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Modern pedagogical approaches to consonance have three problems in common: they often conflate consonance with subjective cultural factors, they do not account for the most recent psychological research, and they do not adequately explain musical phenomena as they are idiomatically written in musical compositions and how they are perceived by both naive and trained listeners. The approach presented in this thesis balances historical considerations, theoretical speculations, and the most recent research in psychoacoustics to offer a more comprehensive and comprehensible definition of consonance than currently available in pedagogical approaches (such as in undergraduate theory texts). Most importantly, the approach advocates a separation between consonance, defined as an aspect of the sonority itself, and harmonic stability, defined by the musical and cultural context. Given these two ideas, sonorities and passages of music may be described as either stable consonances, unstable consonances, stable dissonances, or unstable dissonances.

The approach presented uses schemata theory, Gestalt psychology, and Fred Lerdahl's theories in *Tonal Pitch Space*. Further research extends the approach using Schenkerian analyses of jazz and suggestions for experiments in cognitive and developmental psychology. The approach itself is a simple pedagogical tool meant to affect the way consonance is taught in undergraduate music theory and aural skills textbooks. A thorough discussion of musical examples and methods of teaching is included.

THE EMANCIPATION OF CONSONANCE: A PEDAGOGICAL APPROACH

TO DISTINGUISHING BETWEEN CONSONANCE

AND HARMONIC STABILITY

by

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Approved by

J. Kent Williams
Committee Chair

Children, obey your parents in the Lord, for this is right. "Honor your father and mother" (this is the first commandment with a promise), "that it may go well with you and that you may live long in the land." - Ephesians 6:1-3 (ESV)

This thesis is dedicated to my mother, without whom it would not have been possible, with whom all things seem possible, and through whom it has gone well with me.

APPROVAL PAGE

This thesis has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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PREFACE

Writing about music is a hazardous enterprise at best.[1]

- William Rothstein

And with that thought, William Rothstein opens his book *Phrase Rhythm in Tonal Music.* I can certainly appreciate his sentiment in the course of writing a thesis about music. There are many times when simply writing about the music is not enough. Words on a page can never touch the beauty captured within sound. Words alone will never engage one in the intrinsically-social and inherently-cognitive act that we call music. Of course, this frustration has never stopped scholars from trying.

In his book, *Musicking*, Christopher Small describes music almost paradoxically.

> Music is not a thing at all but an activity, something that people do. The apparent thing "music" is a figment, an abstraction of the action, whose reality vanishes as soon as we examine it at all closely. This habit of thinking in abstractions, of taking from an action what appears to be its essence and of giving that essence a name, is probably as old as language; it is useful in the conceptualizing of our world but it has its dangers.[2]

I am certain that the irony of writing about music as a thing to be described while proposing that it is not a thing to be described was not lost on Mr. Small. However, although he is correct in calling music an activity, one cannot forget that the brain perceives and acts upon those perceptions almost simultaneously. We create abstractions from actions because this is the manner by which our brains understand those actions. In this light, one could regard the words of Mary Louise Serafine as contradicting those of Christopher Small.

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[1] William Rothstein, *Phrase Rhythm in Tonal Music* (Ann Arbor, MI: Musicalia Press, 2007), 3.

[2] Christopher Small, *Musicking* (Hanover, NH: Wesleyan University Press, 1998), 2.

> I construe music as the activity of *thinking* in or with sound and for this reason I favor the term musical "thought" or "cognition" over "music" alone. Musical thought may be defined as human aural-cognitive activity that results in the posing of artworks embodying finite and organized sets of temporal events described in sound.[3]

This definition of music proposes that it is a cognitive thing—"organized sound," as it were, to quote the oft-repeated Edgard Varèse definition.

Could it be that there is some middle ground between music as an activity and music as cognition? Certainly everything we can understand about the aural art cannot be found in nature alone, but also not solely in human activity. Heinrich Schenker recognized this problem, saying:

> While it is easy to recognize the psychologic relationship between tones and emotions, it is much more difficult to find in them even as much as a trace of an order. And yet this very indefiniteness must be considered as a first groping step toward a real art. It is one of the mystifying features of our art that its truth is not penetrated any more easily for having its roots in Nature![4]

If Schenker's assessment were untrue, there would not be such a wide range of descriptions and definitions of this esoteric thing that we call *music*. Yet we press on, and it is necessary to do so in order to glean from nature what is available. Without words on music, nothing meaningful about the phenomenon might ever be known.

The title of my thesis will no doubt evoke exactly the kinds of response for which I was hoping. In my course of learning about *consonance*—an ever-elusive and multi-faceted musical

[3] Mary Louise Serafine, *Music as Cognition: The Development of Thought in Sound*, New York: Columbia University Press, 1987, 69.

[4] Heinrich Schenker, *Harmony*, ed. Oswald Jonas, trans. Elisabeth Mann Borgese (University of Chicago Press, 1954), 53.

topic—it was to stop thinking about Schoenberg's words about *dissonance*. These in particular kept ringing in my ears:

> The term *emancipation of the dissonance* refers to its comprehensibility, which is considered equivalent to the consonance's comprehensibility. A style based on this premise treats dissonances like consonances and renounces a tonal center.[5]

It was a puzzle to me that I simultaneously agreed with and disagreed with Schoenberg. On the one hand, I can agree that as adult listeners familiar with tonal music we can comprehend both consonance and dissonance equally well. On the other hand, his second statement did not seem to follow from the first. Is it really necessary to renounce a tonal center in order to treat dissonances like consonances?

As one of the basic premises of this thesis, my answer is an emphatic "No." Once one begins to study the concept of consonance and dissonance more closely, I believe it becomes apparent that these terms are quite convoluted, often confused, and generally constrained due to misunderstandings. With my theory I hope to define consonance and dissonance as what they are, apart from artistic endeavor and apart from philosophical extrapolation. And, in so doing, I hope to dissolve any notion that tonality cannot exist when dissonance is treated like consonance.

[5] Arnold Schoenberg, "Composition with Twelve Tones," in *Style and Idea*, ed. Dika Newlin, 102-143 (New York: Philosophical Library, 1950), 105.

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CHAPTER I

INTRODUCTION

Preamble to a Theoretical Concept

The often-touted cliché is that music theorists like to analyze music for the sake of analysis, that they are more often found with a score in their hand than an ear bud in their ear. The attempt to combat this apparent tendency was the subject of two well-known and influential articles, Edward T. Cone's "Beyond Analysis" and Joseph Kerman's "How We Got Into Analysis and How to Get Out."[6] Cone and Kerman's suggestions were attempts to find more practical applications for analysis such as the connection between music and poetry, music and references to nature, and compositional style. Despite Cone and Kerman's arguments, most theorists understand the value of analysis without a definite purpose but also the need to provide applications for their analytical findings after the fact.

In his recent keynote address at the annual meeting of Music Theory Southeast, Robert Hatten presented numerous methods for analytical expansion and application including intertextuality, agency, tropes, and spiritual meanings.[7] And, despite the common misconception of analysts analyzing and creating analyses for the sake of analysis, some of the most fundamental shifts have occurred simply because a scholar heard the music in a different way. Heinrich Schenker recognized the importance of listening above all other musical activities:

[6] Edward T. Cone, "Beyond Analysis," *Perspectives of New Music* 6/1 (Winter, 1967): 33-51 and Joseph Kerman, "How We Got Into Analysis and How to Get Out," *Critical Inquiry 7*, no. 2 (Winter 1980): 311-331.

[7] Robert Hatten, "Beyond 'Beyond Analysis'" (paper presented at the annual meeting of Music Theory Southeast, Atlanta, Georgia, March 10, 2012).

> Is not learning to hear the first task, during which time the student might well dispense with composition? Admittedly, to hear correctly and to compose correctly are equally difficult; but no music school can be released from the obligation of teaching to hear correctly. We cannot indulge the student in his favorite objection that he will never be able to reach such a high goal.[8]

Practical applications of theoretical concepts are the foundation of a great many approaches in the field of music theory. Were it not for Rameau's insistence that "[melody] is merely a part of [harmony] and that a knowledge of harmony is sufficient for a complete understanding of all the properties of music," he may never have extended the theory of chordal inversion so prevalent in modern pedagogy.[9] Without Riemann's contributions to the study of harmony, current ideas of harmonic function and triadic progressions would not be possible.[10] And of course, without Schenker's original assertion that "to the extent that the harmonic concept uses as its interpreter the motif...harmony and content become one," his fully formed theories of the *Ursatz* and *Urlinie* may never have come into being and modern reduction-based analysis might be drastically different.[11]

It is from these predecessors that my own theories find their strength. It is often necessary in the course of teaching to set aside one's preconceptions and consider for a moment the purpose of a pedagogical approach. A solid pedagogical foundation for the teacher is a key component in ensuring the students' understanding of everything from the most basic concepts to the most recent research in music theory. The foundation, upon which most topics in practical

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[8] Schenker, *Free Composition*, trans. and ed. Ernst Oster (New York: Longman, 1979), 9.

[9] Jean-Phillipe Rameau, *Treatise on Harmony,* trans. Philip Gossett (New York: Dover Publications, 1971), 3.

[10] Richard Cohn, "Introduction to Neo-Riemannian Theory: A Survey and a Historical Perspective," in *Journal of Music Theory 42,* no. 2 (Autumn 1998), 169.

[11] Schenker, *Harmony*, 212.

music theory rests, is comprised of a few very pithy and yet highly complex concepts, among them the notions of consonance and dissonance. Consonance is a topic that many musicians take for granted without careful consideration. We are taught that certain intervals are consonant and that certain intervals are dissonant. We are taught that in some cases consonant intervals, such as the perfect fourth, are treated as dissonant intervals. We are taught that consonance is part of the basis for closure in a cadence and that dissonance creates tension that eventually needs to resolve. We are taught many things that seem to follow from one another based on the foundation given: *these* intervals are consonant and *those* intervals are dissonant.

My foundation began to crumble when I was teaching a first-semester freshman theory class on the subject of counterpoint. A student asked me, "Why is the perfect fourth sometimes dissonant and sometimes consonant?" I responded that the perfect fourth is dissonant in a harmonic context, such as with a 4-3 suspension in two-part counterpoint, but consonant in a melodic context if it were to occur within the same voice. Then the student asked, "Then why can we have a harmonic fourth in three-part counterpoint?" This was a trickier question. I thought about answering with a brief discussion of figured bass and how intervals in a chord relate to the bass pitch. However, I did not have a clever way of answering him in a short amount of time, so I made a passing comment to move the class along and put it off until later.

But the question kept on bothering me. The fact is that in a consonant root-position triad the intervals contained within are also consonant. However, once the triad is placed in first inversion, the perfect fourth, once considered dissonant in another context, is now considered consonant. One could easily try to explain this by saying that the fourth is not formed between the bass and an upper voice, and hence it is not represented in the figured bass and considered in an evaluation of the consonance or dissonance of the sonority. This example is illustrated in

Figure 1.1a. This explanation seems fine until the bass note is lowered by an octave and the perfect fourth is more exposed, as in Figure 1.1b. Can we now say that the implied reduction of the tenth and thirteenth to a third and sixth, respectively, are more important than the literal fourth between the upper voices?

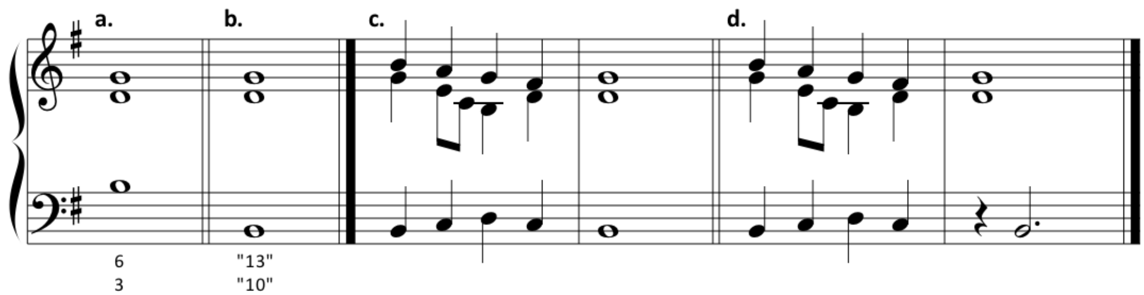

Figure 1.1. A first-inversion tonic triad presented in four contexts within three-part counterpoint.

And what if there were no bass note present? If the chord progression implied that the final chord should be a tonic triad in first inversion (as in Figure 1.1c) and the anticipated bass note were delayed by even a beat (as in Figure 1.1d), are we forced to call the beat with an exposed perfect fourth a dissonant sonority? Of course not. The obvious conclusion is that there is an implied consonance created by the resolution of the third-inversion dominant-seventh chord. We expect there to be a bass note to support the consonant harmonic fourth, and therefore that consonance exists. So we could say that the consonance of the perfect fourth is determined by the expectation created by tonal-harmonic syntax. However, this explanation would also inevitably fall short.

Say that a tonal center of C is established (Figure 1.2a). Then, a G4 is played followed by a C5 (Figure 1.2b). Then the two notes are played simultaneously (Figure 1.2c). Is this final sonority dissonant? I would venture that the majority of readers would say it is not. But why? Is it consonant because it is SOL to DO? What if the note (ostensibly DO) appears as a suspension over an implied dominant triad? Is the sonority dissonant now? This is the problem that continually arose when dealing with the perfect fourth. However, the perfect fourth is just one example of the depth of the problem caused by the terms consonance and dissonance. The two terms cannot be used by themselves to describe how sonorities must resolve and how they are perceived as events of resolution.

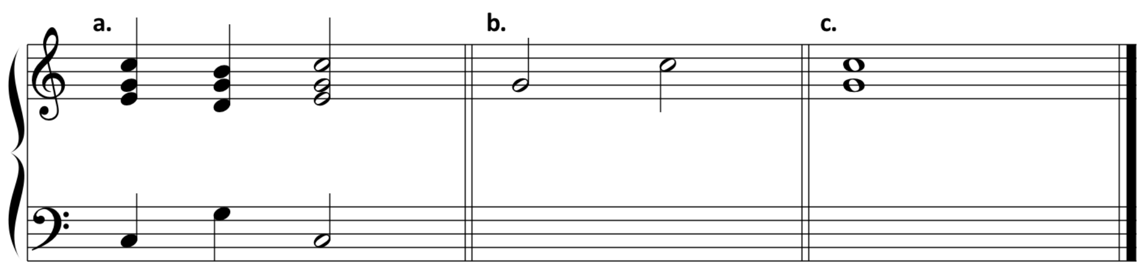

Figure 1.2. Presentation of a perfect fourth in a tonal context.

Incorporating the concept of harmonic stability into the pedagogy of consonance expands the understanding of the subject and its importance in musical passages. Saying that a sonority is, for example, both consonant and stable can more clearly define its place in a musical context. For example, a dominant triad is an unstable consonance because it is a consonant major triad that usually resolves to the tonic. Adding a seventh to the dominant triad makes the sonority an unstable dissonance and further compels its resolution to a tonic triad. However, not all dissonances are unstable, and this is perhaps the most important part of my theory. Dissonant sonorities, to one degree or another, can be used as stable points in a musical passage. The most obvious example of a dissonant stability is an added-sixth chord in jazz or popular music. A tonic seventh chord also has a level of dissonance and is often used as a stable sonority in many jazz pieces.

Separating consonance and harmonic stability and explaining their significance in different styles of music has implications for more than just common-practice tonality and jazz music. The idea that a dissonant sonority could be a point of stability has been introduced before, and the extension of this idea to new analytical methods for post-tonal music is important.[12] If a dissonance can be stable, can it be prolonged in a way that has not to this point been analyzed by theorists? If a consonance can be unstable, what kinds of implications does this have for Schenkerian analysis, which favors consonances as the only foundational sonorities? I propose some extensions here, but much of this work is yet to be completed.

And finally, if consonance and dissonance are attributes of the sonority itself, what psychological basis is there for saying that one can perceive consonance outside of a tonal context? Can a sonority be described as consonant with relative agreement across a group of musical listeners familiar with the same style or idiom? If so, what are the limitations of such intersubjective agreement? Research on consonance in psychoacoustics is relatively new, but there are some promising avenues that may offer insight into how consonance has some similarities between perceptions of listeners of the same background.

Explaining the Distinction Between Consonance and Harmonic Stability

My thesis proposes a pedagogical separation of the concepts of consonance and harmonic stability. Namely, it proposes that consonance is an attribute of the sonority itself (e.g. a consonant triad or a consonant perfect fifth). The tendency for that sonority to resolve is

[12] Daniel Harrison, "Dissonant Tonics and Post-Tonal Tonality" (paper presented at the annual meeting of the Music Theory Society of New York, New York City, April, 2002); James McGowan, "'Consonance' in Tonal Jazz: A Critical Survey of Its Semantic History," *Jazz Perspectives 2,* no. 1 (May 2008): 69-102; Robert P. Morgan, "Dissonant Prolongation: Theoretical and Compositional Precedents," *Journal of Music Theory 20*, no. 1 (Spring, 1976): 49-91.

dependent on context. Sonorities that appear to have less of a need to resolve are said to be more harmonically stable, those having more of a need, unstable. The context for harmonic stability includes not only the immediate musical context of the tonal center, harmonic syntax, and style, but also the cultural context of the listener's background in music and familiarity with the style in question. Furthermore, I propose that two concepts are independent of one another: consonant sonorities may be stable or unstable, and dissonant sonorities may be stable or unstable.

