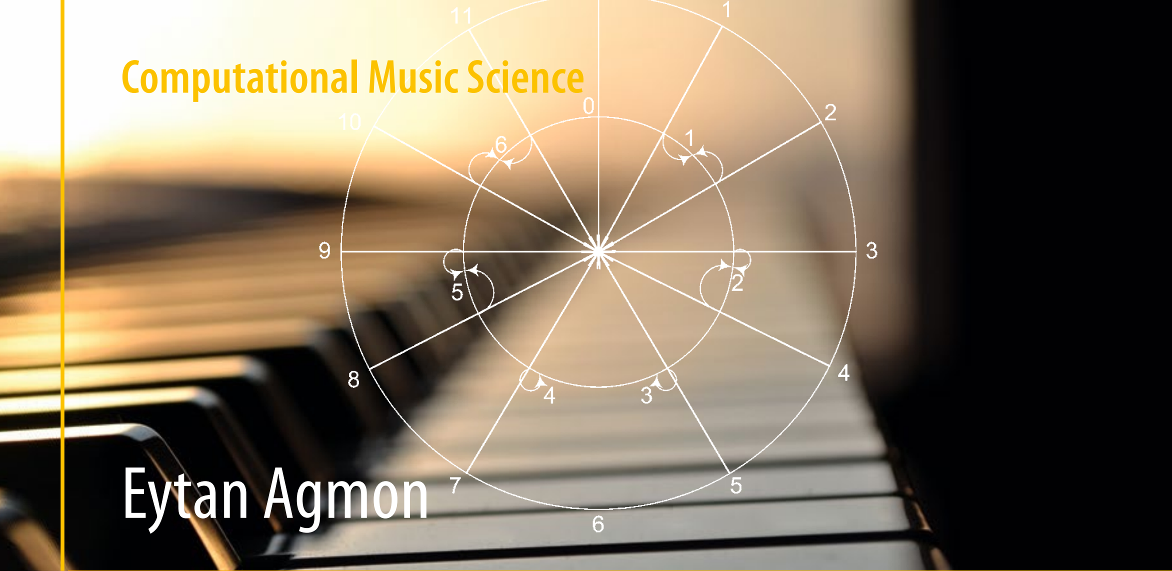
Computational Music Science



Eytan Agmon

The Languages of Western Tonality

Springer

Computational Music Science

Series Editors

Guerino Mazzola
Moreno Andreatta

For further volumes:
http://www.springer.com/series/8349

Eytan Agmon

The Languages of Western Tonality

Springer

Eytan Agmon
Department of Music
Bar-Ilan University
Ramat-Gan
Israel

ISSN 1868-0305 ISSN 1868-0313 (electronic)
Computational Music Science
ISBN 978-3-642-39586-4 ISBN 978-3-642-39587-1 (eBook)
DOI 10.1007/978-3-642-39587-1
Springer Heidelberg New York Dordrecht London

Library of Congress Control Number: 2013951826

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

> ... Each of these four notes governs, as its subjects, a pair of tropes.... Thus every melody... is necessarily led back to one of these same four [notes]. Therefore they are called "finals," because anything that is sung finds its ending (*finem*) in [one of] them.
>
> —Hucbald of Saint-Amand, late Ninth Century[1]

As an object of inquiry, "tonal music" is far from homogenous. The music of the ninth century with which Hucbald was familiar was very different, we may assume, from (say) the music of the seventeenth century. Nonetheless, there are striking points of contact. Most notably, a "background system" of exactly seven notes, orderable within the octave as a cyclic permutation of the sequence T-T-S-T-T-T-S of tones and semitones (alternatively, as a sequence of perfect fifths—the fifth being the most privileged interval following the perfect octave), is "governed" by one of its members—the final (and "co-governed," one might add, by another—the cofinal, the perfect fifth above the final). How can one account for the remarkable stability of such basic features of "Tonality," and, at the same time, do justice to the equally remarkable variety of styles—nay, *languages*—that the history of Western tonal music has taught us exist? This book is an attempt to answer these questions.

