MUSIC, MOTION, AND SPACE: A GENEALOGY

by

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A DISSERTATION

Presented to the School of Music and Dance
and the Graduate School of the University of Oregon
in partial fulfillment of the requirements
for the degree of
Doctor of Philosophy

June 2015

DISSERTATION APPROVAL PAGE

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Title: Music, Motion, and Space: A Genealogy

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Degree awarded June 2015

DISSERTATION ABSTRACT

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How have we come to hear melody as going "up" or "down"? Why does the Western world predominantly adopt spatial terms such as "high" and "low" to distinguish musical notes while other non-Western cultures use non-spatial terms such as "large" and "small" (Bali), or "clear" and "dull" (South Korea)? Have the changing concepts of motion and space in people's everyday lives over history also changed our understanding of musical space? My dissertation investigates the Western concept of music space as it has been shaped by social change into the way we think about music today. In our understanding of music, the concept of the underlying space is so elemental that it is impossible for us to have any fruitful discourse about music without using inherently spatial terms. For example a term interval in music denotes the *distance* between two combined notes; but, in fact, two sonic objects are neither near nor far from each other. This shows that our experience of hearing interval as a combination of different notes is not inherent in the sound itself but constructed through cultural and social means. In Western culture, musical sound is often conceptualized through various metaphors whose source domains reflect the society that incubated these metaphorical understandings. My research investigates the historical formation of the conceptual metaphor of music. In particular, I focus on historical formation of the three underlying assumptions we bring to our hearing of music: (1) "high"

and "low" notes and motion between them, (2) functionality of musical chords, and (3) reliance on music notation. In each chapter, I contextualize various music theoretical writings within the larger framework of philosophy and social theory to show that our current understanding of musical sound is embedded with the history of Western culture.

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ACKNOWLEDGMENTS

I wish to express my sincere gratitude to my advisor, Professors Jack Boss, who encouraged me to pursue this history of music theory project, and provided critical reflections and proofreading assistance throughout the process of my writing.

My interest in the historical formation of musical space goes back to the class on the Enlightenment science taught by Professor Roger Mathew Grant. The final paper for that class was the earliest version of my chapter on the Greek monochord. His continued support from East Coast also guided me throughout the process of writing this dissertation. This dissertation would not have been possible from kind support from him.

My interests in Greek and Medieval music theories come from the first term of the history of music theory class taught by Professor Lori Kruckenberg. All of my knowledge on this topic is rooted from that class. Also, I am grateful for the support from Professor Michael Allen, particularly on his comments on the third chapter of this dissertation.

I am thankful for the support and encouragement from Professor Stephen Rodgers, who carefully listened to my ideas and provided critical suggestions. The discussion of *Mehrdeutigkeit* in the third chapter came from his insight.

Lastly, Wing Lau provided crucial support for meeting the deadline for the submission. She looked over the bibliography as well as general formatting of the first and second chapters. Also, her steadfast writing process for her own dissertation on the notated meter change in Brahms's songs inspired me daily to work on this dissertation.

To my family

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CHAPTER I

INTRODUCTION

Our current conceptualization of music depends upon a framework in which musical objects are related with reference to space. This is assumption so elemental that it is impossible to have any discourse on music without using inherently spatial concepts such as "high" and "low" pitch, intervals between pitches, and inversion of their relations. Also, the modern concept of harmony, as a "sounding together" of different musical objects, contains a question regarding the location of the different harmonious objects. The same goes for the concept of melody; it is a succession of single notes located above or below one another. At a more basic level, a musical note—the most fundamental building block of Western music—is not only a unit of musical sound, but also carries the potential for motion. Notes are distinguished from one another based on their locations in conceptual musical space. Yet, we all know that sounds are not actually high in the air or low on the ground, nor are there spatial intervals between them or inversions among them. Nevertheless, the metaphors have been naturalized; when a melody is described as moving up or down, we do not need to unpack the metaphor of high and low as they map on to the different pitches of corresponding frequencies; we just intuit its meaning. Many music theorists, musicologists, ethnomusicologists, philosophers, and neuroscientists point out that the spatial conceptualization is merely one of many ways to talk about, and understand music.[1] In Western culture, however, the absence of competing models of conceptualization made the

[1] Among many contemporary sources, see in particular Larson (2012); Zbikowski (2002); and Gjerdingen (1994). For a more historical account, see Lee Rothfarb's chapter in *Cambridge History of Western Music Theory* (2002) and Zukerkandl's *Sound and Symbol* (1956).

spatial understanding of musical objects subsume all other possible ways to organize musical sound in our minds.

My dissertation is a genealogy of the contemporary understanding of musical space from its birth in ancient Greek philosophy through to twenty-first century theories of music. Since Late Greek antiquity and early medieval periods, the spatial understanding of musical sound, disguised as the only way to hear music, impacted the entire demographic of Western culture. Most importantly though, it formed how music theorists think about music; the people who constructed the system of conceptualizations in a transmittable form. Within the system, a musical note came to be understood as an entity in a void-like space. Following the Greek concept of monad, as the indivisible and the most fundamental unit of being, a musical note became a sonic monad of which more complex events are built. Along with the concept of monad, a concept of space was formed as it was needed to allow for the potential complexity of the monad. The concept of a note as an entity in space offered a possibility of imagining another note simultaneously occupying the same space. In other words, Western polyphony (in the widest application of the meaning, as non-monophony) is built on the assumption that there exists a space in which more than one note can simultaneously occur. Without the spatial conceptualization and the treatment of a note as a single entity, the sonic element we call polyphony, or more broadly, harmony, would just be considered as a single sonic element of its own. We sometimes experience this outside of musical contexts, such as in the case of a dial-tone or train whistle. Although we can parse out the different pitches that constitute a dial-tone or a train whistle, our immediate intuition is rarely to hear it as a combination of two distinct sounds. Rather, the process of parsing out is only applicable after projecting a musico-spatial filter to the sonic materiality of the dial-tone or train whistle.

The musico-spatial reinterpretation enables commensurability between different types of sound. The reason that we can relate the sound of a piano and a violin, (or any other combination for that matter) as operating in a single conceptual canvas, thereby creating a harmony, is because we normalize the raw sonic materials (piano- and violin-ness) into a feature that is commensurable, a difference in frequency ascribed onto vertically-oriented space.[2] The vertically-oriented space is quantified so that it is possible to measure the vertical distance (the height) of a pitch. Other musical aspects are either quantifiable in different measure—as in the case of duration, or not quantifiable at all in musical terms as in the case of dynamics. However, these aspects do not acquire a meaningful interpretation without a note which they are ascribed to. It is always discussed as duration and dynamics of a note. In other words, other aspects of music are modifiers of a spatially defined note.

In general, establishing commensurability between two distinct objects requires this kind of normalization which enables the act of comparing with the same tools of measurement. This is how Aristotle was able to relate a house and a bed in *Nicomachean Ethics* (5.5.1133a6-14) and also why Karl Marx needed to establish socially necessary labor-time as a common measure of all commodities in *Capital* (1990, 129). In the musical context, the most relevant establishment of commensurability was done in the context of Pythagorean-Platonic

[2] Although it is not the main scope of my work, it is worth noting that temporal unfolding is ascribed onto horizontally-oriented space. Preconditioned by ancient Greco-Roman writing practice, the left-to-right orientation of temporal unfolding was the default mode of any script writing in Western tradition. This, in turn, preconditioned the non-temporal aspect of the music (which ended up being a difference of pitch) to be ascribed in the vertical space. This observation becomes more meaningful when compared with the ancient East Asian practice of writing practice which ascribes the temporal unfolding on to vertically-oriented space—the opposite from Western practice. I think the vertical writing practice of East Asia is imposed by the writing surface, narrow strips of wood or bamboo. The vertical growth of these writing surfaces embodies the temporal changes as vertical, not horizontal.

ontology. In the Pythagorean-Platonic view of the world, the essence of every being and the relationship of beings in the world can be expressed in numbers and ratios. Therefore, the study of number was the study of the essence of the universe. There are four different studies of number: arithmetic—study of discrete number, music—study of numbers in proportion, geometry—study of continuous magnitude, and astronomy—study of magnitude in motion. In this Greek epistemological context, the discipline of music is first defined as a study of ratio. Through the use of number, the musical object was first defined as an inherently commensurable concept. The concept of space, therefore, was not necessary, nor systematized because musical objects moved not spatially but quantitatively. However, throughout the history of Western music, philosophical, scientific, and technological discourses and interventions have altered the concept of space dramatically. My dissertation accounts for these reorientations in intellectual history as they impact the critical study of musical sound.

The document will comprise three main sections, each investigating crucial moments in the history of music which shaped the way we think about space. The second chapter, "The Greek Monochord and the Birth of Musical Space," investigates the epistemological ground in which the concept of musical space emerged. Drawing from Andrew Barker's comment on Aristoxenus's "movement,"[3] David Cohen's work on Aristotelian "directed

[3] Barker argues that Aristoxenus's emphasis on perception suggests categorical difference between the meaning of the word "movement" (κίνησις) used in *Elementa Harmonica* and the contemporary understanding of the motion in musical context. The former denotes motion as change of place felt by the listener and the latter denotes motion as "physical events or processes that might give rise to them." (1989, 132n37) Cohen (2001) also cites Barker's note as part of the summary of Greek understanding of motion and its application in music.

motion" (2001, 139),[4] David Creese's work on the role of the monochord in ancient Greek harmonic science (2010),[5] and Bernard Stiegler's recent writings on technics, I reinvestigate the role that the monochord played in the conceptualization of musical space among the earliest Greek writers on music. Used as a "venerated tool of speculative canonics" (Christensen 2001, 5) I argue that the movability of the bridge on the monochord's stretched string was crucial to the development of a new meaning for motion in the musical context. This new meaning of motion, recontextualized by the use of the monochord and disseminated by the flourishing of script writing in the early medieval period, contributed to the formation of Western pitch space that is still the dominant mode of musical conceptualization today. Primary sources will include Plato's *Timaeus* (Strunk and Treitler 1998, 19–23), the "Euclidean" Sectio canonis (Barker 1989, 190–208), Aristoxenus's *Elementa harmonica* (Barker 1989, 119–198), and Ptolemy's *Harmonics* (Barker 1989, 270–391), in order to show the broadening definition of "motion" in the musical context and its relation to the way the monochord is described.

A stretched string with a movable bridge, the monochord offers us a bodily basis within which motion can be interpreted in terms of space. In the context of the Aristotelian definition of motion as an interaction of potentiality and actuality, change of place is one of the four species of motion, but was not used in musical contexts. Instead, when the word "motion" (κίνησις) was used, it referred to a change of quality (i.e. a man becoming musical). As we shall see, even in the Euclidean *Sectio Canonis*, motion is still not defined in spatial

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[4] See especially his footnote one for the summary of Aristotelian concept of motion and its various application by Pythagoras-Plato, Aristotle, Aristoxenus, and Theophrastus.

[5] Creese argues that the physical nature of the monochord instigated geometrical thinking into ancient harmonics.

terms. The motion described in these documents more closely resembles vibration. It is important to note that although these documents discuss the monochord, there is no mention of its construction—there is no description of the moveable bridge. Compare these with Ptolemy's *Harmonics*, which offers a more embodied description involving the shifting of a bridge as a way of generating a different ratio–thereby moving to a different pitch. As the change of ratio is recontextualized as change of location, a pitch is concurrently understood as an entity navigating through pitch-space determined by ratio. Drawing attention to the classical and antique definitions of motion—too often read uncritically in musicological literature—I aim to demonstrate the critical role that the monochord played in the solidification of the concept of space.

The third chapter, "the Genealogy of Musical Function" investigates the emergence of musical function in eighteenth and nineteenth century theoretical treatises. In this section, I argue that the rise of function as the organizing principle of musical composition is situated with and influenced by the changing mode of production from craftsmanship to industrial production. Contrast to the craftsmanship model where one artist oversees the entire process of production, the newly emerged industrial production segmented the process of production into many steps. This change inspired the metaphorical conceptualization of a musical work as a combination of various objects where the quality of the production hinges on the lawful behavior of the internal objects.

To present the conditions that made this metaphor possible, I begin by making the distinction between identity and function of a musical object. By looking at music theoretical treatises of Jean-Philippe Rameau (1726), Georg Joseph Vogler (1802), and Gottfried Weber (1830), I will show the process in which the three terms dominant, tonic, and sub-dominant change their meaning. I argue that, in Rameau's theory, these three concepts did not

distinguish where they are located in vertical pitch-space and how they are connected in horizontal time-space. This, however, began to change following Vogler's introduction and Weber's popularization of the Roman numerals. As Roman numeral had exclusively denoted a location in vertical pitch-space, the pre-existing terms (dominant, tonic, and sub-dominant) became exclusively used for horizontal designation; this eventually made these terms a functional designation. With two systems operating at two different spheres, a musical chord that both systems refer to was solidified into an inseparable entity thereby becoming a basic building block of composition. The primacy of a triad over a note was further increased as the concept of the overtone series was adopted by music theory of the time. The two observations that a major triad can be represented by its chordal root and the root contains the major triad via overtone formed a feedback loop out of which came the notion that a triad is a natural phenomenon, not an artificial combination of tones.

This ontological solidification of a musical chord is met with another, similar, process at the other end: the emergence of the musical work-concept. As observed by Lydia Goehr (2007) and other historians, a musical composition started to become an entity that is regulative where the boundaries of the concept are clearly set. This shifted the focus of compositional theory since the eighteenth century from how to emit a consistent affect through the rules of rhetoric to how to fit musical objects within the boundaries of a compositional framework. In this context, coming up with a logical connection from one chord to another and one formal section to another, with the goal of a finished work became the main concern. This led to the investigation of the function of each part.

I conclude this section with the claim that we, as human beings in an industrial society, conceptualize a musical composition as an industrial product. A musical chord and it function are conceptualized as a worker and a task (respectively) in a factory. The fulfillment

of each step generates a product which is designed beforehand. This underlies that the behavior of the internal part affects the quality of the final product. And because each step is distinguishable, a quality of a composition can be controlled after the process of production. This provided the epistemological ground for two seemingly contradictory movements; one is *Werktreue* and the other is the practice of revision. This also provided the ground for the ownership of the musical work by the composer, not the publisher. As the internal components are considered to be the workers in the factory, the composers saw themselves as the rightful owner of the product.

The fourth chapter, "Reflection on (and in) Strunk's *Tonnetz*," investigates current music theory's reliance on notation. By surveying various branches of Neo-Riemannian analysis in light of a jazz music theorist Steven Strunk's adaptation (Strunk 2003), I show the assumption of notationality of musical sound. In Neo-Riemannian analysis, there are three major operations (*parallel*, *relative*, *leittonwechsel*) that can be applied to any major or minor triad. Although originally defined as vertical inversion of a triad (a "contextual" inversion) by Hugo Riemann in the nineteenth century, Neo-Riemannian analysis breaks the bond of unity of triad and treats these operations in the realm of voice-leading. Although Neo-Riemannian theorists still acknowledge the contextual inversion as the origin of the operations, their focus was never the inversion of a triad, but a voice-leading of a chord-tone. The Neo-Riemannian theorists continued this idea by constructing a geometrical mapping of these relations that created a torus-like network, for which they adopted the term *Tonnetz*. From this origin, a *Tonnetz* became a representational surface where a musical notes are arranged so that certain relationship between chords and chord tones are brought out. This meant the operation of voice-leading would still be done in a staff notation; only the result is transferred onto the *Tonnetz*. Strunk's article redefines the three operations without any

reference to contextual inversion on staff paper, thereby treating the *Tonnetz* as an operational surface, not a representational one. Rooted entirely in geometrical terms, he based his theory not on Riemannian contextual inversion, but on "a college geometry text" (49). By doing so, he was able to relate two seventh chords (Major-major and Minor-minor) that are not contextual inversions of each other.

In this chapter, I argue that the unique relationship between notation and music in the jazz context led Strunk to rethink the conventional use of the *Tonnetz*. I believe that Strunk's insistence on proper terminology is informed by jazz performance practice, which has an entirely different conceptual origin than that of conventional Neo-Riemannian methodology. Instead of relying on notationally-based contextual inversion and parsimonious voice-leading (the two "foundational topic[s] for Neo-Riemannian literature"), Strunk focuses on the function of the chord—in other words, how the chord sounds in context. This consideration for the sonic dimension can be observed not only in Strunk's analysis but also in the field of jazz analysis in general. By reflecting on Strunk's use of the *Tonnetz*, I investigate Strunk's reconceptualization of Neo-Riemannian theory in order to shed light on the loose relationship between notation and music in a jazz analysis.

This chapter is in two parts. In the first half, I investigate the methodological difference between the conventional and Strunkian uses of the *Tonnetz* by focusing on the degree to which they rely on notation. Second, I explore the weaknesses of Strunk's method by demonstrating the potential inconsistency of treating the *Tonnetz* as a purely geometric surface, and also its strengths by demonstrating new relations made possible by Strunk's method. In particular, the Strunkian *Tonnetz* is especially powerful to draw a visual connection between two Z-related sets when they are represented as asymmetrical figures on

a *Tonnetz*. More broadly, I show that a more geometrically grounded conception of the *Tonnetz* allows us to visualize the inner-interval structure of pitch-class sets.

