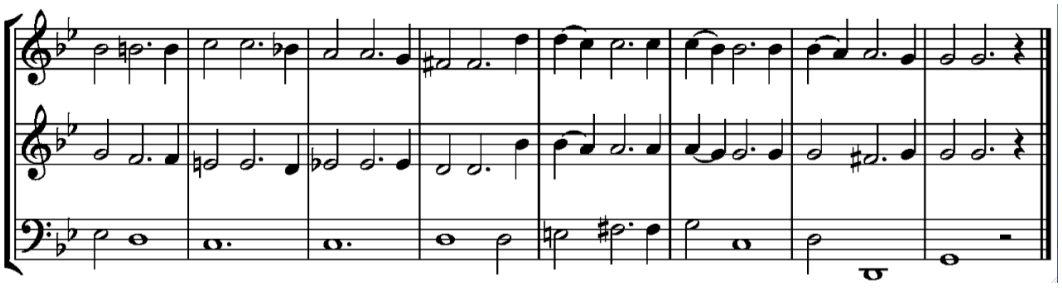
By contrast, in the second eight-measure phrase both treble lines move in thirds as shown in Example 5.15 below. This phrase begins in B flat major, reaches A major in the fourth measure and then arrives at D major at the end. The most dramatic dissonance occurs in the fifth measure of this phrase, the expressive upper neighbor F forming a diminished fourth between the two upper voices. See Example 5.15 below. Here Purcell

builds tension with these successive points of dissonance, and then dissipates it with the return to D major. The movement out of the dissonance is led by the stepwise downward scalar bass movement from F to B flat, and the 4/3 cadential suspension.



Example 5.15. **Purcell, Sonata in G minor, Adagio (1683), mm. 9-16.**

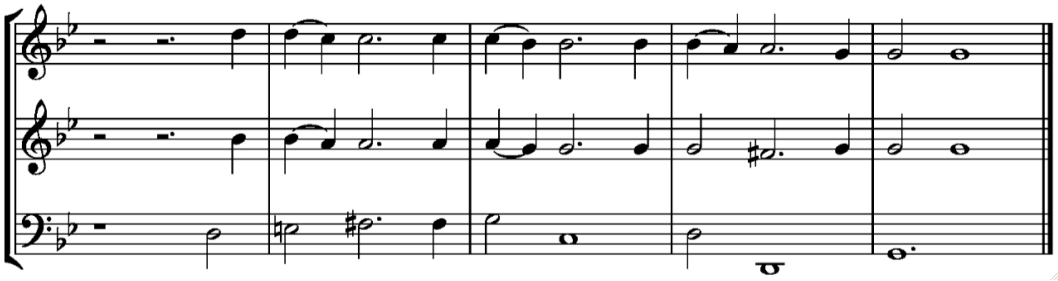
Example 5.16 shows the final phrase, moving from E flat major through D major to the tonic g minor, the two treble voices move in the same direction with the same rhythmic values. The half cadence at the mid-point on the dominant D major chord has the lowest tessitura of the entire movement, allowing a momentary point of quiet repose, while simultaneously preparing the final authentic cadence. The three successive appoggiaturas in parallel thirds lead the progression to the final chord.



Example 5.16. **Purcell, Sonata in G minor, Adagio (1683), mm. 17-24.**

These last four measures are then repeated as a *petite reprise*, shown in Example 5.17. The presence of the *petite reprise* could be another reference to this movement's

relationship to a dance, as the repetition of the last four measures was typical final gesture in French Sarabandes.



Example 5.17. Purcell, Sonata in G minor, Adagio (1683), mm. 25-29.

Looking beyond these technical elements to the "embodied gestures" examined by Tolbert and described by Weaver, a description of the Sarabande from *Le dictionnaire royal augmenté* provides more clues to its expressive content. There are a total of nine paragraphs in this description, all attesting to the communicative power of the mimesis of movement. Here is a portion of the description of the Sarabande dance gestures:[193]

> (1) At first he danced with a totally charming grace, with a serious and circumspect air, with an *equal and slow rhythm* and with such a noble, beautiful, free and easy carriage that he had all the majesty of a king, and inspired as much respect as he gave pleasure.
>
> (2) Then, standing taller and more assertively, and raising his arms to half-height and keeping them partly extended, he performed the most beautiful steps ever invented for the dance...
>
> (7) But all this was nothing compared to what was observed when this gallant began to express the emotions of his soul through the motions of his body, and reveal them in his face, his eyes, his steps and all his actions.

[193] Father François Pomey, *Description d'une Sarabande dansée* in *Le dictionnaire royal augmenté,* Lyons, 1671). Page 22 is reproduced in facsimile and translated into English by Patricia Ranum in "Audible Rhetoric and Mute Rhetoric: The 17th-Century French Sarabande," *Early Music* 14, no. 1 (February 1986): 34-35.

Physical gestures could be correlated with harmonic and melodic gestures at some times, but they are not necessarily coordinated:

> (3) Sometimes he would glide imperceptibly, with no apparent movement of his feet and legs, and seemed to slide rather than step. Sometimes, with the most beautiful timing in the world, he would remain suspended, immobile, and half leaning to the side with one foot in the air; and then, compensating for the rhythmic unit that had gone by, with another more precipitous unit he would almost fly, so rapid was his motion.