The book is divided into two main parts. Part I, *Proto-tonality*, studies the background system of notes prior to the selection of a final. The "proto-tonal system" ultimately posited is *harmonic* and contains a "harmonic message." However, the harmonic message may be empty, in which case the system reduces to its *diatonic* component. In other words, a harmonic system is diatonic, but not vice versa (a diatonic system is oblivious of such constructs as "chord," "chord progression," and "voice leading"). An important component of every diatonic system is its "core": a length-7 segment of the "line of fifths," for example, F, C,..., B.

After some preliminaries that concern consonance and chromaticism, Part II, *The Languages of Western Tonality* (also the title of the book as a whole), begins with the notion "mode." A mode is assumed to contain a "nucleus." A nucleus is a subset of the core *that is consonant* while containing a maximal number of

[1] Trans. from Cohen (2002), p. 322.

elements. The mode's final is the unique nucleus element that is *a root* relative to every other nucleus element. For example, the final would be the lower member (rather than the upper) of a perfect-fifth dyadic subset of the nucleus.

Crucially, the notion of "consonance" is itself dependent on the proto-tonal system's status as diatonic or harmonic. In particular, in the harmonic case the major and minor third and sixth are deemed consonant in addition to the diatonic perfect octave, fifth, and fourth. As a result, the modal nucleus is a perfect-fifth dyad in the diatonic case and a triad (major or minor) in the harmonic case. Early in Part II, in other words, a distinction is established between two types of mode, *dyadic* and *triadic*. Moreover, within each type, the degree to which the nucleus (or a privileged subset thereof) is consonant *in relation to the non-nucleus core elements* defines "semi-key" as a special type of mode and "key" as a special type of semi-key. On the basis of these distinctions, seventeenth-century music (for example) presents itself as a (tonal) language of triadic semi-keys; ninth-century music, by contrast, is a (tonal) language of dyadic modes.

Thus, in a nutshell, the theory accounts for tonal variety. The question of tonal stability is addressed mainly in the proto-tonal Part I, though it continues to inform ideas put forth in Part II as well. In a nutshell again, tonality is seen as a highly successful "communication system." Communication, indeed, is the most important high-level principle that guides the theory offered in this book.

Theory; History; Cognition

From the preceding remarks it is clear that the book draws upon three distinct fields of study, namely music theory, music history, and music cognition. Like the three edges of an equilateral triangle, the contribution of each field to the project as a whole is inconceivable without the other two.

Music theory is the oldest and most established of the three. Music theory has not only handed us, early in the nineteenth century, a valuable though elusive concept—Tonality—but is on record for centuries if not millennia for attempting to demystify that extraordinary gift of mankind to itself: music. The story of music theory is fascinating in its own right, replete as it is with turns and twists, progressions and regressions. Be that as it may, the present project is unthinkable in the absence of the rich and complex heritage of ideas that constitute the music-theoretic endeavor.

It is all too easy to absorb oneself in the familiar and the readily accessible, forgetting not only that the past may have been different from the present, but also that the present may be very different elsewhere. Historical musicology and ethnomusicology have taught us to respect the chronological and cultural Other.

As should be clear from the Preface's opening remarks, this study takes seriously the historical challenge, offering a theory that, while not explicitly diachronic, nonetheless renders conceivable a historical process of the sort that seems to have taken place in Western culture, namely from dyadic to triadic tonality, and more or less concurrently, from modes, through semi-keys, to keys. Self-consciously focusing on the West, the study is obviously less responsive to the cultural challenge. Nonetheless, a reference to the Javanese *pélog* scale may be found in Part I, Sect. 8.1; a reference to north Indian music may be found in Part II, Sect. 14.1.

Finally, music cognition has made us keenly aware that music is a reflection of the human mind. In current music-cognitive discourse much emphasis is placed on *perception*. The present book, by contrast, places equal emphasis on *conception*. The difference reflects the book's communicative bias, coupled with the observation that communication takes place where perception meets conception. In many ways, we shall see, the languages of Western tonality reflect the logical and cognitive constraints that make musical communication possible.

Even for the professional music theorist, the book is no easy reading. This is especially true of Part I, *Proto-tonality*, where abstraction and formal rigor reign supreme. Formal rigor in the book, however, is no ornament. As explained in Chap. 2, the book strives for the highest possible standard of scientific acceptability, namely explanatory adequacy. To this end, it was necessary to strip tonality down to its barest elements, generalizing parameters whenever possible. That this approach pays off becomes apparent already in Chap. 8, where an alternative theory is compared to the proposed theory precisely in terms of explanatory adequacy.