I have selected the topics of these chapters because each of them represents fundamental assumption of Western music: spatiality, functionality, and "notationality" (i.e., the notion that musical sound is representable through staff notation). Among the three topics, the spatiality of musical sound is perhaps the most primordial in our musical thinking. Without the assumption of spatiality of musical sound, the ontological ground of a note (i.e., the background structure that makes the idea of a note possible) falls apart. Without spatiality, there will be no note, chord, harmony, notation, and, quite possibly, what we know today as "music."[6] The concept of the underlying space turns all change of pitch into the motion through the musical space. We no longer hear change from one note to another in terms of loosening and tightening as the ancient Greeks did. It is conceptualized as moving (of a note) from one place to another. Likewise, the concept of functionality of musical motion turns all motion into either functional or non-functional. This function/non-function dichotomy is perhaps more commonly understood as structure/embellishment dichotomy. Under the assumption of functionality, all musical notes are determined as to how significant their contribution to the overall form is. When a composition is reduced down to its essential voice-leading (and this voice-leading reduction is still considered to carry the essence of the composition in some way), the ground for this reducibility of musical notes is the assumption of function inherent in the notes themselves; and this function is determined according to how they move. And, finally, the criteria for the motion

[6] Of course, this is not to say that the artful creation of sound relies on the notion of spatiality—it is not. Our prototypical concept of music, however, is dependent upon the spatial reinterpretation of sound.

of musical note are set by the staff notation. The musical distance that a note travels can be quantifiably measured only because the motion is defined by the note's notationality. My discussion on notationality investigates further the concept of musical motion by looking at Steven Strunk's analysis that does not entirely rely on the notationality of musical motion. In this case, the assumption of notationality is proven negatively by studying its counter example. The type of music Strunk analyzes (i.e., jazz) somehow forces him to reinvent non-notational musical motion because its ontological ground is different from that of classical music. Because the oral (and aural) tradition of jazz is considered superior to its written counterpart, the analysis of jazz must also consider unwritten aspect of its work-concept. Given the rise of popular music analysis in recent years in music theoretical discourse, Strunk's departure from the notationality of musical motion can be considered as the watershed moment in the music theory scholarship. Ultimately, by investigating in what historical context these assumptions were constructed, I hope to show our musical intuition, no matter how personal it may seem to us, is shaped by our everyday experience as a social being.

The study of musical space is also the study of space in general. The different ways in which musical space has been constructed and conceptualized throughout the Western music-theoretical tradition are closely correlated with the history of the metaphysics of space. As the discussion of space is rarely at the forefront of musicological writing, my investigation of spatial conceptualizations will not only shed light on the concept of space in musical discourse, but also provide direct insight into how the concept of space has been construed throughout Western intellectual history. As my study will show, the study of

musical space will elucidate how our musical thought has always been intertwined with the development of philosophy, science, technology, and society.

CHAPTER II

THE GREEK MONOCHORD AND THE BIRTH OF MUSICAL SPACE

2.1. INTRODUCTION

This dissertation traces how musical sound has come to be understood in terms of its location in an imagined musical space. I will trace the concept of musical space from its inception in ancient Greece to a branch of twenty-first century music theory commonly known as "Neo-Riemannian" analysis. When dealing with historical documents, details such as dates, authors, authenticity, the reception of the document, and the document's transmission history usually help anchor the document at a certain time period and place, as well as align it within a cultural and philosophical school of thought. This chapter in particular demands an additional disclaimer regarding the historiography, or more specifically, how I approach Greek and Medieval writings. As with most ancient and medieval sources, it is extremely difficult and unsatisfying to try to discover every detail possible. It is common that the author of a treatise is either disputed or remains unknown when it comes to the early sources.[7]

It is for this reason that I do not intend to treat the writings as a product of one specific creative mind, or even as a product of one stand-alone discipline, but rather, as a product of the given time period. This frees me from ambiguities of authorship and allows me to investigate the philosophical thoughts and mental conceptions available at the time,

[7] Many scholars of Greek and Medieval music has already commented on the inherent limitations of the historical sources. See Treitler 1992, Thomas J. Mathiesen's "Greek Music Theory" (Christensen 2002, 112-135), and Barbera 1990.

which ultimately shaped the way the music was understood.[8] It is, of course, a conscious choice of action, but also it is an inevitable choice for two reasons: (1) the aforementioned inherent limitation of the historical sources and their authorship, and (2) the amalgamated nature of ancient Greek music theory.

In ancient Greece, the study of music was not delineated as a stand-alone discipline. None of the writers on music during that time period wrote exclusively on music. Instead, most Greek music treatises were written alongside treatises on arithmetic, geometry, and astronomy. These four subjects made up what is known as the *Quadrivium*, four disciplines which could be conducted through number. Even in Aristoxenus's treatises (such as *Elementa Harmonica* and *Elementa Rhythmica*), which criticize the idea of generating musical pitches from a purely numerical (not sonorous) basis, we cannot readily assume that music was treated as a discipline of its own right outside of the *Quadrivium* because Aristoxenus still considered music as part of a larger philosophical context. Therefore, when investigating the emergence of the musical space-concept, one must negotiate historical documents that may not exclusively discuss music. It is important to consider philosophical and mathematical writings at the time to fully understand in what intellectual context the concept of musical space emerged.

For Greek and Medieval music theorists, a simple construction of a monochord, a single stretched string with a movable bridge in the middle, made possible the conversion of sound into number. Through the division of the string (achieved by moving the bridge at

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[8] This approach models after the historiography of French philosopher Michel Foucault (1977a, 1977b, 2002) which he called initially "archeology" and later "genealogy." Nearly all of his intellectual output avoids human agency. Instead, he investigates historical documents to explore what kind of knowledge was possible at the time of writing. Therefore, an author's creative genius is reconsidered as a transcription of possible thoughts at the time.

different positions), the ratio of 2:1 became an interval of an octave; the ratio of 3:2 became an interval of a fifth; and so on. Instead of a wind instrument, which produces different pitches depending on the velocity of the air (size of the column of air), a monochord offered a controlled environment in which the cause of the sonic difference could be demonstrated visually. Although the construction of a monochord was later adopted as a musical instrument known as *tromba marina* around the sixteenth century, for Greek and Medieval music theorists, the study of the monochord was never about musical performance but rather about numerical relations. To explain the relationship between Greek music theory and the monochord more clearly, let me use an analogy employing objects that are familiar to us. In many ways, this relationship is similar to that of a computer processor and a monitor. A computer processor is a unit which performs calculations and the monitor is just an output of the result. Ancient Greek music theory calculates the musical concord with numbers and the monochord is just an output of the result. In other words, for Greek music theorists, the information flows unidirectionally from ratios to sound, and sound that was not a result of numerical ratios was not considered part of the discourse of music. In this regard, the treatises on the monochord freely adopted proofs and axioms from earlier mathematical treatises while also adopting ideas from treatises on music and philosophy.

In this chapter, I argue that the physical experience of using a monochord, especially the experience of moving the bridge of the monochord, introduced a new conceptual model which was far less abstract than the different modes available at the time. This new conceptual model was defined by the motion of the monochord's bridge. As the numerically defined musical notes were mapped on to the monochord, change from one note to another was reinterpreted as a change of space, rather than a change of number. This reinterpretation was not done in any one specific treatise but rather over a significantly long period of time

and by multiple authors, whether knowingly or not. As we shall see, the treatises which explain music through the monochord began as simple lists of axioms, but, over time, developed into more complex and physical descriptions which involved instructions on how to construct the monochord and how to move the bridge to generate the desired sound. Although the Greek writers did not consider the monochord as a source of new musical ideas, mapping different musical notes onto a continuous line (according to their numerical properties) nevertheless instigated a new way of thinking through musical sounds. Following the alignment of musical notes, what was previously considered as purely numerical change became numerical *and spatial* change. As the derivation of musical notes relied on the monochord with growing prominence during the early history of Western music, the musical notes gradually became increasingly spatial in nature. Alongside this gradual epistemological shift, the interest in spatial representation of musical sound grew, which ultimately lead to Western musical notation. Western musical notation, then, is a tool which stripped away the explanatory power of the number and ratio in music and gave the power to the visual representation of musical sound. Now, the understanding of musical sound no longer hinges upon knowing the underlying numerical relations, but instead hinges upon knowing the spatial relations of the sonic entities.

To claim that the monochord played the crucial role in shaping the concept of musical space implies that the concept of musical space had not existed before the prominent use of the monochord; or, the musical space-concept was different from our own. It is difficult to provide the definite proof for this implication, however, close observation of how a musical note is described can shed light on how music was understood before, and during the early stages of, the dissemination of the monochord treatises. In most

Greek writings, a musical note was described as being acute (ὀξύς, *oxýs*) or grave (βαρυς, *varys*) based on what we would call its "highness" or "lowness." In some occasions, it was described as being black or white. According to the Pythagorean and Platonic understanding, the quality of a musical note is determined by its underlying numerical property. When the number increases, for example, the pitch becomes more acute or whiter. All of these early conceptualizations of musical sound can be understood without referring to the location of the musical note. For example, an acute note can turn grave, a white note can turn black, and a numerically small note can become large, all the while not invoking any sense of the change of place. In other words, these adjectives do not require the concept of musical space. On the other hand, the Greek words for "high" such as "ἄνω (*áno*)" and "ὑψηλός (*hypsēlós*)" and "low" such "βραχύς (*brachýs*)" and "ταπεινός (*tapeinós*)" were not used to describe the quality of a musical note.[9] The only instance that I could find where the inherently spatial terms were used is in Aristoxenus's treatises where he uses words such as "raising (ἄρσις, *ársis*)" and "lowering (θέσις, *thésis*)" of a foot to describe a musical beat and also "interval (διάστημα, *diástēma*)" to describe the distance between two musical notes. However, lacking any references to vertical space when describing a pitch of a note, Aristoxenus's musical space would be significantly different from ours. (Later in this chapter, I will further investigate

[9] Here, I did not consider the note names assigned to the strings of a lyra or other instruments because they refer to the specific strings, not the quality of sound. Also, although the common translation of the note names, such as the "highest note (ὑπάτη, *hypátē*)," may seem to suggest some spatial connotation, we cannot readily assume that it refers to "highness" in spatial sense. It seems to me that the word "highest" in this context may refer to "supreme" or "profound" because the same word is often used to describe the Greek god Zeus in Homer's *Odyssey* ("supreme ruler," "ὔπατε κρειόντων," 1.45) and *Iliad* ("supreme god," "θεῶν ὔπατος," 19.258). (Keep in mind that the Greek "highest" note is our "lowest sounding" note.) Also, when the pitch is raised from this note it is described as "tightening (ἐπίτᾰσις, *epítasis*)" of the note instead of referring to any vertical motion. For example, see Cleonides's description in section 2.4 later in this chapter.

Aristoxenus's musical space.) According to our current understanding of musical sound, we consider a pitch to be "high" or "low" and a melody to be "in motion." Additionally, a harmony is represented and understood as a vertically-oriented sonic simultaneity.[10] All of these descriptions of musical sound become meaningless if we do not assume the underlying space in which these sonic objects are placed. No matter how elemental it may seem to us, the Western contemporary understanding of musical sound is not the only way that a musical sound is conceptualized in the rest of the world. It is, therefore, not "hard-wired" in our brain to hear a sound in exactly the same spatial terms. Therefore, no matter how often the Greek words are translated into inherently spatial terms such as "high" and "low," close reading of the original texts always suggests that we cannot impose our spatial understanding of musical sound upon the Greek sources. What becomes evident from the treatises that I examine is that the Western way of hearing a musical note as an entity in musical space emerged alongside the growing popularity of the division of the monochord.

This chapter is in two large sections containing several small subsections within. First, I will sketch the intellectual context of musical sound in ancient Greece by outlining two closely related concepts: the Greek concept of motion and the Greek concept of number. Second, I will survey the Greek monochord treatises to highlight the growing interest in the physicality of the monochord, and I will investigate how this growing reliance

[10] We may still use terms that may signify other modes of conceptualization (e.g., sharp and flat, or *grave* and *aigu* in French). However, these terms are largely used as an attribute to a musical note; and the musical note that these terms describe is still considered as a point in a space. Similarly, the descriptors of the dynamics such as loud and soft also work as the attributes of spatially defined notes. In other words, if we think about exactly what entity is perceived as sharp, flat, *grave*, *aigu*, loud, soft, and etc., we would arrive at the conclusion that it is the musical note(s) that these adjectives describe. Therefore, at the basis of these descriptions, there still lies the inherent spatial understanding.

on the monochord shifted the epistemological ground of music from numerical to spatial. The primary sources that I will look at for this chapter include some early treatises that are not solely dedicated to music, but treat music as part of a larger philosophical context, such as Plato's *Timaeus* (Strunk and Treitler 1998, 19–23), Aristotle's *Physics*, *Metaphysics*, and *De Anima*, and those that are dedicated solely to music, such as Aristoxenus's *Elementa Harmonica* and *Elementa Rhythmica*, the Euclidean *Sectio Canonis*, Cleonides's *Isagoge Harmonike*, Nicomachus of Gerasa's *Inchiridion*, and Ptolemy's *Harmonica*.

The first section is in three parts, and it begins with reviewing the secondary scholarship. Although, little research has been done regarding the influence of the monochord on the emergence of the concept of musical space during the Greco-Roman era, there are significant studies that focus each topic separately. By summarizing these studies briefly, I position my research at the intersection of two studies: the study of technology and the history of ideas. By doing so, I advocate for the critical reflection on the role of technology when considering the history of ideas. I will, then, investigate how music may have been understood in the Greek philosophical context by focusing on the usage of the word "motion (κίνησις, *kínēsis*)" in the Greek music treatises. As mentioned earlier, the Greek writings on music suggest that music was perhaps understood within an entirely different conceptual framework than the present-day understanding. By focusing on the word "motion," which did not mean "change of place" in musical context, I hope to highlight the difference between the Greek and the present-day conceptualization of music. And by way of comparison, I hope to investigate the Greek conceptualization of music.

Then, I will examine the Greek concept of number in order to elucidate its influence on the early concept of musical note. Throughout the early formation of harmonic science, mathematical knowledge incubated musical concepts to grow. This means that in order to

understand the Greek musical concepts, one must consider their mathematical background, in particular, the Greek concept of number. As we shall see, the Greek concept of number directly impacted how the musical notes and concords were understood within the *Quadrivium*. Since the Greek concept of number is based on its countability, the study of number did not allow for the possibility of a number in between two integers. For example, the number "1.5," as an entity between the numbers "1" and "2," would not have been possible. This conceptual difference is crucial in understanding the Greek concept of musical note because the study of music was the study of proper ratios, a discipline closely associated with arithmetic. Together, I will show that the word "motion" in Greek musical context did not necessitate an underlying space, or at the very least, the concept of musical space in ancient Greece meant something entirely different from present-day understanding. Furthermore, I will show that due to its reliance on numbers, Greek musical motion (both spatial and numerical) is not a smooth change but a quantized and discontinuous change.

In the second section, I will argue that the sustained use of the monochord in the context of the *Quadrivium* formed the basis of our current understanding of musical motion and the space in which this motion takes place. In particular, two essential concepts: (1) the notion that the identity of a musical note is determined by its position in imagined musical space (i.e., a note *is* "high" or "low") and (2) the fact that what is represented as a note does not form a correspondence with the sound itself unless a spatial structure is imposed, would not have been possible without the use of a stringed instrument with a movable bridge, as in the case of the monochord. I will first show how the study of ratio was associated with musical sound. Then, I will investigate how the monochord was employed in early treatises to show that, at the outset of its adaptation, it was situated firmly within the study of ratio and number. Here, I argue that the physical experience of operating a monochord was,

perhaps, considered an inessential at first to the study of number. Then, I will trace the growing description of the physical property of the monochord to show that the act of generating a different pitch through the shifting of the bridge may have inspired a new heuristic interpretation of the cause of the change of pitch.[11] Through the use of the monochord, the more abstract notion of change of underlying numerical property might have mapped onto the more experiential notion of change of place wherein the previously preferred ratios became nodes of sonic possibility in two-dimensional space. Finally, I will suggest that this spatial recontextualization of musical sound was developed alongside, or perhaps even was responsible for, the realization of speech as having both a semantic element and a sonic element. As the two distinct properties of a voice were being recognized, the role of written words were concentrated as an agent of meaning, and the sonic element of speech was rendered meaningless. This recontextualized the upward or downward strokes as the signs for intonation of speech, which prefigured the early neume scripts. By comparing the semantic structure of various early musical notations traditions such as (1) the Greek musical notation from the *Epitaph of Seikilos*, and (2) the early spatial notation from the Carolingian treatises such as *Musica Enchiriadis* and Aurelian of Réôme's *Musica Disciplina*, and also (3) early chant notations, I hope to lay bare the influence of spatial

[11] This observation is informed by heuristics and biases research in the field of cognitive psychology. More specifically, the use of the monochord can be considered within the framework of "an attribute-substitution model" designed by Daniel Kahneman and Shane Frederick (2005). An attribute-substitution model of heuristic judgment "assumes that difficult questions are often answered by substituting an answer to an easier one." (269) For example, a hypothetical question "what is the numerical relationship between two pitches?" may be substituted by the question "how much should I move the bridge to change one pitch to another?" Given the presence of the monochord, the second question is far easier to answer. Kahneman and Frederick write, the "process of attribute substitution is a general feature of heuristic judgment; that whenever the aspect of the judgmental object that one intends to judge (that *target attribute*) is less readily assessed than a related property that yields a plausible answer (the *heuristic attribute*), individuals may unwittingly substitute the simpler assessment" (269). See also Kahneman 2011.

thinking instigated by the use of the monochord in the historical formation of musical notation, and more broadly, the emergence of the musical space-concept.