The rhetoric of the body need not necessarily shadow the rhetoric of the music, as one is not a translation of the other. As is clear from the descriptions above, the two types of movement can be in counterpoint with each other. Yet the overall Sarabande rhythm framing the dance is common to both.

Purcell's musical gestures, arranged in their formal patterns, provide a strong framework within which the dancer can be expressive. Each four-bar unit echos the same or close to the same rhythm, thus further advancing the periodic syntax associated with a dance movement. The prevalence of these gestures precludes utilization of the hemiola figure so ubiquitous in both the Ravenscroft and the Corelli examples.

Compared to the previous examples, there are in this example relatively few opportunities for inflected expressive intonation. It would seem that the dissonances that provide those opportunities in the other examples by Corelli and Ravenscroft have been bypassed in favor of the regular, periodic syntax so characteristic of dance movements. The harmonic grouping is indicated by brackets in Figure 5.1 below. Also indicated are the general tonal areas and the beats for each four-bar phrase. These four measure phrases are also indicated by brackets above the staff in Example 5.13 above. Positions of the most dissonant harmonies are indicted by the underlined beats.

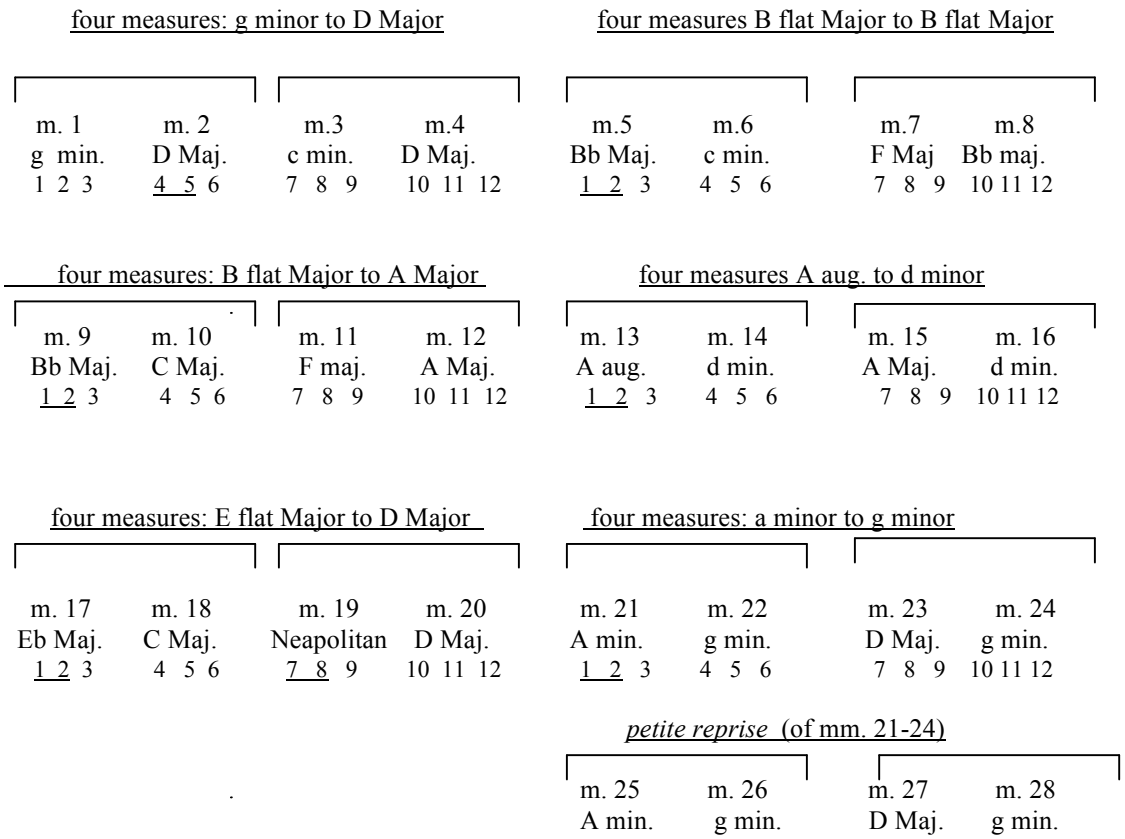


Figure 5.1. Purcell, Sonata in G minor, Adagio (1683), phrase organization.

Using Rhetorical Skills

In tracing Lamy's concept patterns of construction, his "motions of the mind," as revealed in syntax, in motion and in gesture, the goal of each mode of expression is to successfully carry images from the speaker's mind to the audience. Studies in cognitive science, anthropology and neuroscience seem to indicate a biological basis for some of these expressive skills and link those to characteristics common to both language and music. Using examples from instrumental repertoire of the late seventeenth century, I have indicated where some of these expressive patterns of construction can be

emphasized in performance by means of expressive intonation. All of these efforts at communication could be classified as rhetorical processes. Whether these are skills learned and given meaning through cultural representations or are instincts that are yet to be fully explained by science, both are grounded in the desire to be expressive.

The desire of the natural philosopher of the seventeenth century to explain exactly "how things work" was the beginning of this new direction in epistemology. I have cited the earliest monograph of Descartes and the last work of Lamy as examples of the seventeenth-century desire to explain aspects of music and rhetoric, and applied their perspectives as analytical tools for musical examples from the same period. Rhetoric has been a convenient lens through which particular expressive elements can be explored. The technique of expressive intonation, grounded in Descartes' description of intervals and understood from his performance-based perspective, is just one of the skills performers can use to enhance expressive power. How these skills can be acquired and understood in performance is the subject of the next chapter.