A number of strategies may help the interested reader overcome the difficulties of Part I. The tried-and-true strategy of nonsequential reading may not only help combat fatigue but may offer a larger (if not completely coherent) perspective from which the intricacies of a given phase in the theory may be easier to digest. In particular, Chap. 4, "The Conventional Nomenclatures for Notes and Intervals," is a relatively accessible exercise that may be fruitfully studied before or concurrently with Chap. 3. In general, examples of formal definitions are presented *after* the definitions themselves. Easier access into an abstruse definition may be gained by skipping ahead to an accompanying example.

The reader may feel overwhelmed by the sheer number of definitions and notations introduced. Partial help in this matter is provided by three indices found in the back of the book: a General Index, where formal definitions are easily identified by the corresponding page number's formatting in bold; a List of Definitions; and a List of Notation. Two mathematical appendices provide the basic mathematical background.

The origins of this book go back to my 1986 PhD dissertation, "Diatonicism, Chromaticism, and Enharmonicism: A Study in Cognition and Perception." The book has thus acquired many debts over the years.

Carl Schachter, the dissertation's supervisor, with whom I spent a couple of years as a graduate student at the City University of New York, has had a profound influence on my identity as a music theorist. Schachter's immense knowledge and deep understanding of music and music theory, his astounding eloquence in verbalizing his ideas and insights, his generosity towards students and colleagues alike, and his down-to-earth, unpretentious human warmth have enriched and nourished me for life.

I was very lucky to have had Joel Lester as a reader of my dissertation. Lester showed interest in my work early on and has always been extremely generous in lending support and guidance. Lester provided important feedback on early versions of Chaps. 12 and 13.

John Rink and William Rothstein commented insightfully on an early version of Chap. 15. Section 15.2 in fact developed from a brilliant suggestion of Rothstein's.

A number of individuals provided invaluable help with the mathematical aspects of the book.

I feel very lucky to have two renowned mathematicians in my immediate family: my father, Shmuel Agmon, and my brother, Ehud de-Shalit. Both have been involved in my work since the dissertation. Without their patient guidance over the years, this book could not have come into being.

In 2010−2011 Nori Jacoby and I gave a course at Bar-Ilan University, "Music, Mathematics, and Cognition," based on Part I of the book. Nori contributed numerous improvements to the mathematics, substantive as well as stylistic. Thanks must also go to Thomas Noll, who read Part I and offered valuable insights and suggestions, to Avinoam Braverman for commenting insightfully on Chap. 3, and to Reuven Naveh for commenting on a very early version of Chap. 4.

Although it has become a cliché to thank one's spouse and children, in the present case my wife, Lea, and two wonderful daughters, Einat and Orly, are true partners in the endeavor. My wife, an accomplished musician in her own right, has been part of this project from the very start, lending her ear, heart, and mind with uncompromising patience and devotion at every turn. My daughters have grown accustomed to music-theoretic discussions at family dinners. They have found early on that the best way to get Daddy genuinely upset is to argue with him that there is no difference between G♯ and A♭.

I dedicate this book to Lea, Einat, and Orly, with love.

Reference

Cohen, D. (2002). Notes, scales, and modes in the earlier middle ages. In T. Christensen (Ed.), *The Cambridge history of Western music theory* (pp. 307–363). Cambridge: Cambridge University Press.

Contents

List of Figures

List of Tables

List of Definitions

List of Notation

Chapter 1
Proto-tonal Theory: Tapping into Ninth-Century Insights

Abstract The ninth-century treatise *Scolica enchiriadis* (SE) offers two notions of "interval," namely ratio (proportion) and step distance. The latter notion entails a "generic" distance (cf. "fifth"); however, suggestive diagrams clarify that a "specific" distance is assumed as well (cf. "*perfect* fifth"). SE raises the question, how to pair step distances such as perfect octave (*diapason*), perfect fifth (*diapente*), and perfect fourth (*diatessaron*), with ratios such as 2:1, 3:2, and 4:3, respectively. In answer, SE departs from the Boethian tradition whereby the distinction between say, duple (2:1) and *diapason*, is merely terminological. Moreover, SE points out that multiplication of ratios corresponds to *addition* of step distances, in a manner to which a modern-day mathematician would apply the term *homomorphism*. Even though the "daseian" tone system proposed in SE (and the "sister" treatise *Musica enchiriadis*) was discarded already in the middle ages, the SE insights into "proto-tonal" theory, the background system of tones prior to the selection of a central tone or "final," are still relevant.