2.2. SECONDARY SCHOLARSHIP

Regarding the scope of this chapter, two branches of secondary scholarship should be considered. As we shall see, both branches exemplify a common tendency among music scholars to treat tools and technology as somewhat inferior to historical people and their writings. Within this intellectual context, the monochord has not been seriously considered as a source of new musical ideas, and the role of inspiration has been largely accredited to the writers of the music treatises. The two branches of music scholarship are (1) the study of the monochord itself and (2) the study of the emergence of the musical space-concept. The amount of scholarly interest for the first category is somewhat underwhelming considering the long history of the monochord. Perhaps, the relative lack of discourse on the Greek monochord in today's music scholarship more clearly exemplifies the tendency of elevating people over tools. For this reason, the study of the monochord was largely considered within the study of the monochord treatises. The earliest North American scholarly writing on the monochord is the doctoral dissertation by Cecil Adkins (1964).[12] This work traces theoretical and practical applications of the monochord spanning 2500 years of Western music history since Classical Antiquity. As a seminal study seemingly dedicated solely to the monochord, his dissertation centers around how the monochord was constructed and used, according to

[12] Many scholars point to Wantzloeben (1911) as the first scholarly writing dedicated to monochord. In this brief monograph, Wantzloeben discusses how the monochord was used from Classical Antiquity to the Renaissance.

various music treatises. In doing so, however, the monochord itself is never the subject of critical reflection. Instead, the research focuses on the practitioners of the monochord and how they used it. In other words, the monochord, as a tool, is never considered seriously as a source of inspiration. André Barbera's writings, especially his 1991 book, *the Euclidean Division of the Canon*, explores the Greek monochord through a survey of historical transmission of the treatises *Sectio Canonis*, the first treatises explaining the division of the monochord (1991). He summarizes the historical transmission of *Sectio* in terms of three branches: (1) as the semi-independent version written in Greek, (2) as it appears in Porphyry's commentary on Ptolemy's *Harmonics*, and (3) as it appears at the beginning of the fourth book of Boethius's *De institutione musica*. The purpose for his research is clear: to construct a critical text and translation of *Sectio Canonis*. Throughout the book, he carefully delineates the three branches by providing separate diagrams used in different source traditions and by annotating the translation with an alternate version of the text. Again, his research is crucial in understanding how the text of the treatise, *Sectio Canonis*, would have been read by later musicians, but it mostly remains a study of the treatise, not the monochord.[13] Recently, David Creese, a scholar of classical studies, researched the influence of the monochord in Greek mathematics. His work is one of few writings on the Greek monochord which does not perpetuate the bias against the influence of technology (Creese 2010). He observes the challenges and reconciliation of employing a geometric, thus

[13] Various other translations of *Sectio Canonis*, most notably those by Thomas J. Mathiesen and Andrew Barker are also primarily studies of the treatise rather than of the monochord itself.

continuous, instrument in the context of Greek harmonics, which is a study of discrete number. He summarizes his book as follows:

> The geometricisation of harmonics, in its various aspects, was the inevitable result of attempts to make compelling mathematical arguments for the use of numbers and ratios as a language and analytical tool for the investigation of harmonic structures with the assistance of an instrument which represented numbers and notes as measurable visible distances. (Creese 2010, 356)

At many levels, his research is similar to mine, in that he focuses on the change in mental conception instigated by the use of the monochord. However, his discovery is mainly in the change of mathematical thinking, not the musical one. Therefore, he does not answer the question of how the monochord shaped our understanding of music. To summarize, existing scholarship on the monochord has not fully considered the *musical* influence of the monochord.[14]

The scholarship of the second category, study of the emergence of the musical space-concept, also has not considered the influence of the monochord on how we think about music. Marie-Elizabeth Duchez (1979) has attempted to understand the transformation of musical designations from acute and grave to high and low through genealogies of the descriptive terms themselves. I see two limitations when considering Duchez's research in context of the historical formation of musical space. First, Duchez's research considers mostly the change in the usage of the descriptive terms as opposed to the change in the underlying episteme. Second, there seems to be a tendency to elevate the influence of the written words over the technical tools. Although Duchez acknowledges,

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[14] In the *Cambridge History of Western Music*, Jan Herlinger provides an overview of the monochord tradition, especially its use in Medieval and Renaissance music treatises. This would be a great starting point for anyone who is interested in studying the monochord and its later adaptation.

very weakly, the slight possibility that the Greek monochord may have played a role in the construction of musical space, it is quickly dismissed. (Notice the weak verb tense, "could have accepted," in the following quotation.)

> A côte de cela, la Théorie pythagoricienne des intervalles, avec les divisions au monocorde des cordes et des tuyaux, aurait pu accepter de dénominations de caractère spatial: mais ni les pythagoriciens canoniciens, ni les constructeurs d'instrument n'avaient besoin d'images spatiales des sons et de leurs relations: théoriquement et pratiquement, les nombres, réalités instrumentales concrètes et caractéristiques ontologiques des sons, leur suffisaient. (Duchez 1979, 59)
>
> [T]he Pythagorean theory of intervals, with the division of strings of the monochord and the division of the tuyaux [a kind of measuring windpipe], *could have accepted* denominations of spatial character, but neither the Pythagorean canonists, nor the constructors of the instruments needed spatial images of sounds and their relations; theoretically and practically, the numbers, the reality of concrete instruments, and the ontological characteristics of sounds would suffice. (translation and emphasis mine)

According to her understanding, the relationship between the technical tools, the monochord and tuyaux, and the "ontological characteristic of sounds" only allows the influence from ideas to tools and does not afford the possibility of the tools inspiring new ideas. Michael Walter (1994) also investigates the historical formation of musical space and also focuses mainly on the written words. He investigates the word *spacium* as it was used by different writers of the Medieval era to show the changes of its reference from physical space (on a page or on an instrument) to the imaginary musical space. However, he does not set out to answer why spatial terms such as *spacium* and *intervallum* came to be used in musical contexts in the first place. In fact, he separates the terms that had and had not been used in musical writing and thus considers the word *intervallum* (which literally means between walls) to be non-spatial in musical contexts. In contrast, I find the word *intervallum* to be a Latin

translation of the Greek word *diastema* (which means "distance"), which is inherently spatial. This over-reliance on the written words blinded the historical musicologists from considering the monochord as a source of new ideas.

The recent reevaluation of technics in the creation of new ideas therefore offers much insight into the emergence of the musical space-concept.[15] This new trend stems from the interest in the influence of technology in the field of critical theory. I have considered two main intellectual threads when considering the influence of technology on the way we think: Karl Marx and Bernard Stiegler. Marx writes in *Capital*:

> Technology reveals the active relation of man to nature, the direct process of the production of his life, and thereby it also lays bare the process of the production of the social relations of his life, and of the mental conceptions that flow from these relations. (Marx 1990, chap. 15)

In particular, when looking at Greek musical writings and their transmission of the ideas, the study of technics becomes crucial because the music-theoretical ideas of the time were not reified and systematized through writing practices. However, the monochord had been the most common tool for the Pythagorean-Platonic study of music during the first millennium of Western music theory. French philosopher Bernard Stiegler takes Heidegger's view on equipmentality further and observes the importance of looking at the relationship between technics and heritage when he writes

> The experience of an animal is lost to the species when the animal dies, while in a life proceeding by means other than life, the being's experience, registered in the tool (in the

[15] An American historian and philosopher Lewis Mumford is another key contributor for the study of the influence of technology. In particular, the word "technics" is first used by him in order to adopt associate meaning of the Greek *tekhne* (Mumford 1934). The word "technics" refers to not only technology and the skill necessary for the technology, but also the relationship between the society and technology.

> object), becomes transmissible and cumulative: thus arises the possibility of a heritage. (Stiegler 2008, 4)

Musical notation is also a kind of technique that Stiegler would consider to generate a similar relationship. However, the lack of stand-alone musical notation in ancient Greece and the fact that the practice of notation changed from "aspatial" to spatial during the early history of Western music strongly suggests the role of non-notational techniques in the conceptualization of musical sound. The monochord, then, becomes a critical element in shaping the Western understanding of music because it is the instrument continuously referred to throughout the history of Western music theory up to and including the Renaissance.

2.3. THE ANCIENT-GREEK CONCEPT OF MOTION

Perhaps the greatest challenge to the suggestion that ancient Greek thinkers did not consider a musical note in terms of an underlying space is that there is an abundant use of the word "motion" (κίνησις, *kínēsis*) in Greek music treatises. Motion, as we moderns understand it, involves a change of place or position. Even in the case when the word "motion" is used metaphorically, as in the case of melodic motion, its meaning is entangled with physical motion. In other words, when we say, "the melody goes up," we are referring to an upward physical motion.[16] When there is motion, it necessitates, at least, two different

[16] There are abundant resources dealing with this conceptual metaphor. See Larson 2012 (61–81), Cox 1999, and Zbikowski 2002.

points of location: the point of origin and point of destination. In other words, motion as change of place is only possible in spatial terms for us.

The meaning of the word "motion" in Greek contexts, however, was not limited to change of place. Instead, it meant broader categories of change as resulting from an expression of potential energy. According to Aristotle, motion is "the fulfillment of what exists potentially, in so far as it exists potentially" (Aristotle, *Physics* 3.1.200b33-4). This broader definition gave rise to different realizations of motion, of which change of place is only one. David E. Cohen summarized the Greek concept of motion as follows:

> The word translated as "motion," *kinēsis*, was used by Aristoxenus's teacher Aristotle as a general term sometimes denoting all four of the species of change (*metabolē*) that Aristotle recognizes (change of substance, quantity, quality, and place) but more properly denoting only the last three of these, the last of which is what we usually mean by "motion," i.e., change of spatial location or *local motion*. (Cohen 2001, 139)[17]

Because of this broader definition of motion, we cannot readily assume that Greek writers thought in terms of an underlying space when they used the word "motion."18 The only case in which motion necessitates this underlying space is when it referred to a change of place. Therefore, it is important to pinpoint exactly what each writer meant for the word "motion" in each context. At times, it was used to mean something close to the physical sense of the word, the physical progression of expansion and contraction of the air, as in the

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[17] Cohen refers to several passages from Aristotle's Physics regarding this summary. See Aristotle, *Physics* 5.1, esp. 225a34–b9; 5.2, esp. 226a23 ff.; and idem., *Metaphysics*, 11.11–11.12, esp. 1067b12–1068a16; 12.2, 1069b9–13.

[18] Of course, we cannot assume that all Greek writers were using the word "motion" as Aristotle intended. Perhaps, more sensible way to look at it would be that Aristotle was trying to form a coherent explanation of various usages of the word. In either case, it is clear that the word motion does not mean change of place exclusively.

case of Aristotle's *De Anima*: "what has the power of producing sound is what has the power of setting in movement a single mass of air which is continuous from the impinging body up to the organ of hearing" (Aristotle, *De Anima* 2.8). At times, it would mean the vibration of a string, as in the case of the Euclidean *Sectio Canonis* (Mathiesen 1975): "of motion, there are more frequent and the intermittent; and the more frequent make acute notes, the intermittent, grave [notes]."[19] Here, since the character of a note is determined by the frequency of the motion, the motion would be something like the rate of vibration of the string.[20] In the case of the Pythagorean-Platonic tradition, movement from one note to another would have been considered a change of numerical property, a quantitative change. The theoretical structure which enabled the writers in this tradition to attach numerical property to sound is outlined by Andrew Barker (1989). He writes,

> [T]he application of mathematical concepts to musical phenomena is mediated by a physical theory that re-identifies the entities under discussion, perceived in the guise of notes, as movements in a material medium. It is to these movements that the quantitative characteristics can be attached directly. (Barker 1989, 8)

This Pythagorean-Platonic view dominated much of Greek music theory and theorists, including the writer of *Sectio Canonis*, Nicomachus of Gerasa, and Ptolemy. These three writers were especially influential to later medieval music theorists because their treatises

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[19] Although the treatise Division of a Monochord is listed here with Euclid as the author, the authorship of the treatise is now contested. For this reason, when I refer to the original text of the treatise, I refer it as "the Euclidean *Sectio Canonis*" throughout this dissertation.

[20] As mentioned earlier, "acute" and "grave" are common descriptors of pitch difference which corresponds to the present-day "high" and "low." Later in this section, I will discuss Greek conceptualization of pitch difference further.

were compiled, adopted, and integrated into Boethius's *De Institutione Musica*, possibly the most widely read music treatise in the Medieval and Renaissance eras.[21] This is important because through the numerical interpretation, the musical notes were considered scientific, thereby persisting as the unaltered ordering of musical notes in Greek and Medieval music treatises. From this investigation, we shall see that, for Greek thinkers, the essence of musical notes was numerical in nature.

2.4. ARISTOXENUS'S CONCEPT OF MUSICAL SPACE

Perhaps Aristoxenus was the one who came the closest to the use of the word "motion" in a spatial sense. His clear dissatisfaction with the contemporary explanations of music, which were overly dependent on number, may have prompted him to embark on a study of music that is purely experiential.[22] He was among the earliest, if not the earliest, writers on music who used the word "motion" or "movement" as change of location (τόπος, *topos*); he also used the word "intervals" (διάστηματα, *diastēmata*) to denote the discrepancies between two notes. These terms were, however, used in conjunction with non-spatial adjectives that were commonly used to describe pitch characteristics: acute (ὀξύς, *oxýs*) and grave (βαρύς, *varýs*). It is important to clarify the meaning of words that are inherently spatial

[21] Calvin Bower (1989) suggests that much of Boethius's *De Institutione Musica* is a translation of Nicomachus of Gerasa's lost treatise called *On Music*. He supports his suggestions on these grounds: Boethius frequently mentions Nicomachus in the treatise; Nicomachus's surviving treatise, *Manuale Harmonices*, is in accordance with Boethius's work; and it is a known fact that Boethius's treatise on mathematics, *De Institutione Mathematica*, is a translation of Nicomachus's mathematical treatise.

[22] It is clearly evidenced in his criticism against the harmonicists' tendency to "close-packing" (καταπύκνωσις, *katapyknosis*) of notes, a tendency to arrange all possible musical notes according to their numerical property. Nearly all Greek and Medieval treatises on the monochord ends with a diagram of "closely-packed" notes. See Aristoxenus, *Elementa Harmonica* 1.7.25.

in Aristoxenus's two treatises *Elementa Harmonica* and *Elementa Rhythmica* because many later treatises such as Cleonides's *Isagoge Harmonike*, Aristedes Quintilianus's *De Musica*, and Gaudentius's *Harmonic Introduction* (Strunk 1998, 66–85) adopt Aristoxenus's terminology as well as the way the treatise was organized. Close reading of Aristoxenus's treatises will show that the spatial terms were originally used metaphorically to describe forward-and-backward motion on a "road" (ὁδός, *hodós*), where each extremities lead to "acuteness" and "graveness." However, these spatial terms were recontextualized as the later treatises attempted to reconcile Pythagorean-Platonic tradition with Aristoxenus's writings. In the end, the forward-and-backward motion on a road were reconeptualized as upward-and-downward motion on a vertical space wherein the height was determined by the numerical properties of the musical notes.

To begin, I cite two passages from Aristoxenus's *Elementa Harmonica*.

> First of all, then, the prospective student of melody must analyse the movement of the voice, its movement, that is, with respect to place [*topos*], for there is not just one variety of this movement. The voice moves in the kind of movement I have mentioned both when we speak and when we sing (since high ["acute," ὀξὺ, *oxy*] and low ["grave," βαρὺ, *vary*] are obviously present in both of these, and movement with respect to place is that through which high and low come about), but the two movements are not of the same form. (Barker 1989, 127)

> First of all, then, we must discuss the different kinds of movement with respect to place [*topos*], and try to understand what they are. While every vocal sound can move in the manner mentioned, there are two forms of this movement, the continuous and the intervallic. In the continuous form the voice seems to perception to traverse a space [*topos*] in such a way as never to stand still even at the extremities themselves, at least so far as its representation in perception is concerned, moving continuously to the point of silence; whereas in the other, which we call intervallic, it seems to move in the opposite way. During its course it brings itself to the rest at

> one pitch and then at another: it does this continuously (I mean continuously in respect of time), passing over the spaces bounded by the pitches, but coming to rest on the pitches themselves and sounding them alone, and is described as singing, and as moving in intervallic motion. (Barker 1989, 132)

From these quotations, we can see that there is no doubt in Aristoxenus's description that he was thinking about sound, more precisely the human voice, in spatial terms. However, it is also clear that Aristoxenus's musical space is somewhat too unquantified to resemble our own. As it can be observed elsewhere in the treatises, and also is pointed out by scholars, such as Andrew Barker and Thomas J. Mathiesen, that the unquantified nature of Aristoxenus's musical space is due to his belief that "the science begins from the data presented to perception and grasped by it as musical" (Barker 1989, 4)[23] In other words, Aristoxenus sought to explain what makes certain sound more (or less) musical. In determining the musicality of sound, all he relied upon was his own ears.