My approach is simple at its core: consonance theory in its current incarnation is broken. The history of approaches to consonance pedagogy has an extensive number of approaches as to the purpose of classifications and often includes arguments for or against the practical use of the phenomenon in music analysis. There has been little common agreement through the ages about what constitutes consonance and what constitutes dissonance and why either of those definitions should be true. Add to the problem psychological research from the late-nineteenth and early-twentieth centuries that attempted to find some kind of scale by which sonorities could be rated more or less consonant and subsequent studies that attempted to prove that these scales were false. Furthermore, attempts by some psychologists and theorists to reject these confused terms on the basis of cross-cultural research are perhaps unnecessary given a broader understanding of consonance.

To fix the problem, it is necessary to separate from the term consonance that which does not belong: harmonic stability. In addition—at perhaps more importantly—it is necessary to separate harmonic instability from dissonance. Harmonic stability is a phrase that most musicians have probably used at some point without realizing it. Often, especially when talking about cadences, listeners will remark about how "restful" or "relaxed" the music has become, for example at the conclusion of a perfect authentic cadence. To a lesser extent, a listener may remark on how a passage of music does not seem to be "going anywhere" or it sounds more "mellow" or perhaps "calm." All of these terms can be used to describe what I would call harmonic stability[13]—the absence of a need for resolution in a passage of music. This passage could be as short as a single sonority or as long as an entire piece.

Psychologically speaking, our brains create patterns of association from continued exposure to stimuli. We create categories for understanding all kinds of information around us. For example, our brains develop a sort of blue print for the basic concept of a chair. We store vague representations of *chair* in this category and can compare perceptual stimuli with this category. The more chairs we see, the more well-defined this category becomes and the easier we will determine that an object is or is not a chair. Our brains do the same thing with musical stimuli. Over time, we encounter the same melodic and harmonic patterns in various tonal contexts. The more contexts in which we encounter these patterns, the more well-defined our ideas of them become. These patterns of association are called *schemata*.

Immanuel Kant was the first to describe the *transcendental schema* as a philosophical concept for storing and recalling information.[14] Later, Frederic C. Bartlett would apply the concept of *schemata* to social psychology and memory.[15] Most recently, Robert Gjerdingen has

[13] Obviously, other aspects of music may be described with these terms as well. However, in a discussion of the tonal background of a piece or section of a piece of music, these terms are often used in descriptions of stability and instability.

[14] Immanuel Kant, *The Critique of Pure Reason,* Great Books of the Western World, ed. Robert Maynard Hutchins (Chicago, IL: Encyclopedia Britannica, 1952), 61.

[15] Frederic C. Bartlett, *Remembering: A Study in Experimental and Social Psychology* (New York: Cambridge University Press, 1967).

used *musical schemata* extensively to analyze the music of the galant style.[16] Schemata are associated with patterns of expectation in music as well. Given the likelihood of one common schema appearing in the temporal span of a musical passage, our brains begin to expect certain outcomes based on the schemata with which we are the most familiar. These patterns of expectation were theorized by Leonard B. Meyer in his book *Emotion and Meaning in Music*.[17] It is these expectations based on musical schemata that are involved in the sensation of harmonic stability.

Modern theoretical textbooks use the terms harmonic stability and instability (often in conjunction with consonance) frequently.[18] More often than not, the definition for consonance is dependent on the sonority being more stable and the definition of dissonance on the sonority being more unstable. While these textbook descriptions sometimes conflate the terms I am proposing as separate, they do illustrate how harmonic stability (or at the very least musical stability) is understood intuitively.

Fred Lerdahl's theories from *Tonal Pitch Space* offer the possibility of quantifying the level of instability in a passage of music. Using Lerdahl's "chord-distance rule" and his ideas about "harmonic tension," relative levels of stability within a tonal context can be shown using

[16] Robert O. Gjerdingen, *Music in the Galant Style: Being an Essay on Various Schemata Characteristic of Eighteenth-Century Music for Courtly Chambers, Chapels, and Theaters, Including Tasteful Passages of Music Drawn from Most Excellent Chapel Masters in the Employ of Noble and Noteworthy Personages, Said Music Collected for the Reader's Delectation on the World Wide Web* (New York: Oxford University Press, 2007).

[17] Leonard B. Meyer, *Emotion and Meaning in Music* (University of Chicago Press, 1956).

[18] Edward Aldwell and Carl Schachter, *Harmony & Voice Leading*, 4th ed. (Boston: Schirmer, 2011) 26; Steven G. Laitz, *The Complete Musician: An Integrated Approach to Tonal Theory, Analysis, and Listening*, 3rd ed. (New York: Oxford University Press, 2012), 16; Miguel A. Roig-Francolí, *Harmony in Context,* 2nd ed. (Boston: McGraw-Hill, 2011), 14.

mathematical variables.[19] Lerdahl's theories are especially useful when discussing the distance of a chord from the tonic triad and thereby how many steps it would take to resolve the chord. Taken together with the concepts of schemata and expectation, harmonic tension and chord-distance offer clear variables for determining the level of relative instability within a passage of music.

In the textbooks referenced above, music theorists have come to use the term consonance to describe a primarily cultural phenomenon. In contrast, the psychological community has been using the terms *sensory consonance* and *musical consonance* to refer to what they view as two very different ideas. On the one hand, *sensory consonance* involves the interaction of two tones along the basilar membrane and whether or not those two tones lie within the critical bandwidth of an auditory filter (more on this concept later).[20] With regard to complex tones, peaks of sensory consonance occur when the fundamental frequencies of two tones possess simple-integer ratios of relatively small numbers. Dissonances involve the interaction of the partials of different tones within the auditory filter regardless of their proximity to the fundamental frequency.[21] The mostly learned response to tension and relaxation schemata in music is referred to as *musical consonance*.[22] Even naive listeners have a certain amount of enculturated bias toward some intervals being more musically consonant and

[19] Fred Lerdahl, *Tonal Pitch Space* (New York: Oxford University Press, 2001), 55 and 142.

[20] Thomas Stainsby and Ian Cross, "The perception of pitch," in *The Oxford Handbook of Music Psychology*, ed. Ian Cross, Susan Hallam, and Michael Thaut (New York: Oxford University Press, 2009), 52-53.

[21] Ibid., 53.

[22] E. Glenn Schellenberg and Laurel J. Trainor, "Sensory consonance and the perceptual similarity of complex-tone harmonic intervals: Tests of adult and infant listeners," in *Journal of the Acoustical Society of America* 100, no. 5 (November 1996): 3321.

others being more musically dissonant. This response varies depending on the musical culture being described.

What is not clear about this definition of musical consonance is the degree to which enculturation changes consonance valuations when comparing different cultures. Also, sufficient research does not exist to support the idea that both of these concepts depend upon the sonority itself and not upon the musical context surrounding it. Namely, the definition provided for musical consonance by music theory textbooks could surely be a culturally-driven response to tension-relaxation schemata within a musical idiom. This understanding of the psychological definition for musical consonance is in agreement with my notion of harmonic stability, at least in the context of Western music.

Setting aside the need for further study of how musical context affects consonance as defined above, my theory essentially takes the psychological concept of sensory consonance as **consonance**. In this way, the confusion between two definitions of consonance is removed and the phenomenon is taken to be a description of the sonority itself and not of the context surrounding it. Musical consonance is then slightly modified and applied to Western music more specifically as **harmonic stability**. Western music for at least several centuries has been firmly grounded in the connection between harmonic and melodic motion, and the theoretical basis for harmony has been firmly established within our cultural tradition. It is not a stretch then to consider the primary enculturation of Western music to be the concept of harmony. Hence, harmonic stability in Western music deals with a sonority's location within a tonal pitch space, whether immediately or indirectly (such as the difference between a local tonicization and a global key area).

Separating consonance and harmonic stability is a necessary step in explaining the musical importance of consonance and dissonance. This need is especially apparent when considering the current definitions given for consonance by the most prominent music theory textbooks. Many texts say outright that consonance produces stability and that dissonance requires resolution.[23] Some texts go so far as to say that intervallic consonance in music developed *primarily* from cultural and historical contexts when current psychological research proves otherwise.[24] I will present a comprehensive look at the definitions for consonance given by the most popular textbooks today at the end of chapter two and correct some of the misconceptions with a discussion of current trends in psychoacoustics research.

Left without the idea of stability, consonance is described as the absence of roughness along the basilar membrane. In this way, the definition for consonance is merely a privation of dissonance. Dissonance is then described as the presence of a greater amount of roughness along the basilar membrane and the presence of harsh beats between the partials of multiple complex tones.[25] Consonance and dissonance can also be mapped onto a continuum like stability and instability, and it is often difficult to determine how two closely-related sonorities are evaluated along this continuum. What is clearer is that harmonic dyads that occur outside of the critical bandwidth are considered consonant and those that occur inside the critical bandwidth are considered more dissonant. When dealing with complex tones, however, when

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[23] Laitz, *The Complete Musician*, 15; Roig-Francolí, *Harmony in Context*, 16; Robert Gauldin, *Harmonic Practice in Tonal Music*, 2nd ed. (New York: W. W. Norton & Company, 2004), 17.

[24] Roig-Francolí, *Harmony in Context,* 15.

[25] It is not possible to go into great detail about the psychological research concerning the basilar membrane, place theory, the critical bandwidth, and the connection to sensory dissonance. For more information see Reiner Plomp and W. J. M. Levelt, "Tonal Consonance and Critical Bandwidth," in *Journal of the Acoustical Society of America* 38 (1965): 548-560.

the ratio between the two fundamental frequencies is close to a simple-integer ratio, peaks of consonance occur where they would not occur between two pure tones.[26]

Now the proposed theory has two continuums—consonance to dissonance, and harmonic stability to instability—that interact to create perceived points of tension and resolution in music. Sonorities may now be described as either stable consonances, unstable consonances, stable dissonances, or unstable dissonances. Examples of each of these combinations will be described in Chapter 3. In this way, the root-position tonic triad in Figure 1.3a can be described as a stable consonance. In contrast, the second-inversion triad in Figure 1.3b can be described as an unstable consonance. In fact, I will show how some pieces are comprised primarily of unstable consonances. It is possible to write an entire piece of music without once using a harmonic dissonance.

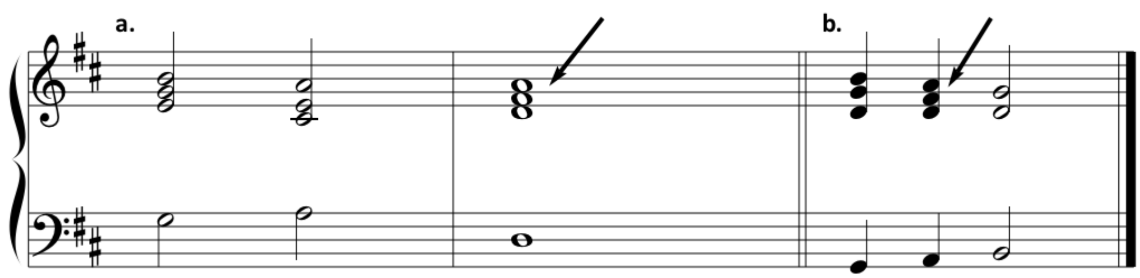

Figure 1.3. Two tonal contexts for a consonant sonority in D major.

After explaining my theory in depth and providing examples of how each description can be taught, I will provide some ideas for extensions of this theory. Extending Daniel Harrison's and Steve Larson's work on dissonant prolongation, my theory can be used to show the prolonged stability of a dissonant sonority. These analytical considerations can also be helpful in

[26] Stainsby and Cross, "The perception of pitch," 53.

extending Schenkerian analysis into jazz and post-tonal music by defining new characteristics for tonics and other preferred foundational harmonies. Finally, psychoacoustics provides some promising directions for testing the perception of these theoretical concepts both among listeners of the same musical background and of differing backgrounds. It would be extremely beneficial to the psychological and music-theoretical communities to study how the perceptions of harmonic stability and consonance differ and how they are similar.

Before explaining my theory however, it is first necessary to take a brief excursion into the history of consonance theory beginning with Pythagoras and ending with a comparison of modern pedagogical approaches in several of the currently available textbooks.

CHAPTER II

A BRIEF HISTORY OF CONSONANCE

The history of theoretical concepts dealing with consonance is almost as old as the history of music theory itself. Most major changes in music theory throughout the ages also had developments in consonance theory dating all the way back to Pythagoras in the sixth-century BCE. However, despite its longevity, there is probably a greater amount of variety in ideas about consonance than exists for any other musical concept. Ancient Greek theorists, Medieval theorists, Renaissance theorists, Romantic theorists, and contemporary theorists all had different things to say about consonance and its place in Western music theory. It is necessary to understand the impetus behind each of these differing concepts and to view them in light of the context in which they are presented. It is often too possible to look back on history and implant our own biases and extract the information we see as most beneficial to our own ideas.

In this brief look at the history of consonance theory, I will examine curiously the most important ideas starting from the ancient Greeks and touching on Medieval, Renaissance, Baroque, Classical, Romantic, and twentieth-century theories. Theories from music theorists, philosophers, psychologists, composers, and researchers in various fields will be discussed. I also consider the context in which they were presented and illuminate their meanings to a contemporary theory of consonance pedagogy. After these theories, I provide an overview of current trends in psychoacoustics research on consonance followed by a discussion of how consonance is taught in leading tonal harmony textbooks.

<u>Early Greek Writings to the Middle Ages: Pythagoras to Zarlino[27]</u>

Greek writings on music beginning in the sixth-century BCE roughly fall into three categories, two of which still have echoes in modern theory. The Pythagorean tradition was concerned with number theory, the relationship between music and the cosmos, and the influence of music on behavior, as held by Plato and other philosophers of the time.[28] The Harmonicist tradition attempted to marry the Pythagorean's mathematical principles with actual musical practice. And finally, the Aristoxenian tradition based its theories on Aristotle's writings on music and "was concerned with the philosophical definitions and categories necessary to establish a complete and correct view of the musical reality of scales and tonoi."[29]

Probably the earliest systematic theory of consonance was developed by Pythagoras (c. 570 - c. 490 BCE) and his followers. The Pythagoreans claimed that consonances were determined mathematically by ratios of small integer values (from one to four). These included only the perfect consonances and their octave additions. Far from being concerned with actual musical practice, Pythagoreans wanted to show how music mirrored nature.

> The important truths about music were to be found instead in its harmonious reflection of number, which was ultimate reality… The employment of this harmonious structure in actual pieces of music was of decidedly secondary interest.[30]

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[27] A more comprehensive history of consonance theories from Pythagoras through Zarlino can be found in Claude V. Palisca, "Grove Music Online: Consonance; 1. History," In *Oxford Music Online, Grove Music Online* (accessed October 16, 2012).

[28] Thomas J. Mathiesen, "Greek music theory," in *The Cambridge History of Western Music Theory*, ed. Thomas Christensen, 109-135 (New York: Cambridge University Press, 2007), 127.

[29] Ibid., 120.

[30] Ibid., 114.

Despite the Pythagoreans' abstract ideas about musical elements, their theories have been passed down through the ages into several other works (as will become clear in this brief history). The basics of number theory and the consonance of simple integer ratios, while not accepted solely on the grounds of mathematical simplicity, would certainly ring true for other reasons even several millennia later.

The Harmonicist tradition can be traced throughout several treatises overlapping with ideas of both the Pythagoreans and the Aristoxenians. These treatises include the *Division of the Canon*, Aristoxenus' own writings (or rather his negative assessment of the Harmonicist viewpoint), and the writings of Aristides Quintilianus.[31] The Aristoxenian tradition is most clearly understood through the writings of Aristoxenus and Ptolemy. Aristoxenus (fourth-century BCE) practically held to the same consonant intervals as Pythagoras but on the grounds of sensory phenomena and their use in musical practice rather than their numerical ratios. Furthermore, the more important intervals for Aristoxenians were the fourth and the fifth given their importance in the creation of scalar structures.[32]

Although not heavily cited, Ptolemy (fl. 127-48 CE) clearly considered intervals smaller than the fourth (*emmelic* intervals) consonant when used melodically.[33] This is an important distinction when dealing with consonance in music from ancient Greece through the Middle

[31] Mathiesen, "Greek music theory," 117.

[32] Ibid., 121.

[33] Ptolemy, *Harmonics,* trans. Jon Solomon (Boston: Koninklijke Brill NV, 2000), 16.

Ages, which until the thirteenth century was primarily monophonic.[34] It is also important to note the separation between melodic and harmonic intervals. The Greek musical system was either primarily monophonic with instrumental doubling or semi-accompanimental with a single melodic line and either a heterophonic instrumental accompaniment or a basic dyadic or single line accompaniment.[35] Given this definition of consonant emmelic intervals in a melody, there would most likely have been opinions about harmonic intervals as well. Furthermore, since Ptolemy's comment is in response to other dissensions, it is clear that several views existed on the nature of consonance both melodically and harmonically.[36]

Boethius (c. 480 - c. 526), a highly influential medieval music theorist, followed the Pythagoreans and was pivotal in transmitting ancient Greek theory into the Middle Ages. Boethius used examples from chant to exemplify Pythagoras' simple integer ratios, thus connecting the once lofty theories to actual musical practice. Consonance theory, dominated by mathematical theories at this point, remained essentially unchanged until the thirteenth century. Johannes de Garlandia (fl. c. 1270-1320) was the first to propose a threefold distinction of consonances based on their use in actual compositions: perfect, intermediate, and

[34] Of course, *primarily* monophonic is a bit misleading. Medieval church music is often thought to be monophonic due to the relative lack of theories and literate music supporting a polyphonic practice. However, Richard Taruskin has noted that while written music may have been monophonic, polyphony almost certainly existed in many forms for a long time before and during the Middle Ages. Richard Taruskin, *Music from the Earliest Notations to the Sixteenth Century,* vol. 1 of *The Oxford History of Western Music* (New York: Oxford University Press, 2010), 147.