CHAPTER VI

INTONATION IN PERFORMANCE PRACTICE

> Directly, in itself, music signifies nothing, unless by convention or association. Music means nothing and yet means everything. One can make notes say what one will, grant them any power of analogy: they do not protest. In the very measure that one is inclined to attribute a metaphysical significance to musical discourse, music (which expresses no communicable sense) lends itself, complaisant and docile, to the most complex dialectical interpretation.[194]
>
> Jankélévitch, *Music and the Ineffable*, 1983

> Musical sounds are complex individuals, too, and tired of being pushed around by a language – which has presumptuously thought of itself as the ultimate model of signification and mediation.[195]
>
> Monson, Hearing, Seeing, and Perceptual Agency, 2008

Finding a way to correlate the practical experience of musicians and the prescriptive theories of science was a challenge for the natural philosophers of the seventeenth century as well as to scholars today. Perhaps Frances Bacon was asking for more than could be achieved when he suggested that theory could explain practice accurately. A more difficult issue is the one that addresses the criteria for good intonation. Since as Haynes observed that "Playing 'in tune' is a relative and very personal affair, and no set of rules or abstractions from practice can possibly encompass its complexities...," what factors cause a performance to be heard as "out of tune"?[196]

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[194] Vladimir Jankélévitch, *Music and the Ineffable,* trans. Carolyn Abbate. Princeton: Princeton University Press, 2003), 11.

[195] Ingrid Monson, "Hearing, Seeing, and Perceptual Agency." *Critical Inquiry* 34, no. S2 (Winter 2008): S36.

[196] See Chapter I: 16.

Sounds in Relation: Science and Music

In his study of early music performances (Bach and Scarlatti) from the 1960s through the 1990s, Eitan Ornoy used recordings of well-known early music and mainstream performers to measure pitch, intonation, tempo, rhythmic interpretation and ornamentation. He compared the success or failure of these performances against the directives for performance derived from scholarly opinions.[197] His conclusions about intonation were that:

> While the elements of pitch and tempo are executed in accord with most theoretical findings, clear deviations from scholars' directives can be traced in the parameters of intonation and temperament, where compliance was roughly traced in the execution of chromatic intervals only. Contrary to performers' declarations, it seems that intonation is more confined to idiomatic limitations than to theoretical directives.[198]

> Comparison between the early music group of performers and their 'mainstream' colleagues shows clear similarities in many of the analyzed parameters. This is most obvious with respect to intonation, by which the interval sizes executed in practice by both groups deviate considerably from what could be regarded as historical practice.[199]

Intonation variance was measured against Ornoy's "scholars' directives," a chart that seemed to be based on a conflation of several early eighteenth-century sources. For each pitch he lists an acceptable variance from four to nine cents, and this seems to have been developed from a conflation of Werckmeister III (1691) temperament and the modern system suggested by Kellner (1977). Measuring the pitches of individual notes in each

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[197] Ornoy lists in his footnote 5 the four sources (the "scholarly opinions") from which he derived the acceptable range in cents for each note in a chromatic scale. These are H. Kelletat, *Zur musikalischen Temperatur, insbesondere bei Johann Sebastian Bach* (Kassel, 1960); M. J. Barbour, *Tuning and Temperament* (Michigan, 1972), 10-12; J. Barnes, "Bach's keyboard temperament: internal evidence from the Well-Tempered Clavier", *Early Music* 7 (1979), 236-49; H. A. Kellner, *'Eine Rekonstruktion der wohltemperierten Stimmung von Johann Sebastian Bach', Das Musikinstrument* 26 (1977), 34-5.

[198] Eitan Ornoy, "Between Theory and Practice: comparative study of early music performances." *Early Music* 34, no. 2 (May 2006): 242.

[199] Ibid, 243.

recording, Ornoy registered as deviant any performance where pitch choices exceeded those "scholar's directive" parameters by ten cents or more. His conclusion is that for both period-instrument and mainstream performances the intonation variances observed in these recordings "deviate from historical practice," yet none of the performances sounded radically "out of tune."

Establishing criteria beyond purely subjective evaluation seems to lie within the domain of science, and the early natural philosophers were eager to address the issue. Musical subjects, and especially intonation issues, were of great interest to members of the Royal Society in London. Thomas Salmon's experiment was one example designed to show a theory of pitch relationships with certainty. The challenge, like that of Bottrigari, was to find euphony in ensembles. The answer was to have everyone playing within the same diatonic scale. Discovering a way to apply a fixed-pitch system to string instruments was Thomas Salmon's means to demonstrate his theory:

> Having had the honour last week of making the trial of a Musical experiment before the Society at *Gresham College*, it may be necessary to give a farther account of it: that the Theory of Musick, which is but little known in this Age, and the practice of it, which is arrived at a very great excellency, may be fixed upon the sure foundation of Mathematical certainty. The propositions upon which the experiment was admitted were: that musick consisted in proportions, and the more exact the proportions, the better the music; that the proportions offered were the same that the ancient Grecians used: that the series of notes and half notes was the same our modern music aimed at, which was there exhibited upon fingerboards calculated in mathematical proportion. This was demonstrated upon a viol, because the strings were of the greatest length and the proportions more easily discerned; but may be accommodated to any instrument, by such mechanical contrivances as shall render those sounds which the musick requires.
>
> To prove the foregoing propositions, two Viols were Mathematically set out, with a particular Fret for each String, that every Stop might be in perfect exactness: Upon these, a Sonata was perform'd by those two most eminent Violists, Mr. *Frederick*, and Mr. *Christian Stefkins,* servants to his Majesty; whereby it appear'd that the Theory was certain, since all the Stops were owned by them to be perfect. And that they might be prov'd agreeable to what the best Ear and the

> best Hand performs in Modern practice, the famous *Italian*, Signior *Gasperini*, plaid another Sonata upon the Violin in Consort with them, wherein the most compleat Harmony was heard. The full knowledge and proof of this experiment may be found in the two following schemes, wherein musick is set forth, first Arithmetically and then Geometrically.[200]

Salmon then shows with diagrams the calculation of ratios for string divisions and his drawing of the placement of frets on the viols. In his final sentence of the nine-page summary he notes that "If we go not further, this experiment demonstrates the true theory of music, and brings the practice of it to the greatest perfection."[201]

Two issues are of interest here: first, pure, beat-less intervals ("perfect exactness") were possible and desirable; second, that a musical performance could have been considered as a scientific experiment. This first issue, achieved by setting the frets to a particular tuning system, pre-determines all pitches in advance of the performance. The diagrams show fret placement to be a series of just intervals for the six notes of the *senario* on each of the strings, D, G, C and E, which would allow consonance for compositions in the keys of D, G, C and E. For music in different keys a new fingerboard could be applied. Salmon writes: "the instrument maker can provide moveable Finger-boards as will serve exactly for every key. They are taken out and put in upon the neck of

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[200] Thomas Salmon, "The Theory of Music reduced to Arithmetical and Geometrical Proportions," *Philosophical transactions: giving some accompt* [sic] *of the present undertakings, studies and labours of the ingenious in many considerable parts of the world,* 24 (London: John Martyn at the Bell, printer to the Royal Society, 1705): 2072-2069-2077 (misnumbered) in Royal Society (Great Britain). Philosophical transactions: giving some accompt [sic] of the present undertakings, studies and labours of the ingenious in many considerable parts of the world. 24. London [England], n.d. Eighteenth Century Collections Online. http://find.galegroup.com/ecco/infomark.do?&contentSet=ECCOArticles&type=multipage&tabID=T001&prodId=ECCO&docId=CW3310463782&source=gale&userGroupName=euge94201&version=1.0&docLevel=FASCIMILE (accessed November 5, 2011).

[201] Ibid, 2077.

the viol with as much ease, as you pull out and thrust in the drawer of a table."[202] This, of course, precludes a repertoire in which modulation to distant tonalities occurs.

The second issue of interest is that the Royal Society would have even considered a musical experiment as appropriate for their consideration. But, as Benjamin Wardhaugh has shown, the English scientists and mathematicians of the late seventeenth and early eighteenth centuries were interested in the relationship between the mechanics of music and their natural philosophical pursuits. Robert Hooke, Robert Boyle, Isaac Newton, Francis North and William Holder were among those seeking to show how the mechanics of music could be explained, and how those explanations were related to other phenomena in the natural world.[203] Holder had given papers on the physiology of the ear, on the elements of speech, on time and the reform of the calendar. His publication about music that reveals an attempt to find the connections between science and music, and especially reconciling the mathematical basis for tuning and music that "delights the ear." Holder attempts to bring together so many sources that his argument seems unnecessarily complex. In presenting his numerical argument, he intended to show that tuning was based on the fundamental pitch of a "sonorous body." He also used the just scale for the six consonances (the same *senario* of Zarlino and Descartes) and showed how proportional ratios for the whole steps and diatonic and chromatic half-steps of the diatonic scale could be derived from these. He also was concerned with the origin of sound, and considered Boyle's theories of bells and North's ideas on the transmission of sound as vibration. All of these issues were discussed at the Royal Society in 1664, well

[202] Ibid, 2078.

[203] Wardhaugh, *Music, Experiment and Mathematics*, 112-141.

before Holder's book *Treatise of the Natural Grounds, and Principles of Harmony* was published in 1694. Holder's argument was intended to confirm the pleasurable effect of pure intervals on the listener. The chapter in his book, the "Reasons of the Agreement of Sounds, and consequent Delight and Pleasure of the Ear," demonstrates his desire to reconcile theory and practice.[204] Like Descartes, Holder emphasized the evidence of the senses and concludes that the final arbiter in matters of "concords and discords" is the ear, i.e., whether they are deemed to be pleasing or unpleasant. Also like Descartes, Holder used logarithms to divide intervals that allowed for many degrees of variation in pitch, and gave an extensive table to show the number of commas in an octave. Descartes' *Compendium musicae* had been translated into English and published in London in 1653, but there is no direct evidence that Holder based his ideas directly on Descartes' *circulus* or on his procedures for choosing intonation options in performance. But like Descartes, he does affirm the desirability of just intervals, describing the current musical practice and trying to explain the basis for this to the scientific community.[205]

Much of the discussion thus far has been about the intersection between the science of music and the performance of music. Citing sources and using musical examples from the seventeenth and early eighteenth centuries, it is clear that a break from what Francis Bacon called the "certain mystical subtleties" had been made. At the same time there was in the seventeenth century a stylistic change in music itself that had consequences for the science of music. This involved the more free use of dissonance,

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[204] Wardhaugh, *Music, Experiment and Mathematics*, 134-141 for a full discussion of Holder's theories.