Based on the two quotations above, I will conjecture Aristoxenian conceptualization of musical space in order to better understand Aristoxenus's prose and also to contrast his view to the present day conceptualization of musical space. Although the words "acute" and "grave" are readily translated as high-pitched and low-pitched, it would be a mistake to assume that these words would have any association with verticality to Greek people. It is because Aristoxenus does not use "high" and "low" in his treatises on harmony, but reserves them for his treatise on rhythm, *Elementa Rhythmica*. When dividing *chronos* (musical time) into a perceptible unit, or the "foot" (πούς, *poús*), he describes each unit as involving upwards

[23] See also Mathiesen's discussion (1999, 294-344).

(ἄνω, *anō*) and downwards (κάτω, *kátō*) motion.[24] It seems that it was the translator's decision to modernize the Greek adjectives. The terms used in *Elementa Rhythmica* are clearly associated with highness and lowness as he later associates them with lifting (ἄρσις, *ársis*) and stepping (βάσις, *básis*). With vertical space occupied with the rhythmic foot, we are left with horizontal (left and right) and sagittal (front and back) spaces to imagine acuteness and graveness of a note.[25] It is less likely that Aristoxenus had in mind a mapping which corresponds left or right with acuteness or graveness because of Greek music notational practice. As Greek musical notation was inscribed atop a script, left-and-right space was probably associated with temporal progression. This leaves us with sagittal, (forward-and-backward) space, which is more likely what Aristoxenus's musical pitch-space would look like. Different pitches mapping onto sagittal space correspond to his metaphorical use of the word "road" (ὁδός, *hodós*) when describing the magnitude of intervals. Especially in the third book of the *Elementa*, towards the end (theorems 17–19), he uses the word "road" extensively as a way to explain acuteness and graveness. Here, I cite the theorems only, without Aristoxenus's explanations. (All of the available English translations of the treatise translated the word "road" as "progression," and "acute" and "grave" respectively as "upwards" and "downwards."[26])

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[24] Aristoxenus, *Elementa Rhythmica* 2.17. For original text and translation, see Aristoxenus (1990, 11).

[25] Although it may not be entirely historically sensitive, horizontal, vertical, and sagittal spaces would corresponds to our x-, y-, and z- axes.

[26] This includes both Andrew Barker's and Henry S. Macran's. It was Mathiesen's paraphrase of Aristoxenus's discussion on the size of intervals that I came to notice the literal meaning of the word. (1999, 332)

> 17. From the ditone there are two progressions [ὁδοὶ] upward [ὀξὺ] and one downwards [βαρύ]
>
> 18. From a pyknon, conversely, there are two progressions downwards and one upwards
>
> 19. From a tone there is one progression in each direction, to a ditone downwards and to a pyknon upwards (Barker 1989, 178–9).

With pitch space as oriented forward and backward, we can delve deeper into the earlier quotations from page nine. We first need to imagine two different locations that acuteness and graveness occupy. As we imagine ourselves standing in front of a road, each end of which leads to acuteness and graveness, we can better understand what Aristoxenus meant by "two movements" at the end of the first quote (Barker 1984). With this conceptual model, the second quote becomes less abstract. The continuous form of the voice, which is a speaking voice as opposed to singing voice, "traverses a space [*topos*] in such a way as never to stand still even at the extremities themselves," which means the voice moves forward and backward (i.e., up and down in the modern sense) without resting at a single point. "At the extremities," the continuous voice does not stand still, meaning that a speaking voice does not end with a single perceptible pitch. On the other hand, the intervallic voice of a song "brings itself to the rest at one pitch and then at another." It is as if the continuous voice is moving on a ramp whereas the intervallic voice moves on stairs where each step is clearly separated.

This observation brings a more nuanced meaning to the word "interval" (διάστημα, *diástēma*) in Aristoxenus's treatise. Since the word *diástēma* could mean distance in a non-musical context, it may carry a similar connotation in musical context. Since we can measure the distance when we assume two different *fixed* points, when the voice moves without

resting at one point, the measuring of distance is difficult, if not impossible. Also, it is not the musical interval in the way that we conceptualize it today, but a distance between two points in a way we think of distance between, say, New York City and Boston. It also changes the meaning of the word "motion" (κίνησις, *kínēsis*) slightly. When moving within an interval, Aristoxenus's motion resembles a walking motion, in which it is the perceiver's body that moves. Referring back to the earlier discussion of the concept of motion, Aristoxenus's use of the word is more physically based. It is not the change of quality, quantity, or substance that generates different pitches. It is that we move forward and backward on the road of pitches, and when we rest at one point, that pitch where we stand becomes perceptible.

In her dissertation on the medieval remakings of Boethius's *De Institutione Musica*, Elizabeth Ann Mellon (2011) comments on the section of Boethius's treatise that is equivalent to the quoted paragraphs above. She observes that since Aristoxenus's categorization of voice into continuous and intervallic, nearly every writer paraphrased this passage to the point that, "for a medieval reader without access to actual Greek texts, essentially all Greek music theory handed down to them contained that passage" (Mellon 2011, 49). She follows that, however, "after the sixth century, this passage virtually disappears from the Western music theoretical tradition" despite the fact that "so many [other] arcane details are preserved." She offers her explanation on the ground that, around and after the time of Boethius's writing, the human voice, especially the verbal nature of song, was situated uncomfortably in between two disciplines: music and grammar.[27] As the

[27] I will discuss later in this chapter that there was another disciplinary competition on the status of the human voice, between arithmetic and geometry. The emphasis on the distinction between

first chapter of her dissertation shows, in this disciplinary competition, the human voice was "more securely grammatical than musical in Boethius's era" (25). Therefore, Aristoxenus's categorization of voice would no longer be suitable in the discipline of music and music treatises of the Late Antiquity and Medieval era.

Here, I offer additional explanation of the omission of the Aristoxenian categorization of voice. From as early as second century C.E., theorists such as Cleonides, Nicomachus, and Ptolemy had attempted to reconcile the theories of Aristoxenus and Pythagorean-Platonic tradition (concentrated in the monochord treatises). However, amidst this reconciliation, some of Aristoxenus's explanation, especially the aforementioned road metaphor, might have not been considered essential, and thus discarded.[28] As I will explain later in this chapter, this reconciliation nevertheless integrated Aristoxenian spatial thinking with Pythagorean-Platonic numerical reinterpretation of musical sound, thereby creating a musical space in which its different locations are numerically ascribed; and this is the system that was carried over to Late Antiquity and Medieval music treatises. It is clear that by the time of the writing of *Musica Enchiriadis* and other Carolingian treatises (around the tenth century), musical space was vertically oriented where each extremity represented "high" and "low."[29] Without the access to Aristoxenus's original text which helps unpack the metaphor

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continuous and intervallic also shows Aristoxenus's attempt to categorize music as arithmetical in nature as oppose to geometric. See section 2.3 for in-depth discussion.

[28] It is true that in Cleonides's *Isagoge Harmonike* and in Nicomachus of Gerasa's *Manuale Harmonices*, there are no mention of the road metaphor while continuous and intervallic movement of the voice are treated in more abstract terms in both treatises.

[29] Even though the pitch space began to be vertically oriented by tenth century, there were intellectual quandary as to which extremes were oriented at which end. As many of the diagrams of the monochord and Greater and Lesser Perfect System during this time period show, what we

he used here, a medieval reader would have considered the Aristoxenian division of voice overly abstract. Also, as the concept of musical motion became more vertically oriented, the sagittal orientation of Aristoxenian motion might have been considered incompatible, or at the very least, caused confusion in the readers' mind.

Thus far, we have seen different possibilities in which the word "motion" can mean. As the realization of an entity's potential energy, the Greek concept of motion includes change of substance, quality, quantity, and place. According to the Pythagorean-Platonic view of music, it was usually assumed that musical motion was quantitative in nature as musical sound is considered a realization of its numerical property. Although the Pythagorean-Platonic view dominated many music-theoretical writings in Ancient Greece, Aristoxenus offered a contrasting, and compelling, model of musical space which provided experiential and phenomenological interpretation and demonstration of musical understanding. In this view, musical motion is physical in nature and one can traverse within an interval; and based on the way one moves, different "shades" of genera can be generated. However, we have to remind ourselves that his musical space does not resemble our own in many ways. Our vertical mapping of the pitch difference (i.e., high pitch is "high" and low pitch is "low.") combines Aristoxenian spatial thinking and Pythagorean-Platonic numerical relation. Therefore, it is important to investigate the Greek concept of number and its influence on the shaping of musical space.

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consider as "low" pitch was often located at the top and "higher" pitches followed downward from it. For extensive historical survey and investigation on the two different orientations of verticality during the Medieval era, see Atkinson 2009.

2.5. THE GREEK CONCEPT OF NUMBER

The most relevant, and perhaps most distinctive, difference between the Greek and the present-day Western concept of number lies in the possibility of divisibility. We allow for a theoretically infinite possibility of numbers in between two integers by using longer and longer decimals. In between the numbers "1" and "2," there is "1.5"; in between "1" and "1.5," there is "1.25"; and so on *ad infinitum*. However, in the Greek concept of number, each number was understood as a representation of a countable object. As we shall see, such reliance on countability rendered the division between integers impossible, or at the very least, pointless. In this section, I will first present a more detailed description of how the concept of number came to be in Ancient Greek philosophy. Then, I will expand the description to include the ontologies of Pythagorean and Platonic traditions in order to investigate the intellectual context in which the discipline of music was situated. In particular, I argue that the use of the monochord intensified the disciplinary contest between arithmetic and geometry over which was to be the theoretical foundation of the discipline of music. Originally instituted as the study of ratio, music was arithmetical in nature; but the repeated use of the monochord and the division of the string challenged the indivisible nature of the arithmetic concept of number in favor of the divisible geometric concept of number.

Perhaps the most extensive analysis on the Greek concept of number was done by Jacob Klein in *Greek Mathematical Thought and the Origin of Algebra* ([1986] 1992, kindle edition; this book will be cited with Kindle location number, e.g., Kindle Location 500). In his book, he traces the historical formation of the mathematical formal language that is currently in use as the basis of modern physics. He criticizes the scholarship on Greek mathematics from his time, claiming that it does not acknowledge the conceptual difference between Greek and

modern mathematical thought. He writes that, "most of the standard histories attempt to grasp Greek mathematics itself with the aid of modern symbolism, as if the latter were an altogether external form which may be tailored to any desirable 'content'" (Kindle Location 250). As we can see from his criticism of contemporary scholars on Greek mathematics, his goal is to "rehearse the actual course of its genesis" (Kindle Location 250) as it would have happened. For this reason, he does not rely on modern mathematical concepts when analyzing Greek mathematical thought; and he presents the concept of number as the ancient Greek philosophers would have understood it. He does this by investigating an extensive collection of Greek mathematical writings that includes works by the Pythagoreans, Euclid, Plato, Aristotle, Nicomachus, Theon of Smyrna, and Domninus of Larissa. I will refer to his research heavily in the following section, as I believe it will provide much-needed insight into the Greek concept of number, a seemingly perplexing subject.

In his discussion on the concept of Greek arithmetic, he cites various passages from Greek sources, summarizes them, and provides examples to explain how number would have been conceptualized in Ancient Greece. He writes,

> The fundamental phenomenon which we should never lose sight of in determining the meaning of *arithmos* (ἀριθμός) is counting, or more exactly, the *counting-off*, of some number of things. These things, however different they may be, are taken as uniform when counted; they are, for example, either *apples*, or apples and pears which are counted as *fruit*, or apples, pears, and plates which are counted as "*objects*." *Insofar* as these things underlie the counting process they are understood as *of the same kind*. That word which is pronounced last in counting off or numbering, gives the "*counting-number*," the *arithmos* of the things involved ([1986] 1992, Kindle Location 1220).

This explanation may not prove so difficult to comprehend because it is largely experientially based. For example, when we say there are a dozen doughnuts in a box, we are using one

whole doughnut as a unit of measurement to count how much of the unit is present. The number "dozen" only applies when we take the unit of measurement to be one whole doughnut. If we try to specify the content further by saying that there are four glazed doughnuts, four jelly-filled doughnuts, and four apple fritters, each type of doughnut then becomes a new unit of measurement. From this practice of "counting-off," the Greek concept of number originated.

The concept of "pure" numbers began to form as that which enables the act of counting. To continue with the example of doughnuts, the fact that there is the same number of glazed, jelly-filled, and apple fritter doughnuts brings out the sameness among the three types, namely the "four-ness." And, the fact that we can assign the number four to each group of the different types of doughnut inspires the realization that there are two domains when it comes to counting: one is the domain in which one assigns the property of number to the things being counted, the other domain is the property of number itself. As Klein shows, "the continual practice of counting and calculation gradually fosters within us that familiarity with numbers and their relations which Plato terms 'arithmetic and logistic art' and which enables us to execute any operation of counting or calculating we wish" ([1986] 1992, Kindle Location 1321) The fact that we can "execute any operation of counting" on various objects, in other words, that we can assign the property (i.e., the number) to countable things, began the study of that which is being assigned. As Klein puts it, "*of what* are these the numbers?" (Kindle Location 1321)

So began the study of number, arithmetic. In ancient Greece, the core concern of the discipline that was called "arithmetic" was not what we now consider to be its core concern, namely: addition, subtraction, multiplication, and division. The distinction between the Greek understanding of calculation and arithmetic is summarized by Klein: by compiling

evidence from Neo-Platonic sources, such as, (1) the reference of Proclus and (2) of the *Charmides scholium* to Plato's instructions for teaching children to calculate, (3) the examples given in the Olympiodorus and (4) the *Gorgias scholium* (Kindle Location 329), he concludes that,

> In calculation that *result* alone, which *varies* as the given multitudes vary, matters. But the possibility of calculation is grounded in certain *immutable* characteristics of the numbers "themselves." With these arithmetic deals, which does not "calculate" with numbers but studies their properties and kinds as they are in themselves, not as they may be read off the countable things. Calculation with numbers is nothing but the "application" of the facts of "pure" arithmetic; logistic is nothing but "applied" arithmetic, which serves, above all, practical ends. (Kindle Location 524)

What was considered to be arithmetic was the study of numbers themselves, as in the study that involves the proof that certain numbers are prime numbers. In short, it was the study of the nature of the numbers. In order to serve a function of being assigned to the objects in the world, there needed to be a concept of number that was "empty and pure," so to speak; the core concern of *arithmos* was the study of these "pure" numbers. In other words, since the objects are things that are perceivable, the numbers must be things that are prior to perception, or things that exist only in reason. Klein calls this (things that exist only in reason) *nóesis* ("noetic," in adjective form), from the Greek word νὸησις (*nóēsis*), which generally means intelligence and understanding. The act of "counting-off," as a Greek concept, assigned the Greek notion of number not only a noetic nature, but also a countable nature. Just as one doughnut becomes a unit when counting doughnuts, the number "one" became the noetic unit for all number. For this reason, the Greek concept of number did not allow division of the number one. For Greek thinkers, dividing the unit of number is pointless and irrelevant to the study of number. To use the doughnut example one again,

when determining how many doughnuts there are in the box, splitting one doughnut into two halves is a meaningless act. The number *one* was the unit of number, the indivisible monad which makes number possible; and through the multiplication of this noetic unit, *number* was conceptualized. As Aristotle wrote in *Metaphysics*, "number is a plurality of units."[30]

With the realization of the concept of the "pure" unit of number, the Pythagorean-Platonic ontology was founded.[31] As Pythagoreans and Platonists saw, order, or "(well-) ordered arrangement" (τάξις, *táxis*), decides "the condition of being a 'world'" (Kindle Location 1623). Conversely, we can order things in the world because "the things ordered are delimited with respect to one another and so become countable" (Kindle Location 1623). In other words, we can only say things are *in order* when we can distinguish one thing from the other. Since the study of number encompassed what made number possible in the first place, the study of number was simultaneously the study of distinguishing things in the world. Therefore, the study of number could become the study of the world. As Aristotle summarizes the Pythagorean metaphysics, "number is the essence of all things."[32] To summarize, because all things are measured with the same unit of number, all things can be ordered well in the world.

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[30] "ἀριθμὸς πλῆθος μονάδων." Aristotle, *Metaphysics* 10.1053a.

[31] Klein distinguishes the two philosophical traits in his discussion. For the current investigation, I will use the term Pythagorean-Platonic to denote a philosophical idea that was originated from Pythagorean school and later adopted by Platonic school. For more detailed inquiry, see Klein (1986) 1992, chap. 7.

[32] "ἀριθμὸν εἶναι τὴν οὐσίαν πάντων." Aristotle, *Metaphysics* 1.987a.

This Pythagorean-Platonic ontology resonated throughout the history of Western music until the Renaissance. Especially, the issue of (in)divisibility was situated at the center of the music treatises and challenged the writers of the treatises to either face the issue head-on (as in Ptolemy's *Harmonica*), propose a new, non-numerical theory of music (as in the works of Aristoxenus), or omit it altogether (as in the Euclidean *Sectio Canonis*). More broadly, this issue placed music in between the two disciplines, albeit somewhat uncomfortably: arithmetic (study of the discrete numbers) and geometry (study of the continuous magnitudes). Music was, first and foremost, the study of ratio. It was the study of the relationship between two discrete numbers. This means that only numerically prescribed notes were considered as viable musical possibilities. Although, the monochord can generate more musical notes, the concept of number and music limited the potential of the monochord. However, the geometric nature of the monochord, as it would be described as "the division of the monochord," continuously challenged the arithmetic nature of music.