[35] J. Peter Burkholder, Donald J. Grout, and Claude V. Palisca, *A History of Western Music*, 7th ed. (New York: W. W. Norton & Company, 2006), 14.

[36] Ptolemy, *Harmonics,* 17.

imperfect.[37] The treatise *Anonymous IV* notes that, in parts of England, thirds were considered consonant.[38]

Until this point, "consonance" referred primarily to tuning methods rather than compositional techniques. Theorists beginning with Boethius and Garlandia developed consonance theories based on musical practice and sensory perception. Beginning in the thirteenth century, polyphonic music became more common—at least in written records—and thirds and sixths were more "pleasing" harmonic intervals than fifths and octaves because of the latter's tendency to create fusion between voices (more on this below).

Concerning the perfect fourth's status as a "dissonance" during this time and afterwards, it is plausible that because of the growing frequency of thirds in musical practice, the perfect fourth began to require *harmonic* resolution in the ears of thirteenth- and fourteenth-century musicians.[39] Far from being an "unpleasant" interval in terms of sensory perception, the perfect fourth was more common as part of a passing tone or suspension figure leading to a third or sixth. Regarding the changing definitions of consonance, Serge Gut noted that "the use of faux-bourdon based strictly on parallel fourths in two upper voices was not simply reminisced as

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[37] Perfect consonances were the octave and unison, intermediate consonances were the fifth and fourth, and imperfect consonances were thirds. Taruskin, *Music from the Earliest Notations to the Sixteenth Century*, 196.

[38] It is important to point out that this treatise was written by an anonymous Englishman from lecture notes later compiled by a French bibliographer. For more information, see Taruskin, *Music from the Earliest Notations to the Sixteenth Century*, 173.

[39] Aldwell and Schachter surmise as much in their explanation of the use of the perfect fourth as a dissonance in common-practice tonality. This topic is discussed later on in this chapter.

primitive organum but was adapted to the 'tastes of the day.'"[40] These changing tastes began to use full chords in parallel motion, incorporating the fourth inside of a full first-inversion triad, rather than pure parallel perfect fourths.

Walter of Odington (fl. 1290-1316) was the first to associate small integer ratios for imperfect consonances (5:4 and 6:5 for major and minor thirds respectively, compared to the Pythagorean tuning of 81:64 and 32:27). Gioseffo Zarlino (1517-90) continued this idea by extending all mathematical ratios to include 5 and 6, in essence allowing natural ratios (based on the harmonic series) for major and minor thirds and sixths in tuning systems. This change might seem small on the surface, but it meant that theorists were starting to view imperfect consonances as simple integer ratios. It would seem that they were trying to reconcile the use of imperfect consonances in musical practice and their harmonic pleasantness to their mathematical tuning system. Although the "music of the cosmos" concept had long since gone out of style, the mathematical basis for consonance and harmonic intervals was widely accepted throughout the Renaissance and into the Baroque period.

Frequency Ratios and the Harmonic Series: Galileo to Stumpf

Galileo Galilei (1565-1642) was the first to discover the relationship between string length and vibration frequency. In doing so, he discovered that interval ratios could be expressed as frequency ratios.[41] Intrigued by the harmonic series and frequency ratios, Marin Mersenne

[40] Serge Gut, "La notion de consonance chez des théoreticiens du Moyen Age," *Acta Musicologica 48*, no. 1 (Spring 1976): 28. "En effet, l'emploi du faux-bourdon basé sur un strict parallélisme à la quarte des deux voix supérieures n'est pas sans faire penser à l'organum primitif, adapté aux 'goûts du jour'." The above is my translation of this passage.

[41] Isaac Beeckman developed many of the same ideas on his own at approximately the same time. For more information, see Burdette Green and David Butler, "From acoustics to *Tonpsychologie*," in *The Cambridge History of Western Music Theory*, ed. Thomas Christensen, 246-271 (New York: Cambridge University Press; 2002), 248.

(1588-1648) was the first to develop a coincidence theory of consonance, whereby the relative vibration frequencies of strings is said to produce their pleasantness.[42] He was also the first to study the nature of the harmonic series in depth. It was Francis Roberts (c. 1650-1718), however, who first correctly identified the partials of the harmonic series using the trumpet and the trumpet marine (other theorists had tried but were not entirely successful).[43]

These early experiments with frequency ratios and the harmonic series were proof of a new approach to consonance theory. Theorists of the time interested in natural resonance frequencies and the interaction of harmonic intervals with the harmonic series as well as with simple integer ratios. These experiments took the mathematical tuning systems of Pythagoras and other Greek theorists and attempted to test them against actual musical practice. There were good and bad outcomes from these experiments, but collectively they served as a pivotal step in establishing consonance as a sensory phenomenon and not just as an abstract mathematical concept.

Following the extension of the Pythagorean ratios as outlined by Zarlino, Jean-Philippe Rameau (1683-1764) based his classification of consonant intervals on the first six partials of the harmonic series, incorrectly thinking that the human ear could only distinguish up to the sixth partial.[44] Although Rameau's writings on consonance lack depth and are primarily an argument

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[42] Penelope Gouk, "The role of harmonics in the scientific revolution," in *The Cambridge History of Western Music Theory,* ed. Thomas Chrsitensen, 223-245 (New York: Cambridge University Press, 2002), 236.

[43] Green and Butler, "From acoustics to *Tonpsychologie*," 250 and 252.

[44] Rameau, *Treatise on Harmony*, 5-7; Reiner Plomp discovered that most listeners could hear out up to at least the 7th or 8th partial. For more on the audibility of upper partials of a complex tone, see Reiner Plomp, "The Ear as Frequency Analyzer," in *Journal of the Acoustical Society of America 36*, no. 9 (September 1964): 1628-36.

for his compositional techniques, his acceptance of simple integer ratios using up to six partials exposes the influence of Greek music theory.

Beginning in the early nineteenth century, psychologists and various types of scientists became interested in consonance. The most intriguing part of the phenomenon for them was the notion of a physiological response to musical stimuli and of the psychological basis for a definition of consonance. Advances in the understanding of human physiology and the way the ear processed sound allowed scientists to theorize about consonance in new ways. Some of the most important of these new methods dealt with beating along the basilar membrane and the fusion of two closely-related complex tones.

Hermann von Helmholtz (1821-94), with his seminal text *Die Lehre von den Tonempfindungen* ("On the Sensations of Tone", 1863), brought the theory of musical consonance into the realm of physiological acoustics. Helmholtz theorized that, physiologically, dissonance occurred when "beats" (slight differences in frequency) were present between upper partials of two complex tones.[45] Furthermore, any two complex tones that had coincidental partials were found to be consonant.[46] His ideas have been expanded and tested by numerous music theorists and experimental psychologists in an attempt to better define the nature of consonance and dissonance. Modern consonance experiments in psychoacoustics have taken Helmholtz's ideas as a starting point and tested the physiological effects of beating. The current definitions of consonance accepted by the psychological community are due in large part to Helmholtz's theories.

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[45] Hermann von Helmholtz, *On the Sensations of Tone*, trans. Alexander J. Elllis (New York: Cosimo, 2007), 194.

[46] Ibid., 188-89.

In the same way Helmholtz did for acoustics, Carl Stumpf (1848-1936) moved consonance theory into observational psychology. In an attempt to understand how the brain processes sound, Stumpf developed a theory of tonal fusion that classified consonant intervals as having more of a tendency to be sensed as a single unit or be "fused".[47] He noted that the octave and fifth have the greatest amount of fusion due to their low placement in the harmonic series.[48] Modern psychoacoustics has developed primarily from an attempt to test and expand the theories of Helmholtz and Stumpf. Stumpf's theories of fusion have more or less been trumped by psychoacoustic evaluations of interactivity along the basilar membrane. The idea of tonal fusion for fifths and octaves still exists, but it has little to do with the definition of musical consonance.

Psychological and Cultural Theories in the 20th Century: Plomp to Parncutt

A slew of psychologists beginning in the mid-twentieth century attempted to show experimentally the physiological nature of consonance. Helmholtz's and Stumpf's theories had been widely disseminated by this time and the concepts of beating between harmonic partials and tonal fusion were well-regarded in the psychological community. The first major effort to refine the explanation given by Helmholtz was in 1965 by Reiner Plomp and Willem J. M. Levelt. Plomp and Levelt found that Helmholtz's theories were generally correct. Complex-tone pairs with interfering harmonic partials were generally considered dissonant and this interference was

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[47] Carl Stumpf, *Tonpsychologie*, vol. II (Leipzig: S. Hirzel, 1890), reprint (Hilversum, F. Knuf, 1965), 127-219. For more information on Helmholtz and Stumpf, see Green and Butler, "From acoustics to *Tonpsychologie*."

[48] Alf Gabrielsson, "Grove Music Online: Psychology of music; §I: History; 2. 1860-1960," in *Oxford Music Online, Grove Music Online* (accessed October 16, 2012).

due to the critical bandwidth of the basilar membrane.[49] The exact size of the critical bandwidth was not known at this time. What was clear was that pure-tone pairs exhibited a maximum level of dissonance somewhere around twenty-five percent of the critical bandwidth and increased in consonance until one-hundred percent of the critical bandwidth was reached where a maximum level of consonance was maintained. Rudolf Rasch and Reiner Plomp more precisely defined the size of the critical bandwidth in 1982.[50]

In 1969, Akio Kameoka and Mamoru Kuriyagawa did extensive testing on the subjective responses of consonance and dissonance relating to harmonic partials and the critical bandwidth. They developed detailed formulae for determining the subjective level of consonance exhibited by complex-tone dyads.[51] Their research further supported Helmholtz's theories about consonance and beating of harmonic partials. A number of psychologists and researchers in the 1970s and 1980s took the work of Helmholtz, Stumpf, Plomp and Levelt, and Kameoka and Kuriyagawa as a starting point and either corroborated or extended their findings. These works include Terhardt (1974a, 1975, 1976, 1977), Krumhansl (1983), Roberts and Shaw (1984), Roberts (1986), DeWitt and Crowder (1987), Thomson and Parncutt (1988), and Parncutt (1989).

During this same period of psychological interest in consonance theory, many cultural theories about consonance perception were published. Eugene Bugg (1933, 1939) was one of

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[49] Plomp and Levelt, "Tonal Consonance and the Critical Bandwidth."

[50] Rudolf Rasch and Reiner Plomp, "The Perception of Musical Tones," in *The Psychology of Music*, ed. Diana Deustch, 1st ed., 89-112 (San Diego, CA: Academic Press, 1982).

[51] Akio Kameoka and Mamuro Kuriyagawa, "Consonance Theory Part I: Consonance of Dyads," in *Journal of the Acoustical Society of America 45*, no. 6 (February 1969): 1451-1459; Kameoka and Kuriyagawa, "Consonance Theory Part II: Consonance of Complex Tones and Its Calculation Method," in *Journal of the Acoustical Society of America 45*, no. 6 (February 1969): 1460-1469.

the first to propose that consonance was too complex to be considered solely a physiological response:

> [C]omparative judgments of consonance are complexly conditioned phenomena—too complexly conditioned to be accounted for by any theory which regards “consonance” as a simple, all-or-none sensory process.[52]

Two researchers were most vocal in taking up Bugg’s torch. The composer Norman Cazden (1945, 1959, 1962, 1972, 1980) wrote several papers on the topic of a cultural theory explaining consonance. In Cazden’s view, there was no such thing as consonance or dissonance, only subjective evaluations determined by enculturation and experience.

> If consonance and dissonance proper are understood thus to refer to the dynamics of musical function, rather than to the static psychoacoustic qualities that may inhere in sonorities isolated from musical contexts, it follows that those terms do not describe or apply usefully to the sonorous constitution of tones or of tone aggregates, but rather to the action that occurs during progressions from one harmonic moment to another. In brief, by this criterion, there is no such thing as a consonant interval or chord, or a dissonant interval or chord… [I]n theory, any sonority whatever may serve in traditional harmony to fulfill either a consonant or a dissonant function.[53]

The psychologist Robert Lundin (1947, 1953) echoed Cazden’s views and went on to cite several psychological studies that showed no consistent spectrum of consonance and dissonance valuations. Butler and Datson (1968) showed further experiments of this kind.

Despite these cultural theories of consonance, psychoacoustic studies were relatively undeterred into the 1990s. The most important psychologist of this time was Richard Parncutt (1996 [with Bigand and Lerdahl], 1997 [with Thomson], 1999 [with Bigand]), who was committed

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[52] Eugene G. Bugg, “An Experimental Study of Factors Influencing Consonance Judgments,” in *Psychological Monographs 45*, no. 2 (1933).

[53] Norman Cazden, “The Definition of Consonance and Dissonance,” in *International Review of Aesthetics and Sociology of Music 11*, no. 2 (December 1980), 156.

to explaining all kinds of musical phenomena using psychoacoustic approaches and experiments. His work extended to the study and testing of pure-tone dyads, complex-tone dyads, triads, and musical chord sequences. Carol Krumhansl (1990, 1996) was also quite active in finding psychoacoustic grounds for tonal hierarchy and pitch recognition as well as the consonance of complex-tone dyads.

A New Field of Study is Born: Developmental Psychology and Consonance

Beginning in the late 1980s and taking shape in the late 1990s to early 2000s, developmental psychologists began to experiment with infants' perception of various musical phenomena. Among these was the perception of consonance. Laurel Trainor and Sandra Trehub began researching infants' perceptions of musical phenomena in the early 1990s, testing their sensitivity to musical structure (1992), key distance (1993), processing of the major and augmented triads (1993), and implied harmony (1994). Trainor studied the effect of frequency ratio on infants' discrimination of simultaneous intervals (1997) and was involved in a number of other studies comparing infants and adult listeners.

Trainor, in conjunction with several other researchers, found that infants as young as two months old showed a preference for consonance over dissonance.[54] This preference could not have been as a result of learned patterns in tonal harmony since infants had no understanding of Western tonal hierarchy.[55] While infants preferred consonance, they were able to distinguish

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[54] Laurel J. Trainor, Christine D. Tsang, and Vivian H. Cheung, "Preference for sensory consonance in 2- and 4-month-old infants," in *Music Perception 20*, no. 2 (Winter 2002): 187-194.

[55] Laurel J. Trainor and Sandra E. Trehub, "A Comparison of Infants' and Adults' Sensitivity to Western Musical Structure," in *Journal of Experimental Psychology: Human Perception and Performance 18,* no. 2 (1992): 394-402.

between consonant and dissonant intervals despite considerations of interval width.[56] Other studies corroborated these findings, including Zetner and Kagan (1998) and Masataka (2006). While these experiments in developmental psychology are still relatively new, the field continues to grow and new researchers are adding to the knowledge base every year. In addition to studying new directions in infant perception of musical structures, researchers also continue to corroborate the findings of Trainor et al.

What Do the Textbooks Say?

Despite this promising research in developmental psychology and the continued efforts of psychologists in the field of psychoacoustics, the majority of current tonal harmony textbooks still describe a cultural theory of musical consonance. It seems plausible that there are two primary reasons for this acceptance. Either theory-textbook authors do not wish to provide detailed explanations of psychoacoustical research and cognitive psychological evidence, or they are simply unaware that such research exists.

As a preface to the following discussion, I must admit that I cannot fault these textbook authors too greatly. Admittedly, the considerations for writing a textbook are far different from those of writing a journal article, book, or other less pedagogical publication. It cannot be overstated that the explanations of consonance given in these textbooks are most likely shortened for space constraints and simplified for the understanding of the target audience. I would venture a guess that most college freshmen do not want to read long explanations about psychoacoustic properties of sensory consonance or the enculturating affects of social schemata. By the same token, what I propose would be a relatively simple emendation to current textbook

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[56] Schellenberg and Trainor, "Sensory consonance and the perceptual similarity of complex-tone harmonic intervals."

definitions. Some information on psychoacoustic phenomena would be included but nothing so technical as to alienate a young reader.

Steven G. Laitz, *The Complete Musician,* Third Edition, 2012

Laitz's textbook is a typical example of the approach taken toward consonance and dissonance in tonal-harmony textbooks. In general, consonance and dissonance are explained as types of intervals and are classified as diametrical opposites. A typical account of this classification appears in Laitz's first chapter "Musical Space and Time" under the heading *Consonant and Dissonant Intervals*:

> The stable intervals—including the diatonic forms of the unison, the third, the fifth (perfect only), the sixth, and the octave—are called consonant intervals; unstable intervals are called dissonant intervals. Dissonant intervals include the second, the seventh, and all diminished and augmented intervals. The perfect fourth is usually viewed as a dissonant interval.[57]

The idea of stability is thus immediately associated with consonance. This points to a tacet acceptance of Cazden's theories about consonance and dissonance being essentially synonymous with resolution and tension respectively. Cazden was one of the first to propose this theory:

> Musical consonance and dissonance are thus functions and not properties of things. As functions, they exhibit a polar opposition. Consonance refers to the stable moment following upon the resolution of dissonance, while dissonance means the unstable moment calling for resolution to consonance.[58]

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[57] Laitz, *The Complete Musician,* 16. To Laitz's credit, the 3rd edition of this text shows a greater awareness than in previous editions of the relative stability of the perfect fourth in varying contexts rather than treating it almost exclusively as a dissonance.

[58] Cazden, "The Definition of Consonance and Dissonance," 166.

Laitz's statement that "stable intervals...are called consonant" echoes Cazden's.