[205] Holder may have found confirmation of his belief in the research by Marcel Zentner, Jerome Kagan and Sandra Trehub: M. R. Zentner and J. Kagan, (1998). "Infants' perception of consonance and dissonance in music," *Infant Behavior and Development* 21 (1998): 483-492; Sandra Trehub, "In the beginning: A brief history of infant music perception," *Musicae Scientiae: The Journal of the European Society for the Cognitive Science of Music* (Special Issue 2010): 71-87.

found in harmonies where the dissonance needed resolution. It also involved motion toward the tonic, especially in dominant-seventh chords where the seventh scale step became the third of the dominant chord and "leaned" toward its resolution. Another consequence was the utilization of more accidentals and the increased use of modulation.[206] There were, however, no discoveries in the science of music that affected musical practice. Music may have influenced science, but science did not influence music.[207]

Sounds in Relation: Teaching Inflected Intonation

If the default position for intonation of intervals is the pure, beat-less consonant intervals of the *senario* and the tuning system of the seventeenth and early-eighteenth centuries was its "intonational surrogate," quarter-comma mean-tone temperament, then one could assume that teaching intonation would focus on reinforcing those consonances. But this is not, and has not, been the case. Few pedagogical treatises addressing the practical aspects of tuning are available from the seventeenth century, and it is not until the early eighteenth century that instruction manuals appear for instrumentalists. There are more resources in our century, but few discuss the subtle changes that occur in

[206] It is the significant change in desire for modulation and the use of keys beyond those that were common for quarter-comma mean-tone temperament that forced the development of circulating temperaments and the parallel development of theories to support their usefulness.

[207] H. Floris Cohen argues against Claude Palisca's often-referenced thesis that the revolution in the science of music was because of increased empiricism, a result of "humanistic ferment." Cohen notes that the revolution in the science of music was the result of newly discovered ancient treatises and the new mechanistic way of framing questions and answers, not from increased empiricism. An early version of Palisca's thesis is presented in "Scientific Empiricism in Musical Thought," in *Seventeenth Century Science and the Arts,* ed. Hedley Howell Rhys. (Princeton: Princeton University Press, 1961), 91-137. It is restated and situated in historical context in one of his last monographs, "Moving the Affections Through Music: Pre-Cartesian Psycho-Physiological Theories," in *Number to Sound: The Musical Way to the Scientific Revolution,* ed. Paolo Gozza (Dordrecht: Kluwer Academic Publishers, 2000), 289-308. Cohen's position is in H. Floris Cohen, *Quantifying Music: The Science of Music at the First Stage of the Scientific Revolution, 1580-1650.* (Dordrecht: D. Reidel, 1984), 251-253.

performance. Rogers Covey-Crump is one of these few, a performer of early vocal repertoire who explains how he changes tuning considerations as he moves from one repertory to another and how he understands inflected intonation:

> For players of instruments that permit flexibility of tuning, and for unaccompanied singers, intonation is far harder to define than other parameters of performance... In practice a keyboard temperament can only be a reference standard since no performer can possibly temper intervals in the precise way demanded by fixed tuning. Indeed, any attempt at tempering will interfere with rather than help a good performance. The instinct of the best performers will produce tuning that is closer to Just or to Mean Tone tuning than to modern Equal Temperament. However, all performers need special guidance in achieving satisfactory tuning in what I will label 'Pythagorean' repertory.[208]
>
> Fine shadings of tuning can best be heard between paired voices or instruments that share a very similar harmonic or overtone spectrum, because our ears identify the quality of intervals between voices by the interaction of the overtones. The beauty of an unaccompanied melodic line is determined by the consistency of pitch so that each note of the melody has precisely one 'slot.' In polyphony some notes of the scale or mode will have two or even three 'slots' depending on the harmonic context.... Good tuning in polyphony demands accurate melodic movement as a starting point, but the vertical relationship of harmony must be accommodated simultaneously.[209]

The interval of the third is critical in ensemble music of the seventeenth century, and for polyphonic music of that period musicians tended to use mean-tone tuning. For repertoire of a much earlier period, one determines the tuning by the function of the major third:

> If few thirds are present, and those that are occur as passing harmonies and not as the result of a harmonic resolution, then the composer clearly had the Pythagorean aesthetic as his starting point. Where thirds are abundant and perceptible points of repose, then it is likely that the composer expected to hear Just thirds.[210]

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[208] Rogers Covey-Crump, "Pythagoras at the forge: tuning in early music," in *Companion to Medieval and Renaissance Music,* ed. Tess Knighton and David Fallows (Berkeley: University of California Press, 1992), 317.

[209] Ibid, 318.

[210] Ibid, 321.

Covey-Crump then goes on to describe how he bends pitches in order to make intervals larger or smaller as needed, and thus inflects the intonation for an entire composition.