2.6. PARAMETERS OF MUSICAL SPACE

In the present day understanding of musical space, there is a sense in which one note can become another through some sort of an operation. In other words, all the musical notes are within the same conceptual plane. Since this notion is extremely natural to us, we might need a counter example to demonstrate a different method of organization. Consider the letters of the alphabet "B" and "C," for example. With their identity within the alphabet, "B" can never *become* "C." Although they are part of the same group, they are not commensurable to each other as musical pitches are. They can be considered to be neighboring letters, but they are still two different entities with different characteristics. Now, take the same letters but consider them as musical notes "B" and "C." In this case,

"B" can truly *become* "C" if we raise it up a half-step, or at least the idea of sound that was represented with the letter "B" can become "C." We can even think of the case which is not possible to represent with letters, as in the case of the quarter tone between "B" and "C."[33] Since the essential domain is a musical sound, all the operations (raising, lowering, or remaining) are done to the sound, or the sound imagined. The letters are mere representations of the sound, a front-end of the ephemeral event.

The commensurable nature of the pitched musical sound, that the musical notes are conceptualized under the same unit of measure, is interdependent with the spatial nature of musical sound. The spatial nature of musical sound manifests two-fold: (1) the distinction between two notes are spatially defined, and (2) the identity of a note is determined by its location on a space. First, consider the two aforementioned pitches, "B" and "C." The fact that we can imagine an infinite number of sounds *in-between* the two pitches signifies that the two notes are conceptualized as two points on a continuous line, a geometrically oriented concept. Contrasting this with the alphabet, which is conceptualized as a collection of discrete entities, musical notes are understood as points on a line of possible sounds. The line is extended infinitely and there is no gap on the line, at least in theory. Second, we identify the notes as being "high" or "low." Considered this way, how musical notes relate to each other is unique and complex; the history goes back to the Pythagorean understanding of musical sound.

Where did the commensurability of musical notes come from? Since when could a musical thinker of the Western culture see with his or her mind's eye one note becoming

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[33] There is another interesting way to look at what is between "B" and "C." If you look at a Standard English keyboard, there is "V" in between the two letters.

another? Also, what conceptual apparatus must one musical note go through to become another? I hope to answer these questions by looking at the parameters of our musical space and comparing them with what would have been possible with the introduction of the Greek monochord to Greek harmonic theories. To begin, we shall scrutinize our present-day conceptualization of musical sound.

It is obvious that we all think differently. However, this should not discourage us from pursuing how we, each as an individual but as an individual within a certain cultural tradition, think about musical sound. The mere fact that we can communicate and describe music with language should indicate that there are common parameters within which we all think. The question, then, is realizing what those parameters are. We all become accustomed to the parameters without anyone prescribing them. People learn them differently based on their musical tastes, as well as in relation to the social and ethnic groups they belong to. It is for this reason that the general parameters that can be applied across the board must be, well, general. For example, in some Classical traditions (and certainly in an undergraduate music theory class), what is called a "leading tone" must resolve up.[34] This very prescribed and specific parameter applies to a wide range of Classical music, but the repertoire that this parameter does not apply to is certainly larger if we consider the music from Western culture in its entirety. However, the fact that there is a concept of a note and the fact that a note can go up and down applies to most, perhaps all, of Western music. Additionally, an individual who grew up in the Western cultural tradition would apply these parameters when listening to music even when the music is not necessarily from Western culture. From this, we can

[34] This means that the sound that functions as "*ti*" (as in solfège, *do-re-mi-fa-sol-la-ti*), has a high tendency to be followed by what functions as "*do*," a note half-step above.

deduce two elemental parameters of Western musical thinking which pertain to the scope of this study: commensurability and spatiality. What I mean by commensurability is that one note can become another; by spatiality, I mean that the identity of a note is determined by its location in an imagined musical space. These two parameters are related, in that, in order for a note to become another note, there must be a certain property that defines their identity so that one note is distinct from another. At the same time, in order for the range of possibility of a note to be realized as a space of some sort, the note that would later be considered as being in the space must be changed, or moved, in a way that the space is recognizable. In other words, we cannot see or feel space unless there is a motion within that space. And through the motion, we can deduce the parameters of the space.[35]

2.7. MOTION AND THE MONOCHORD IN ANCIENT GREEK MUSIC TREATISES

"Vocum Differentias in Quantitate Consitere" (that difference of pitches consists in quantity).[36] Boethius's fourth book of *De Institutione Musica* begins with the above disclaimer followed by an excerpt from the Euclidean *Sectio Canonis* translated in Latin. Considering that the excerpt mostly maintains the original text, the addition of the above disclaimer may strike readers as odd because that sentence is nowhere to be found in earlier versions of the

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[35] Although not directly related to the scope of this dissertation, Henri Lefebvre (2000) summarizes this relationship between space and motion. He writes, "Let everyone look at the space around them. What do they see? Do they see time? They live time, after all; they are in time. Yet all anyone sees is movements. In nature, time is apprehended within space" (95–96).

[36] The translation is taken from Barbera 1991 (228–229). Barbera translated the word "vocum" as "pitch" because the corresponding Greek word seems to be a polysemic word *phthóngos* (φθόγγος). Depending on the context, *phthóngos* can mean note, pitch, voice, and sound.

Sectio Canonis. Why did Boethius (or the scribe) feel it necessary to add such a disclaimer at the beginning of the division of the monochord? Why did he begin the division of the monochord with the declaration that it is *quantity* that results in the difference of pitches?

In this section, I argue that the growing interest in the physicality of the monochord and the increasing reliance on the monochord as a tool to generate musical notes recontextualized the identity of a musical note from numerical to spatial in nature. More broadly, the growing popularity of the monochord shifted the disciplinary status of music from being associated with arithmetic to being more closely associated with geometry. In this context, a change of musical note was no longer a change of quantity, but a change of location. Throughout the process of this recontextualization emerged the musical space-concept because the change of location necessitated the underlying space in which the change occurred. I believe that the aforementioned disclaimer in Boethius's *De Musica* signifies that Boethius, as a Neo-Platonist, attempted to maintain the disciplinary status of music as arithmetically oriented because it was how the discipline of music was originally envisioned in Pythagorean-Platonic tradition.[37] The emphasis on quantity in the above statement should remind medieval readers that quantity only applies to objects that are countable, and the study of countable entities is arithmetic. The above statement should also

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[37] There is a possibility that the above sentence may not have been written by Boethius. As mentioned earlier, this disclaimer could have been written by Nicomachus as Bower (1989) suggests that Boethius's *De Musica* may have been a translation of Nicomachus's lost treatises *On Music*. If this is the case, it will show that the anxiety of the geometrical influence on music could be historically located around second century C.E. (around Nicomachus's lifetime) not sixth century (around Boethius's lifetime). In either case, Boethius's decision to translate the above disclaimer still suggests that the anxiety still concerned scholars in Medieval period. Also, Nicomachus would be another likely candidate to emphasize the arithmetic origin of music, because he is considered to be a philosopher in the Pythagorean-Platonic tradition. Furthermore, as we shall see in the following discussion, Nicomachus's other music treatise *Enchiridion* demonstrates both the arithmetical use of the monochord and interest in the physical property of the monochord.

remind us of the four categories of motion in Aristotle's *Physics* in which change of quantity and change of location are two of these four categories. Announcing that the change of pitch is quantitative in nature is an attempt to pre-emptively denounce any other modes of conceptualization, which, in turn, suggests that other modes of conceptualization were possible at the time. This section of my dissertation looks at ancient Greek monochord treatises in an attempt to demonstrate how the description of the monochord changed over a long period of time. Here, I will consider five treatises: (1) Plato's *Timaeus* (Strunk and Treitler 1998, 19–23); (2) the Euclidean *Sectio Canonis* (Mathiesen 1975); (3) Nicomachus of Gerasa's *Manuale Harmonices* (Barker 1989), (4) Ptolemy's *Harmonica* (Barker 1989), and (5) Gaudentius's *Harmonic Introduction* (Strunk 1998, 66–85)

The narrative of the Euclidean *Sectio Canonis* is composed of axioms and proofs in the style of Euclid, and does not offer any instruction on how to build the monochord or how to manipulate it as part of the discussion of its division. As the first treatise on the division of the monochord, *Sectio*'s argument is firmly grounded in the arithmetic use of numbers. David Creese (2010) observes the following in regard to the style of argument in the *Sectio*.

> The package itself belongs to arithmetic rather than to geometry, for only in arithmetic can the division of the unit be ruled out with the standard *reductio ad absurdum* argumentation formula. Because the proof of the impossibility of the equal division of epimoric [superparticular] intervals is predicated upon the indivisibility of the unit, the use of the terminology both of "unit" (*monas*) and of "interval" (*diastēma*) in the *Sectio Canonis* deserves closer attention. The definition of "unit" and "number," with which

> Euclid opens *Elements* VII, shows the primacy of the concept of unity to arithmatic:
> 1. A unit is that by which everything that exists is said to be one.
> 2. And a number is a plurality composed of units. (Creese 2010, 31)

The arithmetic use of the monochord suggests that at least at the time of the writing, music was conceptualized in terms of number. In this context, change of musical pitch would be underlined by the change of quantity. The musical space-concept had not yet emerged as a way of understanding musical sound.

The absence of the musical space-concept can also be observed in the preface of the treatise. In regard to the motion of the string, the anonymous author offers an experiential narrative of the cause of musical pitch. The author writes:

> If, therefore, anything is to be heard, it is necessary that there first be pulsation and motion. So, since all notes arise from some existing pulsation, and pulsation is impossible unless first arising from motion—and, of motion, there are more frequent and the intermittent; and the more frequent make acute notes, the intermittent, grave [notes]—it is necessary that there be on the one hand higher [notes] since they are compounded of more frequent and abundant motions, and on the other hand lower [notes]…(Mathiesen 1975, 239).[38]

Here, "motion" does not describe a change of place, but rather a vibration of a string. The author first notes that motion is what produces the sound and later writes that closely packed motion produces high notes and widely spaced motion low ones (they are high and

[38] I modified Mathiesen's translation to portray literal meaning of the description of notes. Mathiesen uses "high" and "low" instead of "acute" and "grave."

low in number). In this description, the word "motion" means change of quantity of pulsation. Therefore, no underlying space is necessary.

Instead of axioms and proofs, Nicomachus's *Enchiridion*, a later treatise on the monochord, provides more descriptive instructions about the act of generating musical notes.

> For if you take a long string at a single uniform tension lying above a measuring rod [*kanon*], and fixed away from the rod so as not to touch it, and if you compare the note from the whole string when it is plucked with that from half of it, the string being divided off exactly in the middle by a bridge or something of the sort, so that the vibration from the blow does not extend further than half-way, you will find that the sound from the half string stands at an octave to the *larger* sound from the whole—that is, it is double that sound, being qualified in the opposite way to the relationships of the lengths (Barker 1989, 262; emphasis mine).

Here, the word "larger" in the phrase "larger sound" means larger in quantity as evidenced by the phrase "double that sound." But the concept of large, and its numerical underpinnings enables a kind of non-spatial commensurability. By addition or subtraction of number, a small note can *become* larger and vice versa. Although theorists did not agree as to which sonic extremity would be described with the word "large" (for example, Ptolemy would call Nicomachus's "large" note "small" and vice versa) until later in the history of Western music, nearly all Greek and Medieval theorists would have agreed that musical notes and concords were numerical in nature.

In fact, we can see that this belief was already commonplace during the time of Aristoxenus because he criticized the Harmonicists' tendency of "close-packing" (καταπύκνωσις, *katapyknosis*) of possible musical notes. It is easy to assume that ever since the musical notes were given numerical properties, the Pythagorean-Platonic impulse was to organize them according to their numerical underpinning. Nearly all of the monochord

treatises, therefore, end with the ordering of musical notes according to their numerical property. For example, Theon of Smyrna quotes on Thrasyllus's division of the monochord, which ends with the following statement: "We could also find these things in numbers, beginning from nētē hyperbolaiōn, if we assume that it is 10,368" (Barker 1989, 229). He continues, "the successive epogdoics and the remainders are taken according to the ratios previously stated, which it is unnecessary to set out: it is an easy task for anyone who has followed what we have said." This invitation to the numerical ordering suggests that although musical notes were not spatially defined, the frequent practice of ordering could have heralded later spatial representation as the numbers were being mapped on to the monochord. However, it is important to recognize that without the help of the monochord, the Greek and medieval practice of writing large numbers would somewhat disguise the direct relationship between numbers.[39]

Compared to previous treatises, Ptolemy's *Harmonica* offers a far more experiential description of the monochord and its division. He begins by advocating for the monochord as a superior instrument for the study of ratio to wind-instruments, such as *auloi* and *syringes*. One of the reasons he provides is that the monochord's "limits are appropriately placed so that the limits of the plucked sections between them, into which the whole length is divided, have suitable and clearly perceptible points of origin." In other words, it is easier to perceive, because one can see in front of his or her eyes, what causes the change of pitch. He moves

[39] For example, in *Sectio Canonis*, numbers "262144" and "294912" were written in Greek as "ϐϙυδ" and "ϡϡιβ" and in Latin as "$\overline{\text{CCCLXII}}$.CXLIIII" and "$\overline{\text{CCCXCLLLL}}$.DCCCCXII." See Barbera 1991 (147 and 254).

on to describe how to construct the monochord—a discussion entirely missing in *Sectio Canonis*. And he explains how to operate the monochord. He writes:

> When something of this kind has been found, and the measuring-rod has been divided in the ratios of the concords that have been set out, by *shifting the bridge* to each point of division we shall find that the differences of the appropriate notes agree most accurately with the hearing (Barker 1989, 292; emphasis mine).

Here, he introduces an entirely different kind of motion, change of place, into the discourse of the derivation of musical notes. In his writing, what causes the difference between notes is not only the change of numerical ratios, but also the shifting of the bridge.

To contrast the narrative before and after the introduction of the monochord treatises, consider these two passages: one is from Plato's *Timaeus* and the other is from Gaudentius's *Harmonic Introduction*.

> Plato, *Timaeus*
> Then, taking the three [what is indivisible, divisible, and intermediate], he [the "god younger"] blended them all into a unity, forcing the nature of Difference, hard as it was to mingle, into union with Sameness, and mixing them together with Existence. And having made a unity of the three, again he divided this whole into as many parts as was fitting, each part being a blended of Sameness, Difference, and Existence. And he began the division on this way…(Strunk 1998, 19–23).

> Gaudentius, *Harmonic Instruction*
> [This follows the Pythagoras-in-a-blacksmith story.]
> But not satisfied only with the experience of these things, he [Pythagoras] tested the method in another fashion. After stretching a string over a canon and dividing the canon into twelve parts, when he plucked first the whole string and then half of it—i.e., six parts—he discovered that the whole string to the half was consonant in accord with the *diapason*; just as

> in the first methods, he perceived it to be in duple ratio
> (Strunk 1998, 66–85).

In Plato's narrative, what is being divided is a blend of Sameness, Difference, and Existence, which is far more abstract than Gaudentius's "stretched string over a canon." Plato's division is the division of the soul itself, while Gaudentius's division is a physical and visual division of a stretched string. An experiential narrative of the division, similar to that of Gaudentius, is what was ubiquitously adopted by the *Theorica* tradition, most notably, by Boethius. This experiential narrative provides visual, and thus spatial demonstrations of the ratios.

Based on the trajectory of the growing description of, and reliance on, the physical properties of the monochord in Greek musical writings, I argue that the interest in visual means of demonstration increased. The concept of musical motion which produces pitch difference was situated with increasing opportunity to be reconceptualized as a more physical and concrete notion. In other words, following the prominence of the monochord, the abstract idea of musical motion as change of quantity was replaced with a simpler and more material idea of change of place—the change produced in the shifting bridge of the monochord. This reconfiguration of musical motion as change of place introduced two new concepts to the discipline of music: the entity that moves, and the underlying space in which the motion occurs.

2.8. THE INFLUENCE OF SPATIAL REASONING

Cleonides's *Harmonic Instruction* defines an interval (διάστημα, *diástema*) as that which "is bounded by two notes differing as to 'acuity and gravity' (*ὀξύτητι και βαρύτητι*)" (Solomon 1980, 145) The use of the word "interval" (literally means "distance") signifies that the two

notes that make up the interval are spatially conceptualized. The term "interval" originates from Aristoxenus's *Elementa Harmonica*. However, in contrast to Aristoxenus's rejection of the numerical derivation of musical notes, the transmission history of Cleonides's *Harmonic Instruction* suggests that adopting number as the source of musical notes was not rejected by later theorists. This treatise was transmitted together with the *Sectio Canonis* in thirty-two manuscripts, which strongly suggests that these two books were commonly read as a unified collection. For a reader, the constant use of the word "interval" and the numerical ordering of the musical notes in the *Sectio Canonis* should inspire a conceptual model in which two "bounded" notes are numerically defined. Additionally, the reader would demonstrate the derivation of the notes on the monochord, in which the two "bounded" notes are represented spatially. Throughout Cleonides's *Harmonic Instruction*, there are overtly spatial treatments of musical elements. After defining a note and an interval, Cleonides describes motion as this:

> The following matters are to be considered in researching the quality of sound; the quality of sound consists of two movements—that known as both "continuous" and "spoken," and that known as both "intervallic" and "melodic." Continuous vocal movement renders its tightenings and loosenings undistinguishable, and it does not stand still until it becomes silent. Intervallic vocal movement moves in the opposite way from continuous movement, for intervallic movement produces pauses and the spaces between these pauses, and it makes these pauses and spaces alternately. We call the pauses "pitches," and we call the distances between the pitches "intervals." Tightening and loosening are the processes which produces the difference between pitches; the results of tightening and loosening are acuity and gravity, for the process of tightening leads toward

> acuity and the process of loosening towards gravity (Solomon 1980, 145–146).[40]

This straightforward description of the pitches, the motion of these pitches, and the space created from the motion paints the whole picture of the musical space in Cleonides's time. Most importantly, Cleonides distinguishes between two sorts of motion: "continuous" and "intervallic."[41] By referencing Aristotle's *Categories* and Aristoxenus's *Elementa Harmonica*, he describes the sound of speech as continuous motion in opposition to the intervallic motion of a melody. By doing so, he draws attention to the sonic property of speech, a supplement or part apart from the semantic content. This separation of sound and meaning is instigated by the recognition of musical sound as a separate entity, such as the notion of musical note. Only after sound is understood as independent can it be separated from speech. In other words, the spatial reasoning of musical sound makes possible the differentiation between sound and meaning.