However, if one looks only a few paragraphs back in the text, Laitz contradicts himself, saying that "[Western] musicians also discovered that the same interval in two different musical contexts could be perceived as either stable or unstable."[59] If the "consonant" intervals presented as stable could be considered unstable in another context, why present the idea of consonance and dissonance at all? Of what value is this concept without an ability to illuminate compositional technique or perceptual understanding? Furthermore, even though Laitz claims that "we usually consider intervallic stability and instability to be on a continuum," he still goes on to provide binary distinctions between two categories of musical intervals.[60] The primary function of these distinctions holds for a discussion of first species counterpoint, but other texts purport that the definitions of consonance and dissonance are fundamental to all aspects of music theory.

Robert Gauldin, *Harmonic Practice in Tonal Music*, Second Edition, 2004

A curious feature of Gauldin's explanation of consonance and dissonance is his acceptance of "distinctive sonic quality" among intervals and yet his insistence that this understanding is culturally conditioned. Gauldin admits that intervals have qualities independent of tonal context:

> When we hear a succession of harmonic intervals, we sense that each has its own distinctive sonic quality. It is difficult to put these unique characteristics into words, but the differences are unmistakeable.[61]

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[59] Laitz, *The Complete Musician,* 16.

[60] Ibid., 15.

[61] Gauldin, *Harmonic Practice in Tonal Music,* 16.

One of the reasons Gauldin gives for this "unmistakeable" difference is the mathematical simplicity of consonant intervals. Pythagoras' influence is seen once again when Gauldin proclaims that "the intervals we regard as consonant are at the lower end of the harmonic series, and the mathematical ratios between their frequencies are simpler than those of dissonant intervals."[62]

Gauldin quickly sidesteps any assumption of universalism by accepting a cultural theory of consonance.

> Clearly, the concept of consonance and dissonance is conditioned by the music we are used to and varies from culture to culture and period to period. Our sense of consonance and dissonance is also influenced strongly by musical context.[63]

Evolutionary theories of inherited judgments of consonance aside, the research in developmental psychology showing an innate sense of consonance and dissonance seems to contradict Gauldin's statement directly. Of course, this statement is not Gauldin's own but rather an echo of Lundin's theories on consonance and dissonance:

> In considering a theory of consonance we must realize that a human organism throughout his life builds up behavior equipment the greater part of which is going to be culturally determined. Our discriminative reactions to music will constitute some part of this equipment. The nature of one's consonant reactions—that is, what clangs are called consonant or dissonant, will depend on the conditions under which he has built up his musical behavior equipment.[64]

Unless six months is enough time to build up a sufficient amount of "musical behavior equipment," these explanations of consonance fall short of the truth.

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[62] Gauldin, *Harmonic Practice in Tonal Music,* 17.

[63] Ibid.

[64] Robert W. Lundin, "Toward a Cultural Theory of Consonance," in *Journal of Psychology 23 (*1947), 47.

Miguel A. Roig-Francolí, *Harmony in Context,* Second Edition, 2011

Roig-Francolí unequivocally supports a cultural theory of consonance in his discussion of consonance and dissonance. Not only does Roig-Francolí assume cross-cultural differences but inter-cultural differences as well.

> The concepts of intervallic consonance and dissonance are largely determined by cultural and historical contexts and will vary depending not only on the world culture under consideration, but also within Western music on such factors as geographic location or historical period.[65]

Roig-Francolí goes on to equate consonance with stability and dissonance with instability, just as Cazden did in his theories. Roig-Francolí's statement sounds as though it could have been taken directly from Cazden's own writing.

> Intervals are consonant if they produce a sense of stability. Dissonant intervals, on the other hand, create a sense of tension or instability, which we normally perceive as a clash that requires resolution to a consonance.[66]

Despite this unwavering conviction that consonance and dissonance are culturally determined, Roig-Francolí still insists on providing the typical classification of consonant and dissonant intervals as Laitz and Gauldin. A snapshot view of just these sections from the three texts may suggest that classifications of intervals in such a way could potentially be obsolete and unnecessary. However, a look through their diatonic harmony sections will illustrate the rigid treatment of consonant and dissonant intervals in rules of counterpoint. The sole reason for adding any culturally-determined caveat is the use of the perfect fourth "as a dissonance" in

[65] Roig-Francolí, *Harmony in Context,* 14.

[66] Ibid.

counterpoint. It seems hardly necessary to throw out an entire system of physiological consonance classification based solely on the use of one consonant interval as a dissonance.

Edward Aldwell and Carl Schachter, *Harmony & Voice Leading*, Fourth Edition, 2011

Aldwell and Schachter's text uses the terms stability/instability and consonance/dissonance synonymously. Just as with Laitz, Roig-Francolí, and Gauldin, Aldwell and Schachter state that "some intervals produce the impression of stability; others, the effect of activity or tension. We call the stable intervals consonances...the unstable ones are dissonant."[67] Also fitting for this type of explanation is that it follows a discussion of the harmonic series, thus invoking the Pythagorean concept of simple integer ratios once more. The question of usefulness does not play into Aldwell and Schachter's definition, however, since they do not consciously support any cultural theory of consonance. Instead, they merely note that the perfect fourth is *sometimes* used as a dissonance and leave enculturated biases aside.

What seems to be more important for Aldwell and Schachter is not so much the classification of intervals as consonant or dissonant but rather the use of of these phenomena in actual music. This is why they link the concept of consonance with the concept of scale degree and thus with harmonic stability.

> The division of scale degrees into stable and active tones relates directly to the phenomenon of consonance and dissonance because the active tones are those that form dissonances with one or more tones of the tonic chord, whereas $\hat{1}$, $\hat{3}$, and $\hat{5}$ (the tonic chord) are all consonant with each other.[68]

[67] Aldwell and Schachter, *Harmony & Voice Leading,* 26.

[68] Ibid., 28.

From a Schenkerian point of view this explanation sounds fine. One small problem is that the "sometimes dissonant" perfect fourth usually occurs as a dissonance when $\hat{1}$ appears as a non-harmonic tone above $\hat{5}$ (as a structural tone). Aside from this consideration, Aldwell and Schachter's explanations are surprisingly cogent and straightforward.

A particularly well-formed argument for the status of the perfect fourth as an instability in common-practice tonality appears in this same chapter.

> Over the course of several centuries, composers experimented with the possibilities made available through the use of 3rds and 6ths; the most important of these possibilities were the complete triads, major and minor, that became the basis for later music. Using complete triads effected a fundamental change in musical structure;[69]

If Aldwell and Schachter were to stop their explanation there I could wholeheartedly agree. Unfortunately, the "dissonant" status of the perfect fourth starts to appear as one continues to read.

> [O]ne consequence of this change threatened the consonant status of the 4th. Once the 3rd became a pervasive element in musical texture, many situations arose in which the 4th sounded less like an inversion of the 5th—and thus a more or less stable interval—than like an active interval gravitating to the 3rd. In such situations, the 4th takes on the character of a dissonance.[70]

If one were to replace the words "consonant" and "dissonance" with "stable" and "instability" respectively, this explanation would be more satisfying. By removing the "inversion of the 5th" assumption of stability (thereby not judging Medieval music with twenty-first-century ears), the explanation would be entirely acceptable.

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[69] Aldwell and Schachter, *Harmony & Voice Leading,* 29.

[70] Ibid., 29.

Stefan Kostka and Dorothy Payne, *Tonal Harmony*, Sixth Edition, 2009

Only brief mention will be given to the Kostka and Payne text due to its resounding failure to adequately describe consonance and dissonance in a meaningful way. Not only do Kostka and Payne's definition not reflect psychological research involving consonance and dissonance, it seems concerned with a much older connection to ideas of consonance.

> In tonal music, some harmonic intervals are considered to be consonant, whereas others are considered to be dissonant. *The terms consonant and dissonant can be defined roughly as meaning pleasing to the ear and not pleasing to the ear, respectively*, but these are very dependent on context. Some of the most exciting moments in tonal music involve dissonance, which is certainly not displeasing in that context, *but the dissonances resolve eventually to the consonance that give them meaning*.[71]

Of primary concern is the misconception that consonance and dissonance mean "pleasing to the ear" and "not pleasing to the ear." The word consonance comes from the Latin word *consonare* which literally means "to sound together." In no way does the Latin base suggest preference or pleasantness, but rather it jibes with Helmholtz's concept of sympathetic partials versus dissonant beating. Consonances literally "sound together" in that their constituent harmonic partials more or less beat in conjunction with one another. Dissonances "sound apart" because the beating between their partials creates clearer distinctions between two pitches within a harmonic interval. As Stumpf discovered, the most consonant intervals have a tendency to fuse and sound as one tone, especially when played as pure tones.

Secondly, in what way does consonance give dissonance meaning? Dissonances can stand alone as stabilities given the right context. A consonant sonority is not necessary as the resolution of a more dissonant sonority. A jazz musician might argue that dissonances are the

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[71] Stefan Kostka and Dorothy Payne, *Tonal Harmony: With an Introduction to Twentieth-Century Music,* 6th ed. (Boston: McGraw-Hill, 2009), 23. Emphasis added.

most pleasant sonorities and that they provide depth and color to musical compositions. The argument of personal preference has no place in the definition of consonance and dissonance.

Summary of Textbook Explanations

Most modern tonal harmony textbooks agree for the most part on a few key features of consonance pedagogy: the connection between consonance and the harmonic series (i.e. simple integer ratios), the ambiguous consonance of the perfect fourth, the classification of consonant and dissonant intervals, and the cultural basis for consonance valuations. These textbooks sadly have other, less desirable qualities in common. The most egregious is the hodgepodge of words used to describe consonance: consonant, stable, resolved, pleasing, inactive, restful, etc. The effect of this myriad of terms is an inherent confusion in the pedagogy of consonance theory. The natural outgrowth of this confusion is a lack of depth and meaning in the discussion of consonance and dissonance as aspects of musical analysis.

What I hope to eliminate with my theory is the use of various contradictory explanations when describing consonance. Furthermore, an approach that defines consonance in a clear and informed way would allow students using any and all textbooks to discuss consonance in a way that is both sensitive to musical context and meaningful in analytical discourse. A unified, systematic approach to consonance pedagogy would be a huge step in the direction of its use in meaningful analytical discourse.

CHAPTER III

THE THEORY OF CONSONANCE AND HARMONIC STABILITY

Restatement of the Theory

At its heart, my theory is a pedagogical tool. I do not mean to suggest that all listeners will either agree with my theory or that all styles will benefit from it through analysis. These ideas came out of a desire to better describe and teach consonance and dissonance as meaningful topics in a music theory course. It is my hope that with further research into the understanding of the psychoacoustical properties of consonance and harmonic stability that my ideas will be validated. I also hope that through their use in various pedagogical practices they will prove helpful for the teaching of Western music theory.

Sensory Consonance: The Basis for Simplifying the Definition of Consonance

My theory starts by separating the complex and often convoluted idea of *consonance* into two entities: consonance (or more precisely *intervallic* or *chordal* consonance) and harmonic stability. Consonance in this new sense refers just to the sonority or sonorities being described and has as its base a psychoacoustical definition. My theory takes *sensory consonance* and calls it consonance for brevity. Sensory consonance is a product of the critical bandwidth, meaning that the human ear cannot fully resolve the tension created along the basilar membrane by pitches that stimulate the membrane in close proximity to one another.[72] Maximum dissonance occurs when two pure tones sound at around twenty-five percent of the

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[72] Schellenberg and Trainor, "Sensory consonance and the perceptual similarity of complex-tone harmonic intervals," 3321.

critical bandwidth of an auditory filter, increasing in consonance until a maximum level is achieved and maintained after one-hundred percent of the critical bandwidth is exceeded.[73] For higher frequency tones (above five-hundred Hertz), the critical bandwidth is around three semitones, making maximum dissonance a little less than a semitone; lower frequency tones have a critical bandwidth of about eighty Hertz.[74] In terms of musical intervals, an interval is perceived as more dissonant as its constituent pitches are lowered. This phenomenon also accounts for the variable frequency range of three semitones for higher frequency tones versus the more-or-less fixed critical bandwidth of lower frequency intervals.

For complex tones, dissonance occurs because of the interference between harmonic partials. Hermann von Helmholtz discovered that when two complex tones had more partials that fell within a critical bandwidth they tended to be perceived as more dissonant.[75] When a pair of complex tones had any coincidental pairs of partials it was considered consonant and the more coincidental pairs the more consonant it was considered.[76] Whereas Helmholtz based his theories on up to sixteen partials at times, it is now known that the human ear can only audibly recognize between five and eight harmonic partials.[77] This does not significantly change Helmholtz's findings, but it does create some ambiguity with regard to specific intervals.

When using only eight partials (the most common "maximum" number of partials audible by humans), the order of consonances differs only slightly from Helmholtz's. Table 3.1

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[73] Stainsby and Cross, "The perception of pitch," 52-53.

[74] Schellenberg and Trainor, "Sensory consonance and the perceptual similarity of complex-tone harmonic intervals," 3321-22.

[75] Helmholtz, *On the Sensations of Tone*, 180.

[76] Ibid.

[77] Stainsby and Cross, "The perception of pitch," 51.

shows my own ordering based on the number of semitones and whole tones between the partials of complex tones. The perfect fifth and perfect fourth, while having two semitones and three whole tones, also have two coincidental pairs, giving them a much greater degree of consonance than either major or minor thirds and sixths. All other consonances listed have at least one coincidental pair, with the exception of the minor seventh. The minor seventh is given here as a mild consonance/mild dissonance because it has the same number of semitones as the perfect fifth and only two more whole tones. The degree of dissonance attributed to the minor seventh is due to its lack of coincidental pairs and thus it is considered only a mild dissonance. Helmholtz himself recognized the mildness of the dissonance created by the minor seventh.[78]

Table 3.1. Order of consonances based on the coincidence/non-coincidence of the first eight partials of complex tones.

Consonant	Less Consonant	Mild Consonance/ Mild Dissonance	More Dissonant	Dissonant
P8, P5, P4	M6, m3	m6, M3, (m7)	M7, TT	M2, m2

Justification for the rest of the order is given in Table 3.2. Any interval with a coincidental pair—within the eight partial range— is considered consonant. Intervals with a greater number of semitones and whole tones are considered more dissonant. The perfect fourth is considered slightly less consonant than the perfect fifth since its first dissonant pair occurs lower than that of the perfect fifth and also because the perfect fifth occurs first as an interval within the harmonic series itself (being between the second and third partials).[79] My justification for

[78] Helmholtz, *On the Sensations of Tone*, 188.

[79] There are very few times where I felt that the position of the semitones, whole tones, or coincidental pairs made a difference in my ordering. In the case of the perfect fourth and fifth, the consonance otherwise would be so closely related that a concession had to be made.

placing the major second below both the tritone and major seventh on the table is due to its much higher number of whole tones than any other interval. This qualification could be argued.

Table 3.2. Number of semitones, whole tones, and coincidental pairs between the first eight partials of complex-tone harmonic intervals.

Interval	Semitones	Whole Tones	Coincidental Pairs
P8	0	0	4
P5	2	3	2
P4	2	3	2
M6	2	2	1
m3	3	2	1
m6	4	0	1
M3	5	0	1
m7	2	5	0
M7	5	1	0
TT	5	2	0
M2	3	9	0
m2	10	1	0

My intention, however, is not to make hard and fast distinctions between classifications but rather to present intervals on a fluid continuum with some flexibility depending on context.

Musical Schemata: The Learned Process of Harmonic Stability

In contrast with consonance, harmonic stability is a learned response that causes one to attribute to a sonority or passage of music a sense of restfulness or stasis. This response comes from familiarity with a style or idiom. The term *harmonic* stability is a little misleading in the case of some cultures outside of Western music where the concept of harmony may not exist in the same way as it does in Western music. Nevertheless, the lack of this concept in other cultures does not preclude its existence in Western music. Furthermore, the level of harmonic stability is not determined by a sonority's consonance or dissonance valuation. Rather it is the response to recognized patterns within an idiom, or what may be called *schemata*.

Immanuel Kant was the first to offer the idea of a *transcendental schema* as a means for the brain to make a connection between intellectual conceptions and sensuous ones. Kant introduced the idea and defined the term in his *Critique of Pure Reason*, saying:

> Now it is quite clear that there must be some third thing, which on the one side is homogeneous with the category, and with the phenomenon on the other, and so makes the application of the former to the latter possible. This mediating representation must be pure (without any empirical content), and yet must on the one side be *intellectual*, on the other *sensuous*. Such a representation is the *transcendental schema*.[80]

Kant compared his idea of the *transcendental schema* to images created in the mind as representations of physical properties. His particular use of the word "image" in this case is reminiscent of Plato's concept of the *form*.[81] Kant's implied comparison is easier to comprehend after an example of a simple schema.

> The schema is, in itself, always a mere product of the imagination. But, as the synthesis of imagination has for its aim no single intuition, but merely unity in the determination of sensibility, the schema is clearly distinguishable from the image. Thus, if I place five points one after another . . . . this is an image of the number five.[82]

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[80] Kant, *The Critique of Pure Reason,* 61.

[81] Plato, *The Republic of Plato*, trans. Allan Bloom, 2nd ed. (New York: Harper Collins, 1991), 193-198.

[82] Kant, *The Critique of Pure Reason,* 62.

Although the concept of *schemata* has been transferred into many fields of study, Frederick Bartlett was the first to offer an influential account of its use. Bartlett described the *schema* in the terms of social psychology:

> "Schema" refers to an active organization of past reactions, or of past experiences, which must always be supposed to be operating in any well-adapted organic response. That is, whenever there is any order or regularity of behavior, a particular response is possible only because it is related to other similar responses which have been serially organized, yet which operate, not simply as individual members coming one after another, but as a unitary mass.[83]

This "organization of past reactions" teaches the listener to expect certain common outcomes from tonal harmony. These patterns of recognized musical activity are essential in determining how a passage of music *should* resolve and therefore our own perceptions of tension and relaxation in the music.