Well into the third part of *Scolica enchiriadis*, the second of a well-known pair of Carolingian treatises dated by some scholars as early as 850 CE, the disciple asks the master the following question:

> Although it has been sufficiently shown that the principle of commensurability joins musical pitches (*voces*) to one another, how nevertheless can one know to which proportion any symphony must be assigned? For how is it known that the diapason must be assigned to the duple relationship, the diapente to the sescuple, the diatessaron to the epitritus, the diapente-plus-diapason to the triple, [and] the disdiapason to the quadruple?[1]

This chapter is reprinted by permission from *Music Theory Spectrum 35*(1), pp. 103–110, with minor adaptations.

[1] Erickson (1995), p. 79. All excerpts from *Musica enchiriadis* (ME) and *Scolica enchiriadis* (SE) cited henceforth are in Erickson's translation. Unless otherwise noted, all excerpts from Boethius's *De institutione musica* (IM) are in Bower's translation (Boethius 1989). All excerpts

E. Agmon, *The Languages of Western Tonality*, Computational Music Science, DOI 10.1007/978-3-642-39587-1_1, © Springer-Verlag Berlin Heidelberg 2013

The question, which appears under the title "How it may be known by what proportion any symphony is formed" and to which I shall refer henceforth as Q, follows a detailed exposé (based on Boethius's *De institutione arithmetica*) of the various types of numerical proportions, including the "commensurable" and "connumerable," that is, the multiple proportion (e.g., 2:1, 3:1) and the superparticular (3:2, 4:3). The purpose of this mathematical discussion is to answer a question concerning the "symphonies," that is, the perfect octave, fifth, and fourth (diapason, diapente, and diatessaron), and their compounds, a question posed about halfway through the second part of the treatise (p. 64): "why at some intervals the voices are consonant, whereas in others they are either discordant or not as agreeable?"[2]

It would seem that by rationalizing the commensurable and connumerable proportions the question of consonance has been settled. As the master notes (p. 68), ". . . the symphonies at the diapason and disdiapason are more perfect than those at the diatessaron and diapente, because the former are of multiple inequality, the latter of superparticular inequality. For multiple inequality is more perfect than superparticular inequality." However, as Q makes clear, for the disciple in SE this explanation is at best incomplete. This is because the master has given no reason for *pairing* the symphonies with the privileged proportions, in particular, the perfect octave with 2:1 (duple), the perfect fifth with 3:2 (sescuple or sesquialter), and the perfect fourth with 4:3 (epitritus or sesquitertian). Indeed, in answering the question "what is a symphony" at the beginning of the treatise's second part, "Concerning the Symphonies" (p. 53), *the master makes no mention whatsoever of numerical proportions*, a topic introduced later in the second part, but treated in detail only in the third. Rather, a symphony ("an agreeable combination of certain pitches") is characterized by *the number of steps* it contains: the diapason eight, the diapente five, and the diatessaron four (counting both extremes in each case). As the master explains,

> *diapason* is Greek and in Latin is translated "through all," because the ancient kithara contained only eight strings. . . *diapente* means "through five," because it comprehends five pitches. *Diatessaron* is translated "through four," because it encloses four pitches.

Henceforth in this chapter the terms "type-1 interval" and "type-2 interval" shall be used, respectively, to refer to these two senses of "musical interval" that SE provides, namely, "step distance between two tones" and numerical proportion. The strictly "generic" characterization of type-1 intervals, to borrow Clough and Myerson's (1985) useful term, is misleading. Certain SE diagrams to be discussed shortly (though some appear early on in the treatise) strongly suggest that a type-1 interval is in fact *a pair* of distances, one generic and the other "semitonal" or,

from Ptolemy's *Harmonics* are in Solomon's (2000) translation. Special thanks to Oliver Wiener for granting permission to use his Dasia font.

[2] In the course of the mathematical discussion the author presents a diagram that represents the musically most important proportions in terms of the integers 6, 8, 9, 12, 16, 18, and 24. For an interesting interpretation of this diagram see Carey and Clampitt (1996).