This is a clear departure from the Aristotelian ontology of voice and sound. Aristotle writes in *De Anima*:

> Voice then is the impact of the inbreathed air against the 'windpipe', and the agent that produces the impact is the soul resident in these parts of the body. Not every sound, as we said, made by an animal is voice (even with the tongue we may merely make a sound which is not voice, or without the tongue as in coughing); what produces the impact must have soul in it and must be accompanied by an act of imagination, for voice is a sound with a meaning, and is not merely the result of any impact of the breath as in coughing; in voice the breath in the windpipe is used as an instrument to knock with against the walls of the windpipe. This is confirmed by our

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[40] "Highness" and "lowness" in the translation are modified as "acuity" and "gravity."

[41] This distinction should remind the readers of the distinction between geometry and arithmetic. Here, by defining melody as intervallic, as oppose to continuous, there seems to be an attempt to relate arithmetic with music.

> inability to speak when we are breathing either out or in-we can only do so by holding our breath; we make the movements with the breath so checked. It is clear also why fish are voiceless; they have no windpipe. And they have no windpipe because they do not breathe or take in air. Why they do not is a question belonging to another inquiry. (Aristotle, *De Anima* 2.8.)

Aristotle first defines sound as resulting from an impact of two objects which is propagated through an empty space. From this perspective, Aristotle necessitated two objects which generate voice, a type of sound: a windpipe and the soul. He concluded that voice is, by definition, "a sound with a meaning," and a sound without a meaning is not to be considered a voice, even if it is from a soulful being.

At a more fundamental level, the shift from a-spatial to spatial notation indicates a shift in the metaphysical relationship between the signifier and the signified. Without the possibility of conceptualizing a melody as something that changes place, the Greek letter-notation delineates each note by assigning a different character. This means that the moment in which one melodic note becomes the other does not allow for a space in-between just like the Greek concept of number. Without the recognition of sound as an independent entity from the letter it represents, the concept and recognition of sound must rely on how it is represented in written form or whether or not it is representable. This, in turn, creates a one-to-one relationship between the sound and the notation. In this mode of thought, there is no meaningless musical note—a musical note, in its definition, always refers to a definite non-sonic entity, the underlying numerical ratio. On the other hand, the sound that is notated as a stroke in the manuscript operates within an entirely different semantic structure. There is no longer a one-to-one relationship between sonic material and its semantic content. In

other words, the sonic material and the meaning are separated, and the musical notation becomes an indefinite signifier.

It is not hard to find descriptions of arbitrariness in the treatises that discuss spatial notation, such as *Musica Enchiriadis* or *De Musica Disciplina*. For example, in chapter eight of *Musica Enchiriadis*, the author describes the mnemonic syllables as arbitrary containers of the sonic material without definite semantic content: "*Noannoeane* and *Noeagis*, etc., we do not consider to be words with meaning, but syllables assigned to the intonation" (Erickson 1995, 12). Also, about *Daseian* notation, the author writes:

> For example, let some "strings" (*chordae*), as it were, be extended straight out from the individual symbols for the tones positioned in order. Moreover, let the lines (*chordae*) stand for the pitches these symbols signify. On these lines *any* melody may be represented…(8; the emphasis on "any" is mine).

Here, the *Daseian* symbols serve as placeholders of different notes, and the symbols are further abstracted into horizontal lines that are only distinguishable spatially. Therefore, depending on the context, a line can represent different sounds; this possibility of contextual difference shows the inherent arbitrariness of the sound represented. The understanding that musical entity is an indefinite signifier continues to be observed in the present-day through the use of the Western notational practice. As Theodor W. Adorno writes on Western art music, "the higher the species of music, the more forcefully they say it…but what is said cannot be abstracted from the music; it does not form a system of signs" (Adorno 1993).

2.9. SUMMARY

In this chapter, I showed the conditions under which musical motion came to signify a change of quantity. Within the Greek understanding of music as the study of ratios of

discrete numbers, moving from one note to the other was understood as a numerical change. Through the use of the monochord, the change of ratio was recontextualized as a change of location, and pitch was concurrently understood as an entity navigating through a pitch-space determined by ratios. This newly constructed conceptual framework was the basis of the early *neume* scripts, which later helped to codify modern notational practice. The reinvestigation of the origins of musical space demonstrates why the concepts of musical sound and the underlying space are so intertwined that they are difficult to inspect individually.

CHAPTER III

GENEALOGY OF MUSICAL FUNCTION

3.1. INTRODUCTION

3.1.1. Clarifying the Relationship between Musical Function and Object

The seventh note of the major and minor scale (*Ti* in *solfège*) is called a leading-tone. Upon the dominant to tonic progression (in its proper context), the leading-tone must resolve up. According to harmonic theory from the eighteenth century, the leading-tone is considered unstable in relation to the stable tonic.[42] As Jean-Philippe Rameau famously writes,

> The note which completes the perfect cadence is called the tonic note, for it is with this note that we begin and end, and it is within its octave that all modulation is determined.
>
> The sound which precedes the octave and forms all the major dissonance is called the leading tone [Fr. *Notte sensible*], because we never hear one of these major dissonances without feeling [Fr. *sentir*] that either the tonic note or its octave should follow immediately. This name is thus eminently suitable for the sound which leads us to that sound which is the center of all modulation. (1971, 65)

In today's use, we often use the role of a musical object as a stand-in for what it is. The music object that carries out the assigned role is somehow inconceivable without its assigned role. The leading-tone is not only *functioning as* a leading-tone, but it *is* a leading-tone; the seventh note of the scale must resolve up, and *Ti* must go to *Do*. In all three cases,

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[42] In addition to Rameau I cite below, the tendency of *ti* to be followed by *do* is widely accepted among theorists of the eighteenth century. As Thomas Christensen writes, "All theorists agreed that the leading tone was critical at cadential points for the definition of the *finales* or *tonique*." He regards this as one of the major catalysts for the acceptance of chordal inversions (1993, 69).

they all refer to the same note and same tendency. In this regard, the object (the role refers to) is inseparable from the role. No matter where *Ti* moves to, its motion is judged by what it is supposed to do, which is to lead to the tonic note. Given the same dominant to tonic harmonic progression, if *Ti* does not move to *Do* but, instead, moves to *Sol*, the leading-tone (*Ti*) is said to be "frustrated." Any other motion is illegal in the context of tonal voice-leading because it profoundly violates the inherent tendency of the leading-tone.

This seemingly inseparable link between the role and the object is not a characteristic of a leading-tone alone but a general feature of any musical object that can be analyzed with the currently available methods of music analysis such as notes, chords, and formal segments. For example, the major triad that is built on the fifth scale degree of a major or minor scale is not only functioning as the dominant, but also *is* the dominant chord. The difference becomes clear when we start using the term "function." Dominant chord functions as a dominant; the leading-tone functions as a leading-tone; and the exposition of a sonata form functions as the exposition.

These functions, however, are concepts that are separate from the objects that they ascribe to. For example, we can easily imagine a case where the tonic note functions as the leading-tone to the new key or the sub-mediant triad functions as the dominant to a new key. As we can see in these examples, our understanding of musical functions are considered as attributes of the object, and, therefore, possible to be separated from the object. For example, the function of a dominant chord is different from a dominant chord. Nevertheless, it is clear from the names of the functions that these functions are generated

from the object after the fact. In short, musical functions are derived from musical objects while they are no longer tied to their originating contexts.

Today's music analysis does not leave music as a purely sonic entity. It is constantly swayed by our urge to assign functions to musical objects. For example, sometimes as part of the discussion of a prolongation and sometimes as part of the discussion of a voice-leading, music analysis constantly tries to figure out how one isolated musical object functions in relation to the context. One cannot claim to understand the music without knowing the function of its constituents.

These various functions are then organized as a family of functions. Tonic, Dominant, and Pre-Dominant are grouped together as one family; leading-tone, secondary leading-tone, tonic, chordal-seventh, and other tendency tones are grouped together as another family. These families of functions are different from musical works. These formalizations of functions clarify in which dimension of the musical composition the function of a musical object can have its effects. In other words, they become the tools for interpretation of the different layers of the composition. When the purpose of each note, chord, and formal section are recognized by the analysis, the analyst can finally claim to know the music completely albeit the recognized functions of these musical elements may differ from one analyst to another. Even in case when an analyst acknowledges possibilities of different interpretations, the fact that each of these interpretations promises to lead the reader to the complete understanding of the composition does not change. There may be many ways to know the music, but each way has its end. In this sense, there exists a finitude of knowing any composition; and the finitude is established by the two facts that (1) there are limited number of notes in a composition and that (2) there are a limited possibility of

functions for the musical objects. In music analysis, similar to Michel Foucault's observation of the analysis of language, therefore, there are only two forms: interpretation and formalization—"in fact, we know of no others" (2005, 325). Formalization establishes the family of functions and the interpretation applies these functions to the musical work.

3.1.2. Chapter Overview

This chapter untangles the threads of form, object, and functionality to arrive at the discussion of the conceptual basis of the concept of morality in musical context. In today's music theoretical discourse, the concept of morality creates a basis for the meanings of music theoretical terms. This meaning is bordered by two sets of dichotomies: (1) musical motion is judged between the spectrum of "good" and "bad" or "right" and "wrong" and (2) the musical gestures are judged between the spectrum of "chordal color" and "chord progression" or "embellishment" and "structure." Between the embellishment versus structure dichotomy, the latter is considered to generate more substance thereby contributing to the value of the musical work. Within the boundaries set by these two sets of extremities, today's music analysis navigates to construct musical meaning in terms of its functionality and morality.

Before I go on to the summary of the sections, the concept of morality in music may need a short explanation. To say that a certain musical gesture is moral or immoral may seem odd because we do not directly refer to morality when we analyze, listen to, compose, and perform music. Nevertheless, our understanding of morality creeps in when discussing "right" or "wrong" movement of musical elements in the context of common practice Western classical music. In other words, it is considered good for musical objects to do what

they are supposed to do; and evil to do the opposite. However, the musical objects do not feel or are bound by morality—we are. We are the ones who assign roles to musical objects, and we are the ones who judge goodness or evil of the musical objects based on their behavior. These assigned roles we give to musical objects are inevitably evaluated by the quality of fulfillment of the assigned tasks. We realize the functions not just to understand what they are doing in context but to reveal what they are supposed to do. It is only when these musical objects satisfy their purpose within the harmonic context that the entire composition is considered to be perfect and without error. The concept of function of musical objects therefore underlies the morality of the musical objects. Only when all musical objects of a composition behave according to their function (i.e., behave according to the musical moral law) the resulting final form is considered to be beautiful. The moral-immoral dichotomy of musical objects takes different shapes and forms according to context: chord progression versus chordal color, triadic core versus chordal extension, structure versus embellishment, rule of counterpoint versus lack of rule of chordal extension, and to a certain extent, bass versus treble[43] and harmony versus melody. In all of these instances, what is under the scrutiny of the morality is that which initiates the motion, and the pathway for the motion is prescribed with various music-theoretical rules such as harmonic, tonal, and formal functions. Irrespective of the types of musical objects, our urge

[43] The morality of bass and treble may need further explanation. In the common-practice Western classical music, bass notes are often considered to play more structural role—they are the ones who do the work. The treble (e.g., female voices of a choral music, soprano in a four-part harmony, violin in a string quartet, the right hand of a harpsichordist especially in the case of thoroughbass realization, and so on) is usually considered as an accessory to the structure. Between work and pleasure, the bass corresponds to work and the treble would correspond to pleasure. The association of work with goodness and pleasure with evil and its influence on the conceptualization of music is the main focus of this chapter.

to assign functions or our urge to seek the object's role in a context drives us to a deeper understanding (no matter how arbitrarily it is defined) of the organized whole: a musical work.

There are three sections in this chapter. In the first section, I will show how the concepts of function and form reciprocally reinforce, and thus solidify, each other. This is done by investigating the changing relationship between the concepts of function and form during the late eighteenth and early nineteenth century aesthetic theory of Kant and music theory of Georg Joseph Vogler and Gottfried Weber. These writings are paired with the secondary literature by two scholars: Lydia Goehr's claim about the emergence of the work-concept and Jairo Moreno's claim about the emergence of the autonomous figure of the listening subject. In her book *The Imaginary Museum of Musical Works* (2007), Goehr argues that the concept of a musical work as fixed and regulative entity emerged during the eighteenth century. On the other hand, Jairo Moreno argued in his book *Musical Representations, Subjects, and Objects* (2004) that the concept of listeners who are responsible for understanding musical gesture fully emerged during the early nineteenth century. Based on these observations, I argue that, along with the emergences of the work-concept and modern listening subject came the concept of musical objects as constituents of a conceptually rigid formal structure. As the container becomes more rigid, it required the components to be also solidified in terms of its ontological standing, thereby creating a nested structure of containers at different levels. A note becomes a constituent of a chord, a chord of a phrase, a phrase of a section, a section of a movement, a movement of a musical work. At each level, there is always clearly defined hierarchy of containers. As a result, the act of making music became a process of compartmentalizing musical objects within a fixed, regulative, container:

the musical form. This contrasts the earlier mode of composition which allowed a largely additive process without the necessity of formal closure. In the earlier mode, the closing gesture seemed to be a result of rhetorical necessity, rather than a structural one. This understanding of musical objects as conceptually rigid entities made possible the separation of musical function from the object.

The second section delves deeper into the resultant separation of musical function from the object. By looking at music theoretical treatises of the nineteenth century, I will show the shifting understanding of musical motion from "following the natural law" to "following the inherent tendency of the musical object." For example, the "*Ti-Do*" motion was no longer explained through the laws of gravity, as Rameau did, but explained through the assigned function of the leading-tone (*Ti*). Following the ontological solidification of the musical objects, music theoretical literature began to consider musical objects (e.g., note, chord, and formal segment) as entities capable of possessing their own agency. In the earlier mode of conceptualization, the musical work becomes the mediator between the composer and the listener. In the later modes, the composer becomes the mediator between the will of the tones and the listener; the job of a composer is to realize the tendency of the tones and let them do their job. In other words, "free" them to act upon their nature. This separation of musical function from its originating object and the reassignment of the function to the musical object enabled the metaphorical understanding of the musical objects as the laborers within the process of industrial production.

The third section investigates social conditions in which the metaphorical conceptualization of a musical work as an industrial product emerged. During two-hundred years of Western history of music theory between Rameau and Hugo Riemann

(approximately 1700–1900) Western society underwent tremendous changes in social structure, mode of production, and method of scientific inquiry. The notion that sound (or represented sound in a form of notation) functions in certain ways is constructed with a complex network of metaphors, ontology, and reflection of society because sound, as a purely sonic and ephemeral event, does not rise up to the status of a being that can function. In short, sound does not work unless we first acknowledge it as an entity that is capable of having an autonomy. Then, how come do we readily accept the notion of functionality as some ground of knowledge about musical composition? In this section, I argue that the notion of functionality emerged as the ground for knowledge when the industrial mode of production, most notably Adam Smith's division of labor, became the primary mode of manufacturing in the nineteenth century.

3.2. RECIPROCAL SOLIDIFICATION OF FORM AND FUNCTION

The concept of form and function are inter-dependent. As they are understood today, one cannot exist without relying on the other, and vice versa. When we say "X functions as Y," we first notice the behavior of X as recognizable. In a musical context, for example, when we say "the G major chord functions as a dominant," we are recognizing the G major chord in isolation in order to apply the category of functions (in this case, the dominant) that are previously known to us. This means that in order for us to have a concept of function, we first need a foundation that allows us to delimit and discern a part that is distinguishable from the whole. In other words, we need to be able to point out the object which will be assigned a function. Only then, we can apply the functions. When recognizing certain musical behavior as functional, the possible behaviors for that musical

object must be known (or potentially knowable). If it is not previously known, the behavior will not be considered in terms of functionality but of identification. The possible behaviors do not account for all of the possible ones but only the meaningful. These meaningful behaviors (that are socially, culturally, and historically defined) are formalized as a group of functions that operate within the equivalent conceptual level of analysis. For example, in the context of harmonic function, there are three prototypical types: Tonic, Dominant, and Pre-Dominant. In the context of musical formal functions, there are various families of functions such as James Hepokoski and Warren Darcy's functions as shown in *Elements of Sonata Theory* (2006) or William Caplin's Theory of Formal Function in *Classical Form* (1998). In the context of structural voice-leading function, there exist Schenkerian and Post-Schenkerian voice-leading reduction which takes into account the function of structural and embellishing notes. All of these theories of musical analysis formalize the family of functions so that they can be applied in the interpretation of musical works. This means that as the concept of functions of musical elements are being articulated, one acquires a growing number of possibilities to isolate the musical elements within a musical composition. In other words, our knowledge of function provides us with an analytical scalpel with which we can dissect the musical work into its constituent parts.