Leonard Meyer referred to Bartlett's "organization of past reactions" (though not directly) as "expectations." Meyer theorized that the human brain produced emotional responses to musical phenomena. The mental processes involved in these responses then create expectations of emotional affect and thus contribute to the perceived tension of a musical passage. Meyer compared this musical conditioning to linguistic conditioning:

> [W]e perceive and think in terms of a specific musical language just as we think in terms of a specific vocabulary or grammar; and the possibilities presented to us by a particular musical vocabulary and grammar condition the operation of our mental processes and hence of the expectations which are entertained on the basis of those processes. The mind, for example, expects structural gaps to be filled; but what constitutes such a gap depends upon what constitutes completeness within a particular musical style system.[84]

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[83] Bartlett, *Remembering,* 201.

[84] Meyer, *Emotion and Meaning in Music*, 43-44.

Meyer went on to say that the expectations that arise from these mental processes depend upon "possibilities and probabilities inherent in the materials and their organization as presented in a particular musical style."[85] Schemata are the stored products (or residue) of these mental processes. It is these schemata that the mind engages to determine how one expects a passage of music to resolve and therefore the level of harmonic stability or instability present in the passage.

Kant's concept of the *schema* was most notably transferred into music by Robert Gjerdingen. Gjerdingen's dissertation was a pioneering work in transferring schemata theory into music analysis.[86] He noted that "Among the central concerns of music theory are the definition, representation, and interpretation of musical structures."[87] Gjerdingen set up a historically-contextual definition of schemata based on simple melodic patterns first studied by Burton S. Rosner and Leonard B. Meyer.[88] Later, Gjerdingen would use more complex and varied schemata to analyze music of the galant style.[89]

The way in which schemata affect musical memory was summarized by Bob Snyder in his introduction to the mental representation of music, *Music and Memory*:

> Schemas in music generate expectations about the kinds and order of musical events; they serve as frameworks for memory, increase chunkability, and help us form representations in long-term memory. There is a kind of reciprocal relation between

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[85] Meyer, *Emotion and Meaning in Music*, 44.

[86] Gjerdingen, "A Musical Schema: Structure and Style Change, 1720-1900" (PhD dissertation, University of Pennsylvania, 1984).

[87] Ibid., 20.

[88] Burton S. Rosner and Leonard B. Meyer, "Melodic Processes and the Perception of Music," in *The Psychology of Music*, ed. Diana Deutsch, 1st ed., 317-341 (New York: Academic Press, 1982).

[89] Gjerdingen, *Music in the Galant Style.*

> schemas and some kinds of musical experience. While we derive schemas from musical experiences, we can also construct musical experiences so that they will be easier to schematize.[90]

Snyder cites specifically the compositional technique of theme and variation, whereby a composer takes one passage of music and alters it in various stylistically-consistent ways. The manner by which the mind recognizes these variations as altered copies of the original passage of music is by accessing schemata stored based on musical experience.

Recognized patterns within a musical idiom are often stored in the brain as schemata. These patterns range from anything from simple melodic figurations (e.g. the "change-note" motif referred to by Meyer) to cadential representations. David Temperley notes that one of the most important common-practice schemata is the perfect authentic cadence:

> Perhaps the most important schema in common-practice music is the "perfect" cadence: a V-I progression, both chords in root position, with the tonic in the melody of the I chord… The perfect cadence serves an essential function in common-practice music; it is virtually required for a sense of closure at the end of a piece, and generally establishes sectional points of closure as well.[91]

Temperley's awareness that this cadence produces a sense of closure that is almost undeniable is exactly the kind of harmonic stability created from exposure to the common-practice idiom. Listeners familiar with this music will have heard representations of the perfect authentic cadence any number of times in any number of tonal, rhythmic, and textural contexts.

From the above definitions of consonance/dissonance and harmonic stability/instability there logically follow four categories for sonorities or passages of music: consonant and stable, consonant and unstable, dissonant and unstable, and dissonant and stable. The first three

[90] Bob Snyder, *Music and Memory: An Introduction* (Cambridge, MA: The MIT Press, 2000), 101.

[91] David Temperley, *The Cognition of Basic Musical Structures* (Cambridge, MA: The MIT Press, 2001), 336.

categories are readily apparent in any number of well-known examples. The fourth category is only a theoretical concept in some styles but an idiomatic norm in others. I will explain each category using theoretical terminology suitable for a freshman theory course whenever possible. Musical examples for the fourth classification, dissonant and stable, will come primarily from the so-called "standards" of the American popular song and jazz repertoire, again to provide unity and ease of recognition.

Consonant and Stable

In Western music, the most ubiquitous example of a sonority that is both consonant and harmonically stable is the tonic triad. Whether major or minor, the root-position tonic triad is comprised of entirely consonant intervals (major thirds, minor thirds, and perfect fifths), and in terms of harmonic progressions it is almost exclusively the goal of a musical piece.[92] When a Western listener of almost any style background hears an authentic cadence ending with a root-position tonic triad, the understanding is that the phrase has ended and the music has reached a stable resting point. There is no amount of perceived harmonic tension that causes the listener to feel as though the tonic triad should resolve. There is also little to no internal intervallic tension that would give the tonic a harsh sound.

Figure 3.1 illustrates a common authentic cadence at the end of a Bach chorale. The rising *Do-Re-Mi-Fa-Sol* motion in the bass voice leading up to the cadence clarifies the overall harmonic goal of the chord progression. The descending *Fa-Mi-Re-Do* motion in the soprano voice further clarifies the goal of the passage as a closing gesture with outer voices moving in

[92] There are many examples, especially in Bach's chorales, that have other chords as the goal of the entire piece. In these situations it is often safe to say that while the piece may not have ended on a global tonic, it certainly ended on a local tonic. Furthermore, many Bach chorales were parts of a larger compositions (i.e. cantatas, Passions, etc.) that may have ended on the "global" tonic.

contrary motion to a close on *Do*. This common example of a perfect-authentic cadential progression is an example of the type of schema developed as a part of repeated exposure to the same style of music.

Of course, there are other examples of consonant and stable sonorities. In the case of a deceptive cadence where the submediant triad replaces the tonic, this chord is both stable and consonant. The submediant triad is consonant because it is minor in quality, and stable in this context because it substitutes for tonic (see Figure 3.2). As a perceived replacement for the tonic triad, the submediant plays the role of a stable sonority as well, although somewhat less so than the tonic. The relative levels of stability between the tonic and the submediant triads are created because of the authentic cadence schema already developed in our minds. The presence of a well-formed idea of a dominant-to-tonic relationship encourages us to expect a tonic where instead we hear a submediant. This "surprise" resolution—referred to as such by Meyer—is what creates a slight sense of harmonic instability.[93] Meyer noted that:

> Expectation is not specific; the state is one of suspense. In fact, if doubt and uncertainty are strong enough, almost any resolution, within the realm of probability, which returns us to certainty will be acceptable, though no doubt some resolutions will, given the style, seem more natural than others.[94]

The most important judgment in these cases is whether to describe a sonority or passage as mostly stable or mostly unstable. If when listening to the passage one gets the sense that there is a point of stability, that sense is part of a learned response to the music to which one is accustomed. The deceptive cadence is an excellent example of the fact that harmonic stability is measured on a continuum that has "almost completely stable" on one side and

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[93] Meyer, *Emotion and Meaning in Music,* 27.

[94] Ibid.*,* 27.

“almost completely unstable” on the other. The judgments of relative stability along this continuum will vary depending on context and may even vary between different listeners. Insofar as common-practice tonality is concerned, the level of harmonic stability or instability can be quantified.

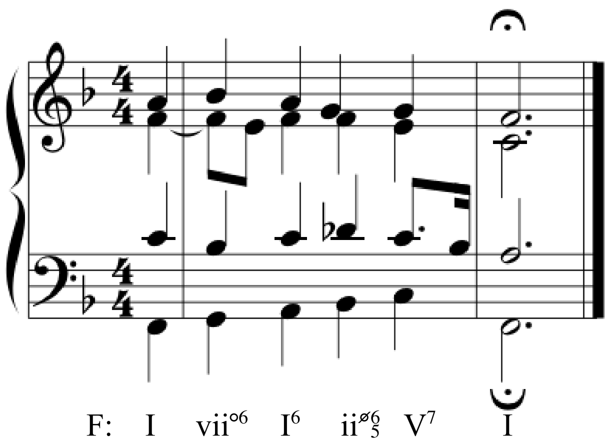

Figure 3.1. Bach chorale no. 6, mm. 6-8. An authentic cadence in F.

Fred Lerdahl’s book *Tonal Pitch Space* explores the possibilities of quantitatively determining the tension of single sonorities and passages of music within a tonal region. In his chapter “Tonal Tension and Attraction,” Lerdahl defines the way in which tonal stability can be determined based on what he calls “pitch-space rules”:

> [T]he more unstable two events are with respect to each other, the further apart two events are in pitch space and the greater the tension that exists for one in relation to the other. The pitch-space rules quantify the degree of stability from one event to another, hence their tensional states. Furthermore, in a hierarchical view, tonic orientation establishes the point of stability against which the instability of other events is measured.[95]

[95] Lerdahl, *Tonal Pitch Space*, 142.

Of particular interest to the present discussion is Lerdahl's "chord-distance rule," which uses two criteria to determine chordal tension: the distance between two chords along the circle of fifths and the number of common tones those two chords share.

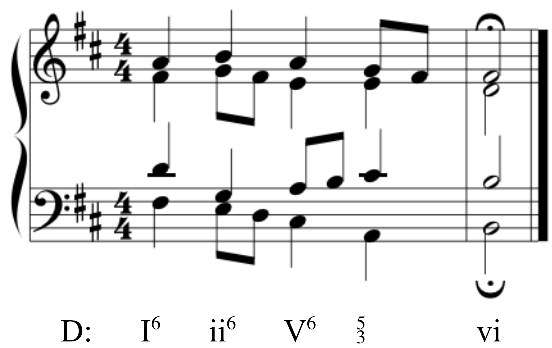

Figure 3.2. Bach chorale no. 60, mm. 9-10. A deceptive cadence in D.

Of primary importance in determining the distance between two chords within a tonal pitch space is their relationship along the circle of fifths. Due to the perceptual supremacy of the second partial of the harmonic series, chords related by fifth are the mostly closely related.[96] The further a chord is along the circle of fifths from the tonic triad, the more perceptually unstable and distant it will appear to be. Regarding common tones, hierarchical positioning within pitch-class spaces must be taken into account to weigh each member of the triad correctly. The root of the chord would be the most significant common tone, followed by the fifth, and lastly the third.[97] Using Lerdahl's *basic space* model to determine the number of distinctive pitch classes one chord has in relationship to another chord's tonal area, one can determine the weighted number of common tones between two triads. The submediant is three fifths away from the tonic and has four distinctive pitch classes in its hierarchical basic space.

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[96] Lerdahl, *Tonal Pitch Space*, 55.

[97] Ibid.

This gives the submediant a weighting of 7, a relatively small number when compared with other diatonic chords (and non-diatonic chords for that matter) not already involved in well-formed schemata (such as a predominant-dominant-tonic cadence schema). In contrast, both the supertonic and leading-tone triads have a weighting of 8. This consideration paired with the stepwise voice leading from the dominant triad to the submediant triad make it an excellent candidate for harmonic stability.

Consonant and Unstable

The majority of chords heard in Western art music are consonant and unstable. Most tonal music is written with a goal in mind and uses harmonic progressions to achieve a sense of motion. Music that is entirely stable would not involve a great deal of harmonic motion or tension. However, music that is entirely consonant need not be monotonous. Figure 3.3 is an example of a Bach chorale that is composed almost entirely of consonant triads. Despite this fact, it features various kinds of harmonic activity. With the exception of the $vii^{\circ 6}$ in m. 9, the chorale is composed of entirely consonant structural sonorities (structural meaning the vertical sonorities not involving non-harmonic tones). There are two "ii^7s" created by passing tones in mm. 2 and 14 that are easily identified as passing sonorities. In m. 3, the 4-3 suspension in the soprano voice creates a minor seventh between the alto and soprano voices for one beat. The neighbor tones in the soprano and tenor voices in m. 11 create a stack of perfect fifths and fourths for half a beat, but these are not dissonances. Similarly, the 4-3 suspension in the tenor in the penultimate measure creates another stack of fifths and fourths.

In total, the chorale has 132 half beats, four of which that contain dissonant harmonic intervals, and is composed of approximately 3.33% dissonant sonorities. This is not to say that the chorale does not feature a great deal of harmonic motion. There is a modulation to the supertonic key area beginning in m. 9. There are secondary dominants in mm. 3 and 15, respectively. Spacing considerations and voicing changes create a large amount of the activity of the chorale as well. The dominant triad is the most common consonant and unstable sonority. In terms of chord quality, the dominant triad is no different from a major tonic triad. Indeed, if the chorale were in D major, the dominant triad in m. 4 would actually be a tonic triad. The difference between these two otherwise identical triads is the harmonic context in which they appear. The same sonority in different contexts will be treated in different ways because of the style in which the sonority is written.

In common-practice Western art music—which for the purposes of this theory is described as Western art music from approximately 1600 until 1900—the harmonic system is based on a tonal hierarchy. This hierarchy is based on scale degrees, which are represented by triads. The tonic triad is at the top of this hierarchy and represents the goal of most harmonic movement. The dominant triad is the second highest in this hierarchy representing the importance of its resolution to the tonic triad and the primacy of fifth-based progressions in Western music. Other scale degrees have a tendency to either resolve to one of these scale degrees or replace them. The leading-tone triad generally serves the same function as the dominant with a much stronger pull toward the tonic (being only a semitone away from it). The submediant and mediant triads are often replacements for the tonic with less stability, though they can also serve as replacements for the subdominant and dominant, respectively. The subdominant triad has somewhat of a pull toward the dominant but can also act as a replacement for dominant in the case of a plagal cadence.

Figure 3.3. Bach chorale no. 102, a "consonant" chorale.

This hierarchy heavily influences our sense of harmonic stability in common-practice music. It is for this reason that otherwise consonant chords are considered unstable and must resolve to other scale degrees in certain stylistically-consistent ways. The bias toward hearing a tonic triad after a dominant sonority engenders in the listener the sense that the dominant is an active chord. It usually resolves to the tonic because that is one of the goals of the dominant: to signal forthcoming closure on the tonic. Within a musical context, almost any sonority that is not the tonic is considered unstable in that it is not the goal of the phrase. The only truly stable sonorities in a passage of music are those that are cadential arrivals on the tonic or replacements for the tonic. Harmonic progressions that mimic cadential material but do not progress to closure can also be considered more stable than surrounding sonorities in that they foreshadow the more long-term goal of the final tonic.

One of the most misleadingly described unstable consonances is the perfect fourth in either a 4-3 suspension or a cadential V^6_4. Although the perfect fourth exhibits the same degree of consonance as the perfect fifth—having the same number of semitones and whole tones between partials as well as coincidental pairs of partials—it is often described as being "usually viewed as a dissonant interval."[98] It is reasoned that since the perfect fourth in this case is "resolving" to a major or minor third, the fourth *must* be dissonant for this particular effect. Curiously, the same reasoning is never used for the major or minor sixth, despite their being involved in the same kind of suspension (this time from a sixth to a perfect fifth) and being just as crucially involved in the cadential V^6_4. Given a definition of consonance based on interaction along the basilar membrane, the minor and major sixth would actually be far more dissonant than the perfect fourth in these cases. Table 3.2 given earlier shows that the minor sixth in particular has four semitones whereas the perfect fourth only has two. The perfect fourth also has a greater number of coincidental pairs, heightening its perceived consonance.

The proposed theory fixes this problem. Rather than being a sometimes consonant, sometimes dissonant interval, the perfect fourth is quite simply a consonance. In certain situations (such as a 4-3 suspension and a cadential V^6_4) it is an unstable interval that is part of a schemata resolving the fourth to a much more stable sonority. With this explanation, the question of why the perfect fourth in an inverted tonic triad is not considered dissonant no longer exists. The reason the perfect fourth must resolve in other situations can be reasoned by its position as part of non-harmonic tone schema.

[98] Laitz, *The Complete Musician,* 16.

Dissonant and Unstable

This particular category is most likely the reason why consonance and dissonance are often linked to resolution and the need for resolution, respectively. That many consider all dissonant sonorities unstable and dissonance as the need for resolution is unsurprising. These concerns will be addressed more critically in the next section. As far as common-practice music is concerned, a greater amount of dissonance generally does mean that the sonority or passage of music is unstable. However, the dissonance is not the *reason* for the instability but rather the fact that a twelve-tone chromatic sonority is being imposed upon a seven-tone diatonic system. The diatonic scale represents a base of stability in Western music in terms of the equal-tempered tuning system, whereas the chromatic scale forces certain scale degrees to be altered and thus creates issues of enharmonic resolution.

A common example is the fully-diminished seventh chord. The chord contains two intersecting tritones and in isolation has no distinct audible (or perceptible) root. Normatively, the a C♯ vii$^{\circ 7}$ (or {147T} in terms of pitch-class integers) will resolve to one of eight pitch-class sets: four major triads ({25T}, {27E}, {48E}, and {158}) and four minor triads ({15T}, {27T}, {47E}, and {148}) usually representing the tonics of the audibly distinct keys. It is still possible that the chord could resolve enharmonically or to a V^6_4 rather than what is implied by spelling. Also possible is the resolution of any of the three distinct fully-diminished seventh chords in a common-tone manner, adding eight more (four major and four minor triads) possibilities for resolution. The fact that the chord divides the chromatic scale equally but the diatonic scale unequally is the basis for this ambiguity and the chord's instability.