Sounds in Relation: The Expressive Value of Intonation

Early Music as a performance art has not been given as much attention by musicologists as archival history, composer biography, hermeneutics or theory. In a 2004 monograph "Music – Drastic or Gnostic?" Carolyn Abbate notes that "The relationship (or lack of one) between musicological dicta and musical praxis has haunted the historical performance movement and the debates about it."[211] She does not elaborate on issues regarding period performance, but discusses musical hermeneutics in general. Her concern is the meanings that are exposed in listening, those meanings that arise from the sensory experience, the "drastic" or supra-audible and immediate aspects of performance.

> Musical sounds are made by labor. And it is in the irreversible experience of playing, singing, or listening that any meanings summoned by music come into being. Retreating to the work displaces that experience, and dissecting the work's technical features or saying what it represents reflects the wish *not* to be transported by the state that the performance has engendered in us.[212]

This focus on how music sounds as it unfolds, on the senses or the "biological episteme," is also the topic Ingrid Monson addresses in "Hearing, Seeing, and Perceptual Agency." Her concern is with how the musician in performance accesses what she calls "perceptual agency." She defines this as follows:

> In this essay I would like to develop the idea of something I call *perceptual agency*--the conscious focusing of sensory attention that can yield differing experiences of the same event. By agency I mean "the socio-culturally mediated capacity to act," and I refrain from confusing it with simple free will or resistance.

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[211] Carolyn Abbate, "Music--Drastic or Gnostic?" *Critical Inquiry* 30 (Spring 2004): 507.

[212] Abbate, "Music--Drastic or Gnostic?" 505-506.

> Agency is intimately connected with practice, in my view, since it is what people choose to do given the particular structural and discursive configurations in which they live.[213]

Neither Monson nor Abbate mention intonation as an element in their analyses, but they both acknowledge the experience of tracking sounds in ways that create interpretations. With respect to intonation, it is part of experiencing the acoustical data, then processing it into images that have intrinsic relationships that are again transformed as music unfolds by one's intention; this is another way to describe musical performance.

Relationships, especially intonational relationships, are not always perceived or evaluated in the same way by performers. In Chapter V the examples from trio sonata Adagio movements revealed several options for inflecting the pitch relationships in an interval. If one pitch were moved higher or lower by a schisma, thus creating more tension in an already dissonant interval, would it be considered as "out of tune" or an example of "expressive intonation"? Evaluating the intonation skills of performers is, at best, a subjective process and one that involves making the distinction between pitch discrimination (being able to distinguish between two different levels of a single pitch), pitch matching (the ability to exactly reproduce a pitch) and intonation (manipulation of pitches in a musical context).

Researchers like Ornoy have tried to establish tests for competency in these areas, and the results confirm the degree of pitch variance that dismayed the interlocutors in Bottrigari's *Il Desiderio.* Different competent and well-trained professional musicians have different concepts of pitch placement, with degrees of variation that can create cacophony in ensemble performance. But this result is not just because of some inadequacy of their instruments or their abilities; it is rooted in a more basic element of

[213] Monson, "Hearing, Seeing," S57-S58.

performance, the musicians' perceptions while playing. The complexities of relationships and meanings experienced by each player as the music unfolds influences choices about where and why they manipulate pitch, both in response to the tonal matrix heard at the moment and to the meanings presented by that musical context. Descartes' explanation of intonation options for intervals and his image of the moveable comma on the continuous pitch spectrum of his *circulus* describe the most basic sensory aspect of performance. Lamy observes the importance of expressive processes that serve to organize expressive gestures, and both Monson and Abbate recognize how pitch choice and expressive intent are part of the immediacy of the musical experience.

In performance contexts, any degree of inflection is evaluated as "in tune" or "out of tune" by the human ear.[214] To be more accurate, it is the brain, not the ear, that establishes the parameters for evaluating correctness, and this action of the brain may be related to other phenomena of interpretation of sounds. No matter what the intonation or tuning standard, even accomplished and well-trained musicians tend to vary their pitch up to 22 cents in their effort to place notes correctly. In her discussion of musical textures and the ways that perceptual agency describes organizing processes of perception, Monson echos the conclusions of Reinier Plomp.[215] Psychoacousticians describe the way we hear and differentiate sounds coming from different sources or sounds that have moments of interruption. The synthesizing brain seems to reinstate sounds that have been obscured by interference "and in the process create a more stable interpretation of the

[214] Allan Vurma and Jaan Ross, "Production and Perception of Musical Intervals," *Music Perception* 23, no.4 (2006): 343.

[215] Reinier Plomp, *The Intelligent Ear: On the Nature of Sound Perception* (Mahwah, N.J: Lawrence Erlbaum Associates, 2002).

auditory landscape."[216] This suggests future lines of research within the cognitive sciences to study how the brain processes pitch perception and intonation stability. If we do indeed naturally prefer consonance in intonation, and in practice actually bend the received data from the soundscape to our will, it would seem that the effort to train musicians to match pitches to an arbitrary tuning system will necessarily fail.