On the other hand, this concept of musical function generates the centripetal force among the constituent parts. Only by the recognition of its function can the musical part be recognized as a constituent of the unified whole. To refer back to the earlier example, the statement "the G major triad functions as the dominant" not only singles out the G major chord, but also refers to its background structure; it is the musical context that makes the behavior of the G major chord dominant-functioning. The observation that any chord is

functioning as dominant must arise from its musical context that made the dominant function possible. In other words, the G major chord by itself does not project any functionality (or, it always projects tonic function); only when it is considered in relation to its surroundings (i.e., within a musical phrase) can the dominant function be recognized. Therefore, the act of recognizing the function of the musical element ultimately solidifies the structure of the musical whole.

3.2.1. Musical Form as a Concept with Hard Boundaries

Given this inter-dependence of form and function, the dual emergences of musical work and musical function around the late eighteenth and early nineteenth century seem inevitable. Many scholars have provided convincing historical evidence that the concept of musical work as we understand it today emerged around the turn of the century. Lydia Goehr summarizes our understanding of musical work which continues from the previously-mentioned turn of century.

> We do not treat works as objects just made or put together, like tables and chairs, but as original, unique products of a special, creative activity. We assume, further, that the tonal, rhythmic, and instrumental properties of works are constitutive of structurally integrated wholes that are symbolically represented by composers in scores. Once created, we treat works as existing after their creators have died, and whether or not they are performed or listened to at any given time. We treat them as artefacts existing in the public realm, accessible in principle to anyone who cares to listen to them. And when called, finally, to give examples of works, we usually look to the tradition of western, European, classical, 'opus' music, to works, in other words, of a 'purely

> instrumental' or 'absolute' sort. (2007, Kindle Location 68–69)

In short, the musical work is considered as a new and distinct creation separated from the composer's earlier efforts. The properties of musical work that Goehr summarized suggest that the ontological status of the musical work-concept resembles that of a physical object. Similar to how we treat a craftwork or an art object, a musical work is considered as an individual entity that is capable of being possessed and also capable of being copied. If we consider that the musical work is purely sonic in nature and is only perceived through our sense of hearing, these properties of musical work would not have been possible. For example, without the aid of recording technology or written notation, the purely sonic object is not graspable to be possessed. To say that a person can possess the musical work implies that the work of music is not considered as purely sonic but understood as if it is a physical object.

This is why scholars such as Roman Ingarden, Lydia Goehr, and Nelson Goodman all emphasize the role of notated score (a physical object) when considering the emergence of the musical work-concept. Erinn Elizabeth Knyt summarizes these writers as follows:

> Ingarden believed a fixed text recorded at a set time based on a single author's creativity to be an essential requirement for a composition to achieve work status… Ingarden's overall vision of the work concept includes a notated score originating at a set time from the creative impulse of a master creator and a series of novel sound constructs organized tonally. (2010, 5)[44]
>
> [Lydia Goehr's] historical approach pinpoints 1800, the general time when notions of originality gained importance,

[44] She refers to *The Musical Work and the Problem of its Identity* (Ingarden 1986). Elsewhere in Ingarden's book, he extends this idea of physicality of musical sound as the basis of musical work-concept to include the development of a recording technology.

> as the period when the musical work concept began to rise in prevalence. Based on the emergence of the term "work" around 1800 in conjunction with new notions of plagiarism and the growing understanding of scores as fixed and unalterable entities to be revered by performers (i.e., notions of *Werktreue*), she identifies the nineteenth century as the period in which the work concept became "regulative," as she puts it, for the production of musical pieces. It created the expectation that a work would feature novel combinations of tones created by a single composer that were recorded in a score and realized in performance. (6)[45]

> [Nelson Goodman] considers a work to be created by a composer and notated with a fixed set of symbols at a specific time. …He differentiates between features like pitches that he considers integral to "the work," and more ambiguous tempo markings that he finds superfluous. (6)[46]

Although Knyt's writing centers around Ferruccio Busoni and the time when Busoni was active (late nineteenth and early twentieth century), I adopt Goehr's position regarding the time of the emergence of the work-concept which is approximately a century prior.

The particular role that the notated score played in the emergence of the work concept needs further explanation because musical notation was around long before 1800. Goehr explains that notation made possible, among other things, the separation of music into work and its performance. Citing Jacques Attali, Goehr claims that "development in copyright laws and publication helped 'institutionalize' works as commodities separable from their performance" (2007, Kindle Location 2533)[47] This commodification of musical work

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[45] She refers to *The Imaginary Museum of Musical Works* (Goehr 2007).

[46] She refers to *Languages of Art: An Approach to a Theory of Symbols* (Goodman 1976).

[47] Her quotation of Attali is as follows, "in order for music to become institutionalized as a commodity, for it to acquire ... monetary value ... it was necessary to establish a distinction between the value of the work and the value of its representation, the value of the program and that of its usage" (1985, 51).

and the emergence of the work concept will be explored later in this chapter. For now, it is important to recognize that Europe during this time was undergoing tremendous social, cultural, and economic change known as the Industrial Revolution. In this historical context, the concept of commodification of musical work must be understood.

3.2.2. Separation of Function from Identity

When discussing the history of musical function, perhaps the most frequently mentioned music theorist would be Hugo Riemann and theorists who influenced him such as Moritz Hauptmann, Arthur von Oettingen, and Hermann von Helmholtz. This would seemingly put the date of the emergence of musical function around the late nineteenth century. However, the concept of musical function predates the use of the word "function." As observed by Brian Hyer, "the function theories begin with prior assertion of a referential tonic;" and this would put Rameau as one of the earliest theorists of musical function. Be that as it may, the treatment of musical function as a separate concept from the identity of the object points us to the discussion of *Mehrdeutigkeit* by Abbé Georg Joseph Vogler and Gottfried Weber.

The names of the three harmonic functions (tonic, dominant, and sub-dominant) come from Rameau's description of the dominant and tonic (and later sub-dominant). However, the way these terms are used by Rameau and by Vogler and Weber differs slightly in its orientation, and clarifying the difference between the two will clarify the distinction between musical object and its function.

As mentioned in the introduction to this chapter, the concept of musical function is perhaps best understood as an abstraction from the commonly occurring musical gestures.

Just like how the abstract concept of number has its basis in the act of counting, and how the abstract concept of height of musical note has its basis on the numerical proportions of the monochord, the concept of musical function has emerged as the inherent property of the musical objects that are involved in common musical gesture. In other words, the recurring pattern of one sonority changed into another in a similar way inspired a causal explanation of the change.

In this context, Rameau treated the dominant to tonic pull as a manifestation of a natural phenomenon and thus this pull played a role of generating principles of all musical motion. This resulted in a concept of dominant and tonic that resembles what Foucault calls "a double-entry system which could be read exhaustibly either from the point of view of the role it played…or from that of its morphological variables (form, magnitude, arrangement, and number)." In other words, a dominant chord is simultaneously recognized as both the identity of the sound it represents and the behavior of it. Lacking a systematized organization of chordal identity separate from chordal function (such as Roman numeral), the dominant, tonic, and sub-dominant played a role of identifying chords as well as explaining their behavior. This is different from today's understanding of chordal identity and chordal function where being a dominant chord is separated from, say, being a V chord. The two systems of designation (Roman numeral and function) each play different roles so that one applies to identity and the other applies to function. This separation is only possible when two systems of designation are firmly established. This is why the concept of function emerged as a separate entity after Vogler and Weber popularized the Roman numeral.

Following the use of Roman numerals, the identity of the chord was defined by its location on a scale which operates within the vertical level, whereas the functional labels of a

chord lost its vertical orientation. This can be observed from the changed meaning of the prefix "sub" in the word "sub-dominant." As it is used today, the "sub" in sub-dominant exclusively refers to the vertical location of the chord. It means "beneath" or "lower." However, in non-music theoretical context, the prefix "sub" often extends it meaning metaphorically and means "secondary" or "subordinate." Therefore, the term "sub-dominant" could mean not only its vertical location on a musical scale but also a sort of musical power-relation.[48]

In Rameau's definition, the latter meaning would certainly be one of the reasons why he maintained the use of the prefix "sub" (*sous*) in the later treatises. But, make no mistake that the spatial location on a scale is still the main reason why he first used the prefix.[49] For

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[48] Some theorists refer to the sub-dominant function as "pre-dominant" function. The word "pre-dominant" is a relatively new term that gained the popularity in twentieth century by North American music theorists. The distinction between the two designations could elucidate further the changing meaning of the prefix "sub-." Until the late twentieth century, the term "subdominant" was used to designate both the fourth scale-degree and the function of a chord that precedes the dominant. Not only Riemann but also Schenker use the term subdominant as not only a spatial designation but also a functional one. I hypothesize that the word "pre-dominant" took over the functional meaning of subdominant as the study of musical phrase becomes formalized during the late twentieth century, most notably, by William Rothstein.

[49] David E. Cohen observes similar dual meaning of the word *sous* in Rameau's use of the word *sous-entendre*. Not only the use of the word *sous* refers to a spatial orientation (*dessous*), it also refers to a passive behavior (2001, 71). He writes, "The verb *sous-entendre*, a compound of *sous* ("below," "under") and *entendre* ("to intend, understand, hear") which is attested in French texts since c. 1650, is defined as meaning "to have [something] in the mind without explicitly saying [it], to let [it] be understood," "to suggest," This sense is evidently based on the meaning of *entendre* in the sense of "intende," so that *sous-entendre* is an act performed by the *speaker*. The opposite sense, however, is suggested by the cognate late-Latin words *subaudire* and *subintellegere* (*sub*, "under" or "below," plus *audire*, "to hear" or *intellegere*, "to understand"), both of which denote an act performed by the *hearer* (or reader) and mean "to understand *or* supply in thought (a word implied but not expressed)." It is in this latter sense that Rameau uses and indeed defines *sous-entendre* as denoting an act performed by the hearer—more precisely, by the "ear" of the musical listener—at the same time interpreting the word in a more literal way as referring directly to hear (*entendre*), and indeed to the "hearing" of the fundamental bass "below" (*dessous*) the actual bass."

example, in *Nouveau Système*, Rameau simply describes that "one names the principal sound of the cadence as the principal sound or tonic note; fifth above it, Dominant, and fifth below it, Sub-dominant" (1726, 38)[50] The metaphorical use of the word "dominant" would certainly imply a hierarchical relation where an entity that is placed above presides as a dominator of the lower. The location of a note and its power-relation therefore create two types of cadences according to the flow of dominance: perfect and irregular (*Cadence parfaite* and *Cadence irréguliere*). When the dominant (fifth above) dominates (precedes) the following note, it is considered a perfect cadence. When this is reversed (i.e., when a note that is fifth below precedes the following note), it is an irregular cadence. Rameau's use of the same term to refer to both location and behavior creates a confusing passage later in the treatise. He writes, "The note A is denoted as the tonic note where it ends the perfect cadence (note B to A) and the irregular cadence of C to A" (see Figure III-1). He continues, "The note B is the dominant that, in turn, becomes the tonic note of the modulation because of the irregular cadence that ends; meanwhile the tonic note becomes the sub-dominant." From this, we can see how Rameau used the terms tonic, dominant, and sub-dominant in two different ways, as a name for the notes in their spatial location in the scale as well as the name to describe the behavior of these notes.[51] It seems that Rameau referred to the each note by a separate

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[50] On appelle *Son principle* ou *Note tonique*, le Son principal de la *Modulation*; sa *Quinte* au-dessus, *Dominante*; & sa *Quinte* au-dessous, *Sous-dominante*.

[51] There is yet another meaning the prefix "sub" could take. For example, in nineteenth-century music theory treatise by Pierre Rigaud (1846, 6), the "sub-dominant" would mean a note that is one scale step below the dominant. For him, the sub-mediant is therefore the second scale step: *Re*. He uses all twelve notes as the basis and refers to the major scale as consisting of first, third, fifth, sixths, eighth, tenth, and twelfth notes (think post-tonal integer notation plus 1). He write, "suppose that one would start from the first note and continues to third, fifth, sixth, eighth, tenth, and twelfth. The first note is called tonic, the third note sub-mediant, the fifth note mediant, sixth note sub-dominant,

name (e.g., A, B, C) and added a musical example to avoid confusion from the admixture of function and identity. In some ways, the note names play a role of fixed identity in Rameau's example. The same role cannot be given to a chord because a chord was still considered as a mixture of three (or more) notes. In other words, the concept of a chord did not have a clearly defined ontological boundary to take on any role. It is only after the recognition of a chord as a single entity (as well as a mixture) with a definite name, that the role of a fixed identity could be assigned to a chord.

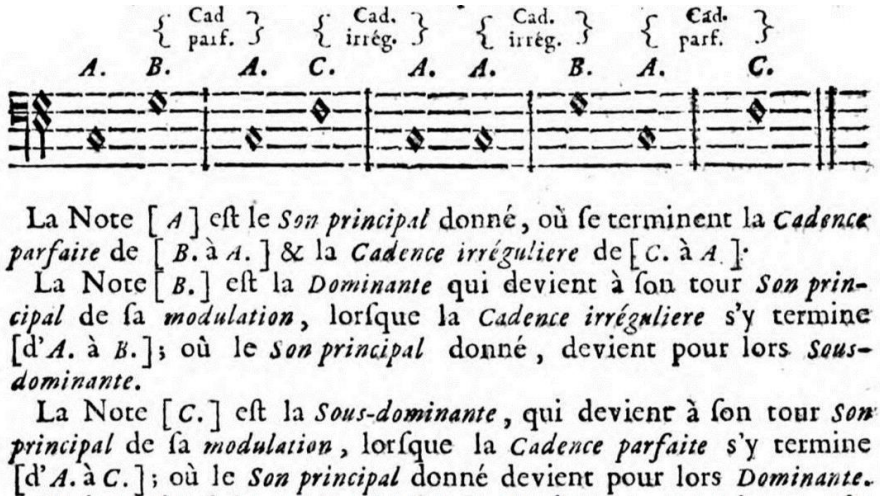

Figure III-1. Excerpt from Rameau's *Nouveau Système de Musique Théorique* (1726, 39)

The dual reference becomes understandably separated when a new set of systems to recognize chords as a unified entity took over the role of giving chordal identification. This is the role the Roman numeral system played in relation to the emergence of harmonic function. It facilitated the discussion of function independent from that of identity. We no

eighth note dominant, tenth note sub-leading-tone, and the twelfth leading-tone." (Supposons qu'on veuille partir du son No. 1 de la 1re série, on fera succéder les sons Nos. 3, 5, 6, 8, 10, 12. Le son No. 1 s'appellera par conséquent *tonique*, le son No. 3 *sous-médiant*, le son No. 5 *mèdiant*, le son No. 6 *sous-dominant*, le No. 8 *dominant*, le No. 10 *sous-sensible*, et le No. 12 *sensible*.)

longer need to call a chord "dominant" if it no longer functions as such. Conversely, the dominant function is no longer tied to the fifth motion of the fundamental bass. In addition, this separation of function and identity occurred in musical motions in general. Not only the functions of the dominant, tonic, and sub-dominant were recognized as independent, but also the function of leading-tone was decontextualized. This separation of function and identity is at the basis of Vogler and Weber's *Mehrdeutigkeit*. It is with the establishment of the stable system of identification that the construction of multiple meaning became possible. From this separation, however, emerged a concept that had been hidden behind function and identity: a purely sonic object as an arbitrary sign.

In Vogler's use of the word, *Mehrdeutigkeit* results from the interaction of two elements: fixed notes and changed context. Perhaps the most telling example of these two elements in action is his "nine leading-tones" (*neun Leittöne*) example (1802, 57–58).[52] In this example (see Figure III-2), what is fixed are the notes G# and A in the soprano voice. The bottom three voices are the ones that give multiple meanings to the leading-tone (G#) to tonic (A) motion. Being recognized as leading-tone within various harmonic contexts, the concept of leading-tone is separated as leading-tone-function that is independent from the actual notes being involved. Later in the chapter five, he explores further on the topic of *Mehrdeutigkeit* at the level of chords by implementing enharmonic respelling of the chords. In all of these cases, the musical notation confirms the meaning of the sound. The sound in isolation will be understood as the relationship between the fixed notes and the referential

[52] The following figure is adopted from Floyd K. Grave and Margaret G. Grave' *In Praise of Harmony: The Teachings of Abbé George Joseph Vogler* (1987, 35).

tonic and key. And, in order for this meaning to be known, the listener (or the listener's ear) must know the relationship between a chord and its relation to the key.