The possibilities for resolving fully-diminished seventh chords are not endless but are numerous. Meyer also referred to how ambiguity increases doubt as to the expected outcome of a passage:

> If the musical patterns are less clear than expected, if there is confusion as to the relationship between melody and accompaniment, or if our expectations are continually mistaken or inhibited, then doubt and uncertainty as to the general significance, function, and outcome of the passage will result… the mind rejects and reacts against such uncomfortable states and, if they are more than momentary, looks forward to and expects a return to the certainty of regularity and clarity.[99]

The expectation from the immediate tonal context can present us the idea of one schema and then subvert that schema, creating an even greater sense of harmonic instability.

Figure 3.4 displays some possible respellings and resolutions of the three fully-diminished seventh chords.[100] All twenty-four key areas are represented in this example: twelve major and twelve minor. It is no wonder that with eight distinct possibilities for the resolution of {147T} that it would sound so unstable given *most* tonal contexts.

An example of how this ambiguity can appear in music appears in Gershwin's "'S Wonderful" from *Funny Face* in Figure 3.5. The rising chromatic bass in mm. 29-34 sets up the expectation of a I - V^{6}_{5} V progression. However, the oscillating 5-6 motion in an inner voice creates an ambiguity as to whether the chord should be interpreted as a V^{6}_{5} of ii or a ct$^{\circ 7}$ of V^{4}_{3} instead. What Gershwin does with these two expectations is quite remarkable. Instead of resolving to either of these possibilities directly, he conflates the two, resolving to what seems like a supertonic at first but then reveals itself as a V^{9} instead the second half of m. 33.

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[99] Meyer, *Emotion and Meaning in Music,* 26.

[100] For the purposes of simplification, common-tone resolutions are omitted. One can easily see how these possibilities would make the expectations for resolution even more numerous, however.

Figure 3.4. All possible normative resolutions of fully-diminished seventh chords. Line one - all enharmonic spellings of a fully-diminished seventh chord on "C". Line two - all those on "C♯." Line three - all those on "D."

When a scale degree is altered in any way, it generally creates instability within the tonal hierarchy. For example, altering scale degrees in an otherwise diatonic seventh chord creates an instability that must resolve to a diatonic sonority. When the diatonic seventh chord built on the supertonic is altered to make it a major-minor seventh chord, that alteration of the fourth scale degree by raising it pulls the chord more strongly toward the dominant. Altered from its diatonic state, it mimics the resolutions of another diatonic space, acting in this case as the dominant of another key area. On the other hand, and perhaps more importantly, the major-minor seventh chord appears diatonically as a dominant seventh chord and the association of this sonority with a dominant-to-tonic schema creates a pull from the supertonic triad to the dominant triad.

Figure 3.5. "'S Wonderful" *from* Funny Face *by Gershwin and Gershwin, mm. 29-36*

The supertonic triad is not the only one that can be altered in this way. The major-minor seventh chord that is considered a dominant in this situation has the same sonic properties as a German augmented-sixth chord. Each distinct sonority will normally resolve to either two or three chords (some V^7s resolving to both major and minor triads, others only to major) and as previously mentioned, the dominant-seventh sonority can be used on more than just the dominant scale degree. The resolution of this sonority in the manner of a Gr^{+6} is quite jarring as well, steering the chord progression to resolve the passage a semitone away from the previous key. The expectation give the common dominant-tonic schema is to resolve by fifth relationship. The half-step modulation subverts this expectation, contributing to the passages instability. Transformations of the V^7 into the Gr^{+6} are common in Romantic music, such as Chopin's Mazurka in B major, op. 56, no. 1, mm. 42-45, shown in Figure 3.6.

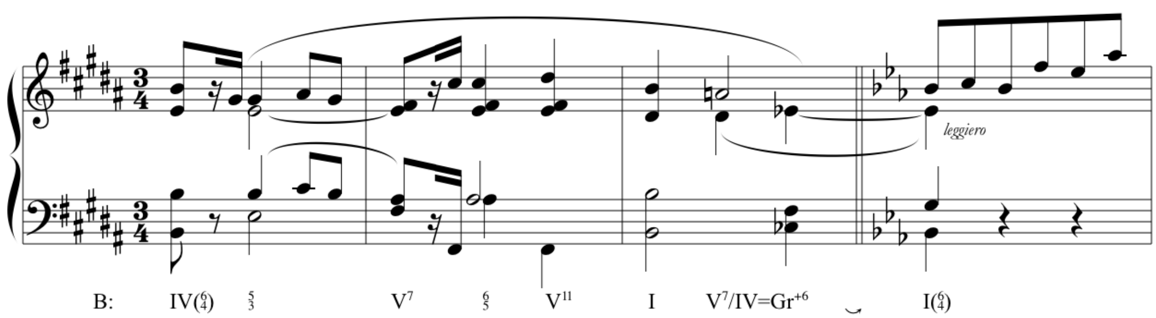

Figure 3.6. Chopin, Op. 56, No. 1, mm. 42-45.

Far more interesting is the myriad of resolution possibilites created by semitonal changes to one of the three fully-diminished seventh chords. By lowering any one note by a semitone, the fully-diminished seventh chord becomes a major-minor seventh chord. By raising any one note by a semitone, it becomes a half-diminished seventh chord, which could act as either a leading-tone or a supertonic seventh. These last possibilities are shown in Figure 3.7.

Figure 3.7. Enharmonic resolution possibilities by modifying the fully-diminished seventh to the half-diminished seventh.

Not shown in Figure 3.7 but certainly possible are semitonal alterations of multiple notes of the fully-diminished seventh chord. By raising (or lowering) two notes one creates a minor-minor seventh chord. By raising one note and lowering the note directly above it one creates a major-major seventh chord. In this way all forms of seventh chords may be created by semitonal motion away from one of the three fully-diminished seventh chords.

<u>Dissonant and Stable</u>

The concept of a stable dissonance is mostly non-existent in common-practice tonal music. One notable exception is the end of Bach's Prelude in C major, BWV 846, shown in Figure 3.8. As Schenker's own analysis of this piece (given as Figure 3.9) shows, the final arrival on the tonic for both the bass and soprano voice occurs on a tonic major-minor seventh chord. A more noteworthy exception may not be possible, but others are sure to exist in other common-practice musical examples.

Figure 3.8. Bach, Prelude in C Major, BWV 846, mm. 24 to the end.

The theoretical concept of a stable dissonance in post-common-practice tonal music is not without precedent, however. Daniel Harrison recently proposed the idea of a "dissonant tonic." Harrison offered four types of sonorities that could be considered tonics given the right position in a passage of music: colored triads, polychords, chords with root representatives, and chords with an amplified root.[101] The last three types do not play a large role in the repertoire of American jazz and popular standards and will not be discussed here. However, the idea of a "colored triad" is a fitting name for added-sixth chords and major-major or minor-minor

[101] Harrison, "Dissonant Tonics."

sevenths in tonic sonorities. These colored triads are also a sufficient illustration of the dissonant and stable category for harmonic sonorities.

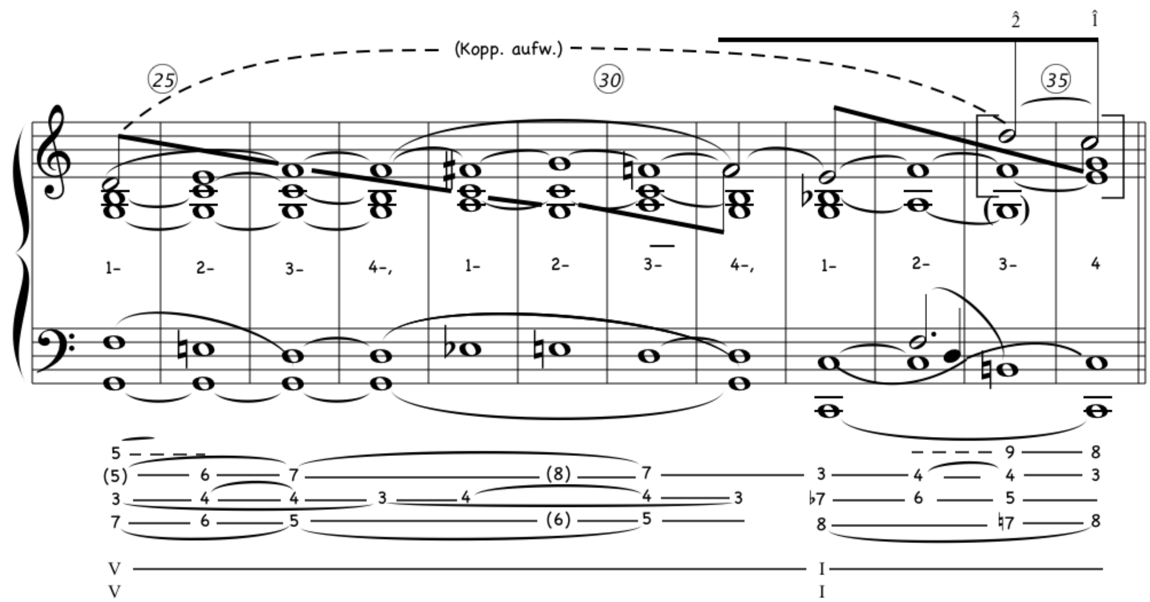

Figure 3.9. Schenker's graph of BWV 846, foreground sketch of mm. 24 to the end only.[102]

Consideration of the added-sixth tonic will be the primary material for showing how somewhat dissonant harmonies can be stable when replacing an otherwise consonant chord in an already well-formed schema. There is also brief mention of tonic sevenths. Before discussing examples of these sonorities in the repertoire, however, it is necessary to demonstrate a connection between the schemata of common-practice tonal music and the American jazz and popular idiom.

[102] Schenker, *Five Graphic Musical Analyses* (New York: Dover Publications, 1969), 37.

Schematic Similarity Between Common-Practice and Jazz Tonality

Although the jazz and popular standards repertoire is not considered part of common-practice tonality it does share many of the same perceptual schemata. Typical common-practice tonal progressions can be found throughout jazz music. This is not surprising considering that jazz music was written with an enculturated bias toward European art music. Gershwin is probably the most well-known crossover composer, writing music in both jazz idioms and classical archetypes. In this case, Figure 3.10b from "Embraceable You" is a fitting crossover schema. The typical tonal progression of $\mathrm{ii}^{\varnothing 7}$ - V^{6-5}_{4-3} - I appears here as a perfect authentic cadence at the end of the song. Of course, Gershwin put his own spin on the progression, inserting the $\mathrm{ii}^{\varnothing 7}$ before the expected resolution of the V^{6}_{4} and using modal mixture with the half-diminished supertonic rather than the minor-minor. Still, these alterations are not uncommon in common-practice literature either.

The other two examples in Figure 3.10, from Cole Porter's "I've Got You Under My Skin" and Rodgers and Hart's "Bewitched," respectively, are further illustrations of the kinds of typical tonal progressions that jazz music uses as a starting point for harmonic embellishment. In Figure 3.10a, the ii^{7} - V^{7} - I tonic-establishing progression is embellished with an added ninth in the dominant seventh chord as well as 7-6 suspension in the tonic chord (creating an added-sixth tonic at the end of the cadence). The underlying stability of this kind of progression is shown by the root motion in the bass voice. The same stability is present in Figure 3.10c, this time as a replacement for the supertonic seventh chord with a secondary dominant and extending the beginning of this longer cadential progression with a short tonic expansion. These are only a few of the representative examples of common-practice tonal progressions found within jazz music. Considering the strong similarity between these progressions and others in common-practice tonal literature, it is safe to assume similar—if not somewhat altered—expectations from the use of these schemata in jazz and popular standards.

"Colored Triads": The Added-Sixth Chord and Tonic Seventh Chords

The clearest way to establish a sonority as a stability is to use it as the goal of an authentic cadence. In common-practice music, the tonic is usually a consonant major or minor triad. The consonance of this sonority aids in the sense of closure since physiologically the ear has an easier time analyzing the stimulus of a consonant sonority. However, schematically, our brains do not classify tonal progressions as concrete entities but as fluid categories. This is why authentic cadences often have different chords preceding the dominant (e.g. IV, IV^7, ii, ii^7, $\mathrm{ii}^{ø7}$, $\mathrm{vii}^{\circ}{}^{6}_{5}$ V, etc.). This is also why the dominant chord itself can be modified by being inverted or by adding chord tones to the triad. The next logical step in the course of these alterations would be inversions of the tonic triad and extended tones on top of its consonant foundation.

Although common-practice tonality does not normally extend the tonic triad with additional chordal tones, jazz tonality often does, sometimes not ever using a simple consonant triad. One extreme example is the 1971 song by Bill Withers "Ain't No Sunshine." The song uses minor-minor seventh chords exclusively, even as the dominant and tonic sonorities in its authentic cadences.[103] Allen Forte referred to the process of jazz tonality incorporating added tones as the "assimilation of decorative notes."[104] He noted that for jazz harmony, "the process of assimilation...converted certain common three-note chords into four-note chords."[105]

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[103] Bill Withers, "Ain't No Sunshine," from *Just As I Am*, Sussex Records, 1971.

[104] Allen Forte, *The American Popular Ballad of the Golden Era 1924-1950* (Princeton University Press, 1995), 7.

[105] Forte, *The American Popular Ballad*, 7.

Figure 3.10. Three examples of typical common-practice tonal progressions in jazz

Furthermore, Forte states that a familiar case "is the one in which a sixth is attached to a major triad, without any preparation whatsoever."[106] The same could be said of other added chord tones, such as major or minor sevenths.

Tonic extensions are found throughout the jazz repertoire. The added-sixth chord is the most common tonic extension, especially at cadence points. Often, a song will end on a tonic with an added sixth to provide color. Figure 3.11 is an example of the kind of tonic extension that often occurs at the end of jazz arrangements. Just as in the Bach chorale example in Figure 3.1, it features contrary motion in the outer voices, in this case between the solo vocalist melody and the left hand piano part in m. 55. Both progressions use the contrary outer-voice motion to strengthen the pull toward and closure upon a final tonic sonority. In Bach's example, the final chord is a consonant tonic triad. In Gershwin's example, the cadential arrival is on a tonic-sixth chord.

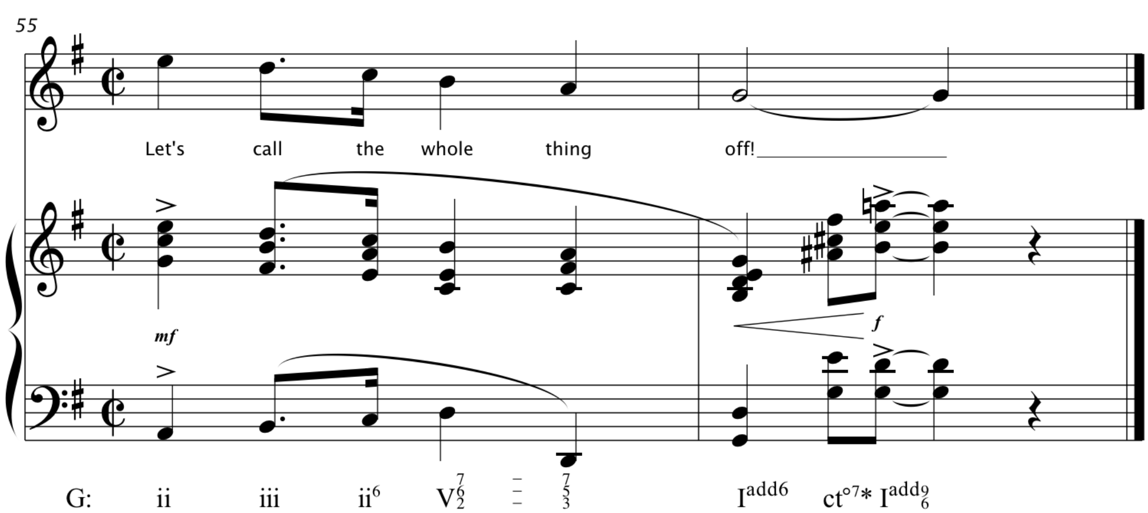

Figure 3.11. "Let's Call the Whole Thing Off" *by Gershwin and Gershwin, mm. 55-end. *This common-tone diminished seventh also includes an added F♯ but describes the function of the analysis.*

[106] Forte, *The American Popular Ballad*, 7.

Another example of a cadential arrival on an added-sixth tonic appears in Cole Porter's "Night and Day." The rich harmonic texture of this piece is evident even in just the few measures at the end where anticipations in the vocal part seem to occur an entire measure before the underlying harmony actually changes. The G in the vocal melody beginning in m. 65 belongs to the V^7 in m. 66 and the C in the second half of m. 66 is an anticipation of the C-major triad arriving in m. 67. It is not surprising that Porter adds an A to the final tonic to enhance its richness and to conform to the dense texture of many of the harmonies already present throughout the song.