This point is reinforced by contemporary research, working with both amateur and professional musicians. Analytical studies of intonation practice like those of Fyk and Vurma tend to focus on the success of test subjects in executing an in-tune performance, and the difficulty of isolating criteria for intonation accuracy from the other variables that contribute to expressive performance. These include the tendencies of particular instruments (wind vs. string), the tempo, volume and range parameters of the composition as well as the performance context (size of ensemble, effects of the room, tempo and difficulty of the music).[217] Those studies that do isolate intonation from other variables and address pitch discrimination from either the auditor and the performer's perspective must still note choices based on harmonic or melodic function. At this level of perception, the desire for understanding actually can alter judgment:

> In order to understand the musical information conveyed in a performance, listeners must not only identify pitches as same or different but must also sort pitches according to melodic or harmonic function. Such sorting requires the listener to disregard strict pitch accuracy and focus instead on the intervallic relationship between pitches according to learned conventions. Within a given scalar convention several pitches quite close in frequency might be identified as the same pitch insomuch as we would call them by the same note name. Similarly, within a familiar harmonic or melodic context several intervals quite close in size might be assessed as the same interval. Researchers have labeled this

[216] Monson, "Hearing, Seeing, and Perceptual Agency," S40.

[217] A majority of research in ensemble tuning has been generated by those involved in music education, and supports the criteria used for adjudication of ensemble performances and for establishing pedagogical methods.

> phenomenon *categorical* or *zonal* perception... this phenomenon has been likened to perception of vowels and consonants in speech. When conversing with other people, we can comprehend their meaning even if their pronunciation of *the* or *ay*, for example, differs from our own. Similarly in music, we will usually recognize the identity of an interval or a tone even if it is considerably out of tune.[218]

The in-tune standard for most studies of pitch accuracy is equal temperament, but in performance it is clear that matching equal temperament is rare. In studies of rehearsal strategies for high school and instrumental ensembles, Steven J. Morrison and Janina Fyk conclude that pitch control, not matching an external standard, is the goal of intonation study:

> Performance practices of the most highly trained musicians and listening preferences of the most discriminating audiences demonstrate that pitch discrepancies are an accepted and even desirable component of the best musical performances... A teacher's or performer's overreliance on an external standard such as an electronic tuner or its corresponding theoretical tuning system may limit the type of pitch flexibility characteristic of expert performances.[219]

Just as in Bottrigari's time, for everyone in an ensemble to adhere to an external fixed-pitch standard is not desirable, especially for the most discriminating audiences.

Not everyone has the same goal for intonation accuracy or determines the possibilities in the same way. Finding a standard can also mean making decisions about melodic and harmonic positioning in relation to the syntax and substance of the composition. As demonstrated with the expressive options for leading-tone pitches in the Ravenscroft example in Chapter V (Example 5.4), the performer may choose to stretch a melodic pitch higher to create tension within a phrase or lower it in order to achieve pure harmonic consonance at a point of repose. These choices are based on expressive

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[218] Steven J. Morrison and Janina Fyk. "Intonation," in *The Science and Psychology of Music Performance: Creative Strategies for Teaching and Learning*, ed. R. Parncutt and G. E. McPherson (New York: Oxford University Press, 2002), 185.

[219] Ibid, 194.

possibilities in performance, and to describe this process musicians often draw the analogy with language arts and rhetoric. In his book *The End of Early Music* Haynes suggests that performers of Baroque music use a "rhetorical" approach:

> What Windows is to computers, Rhetoric was to Baroque and Renaissance musicians; it was their operating system, the source of their assumptions about what music was and what it was supposed to accomplish. And although it was applied to music from the outside, in a sense it would be more accurate to describe music as one form that Rhetoric took. With the rise of Romanticism, Rhetoric was swept away again, which is why it is only in the last few years that we have begun to appreciate its significance in our current pursuits. Rhetoric is remarkably adaptable. It can be applied over a spectrum from writing style to dance. In music it has several facets. Since it serves as a framework of form (with sections like *dispositio, pronunciatio,* etc.), it is useful in establishing and analyzing structure, both large-scale (like whole pieces) and small-scale (like figures).... Rhetoric also acts as a kind of hermeneutics or narrative, providing handles for understanding music's meaning, in ways parallel to discursive thought, stores, and descriptions of emotional states. And it provides performers with a rationale for making emotional contact with their listeners. This is potentially far-reaching because—since the revolutionary days of the 1960s—Baroque music has been constrained by the simplistic idea that expressive performance is Romantic. Rhetoric offers an alternate discourse and validates expressive performing in "Early music."[220]

Haynes references the language arts for more than just organizational tools such as punctuation and formal organization. In his view the performance of early music is a process of decoding a particular kind of expression, and rhetoric itself provides the narrative, the "operating system" of "what music was and what it was supposed to accomplish."

The linguo-centric predicament appears when the rhetoric of music, the "decoding" tool, is mistaken for the meaning of music. It is what Jankélévitch must have referred to when he suggested that music signifies by "convention or association... and

[220] Haynes, *The End of Early Music*, 165-166.

lends itself, complaisant and docile, to the most complex dialectical interpretation."[221] While I have argued that the syntax and substance of a composition have no particular semantic references, the way we describe what musicians do is still heavily influenced by the conventions of linguistic arts.