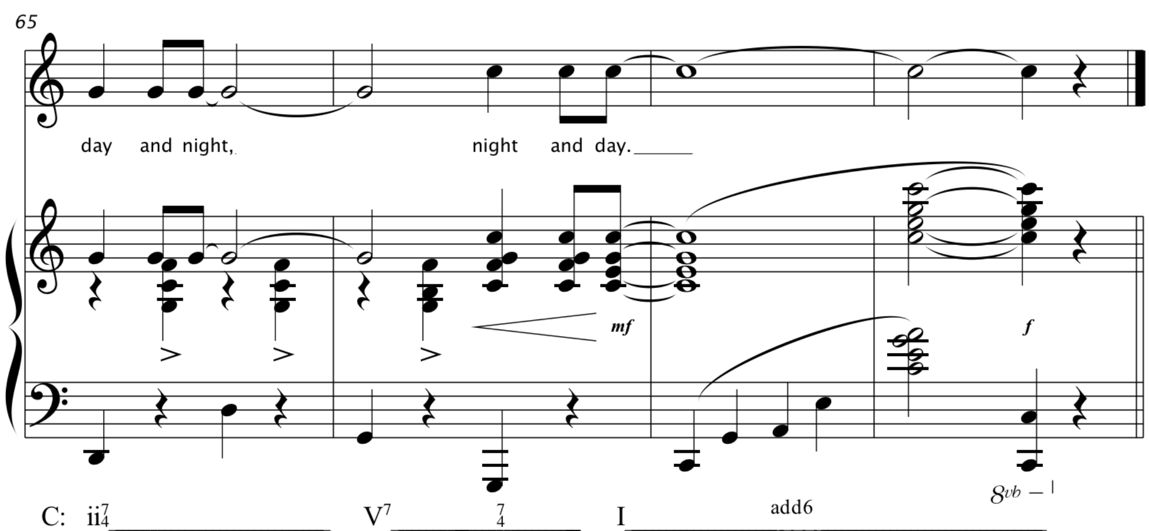

Figure 3.12. "Night and Day" *by Cole Porter, mm. 65-end.*

Rodgers and Hart's song "My Funny Valentine" in Figure 3.13 is yet another example of an authentic cadence leading to an added-sixth tonic. This particular example is even more compelling due to its textbook-style perfect authentic cadence formula. Both the vocal melody and the bass voice arrive on the tonic scale degree in m. 55 and both the tonic and dominant seventh chords are in root position. The added sixth does not occur until one measure after the so-called structural arrival on the tonic, but the stability of this sonority is unquestionable based on the presence of a strong tonic scale degree in the bass coinciding with the final chord.

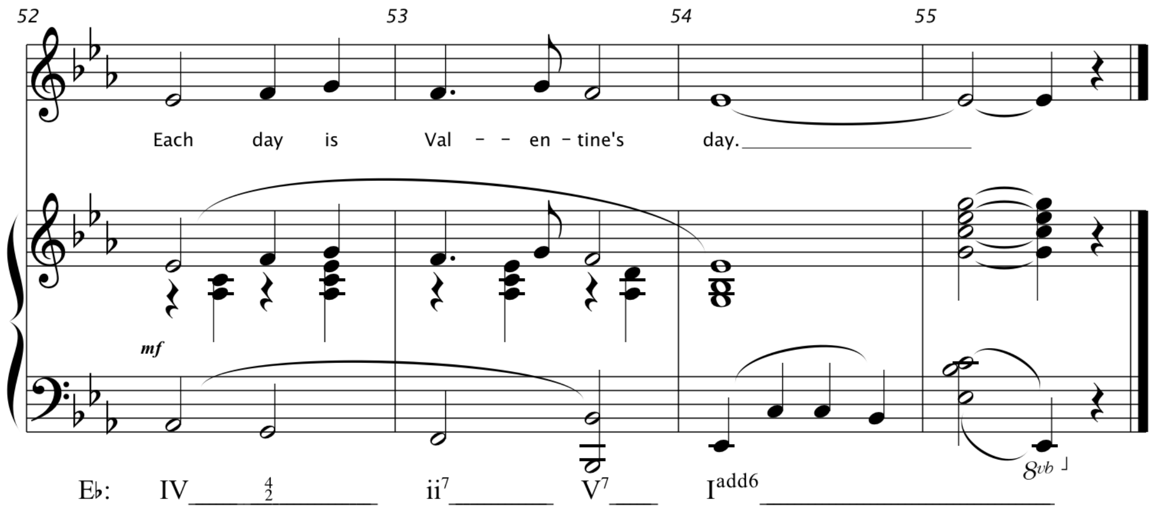

Figure 3.13. "My Funny Valentine" *by Rodgers and Hart, mm. 53-end.*

Not quite as ubiquitous as the added-sixth tonic, the added-sixth-and-ninth tonic usually appears in opening progressions rather than cadential arrivals. Another Cole Porter song, "So In Love" from *Kiss Me Kate*, opens with an F-minor added-sixth tonic before modulating to A-flat major. After opening with a 5-6 motion in the voice over an established tonic harmony in the piano, the voice uses two consecutive leaps of a fifth to add a ninth to the tonic and subdominant triads. The parallelism created between the first four and next four measures of the phrase makes a connection between these added ninths and the previous added sixths. The words "dear" and "close" could potentially be heard as incomplete neighbor figures to "but" and "to", respectively, but the relative length of the added sixth and added ninth fosters their perception as color tones rather than non-harmonic tones.

Figure 3.14. "So In Love" *from* Kiss Me Kate *by Cole Porter, mm. 13-19.*

Of course, one cannot mention the added-sixth tonic and not refer to the classic "Mack the Knife" from Kurt Weill's *The Threepenny Opera*. Even before Bobby Darin popularized the song (replete with semitonal modulations), Kurt Weill wrote "Die Moritat von Mackie Messer" around a characteristic tonic added-sixth chord. Weill's song is not the only one that features the added sixth throughout, however. The familiar oscillation between the tonic added sixth and the

V^{4}_{3} in Gershwin's "Summertime" from *Porgy and Bess* is another illustration of the relatively stable placement of the added-sixth tonic sonority.

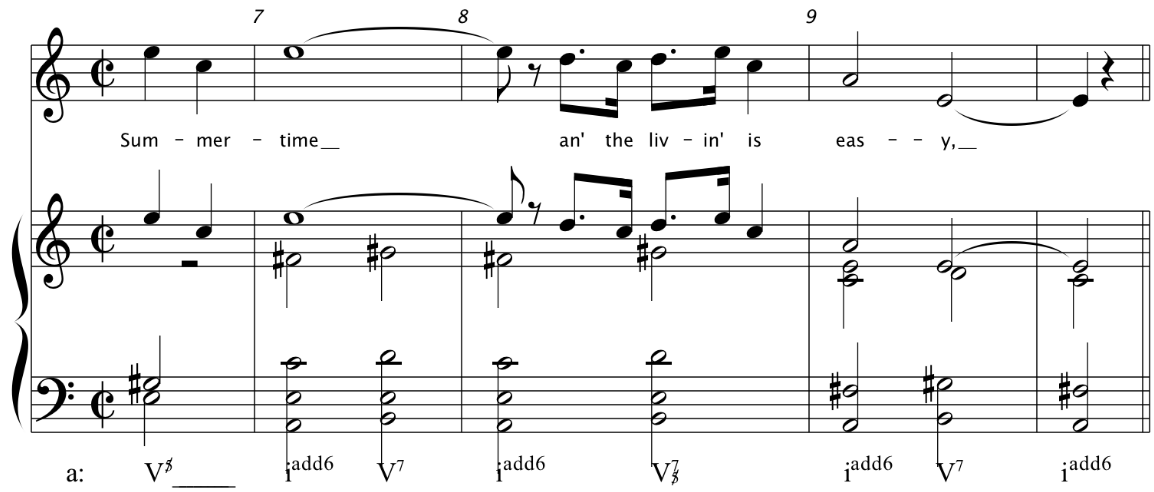

Figure 3.15. "Summertime" from Porgy and Bess by Gershwin and Gershwin, lyrics by DuBose Heyward, mm. 8-11.

This sort of opening directly on an added-sixth chord is not always the norm. Various ways of approaching an added-sixth tonic appear in the literature. The 5-6 motion approach that was used in "So In Love" in Figure 3.14 is also used in "'S Wonderful" from *Funny Face* by Gershwin and Gershwin, shown in Figure 3.5. An approach reminiscent of "Mack the Knife" appears in Cole Porter's "Anything Goes" from *Anything Goes*, in Figure 3.16. In this song, the added sixth is approached as what would appear to be a neighbor tone in common-practice tonality, but in this jazz idiom it provides some of the characteristic color of the song.

Regarding the common-practice use of the added-sixth chord, both Rameau and Riemann considered the characteristic dissonance of the subdominant to be an added-sixth chord.[107] Along with its use in jazz as a colored tonic, the added sixth can also appear as a subdominant function. Figure 3.16 illustrates one of the most well-known examples from "Anything Goes." Indeed, the title of the song first appears over a IV^{add6} - (ii - iv) - I, employing both modal mixture and an added-sixth chord as a subdominant sonority in a plagal cadence.

Figure 3.16. "Anything Goes" *from* Anything Goes *by Cole Porter, mm. 21-27.*

An excerpt from the Rodgers and Hart song "Bewitched" features the tonic seventh chord prominently. The introductory portion of the song is rich with seventh chords and a few other extended tertian harmonies. It is fitting to the style of the piece that Rodgers and Hart would include a tonic major-major seventh within the texture of the introduction. In this case, the seventh of the chord is actually approached by consonant skip in the vocal part, further adding to the essential nature of this "color tone."

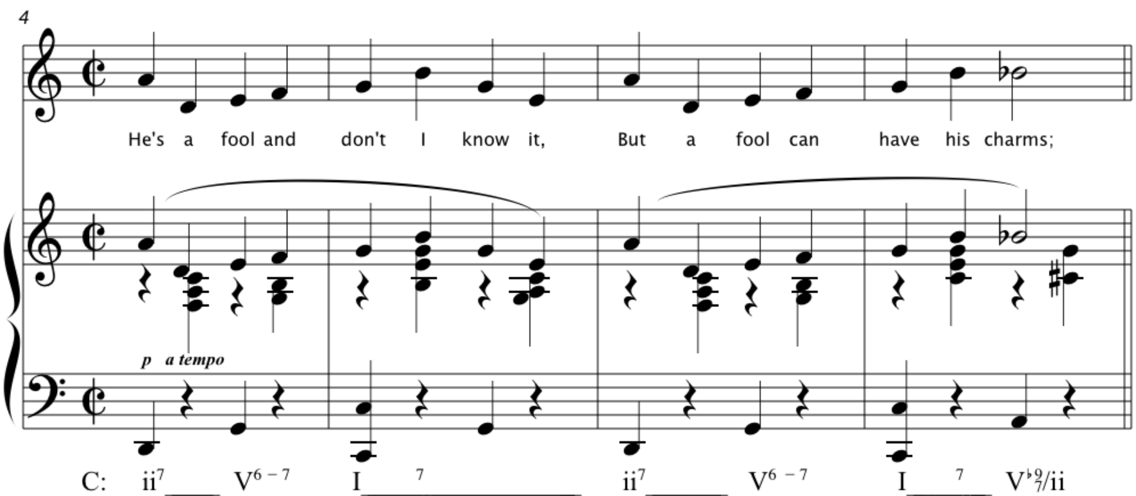

Figure 3.17. "Bewitched" *by Rodgers and Hart, mm. 5-8.*[108]

The connection of the tonic seventh and tonic added sixth through the use of 7-6 suspensions over the tonic scale degree is apparent in some of the earlier examples. Figure 3.10a features this connection prominently. This is an example of what Forte called the "assimilation of decorative tones" referred to earlier. The relative similarity between the two

[108] The recording of this song by Ella Fitzgerald prominently features tonic sevenths whereas the arrangement may suggest more of a 7-6 suspension figure in the vocal part. Ella Fitzgerald, "Bewitched," from *The Best of the Song Books*, Verve Records, 1993.

chords (being only a whole tone or semitone away from one another) also aids in the perception of the two chords as being similar in function schematically.

CHAPTER IV

DIRECTIONS FOR FURTHER RESEARCH

There are two strains of research into which I believe my theories can provide tremendous benefit, strains that I have mentioned previously. The study of infant behavior and perception in developmental psychology was one of the first areas of research that piqued my interest in consonance pedagogy. When I read the studies published by Trainor, Zetner, and Masataka it became clear to me that there was much more to consonance theory than was being taught in undergraduate tonal harmony courses. However, to truly come to a reasonable determination of the limits to infants' perception of consonance, more studies are needed to corroborate the work already done and extend it with the concepts of sensory consonance and harmonic stability as clearly-separated entities.

There is a tremendous amount of research already done on the topic of extending Schenkerian analysis beyond Schenker's own preferred repertoire. While Schenker believed that only the best composers of the common-practice era (especially the "great German composers" of this time) should be deemed masters and studied as such, his ground breaking theories on prolongational harmonic expansion and hierarchical musical structure have much to offer all genres of Western art music. Specifically, a solid foundation for the Schenkerian analysis of tonal jazz has already been established by scholars such as Steve Larson, James McGowan, Henry Martin, and many others. Their extensions of Schenker's own theories have been both well-received and argued against for various reasons. However, I believe this research essential to the pedagogy of musical analysis and fundamental to creating an analytical system based on cognition and perception. My theory presented in this thesis on harmonic stability mesh considerably well with the analytical techniques already used in the Schenkerian analysis of tonal jazz.

<u>Developmental Psychology: An Innate Preference for Consonance</u>

> [F]rom the newborn period on, infants prefer consonant sequences of harmonic intervals to dissonant sequences (Masataka 2006; Trainor and Heinmiller 1998; Trainor *et al.* 2002). Infants remain calm while listening to consonant instrumental music, but they show a variety of negative reactions when dissonant intervals replace many of the consonant intervals (Zentner and Kagan 1996). Infants are also proficient at detecting melodic changes, big and small, but they are considerably more accurate in the context of sequences with consonant melodic intervals than those with dissonant intervals (Schellenberg and Trehub 1996). The perfect fifth interval, which is ubiquitous across musical cultures (Sachs 1943), seems to be especially important for infant listeners (Trainor and Trehub 1993).[109]

With this half of a paragraph, Sandra Trehub summarizes almost twenty years of developmental psychology research into the perception of consonance in infants. This short summary offers a great deal of insight into musical enculturation and the possibilities of delimiting what is learned about music and what is innate. First of all, the preference for consonance over dissonance in infants as young as two months old is a paradigm-altering discovery.[110] Although some research has been done to corroborate this discovery, many more studies should be conducted to solidify the research both inter-culturally and—perhaps more importantly—cross-culturally. Further studies should take advantage of different forms of musical stimuli (i.e. vocal, sound sampling, live performances of both instrumental and choral music, etc.) and break away from the almost purely instrumental and synthesized music already

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[109] Sandra E. Trehub, "Music lessons from infants," in *The Oxford Handbook of Music Psychology*, ed. Susan Hallam, Ian Cross, and Michael Thaut, 229-234 (New York: Oxford University Press, 2009), 231.

[110] Trainor et. al., "Preference for sensory consonance in 2- and 4-month-old infants."

used. And perhaps most importantly of all, the degree to which infants are musically enculturated should be determined to find any sort of evolutionary basis for learned processes in music.

Masataka's article on infant consonance preference is of particular interest to further studies in this field for two reasons: it tested Japanese infants, and it tested infants of both deaf and hearing parents.[111] Masataka's research not only corroborated what Trainor et al. had discovered but also extended it in two unique and important ways. The cross-cultural relevance of infant preference for sensory consonance is an issue of some importance. If there is any evidence of a universal, early onset or innate preference for sensory consonance, can cultural considerations of adult consonance perception be valid? To what extent does this preference change over time? Is this preference physiologically based, as has been suggested by many studies, or could it still possibly be based on experience?[112] Studies involving the prenatal hearing environment and possible experiential contributions should be conducted in future research. Also, more MRI-based research should be conducted to test the emotional response of infants and adults to consonance and dissonance and the similarities therein.

Two more suggestions could potentially illuminate more information as well. While studying the preference for consonance of hearing infants of deaf parents is important—mainly due to the fact that presumably deaf parents would not be presenting their infants with a large amount of intentional auditory stimuli—non-musical environments should be considered. If it

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[111] Nobuo Masataka, "Preference for sensory consonance over dissonance by hearing newborns of deaf parents and of hearing parents," in *Developmental Science 9,* no. 1 (2006): 46-50.

[112] Laurel J. Trainor and Becky M. Heinmiller, "The development of evaluative responses to music: Infants prefer to listen to consonance over dissonance," in *Infant Behavior and Development 21,* no. 1 (1998): 86; Trainor et. al., "Preference for sensory consonance in 2- and 4-month-old infants," 193; Marcel R. Zentner and Jerome Kagan, "Infants' perception of consonance and dissonance in music," in *Infant Behavior and Development 21,* no. 3 (1998): 491.

were possible to avoid exposing an infant to prenatal auditory stimuli and parental vocalization, a close-to-unaltered innate preference could be determined. Aside from this consideration, testing the similarities between vastly different auditory environments and recording the degree of difference in prenatal auditory environments would be beneficial. Finally, the use of varying musical stimuli for the same test subjects should be considered. Not only should synthesized sounds be used, but live performances with the mothers' natural voice, familiar cultural instruments, and other native instrumental and vocal recordings should be used in the testing of consonance preference. This range of stimuli would allow a broader array of data with which to compare as well as a stronger basis for a universal innate preference should the data support such a theory.

A connection to Schenker's theories is also present in the research presented here. The fact that infants find it easier to compare melodies a perfect fifth apart (i.e. closely related keys) rather than a major third apart is consistent with some of Schenker's earliest writings on consonance and the nature of the Western tonal system.[113] Perhaps his metaphor cannot be accepted completely, but he is certainly not entirely wrong:

> [T]he fifth...is more powerful than the third...as the former...precedes the latter… It is not due to chance, therefore, but in accordance with Nature's prescription, if the artist always has felt, and still feels, the perfect fifth to be more potent than the third. The fifth enjoys among the overtones, the right of primogeniture, so to speak. It constitutes for the artist a unit by which to measure what he hears.[114]

Certainly one aspect of Schenker's idea is true: "the perfect fifth is more potent than the third." In the case of infant perception of melodic transposition, quite literally.

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[113] Trainor and Trehub, "Musical context effects in infants and adults: Key distance," in *Journal of Experimental Psychology: Human Perception and Performance 19* (1993): 624.

[114] Schenker, *Harmony*, 26.

A final quotation from Trehub before ending the discussion of developmental psychology.

> Like their adult counterparts, [infants] perceive the equivalence of melodies across changes in pitch level, or transposition (Chang and Trehub 1977; Trehub *et al.* 1987) and across changes in tempo (Trehub and Thorpe 1989). Unlike their adult counterparts, who are differentially sensitive to familiar diatonic scales, infants experience no more difficulty detecting changes to melodies based on the Javanese pelog scales than to those based on Western diatonic scales (Lynch *et al.* 1990). Similarly, they perform as well on invented scales as on the major scale, provided that the invented scales incorporate the principle of unequal step size (Trehub *et al.* 1999). Although infants are surprisingly proficient at detecting melodic changes (Trehub 2000), they are unlike adults in their insensitivity to the implications of key membership or harmony (Trainor and Trehub 1992). The available evidence indicates that such sensitivity requires years of culture-specific exposure to music, emerging between 5 and 7 years of age (Trainor and Trehub 1994) and exhibiting further development thereafter (Lamont and Cross 1994).[115]

Again, developmental research basically upholds my theories that while sensory consonance is more or less an innate physiological response—or at the very least is quickly apprehended by infant experience— the understanding of harmony and tonal context is a learned process that takes years to develop. This is further reason for the separation of physiological consonance perception and enculturated notions of harmonic instablity. The brain seems to distinguish sensory consonance from musical schemata associated with culture-based musical activity; thus it would only make sense to separate the ideas in a pedagogical approach to consonance.

Schenkerian Analysis of Jazz: Extending and Repurposing Schenker's Techniques

The use of Schenkerian techniques for analyzing tonal jazz is not a new concept. Most recently, Steve Larson's book *Analyzing Jazz: A Schenkerian Approach* puts the use of

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[115] Trehub, "Music lessons from infants," 232. The reference to "implications of key membership and harmony" entail that infants cannot identify tonic sonorities within a key and have no real concept of harmonic progression.

Schenkerian theory on jazz repertoire firmly in the realm of acceptable possibilities. However, most scholars still find it necessary to qualify the use of Schenker's theories with any repertoire that Schenker himself did not analyze. I believe these qualifications to be completely unnecessary, especially in light of the theories discussed in this thesis.

James McGowan began his article on consonance and the Schenkerian analysis of tonal jazz with what I have found to be a typical reaction: If consonances are the only stable points in tonal music, what about all the dissonances in tonal jazz?[116] Jazz musicians often freely admit their preference for and awareness of dissonances in jazz music, as is evident by McGowan's own survey of jazz harmony textbooks.[117] However, unlike their use in common-practice tonality, these dissonances often do not need resolution to a more consonant sonority. Dissonances are points of resolution in their own right, given the proper context. McGowan gives an example of three different tonics at the end of authentic cadences in a few tonal jazz pieces. He notes for all of these examples that:

> In each case, a dominant chord implicates the arrival on tonic and the resulting resolution provides a sense of repose. However, beyond the triad, these apparently consonant tonic chords also include a chord tone of an added (major) 6th, major 7th, and minor 7th above the root, respectively. Further, Example 1c also includes an additional major 9th extension.[118]

All of these extended tonic sonorities were discussed in chapter three under "Stable Dissonances." In each case, the "sense of repose" to which McGowan refers is as a result of musical schemata, in this case the general idea of the authentic cadence.

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[116] McGowan, "'Consonance' in Tonal Jazz," 69.

[117] Ibid., 84-92.

[118] McGowan, "'Consonance' in Tonal Jazz," 69-70.

McGowan proceeds to contextualize the idea of consonance as a cultural phenomenon varying depending on context, specifically citing Norman Cazden and the theories discussed in my chapter two.[119] However, it is unnecessary to change consonance from a physiological definition when McGowan himself notes that dissonances are "both idiomatic and *contextually stable* in tonal jazz."[120] The contextually and culturally determined aspect is harmonic stability rather than consonance.

Furthermore, the addition of tones to the tonic triad can be described as what Neil Minturn refers to as "tonal interpreters." Minturn noted that in the music of Prokofiev, a passage will often be embellished by certain ostensibly "wrong" notes, or notes that seem out of place in the given tonal context. He referred to underlying the tonal structure as a "tonal interpreter":

> The concept of tonal interpreter captures those aspects of a passage which create tonal stability without also asserting that all components of the passage so contribute. By a tonal interpreter I shall mean a harmonic triad, a diatonic scale segment, or a functional bass segment or progression whenever such a set is heard to organize pitches around it into a locally tonal scheme.[121]

Of course, looking back on the discussion of musical schemata, what Minturn refers to are in fact schemata. These underlying schemata reflect the stability of the tonal context and the "wrong notes" around these schemata do not adversely affect the harmonic stability. The added tones of the tonic chords in McGowan's example fit this paradigm as well.

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[119] McGowan, "'Consonance' in Tonal Jazz," 71-72.

[120] Ibid., 71. Emphasis added.

[121] Neil MInturn, *The Music of Sergei Prokofiev* (New Haven, CT: Yale University Press, 1997), 61.

Larson's chapter entitled "Questions About Method" has a few key points in the argument about Schenkerian analysis and tonal jazz. Larson posits three questions that often appear when discussing Schenkerian analysis of jazz music:

> (1) Is it appropriate to apply to improvised music a method of analysis developed for the study of composed music? (2) Can features of jazz harmony (ninths, elevenths, and thirteenths) not appearing in the music Schenker analyzed be accounted for by Schenkerian analysis? and (3) Do improvising musicians really intend to create the complex structures shown in Schenkerian analyses?[122]

I would like to readdress two of these questions, taking them from a different standpoint than did Larson. To the first question, I emphatically agree with Larson. Schenker's own ideas about improvisation and the nature of composition have been previously discussed and there is no need for restatement here.[123] It is on the second two questions that I wish to elaborate upon Larson's response.

As to the second question, I believe that when reinterpreting Schenkerian analysis as either a method for illuminating perceptual phenomenon in music or for illuminating compositional properties, features of jazz harmony not appearing in common-practice music need not be a problem. Reduction-based analysis has value on its own apart from Schenker's concept of the *Ursatz* and *Urlinie*. The approaches of Lerdahl and Jackendoff and David Temperley come to mind as examples of reduction-based analysis not linked with Schenker's

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[122] Steve Larson, *Analyzing Jazz: A Schenkerian Approach,* no. 15 of Harmonologia Studies in Music Theory (Hillsdale, NY: Pendragon Press, 2007), 4.

[123] John Rink, "Schenker and Improvisation," in *Journal of Music Theory 37* (1993): 1-54; Schenker, "The Art of Improvisation," in vol. 1 of *The Masterwork in Music*, ed. William Drabkin, trans. Richard Kramer (New York: Cambridge University Press, 1994), 2-19.

overarching theories.[124] Reduction-based (or prolongational) analysis is more closely associated with Gestalt psychology principles of grouping and pattern formation and especially in the principle of *Prägnanz* or the "law of the shortest path."[125] These Gestalt principles in turn help create schemata that appear on both the surface of the musical work and at deeper levels of reduction.

As far as illuminating compositional properties is concerned, these aspects do not necessarily need to be directly linked to the composer's intent, as Larson notes. Larson states that this is an example of the "intentional fallacy" as argued by W.K. Wimsatt and Monroe Beardsley.[126] Literary criticism has long held that a work of art is open for criticism regardless of the author's intent or purpose and that an author's intentions cannot be discerned from a work of literature. Along the same vein, when analyzing music based on either perceptual or compositional grounds, one need not have insight into the composer's thought process. Questions about authorial purpose are unnecessary and often impossible to determine. Phenomenological considerations and structural consistencies within the work can, however, provide an excellent basis for an analysis of the work.

Beyond the considerations of these three questions, deviations from "orthodox" Schenkerian analysis have occurred quite often in analytical literature. David Neumeyer's articles on "The Ascending Urlinie" and "The Three-Part Ursatz" and Irna Priore's dissertation and subsequent article on continuous-$\hat{5}$ paradigm in sonata-form interruption are extensions within

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[124] Fred Lerdahl and Ray Jackendoff, *A Generative Theory of Tonal Music* (Cambridge, MA: The MIT Press, 1983); Temperley, *The Cognition of Basic Musical Structures*.

[125] Lerdahl, *Tonal Pitch Space,* 74.

[126] William Wimsatt and Monroe C. Beardsley, "The Intentional Fallacy," in *The Verbal Icon: Studies in the Meaning of Poetry* (Lexington: University of Kentucky Press, 1954), 3-18.

Schenker's own chosen repertoire.[127] Adam Ricci's use of Schenkerian analysis to analyze modulations in the music of Chicago and Guy Capuzzo's use in the music of Radiohead and King's X are further examples, in these cases outside of common-practice tonality.[128] Given these varied extensions to Schenker's theories, Henry Martin's assertion is no surprise:

> With the complications of fully-developed, multi-part jazz composition mostly avoided in practice, such complex and controversial issues of traditional Schenkerian theory as the status of structural levels over long time-spans, to cite one example, rarely arise: the music remains melodically concentrated and rather circumscribed formally. Further, given bop's chromaticism, nondiatonic fundamental lines and other deviations from Schenkerian orthodoxy occur with frequency. Thus there is no *required* descent of a diatonic fundamental line from $\hat{3}$, $\hat{5}$, or $\hat{8}$.[129]

Martin even addresses the issue of extended chord tones saying that they "may function either as chord tones or nonchord tones" but that "in either case they are relatively dissonant to the pitches of the underlying triad."[130] Here, Martin recognizes the dissonance and yet stability of extended chord tones on triadic structures, thus allowing them to be placed at deeper structural levels in Schenkerian graphs.

When one starts to consider reduction-based analysis and voice-leading graphs as products of cognitive processes—whether perceptual or compositional—problems of

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[127] David Neumeyer, "The Ascending 'Urlinie'," in *Journal of Music Theory 31,* no. 2 (Autumn 1987): 275-303; David Neumeyer, "The Three-Part Ursatz," in *In Theory Oniy 10*, nos. 1-2 (1987): 3-29; Irna Priore, "Further Considerations About the Continuous $\hat{5}$ with an Introduction and Explanation of Schenker's Five Interruption Models," in *Indiana Theory Review 25*, (Spring-Fall 2004): 115-138.

[128] Adam Ricci, "A 'Hard Habit to Break': The Integration of Harmonic Cycles and Voice-Leading Structure in Two Songs by Chicago," in *Indiana Theory Review 21* (Spring-Fall 2000): 129-146; Guy Capuzzo, "Sectional Tonality and Sectional Centricity in Rock Music," in *Music Theory Spectrum 31* (2009): 157-224.

[129] Henry Martin, *Charlie Parker and Thematic Improvisation,* no. 24 of Studies in Jazz (Lanham, MD: The Scarecrow Press, 1996), 13-14.

[130] Ibid., 14.

“Schenkerian orthodoxy” are no longer a factor. Mary Louise Serafine described these kinds of cognitives processes, saying that:

> [I]n addition to changing, style-specific cognitive processes, there must also be some generic cognitive processes that are stable across different styles. I refer to these as *generic* processes because I conceive of them as panstylistic, and I have avoided the stronger term *universal* only because it is difficult to demonstrate true universality. The reader should note, however, that I intend the term *generic cognitive processes* to refer to those cognitions applicable to many if not all styles.[131]

Again, Serafine’s “generic cognitive processes” bear a striking resemblance to musical schemata and are exactly the kinds of things that can be illuminated by Schenkerian analytical techniques.

In connection with my own theories, harmonic stability becomes the primary generator of background structure. Stability is therefore created by musical schemata and is not contingent upon physiological considerations of consonance and dissonance. Dissonance can then be considered stable given a stylistically-consistent tonal context. When analyzing any piece of music with reduction-based techniques, common musical schemata should be the end goal of deeper fundamental structures. Rather, common schemata are exactly the structures that should be illuminated to demonstrate stylistic norms and patterns of perception and cognition.

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[131] Serafine, *Music as Cognition,* 39.

CHAPTER V

CONCLUSION AND SUMMARY

Consonance and harmonic stability are two concepts often talked about in musical discourse but not often completely understood. I have attempted to form a theory based on the knowledge of their uniqueness. Rather than continue to discuss either topic with hints of the other, it is now not only possible but necessary to discuss them as separate entities. Both have a wealth of information to offer music analysis and understanding. Pedagogical approaches, psychological studies, analytical techniques, and so much more should be affected by understanding consonance and harmonic stability as separate perceptual elements of music.

I was able to see the value of my own theories in my approach to aural skills pedagogy. One of the most confounding parts of aural skills training for my students in the past has been chord quality identification. Recognizing and identifying chords in isolation from a musical context, while not without merit entirely, has always been a curious endeavor for myself, as well. When I started to develop my theories about consonance and harmonic stability more fully, however, I began approaching the descriptions of isolated chords differently. I realized that I could use these terms to describe isolated chords for both their inherent qualities (e.g. consonant or dissonant) and their most common schematic association (e.g. stable or unstable).

I started asking my students questions such as, “Does this chord sound like it needs to resolve?” or, “Are there clashing tones within this chord?” to try and elicit a response about either instability or dissonance respectively. Almost invariably, I would play a chord such as a root-position major-major seventh and get “No” and “Yes” as answers, indicating that they thought of the chord as a stable dissonance. Similarly, I would play a fully-diminished seventh chord and get “Yes” and “Yes” as answers, indicating an unstable dissonance. After that experiment, I described to them the basic idea of consonance as “thing describer” and harmonic stability as “context describer.” In this way, I told them they could contextualize every isolated major-minor seventh chord as a dominant seventh.[132] Every isolated major or minor triad could be a tonic. Every isolated diminished-minor seventh could be a supertonic seventh, and so forth.

The most rewarding part of this experiment to me was not the ability to use my theories in a classroom; it was the fact that the students started performing better. Once they recognized their own mental schemata and physiological perception, they could use them to understand music more easily. By that time, I was determined to finish forming my theories and provide adequate support for their realization.

Through the course of this thesis I have outlined a pedagogical approach to understanding consonance and harmonic stability as separate aspects of musical sonorities. Consonance has been described as a physiological perception based on the interaction of tones along the basilar membrane. Due to the complex nature of complex tones (if you’ll pardon the pun), certain two-tone combinations are difficult to evaluate as more consonance or more dissonance, but a continuum of consonance to dissonance can be established. Harmonic stability is a product of musical schemata built up by repeated exposure to the same kinds of musical

[132] Of course, I do not mean to say that every Mm7 chord is a dominant seventh. I only mean that in the course of teaching an aural skills class on the subject, it is helpful to be able to identify a Mm7 chord in isolation as *usually* resolving as a dominant seventh. In this way, students can clearly identify the chord quality of this sonority.

contexts. The expectations for these schemata, either as setting up tension or providing closure, are the basis for harmonic stability and instability in music.

While a vast number of approaches to consonance have been theorized, throughout music history descriptions of consonance have been more or less the same. Harmonic dyads that have ratios of integers 1 through 6 have generally been described as being consonant. When these ratios were transfered into physiological perception through frequency ratios, consonance and dissonance were described based on the beating of upper partials. It was only later, in an attempt to justify musical practice, that the issue of consonance being conflated with harmonic stability arose. Rather than recognize another category—namely, stable and unstable—of musical perception and cognition, many theorists and composers assumed that the human ear had evolved beyond limitations of dissonance requiring resolution.

Modern psychological research has proven otherwise. Infants seem to show a preference for consonance over dissonance. However, infants and toddlers have no concept of harmonic function or tonal syntax. This perception arises later after repeated exposure to musical stimuli. Since the development of tonal perception and consonance perception happen independently of one another, it seems only natural to describe and define consonance and tonality as separate concepts. This is where the idea of consonance and harmonic stability as separate topics starts to take shape.

Since the use of dissonant sonorities in tonal jazz often occurs in the place of more consonant sonorities in common-practice tonality, the use of dissonance within a stable musical schema is apparent. Authentic cadences do occur in tonal jazz, but often the final tonic sonority is more dissonant than a simple triad. Rather than create an instability that must resolve past the cadence, the brain understands the schema to be complete and allows a dissonant sonority to be perceived as stable given the tonal context. Based on this idea, any number of sonorities could be established as stable if a listener has a sufficient familiarity with a musical idiom.

The use of Schenkerian analysis seemed the most fitting extension of my theories. Revising Schenker's theories to allow for stable dissonances as well as stable consonances provides tonal jazz a firm foundation in a prolongational analysis. Rather than challenge the work already done on the Schenkerian analysis of tonal jazz, I merely propose a revised way of defending the use of Schenker's techniques outside of a common-practice tonal setting. Further extensions of prolongational analysis could be possible in post-tonal music as well, given the right contexts for creating musical schemata.

More research on the perception of consonance and harmonic stability is of course necessary. The proposed avenues of research presented here are a small portion of the studies necessary to determine the physiological and psychological basis for understanding consonance and harmonic stability as separate perceptions. The research already done in developmental psychology merely provides the best starting point for expanding such an understanding. Studies using adult listeners as well as cross-cultural studies should of course attempt to confirm my theories as well.

Whatever the outcome of said studies, the approach is still a useful pedagogical tool. Understanding how harmonic entities interact within a tonal context and how their inherent qualities affect those interactions plays a key role in teaching tonality in undergraduate theory courses. I hope that my theories will be corroborated through further research, but even if conclusive evidence cannot be shown they still have a great deal to offer to the understanding of tonal syntax and harmonic tension.

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