The Linguo-centric Predicament

What has influenced music is language and all of the associative meanings that come with narratives of expression. This is an easy seduction because of the convenience and power of analogy. We describe what we do with words, so when metaphor slips into ontology, our descriptions are interpreted as substantive meanings. Musical hermeneutics have become tangled up with rhetorical applications, and the distinction between non-verbal expressions of substance and verbal expressions of style has been lost. As Monson puts it somewhat anthropomorphically, musical sounds are tired of being pushed around by language. What she offers with her concept of perceptual agency is an alternative reading that moves to recover the non-linguistic but meaningful expressive qualities that arise in musical performance. As applied to expressiveness of intonation, Monson's model of signification is related historically to both the mechanistic view of intonation presented by Descartes and the Cartesian view of rhetoric found in Lamy. The point of contact is in performance, where on many levels the impact of sound alone has significance. Monson's example of this is from her study of the shifting patterns in the music of Neba Solo. In her analysis she is addressing more than cognition and more than musical analysis:

[221] The full quotation and reference is the *captatio benevolentiae* of this chapter.

> My use of the term *perceptual agency* to describe what the psychology of perception literature calls attention or cognitive control has deliberately deployed *agency* to index well-known debates in anthropology, ethnomusicology, and social theory about the relationship of individuals and groups to the dynamics of power in which they live. Perceptual agency from this perspective is what people choose to do with musical sounds given the sensory inputs, the manifold cognitive processing possibilities of the brain, and the socio-cultural contexts in which they listen and perform.[222]

The complex textures of Neba Solo's music, and the shifting patterns that are revealed only when heard (that is, not evident from the score) are not unlike the complex intonation contexts of early music I have described. Expressive intonation that results from inflected pitches comes into play only in performance. Those who approach this repertoire with expressive intonation as a performance practice touch on the "agency" aspect of perceptual agency. "Agency" activates the sensory process, the cognitive process and the contextual frame. Descartes' model of thought that includes the sensory, the theoretical and the perceptual (conceiving/synthesizing) has a certain resonance with Monson's construct as well, and the applicability to musical performance is much the same.

Conclusion

Discussing expressive intonation as a performance practice brings together issues from several disciplines. Music as a self-reflective and ambiguous medium defies fixed meanings, even when plausible arguments for specific references are offered. I have noted that mathematical, acoustical and organological studies can describe intonation options. Cognitive approaches, whether those suggested by Descartes in the seventeenth century or those being proposed today, attempt to describe the mechanisms that shape

[222] Monson, "Hearing, Seeing, and Perceptual Agency," S52.

musical practice. Contextual studies suggest associative meanings for particular compositional styles, but no theory can initiate the experience of music itself. This is up to the performer and is why performance practice studies, especially those on intonation that address the very essence of sound and the intention that creates musical expression, are valuable.

I have based my study on a close reading of two seventeenth-century documents that were available to and read widely in London, and applied my theories of inflected intonation as an expressive performance practice to selections of instrumental trio sonatas from the late seventeenth and early eighteenth centuries. While this application is contextually appropriate for period-instrument performance of early music, the general theories of intervallic intonation and expressive intention found in Descartes' *Compendium musicae* and Lamy's *La Rhétorique ou l'art de parler* could apply to any repertoire. But employed specifically for the instrumental ensemble music of the late seventeenth and early eighteenth centuries, the clarity resulting from beatless consonant intervals and the subtle variations in pitch available through inflected melodic gestures can contribute remarkably to rhetorical effectiveness in performance. Any new perspective for understanding intonation can be valuable to the early music performer today, especially considering the many styles and periods of music those musicians are presenting. In current early music performance practice, where vibrato is no longer ubiquitous and especially with one-on-a-part instrumental performance, intonational inflection can be easily achieved and heard. Having a clear understanding of what a performer of the seventeenth century would have assumed as intonation practice and

employing it should result in a distinctly different sound from using intonation practices from later periods.

As demonstrated in my analysis of the Ravenscroft *Adagio*, the framing of rhetorical syntax can be enhanced by relaxing or intensifying dissonant intervals at cadences. The example by Corelli presented several choices for intonation inflection, from presenting beatless consonant intervals at significant moments of repose to emphasizing moments of agitation and motion with intensified dissonance within a phrase. In the example by Purcell, the series of embodied rhetorical gestures of the sarabande can be enhanced by parallel patterns of expressive intonation. Moving beyond the conventional categories of rhetorical performance, especially those modeled on the linguistic paradigms of the German *musica poetica* tradition, my goal of communicating one's understanding of musical intent with inflected intonation provides a mode of musical expression that can be understood as rhetorical in the broadest sense. Lamy provides the justification for this view of expressive rhetorical delivery, and Descartes' unique perspective on interval intonation provides one element of the means.

My claim is that expressive intonation can be analyzed and explained as a rhetorical practice, and I have described theoretically how inflected pitches can serve an expressive function. But as Jankélévitch and Monson suggest in the excerpts at the beginning of this chapter, it is only in the performance that these understandings can be clear. It is in the listening in performance, both by the musician and by the audience, that signification ultimately occurs. As Kofi Agawu notes, the intention of the performer is the catalyst:

> ...whereas the theorist can afford to sit on the fence, the performer cannot. Performers are, of course, not unaware of ostensibly ambiguous situations. At the

> moment of execution, however, they must decide one way or other and convey their interpretation with conviction.[223]

The moment of execution is the moment of rhetorical intention of Lamy and the perceptual agency of Monson. It is that which reveals music as an art–intentional, experiential and persuasive.

[223] Kofi Agawu. "Ambiguity in tonal music: a preliminary study," in *Theory, analysis and meaning in music*, ed. Anthony Pople (Cambridge: Cambridge University Press, 1994), 98.

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