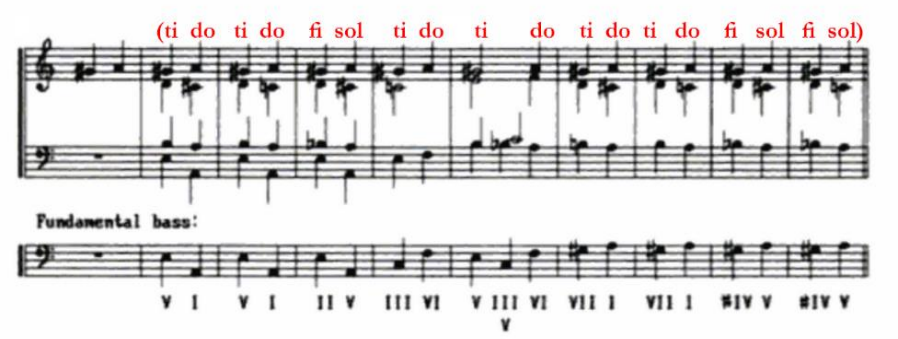

Figure III-2. The nine leading tones imagined by Vogler

In Vogler's discussion of *Mehrdeutigkait*, we see a new concept emerging that is separate from identity and function—it is the concept of sound itself. In his rejection of immediate intelligibility of sound (in other words, when rejecting that only one meaning is possible for a given sound), he revealed a moment in which the sonic object was not yet assigned its meaning. The concept of meaningless sonic object can be also observed in his detailed employment of the enharmonic spelling of the chords. The act of spelling notes enharmonically would solidify not only the concept and implied behavior according to the different spellings, but also confirm the sameness of the entity that is being assigned different spellings. This concept of a sonic object as an indefinite signifier had been effectively hidden either behind the behavior of the note (e.g., being a dominant) or the originating source of sound (e.g., sound of a violin). This realization of purely sonic entity resembles Immanuel Kant's Copernican revolution in many ways. But it would be a mistake to assume that Vogler's discovery of *Mehrdeutigkeit* is informed by Kant's philosophy.

Instead, in his description of the *Mehrdeutigkeit* we see influences of another philosopher a generation earlier than Vogler: Moses Mendelssohn. On *Merhdeutigkeit*, Vogler writes,

> In music, as in rhetoric, there are cases where one can put multiple meanings to one opinion. The theory of *Mehrdeutigkeit* determines, once and for all, all possible cases where either the very same harmonies seem to the sense of hearing as different, or different harmonies seem as the same. (1802, 6)[53]

The phrase "as in rhetoric" in the opening sentence may be puzzling to today's readers because the "cases where one can multiple meanings to one opinion" does not seem to be directly related to rhetoric. Vogler's reference to rhetoric, therefore, suggests that it could refer to a more specific view rather than rhetoric in general. In this regard, Moses Mendelssohn's categorization of rhetoric among the "arbitrary" signs helps us contextualize Vogler's position within the discourse of eighteenth century rhetoric. Mendelssohn divides signs as "natural" and "arbitrary" (1997, 177). Signs are "natural if the combination of the sign with the subject matter signified is grounded in the very properties of what is designated." For example, the crying of a hungry baby would be considered a natural sign because it is directly connected to the hunger. For this reason, Mendelssohn places music as part of natural signs alongside painting, sculpture, architecture, and dance because sounds, gestures, and movements that express an emotion are all connected to the passion (179). On the other hand, sings are arbitrary if "by their very nature [they] have nothing in common with the designated subject matter, but have nonetheless been arbitrarily assumed as signs

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[53] My translation. "In der Tonsprache, so wie in der Redekunst kommen Fälle vor, wo man einer Meinung mehere Deutungen unterlegen kann. Die Lehre der Mehrdeutigkeit bestimmt ein für alle Male alle möglichen Fälle, wo entweder dieselbigen Harmonien dem Gehöre wie verschiedene, oder verschiedene dem Gehöre wie dieselbigen vorkommen." Janna Saslaw's transcription from *frakturschrift* erroneously added umlaut over the word "Male" of "für alle Male" in the second sentence (1990–91, 76).

for it" (180). Within this category falls rhetoric and poetry because they "express objects by means of arbitrary signs, perceptible sounds, and letters." Vogler's theory of *Mehrdeutigkeit* can, therefore, be understood as his attempt to reaffirm the potential arbitrary signs of music into the realm of the natural sign. By determining "once and for all," all possible cases of ambiguity, Vogler clarifies that music, after all, is an art which deals with natural signs. Vogler's doctrine of *Mehrdeutigkeit*, as well as his system of Roman numeral, therefore, resonate strongly with what Foucault observes as the fundamental task of Classical discourse, that is, "to ascribe a name to things [nomenclature], and in that name to name their being [taxonomy]" (2005, 132) However, this does not mean Vogler's attempt was successful.

Weber's description of *Mehrdeutigkeit* is markedly different from that of Vogler's. Whereas in Vogler the concept of indeterminate sonic object was effectively hidden from the discussion, Weber, now armed with Kant's philosophy, seems to have found comfort inside the space of ambiguity. Instead of treating the functional ambiguity of the sonority within the realm of one's sense of hearing, Weber writes that "Multiple meaning is what we call the possibility of explaining a thing in more than one way, or the quality of a thing, whereby it can be considered sometimes as this, sometimes as that" (Saslaw 1990–91, 75).[54] The most important distinction I make in Weber's definition in relation to Vogler's is the use of the word "a thing" (ein Sache).[55] During approximately the twenty years between Vogler and

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[54] Saslaw's translation. "Mehrdeutigkeit nennen wir nämlich die Möglichkeit, Eine Sache auf mehr als Eine Art zu erklären, oder die Beschaffenheit einer Sache, wonach sie bald für Dieses, bald für Jenes gelten kann" (Weber, Versuch einer Geordneten Theorie der Tonsetzkunst 1830, 42).

[55] Moreno makes a similar point by emphasizing the use of the words "this," "that," and "or" but he does not point out the word "a thing" as part of his observation. Moreno's emphasis is on the role of autonomous listener who can determine if "a thing" is "this" "or" "that" (2004, 137).

Weber, the concept of "a thing" found its place as a reference to a musical sound. Once again, after its initial appearance during the Carolingian era in the treatises such as *Musica Enchiriadis* discussed in the earlier chapter (see page **Error! Bookmark not defined.**), the idea of musical sound as arbitrary sign re-emerged. But this time, it is not "syllables without meaning," but the sonic object itself stripped of any intelligible designation.

Of course the emergence of the sonic object did not happen independently. On the other side of the spectrum, there exists the emergence of the listening subject. Jairo Moreno refers to the same passage of Weber as part of his detailed historical account of the emergence of the subjectivity of listeners (2004, 128–159). His philosophical investigation of the emergence of subjectivity begins from Descartes's assertion at the opening pages of his *Compendium Musice*, that "it's [music's] object is sound."[56] From this, Moreno observes that "…music (i.e., as sound) had to be brought into the fold of the cogito by the analysis of perception. This was made possible by understanding the natural physico-acoustic materiality of sound, newly established as "object" of knowledge" (2004, 131). And understanding the object was only possible, as observed by Moreno, by the reference to nature. For example, remember how Rameau explained that certain musical motion happens because of the gravitational pull. Here, gravity would be the natural force. For a person to claim that he or

[56] "Huius objectum est sonus."

she knows a musical work, therefore, he or she must be able to recognize the natural forces at work in music.

From Weber's music theory on, however, the invocation of nature is replaced by the subjectivity of the listener. Moreno observes that:

> By assigning the jurisdiction of multiple meaning to the subject's cognition (i.e, as a domain of explanation) and designating it as a quality inherent in the musical object, Weber shifts the epistemological balance further away from an order of things dictated from without. This is an epistemological gesture that could only have happened in the wake of Kant's "second Copernican revolution": the fundamental conditions for both understanding and the order of knowledge are conceived by Weber from the perspective of the consciousness that attains it. It is the subject who may explain a thing "as this" or who may instead consider the thing "as that." (2004, 138)

Along with this departure from nature came the tripartite structure of the musical object. A musical sound could be identified as various concepts; and these concepts could function as different constituents of a musical whole. Moreno summarizes that the "indeterminacy with regard to knowing subject and known object" is

> grounded on three preconditions, which the definition presumes and links together: (a) sensory certainty—as immediate awareness of sense-objects (i.e., "things")…(b) perception of these objects—as a mediated knowledge of things on the basis of recognizing some properties (i.e., "qualities"); (c) understanding—as knowledge of things (i.e., "explanation") that manifest some underlying order. (2004, 137)

To adopt these three preconditions into my observation which is oriented on the side of objectivity, the first part corresponds to the sonic object prior to any identification; the second part to the labeling system which determines aspects such as key area, Roman numeral, and leading-tone; and the third part to the function of the object. Therefore, in the

structure of musical objectivity, the three parts are not merely linked together but each part is built on the confirmation of the earlier step. One can claim to know the musical work when one (1) hears the music (hearing), (2) recognizes its identity (identifying), and (3) investigates the relationship between the recognized parts with the entire musical work (analyzing). Conversely, this also means that the contemplation of the latter two steps resides outside of the listening experience. The investigation of musical function, for instance, does not concern from what medium does the sound come from. It no longer matters what instrument is used to produce the sound in question. The three steps are not coexisting but the termination of one step is required to advance to the next. Therefore, during the investigation of musical function, one must sever the connection of the sonic dimension. It is clear now how the concept of musical function was originally ascribed to the behaviors of the musical object. The identification of the musical object occupies the vertical axis of musical work while the motion of the object occupies the horizontal, thus temporal, axis of the musical work. It is the temporal progression that completes the musical work, not the identification of vertical sonority.

3.3. EMERGENT AGENCY OF MUSICAL OBJECTS

3.3.1. Concept of a Chord as a Regulative Entity

The tripartite structure of a musical object as well as the popularity of the Roman numeral system gave the regulative power to the identification of a musical chord. Particularly, the change of labeling system from figured bass to Roman numeral shows that the musical chord was no longer identified descriptively (as a figured bass system would), but prescriptively (as the Roman numeral system does). With Roman numeral, the three notes

that make up a diatonic triad formed a boundary in which any vertical sonorities are judged. In this respect, the conceptual order of the first two of the three-step process—i.e., (1) hearing, (2) identifying, (3) analyzing—is reversed. One no longer identifies what one has heard; one listens for identifiable sonority among that one hears.

Although the two systems are separately used in theory and practice to some extent, the introduction of Roman numeral in music theoretical writings effectively demoted the figured bass numbers to attributes for Roman numerals. This is not to say that figured bass became a useless tool, as its popular use in today's music theoretical literature shows. However, figured bass did lose its designating power (i.e., determining what the chord is) to the Roman numeral system. In this section, I will investigate the different modes of conceptualization that underlie the two systems and the implication of the popularity of Roman numerals in music theoretical writings of the nineteenth century. As we shall see, the shift of popularity from figured bass to Roman numeral was not merely a rise of popularity of the new tool, but signifies the changing relationship between nature and the musical work.

The figured bass number emerged out of the long history of the Western concept of harmony. The concept of harmony implies an admixture of two or more sonic elements. And the foundation of these sonic elements is at vibrating string which generates them *one note at a time*. The additive process of creating a harmony therefore makes all harmony a result of an addition. In other words, a triad, although recognized as a special combination, was still understood as a combination of three notes or two intervals. The figured bass as a tool to account for these added notes, therefore, does not hold a regulative power over the notes. It was the study of ratio and, more generally, mathematics that regulated the

formation of harmony. In other words, it was the numerical property that determined some chords as consonant and some as dissonant.

This way of thinking about a triad began to change with Rameau's concept of fundamental bass, Vogler's naming of triads as Roman numerals, and, the growing discovery and inclusion of the overtone series in musical theoretical literature. At each step of the way, the concept of triad became more solidified as a single indivisible entity. Consequently, the ontological status of a triad became stable enough to grant the triad its own agency and desire. Simply put, Rameau's theory of fundamental bass made it possible to represent a harmony with a single note and Vogler's Roman numeral provided categorical distinction between a note and a chord. Nevertheless, between the progressively hardening boundaries of the musical work-concept at one end and the physical reality of musical note generated by a vibrating string at the other end, the ontological stance of a chord was still relatively weaker than the concept of musical work and a musical note. The concept of a chord would still reside somewhere in between the two well defined concepts (a note and a musical work). A chord would be still considered as a combination of notes and the process of combination still relies largely on the mathematics.

This, however, began to change as more and more music theoretical writing incorporates the discussion of the overtone series.[57] The progressive containment from a musical work to a single note would have been generally accepted unless the study of overtone series exploded a single note back into a chord that is generated by the first five

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[57] Detailed historical account of acoustics would include discussion on seventeenth century (or perhaps earlier) instrument makers up to twentieth century study of acoustics. Burdette Green and David Butler's chapter in *Cambridge History of Western Music Theory* presents one such account (2002).

partials. The discussion of overtones formed a feedback loop between a note and a chord which eventually granted a stronger ontological standing ground for a chord, as the study of acoustics moved towards the realm of empirical science. The loop goes something like this: (1) a chord is a combination of different notes, (2) among these different notes, there is a note that is more fundamentally important than the other, (3) this fundamental note has empirical reality within a sounding body, and (4) this sounding body not only generates the fundamental note, but also generates the other non-fundamental notes of the chord. And the fourth step will revert back to the first step. As this loop circles around the concept of note, chord, and the overtone series, a new membrane is formed that divides what is considered nature and what is considered human rationalization. Prior to the popularity of the overtone series, a note was the first abstraction of nature where the sonic materiality first meets the mental faculty of a human being. The status of a note was changed when the overtone series became the generating principle of a chord. Since then, the chord became the first rationalization of nature because the major triad became the unavoidable reality of any sounding note. This feedback loop, with its new empirical reality, ultimately demoted the status of a note as a fundamental building block of the musical work and replaced it with the status of a chord.

A musical phrase was no longer considered as combination of notes, but a progression of chords. And each chord was defined with clear boundaries that facilitated the separation between inside and outside of the chord. For example, when C, F, G, and B sound simultaneously (or are notated vertically), one can form a chord with G, F, and B and treat C as an outlier of the chord that needs resolution. This process of excluding one note from the sonic simultaneity shows the regulative power of the concept of chord. Just like

how the limit was set at the fifth partial of the overtone series when determining a chord, the same operation would delimit notes as being part of the chord or not. This newly emerged concept of a chord gains intelligibility from two different sources. One is vertical and the other is horizontal. In a vertical space, a chord becomes intelligible when it conforms to the identifiable configuration, i.e., a diatonic triad built on each scale-step. In a horizontal space, a chord becomes intelligible when it conforms to the identifiable progression, i.e., a fifth motion of the (fundamental) bass. This vertical and horizontal aspect of a chord and the regulative concept of Roman numeral solidified the concept of a chord as an entity which has clear ontological boundary.

What came out of the dual solidification of musical work-concept and musical chord is the systematic regulation of how the objects fit together inside the musical work. Musical objects were no longer the building blocks of potentially endless musical composition; they have to fit snuggly inside the musical work because the combination of the objects must produce a finished work. And this process of completion imposed a new set of rules upon the behaviors of the musical objects. This transformed what it means to function for a chord. The overarching question on function was no longer "how this chord functions in relation to the referential tonic?" but "how this chord functions in relation to the phrase?" It is in the latter meaning of the function that the word "function" was actually used later in Hugo Riemann's theory of musical function (*funktionstheorie*).

3.3.2. Form, Function, and Organic Unity

The relationship between a finished work and the progression that leads to its completion was the subject of investigation not only in music, but also in philosophy and

biology. The fact that the concept of musical work and musical object are both clearly defined with their new ontological boundaries, and the fact that they (i.e., musical work and object) are both non-physical and abstract (e.g., they are neither visual nor project repeatedly consistent emotion) made the conceptualization of a musical form particularly susceptible to adopt metaphors from less abstract domains. Just like we project our understanding of family to conceptualize more abstract concepts of country and government (e.g., "homeland," "mother tongue," "forefather"), the conceptualization of musical form was heavily influenced with the ideas available at the time that provided less abstract and conceptual models for a form. In this section, I will briefly investigate discussions of form in Kant's aesthetic theory and Georges Cuvier's comparative anatomy (by way of Foucault's observation). It is clear from the music theoretical writings posterior to this period in question (ca. 1800) that both biology and aesthetic discussion on form influenced how the musical work was conceptualized. This investigation, however, will eventually face more challenging question: what influenced what when they first emerged? The timing of the three similar investigations (of form in music, aesthetics, and biology) does not help us to determine the direction of influence (if it is, at all, possible). However, the nearly simultaneous emergence of reconceptualization of form and function in all three disciplines does point us to a broader investigation of the social condition of 1800. The investigation of this section, therefore, will conclude with the discussion on the Industrial Revolution and modes of industrial production.

Kant, in his *Critique of Judgement*, famously discussed the relationship between form and function in terms of "purposiveness" (Zweckmäßigkeit) (2000, 105).[58] Kant defines the word purposiveness as "the causality of a concept with regard to its object" (idem.). Elsewhere, he also provided description of purposiveness as the "lawfulness of the contingent as such" (2000, 20).[59] Kant's view puts a concept (e.g., a musical composition) in a position where the concept's existence relies upon the lawful progression of the concept's internal components. As a result, the concept at any given time would mark the end of the progression that made the existence of the concept possible. In order for this progression of the internal components to arrive at the intended product (i.e., the concept), the component's behavior must be considered in terms of its result. In other words, the "lawfulness" of the contingent would be determined according to the contribution of the component to its final form. This idea of purposiveness applies to a musical work in following ways. A musical work with its finished form is composed of musical objects. How the internal objects, such as notes and chords, are put together can be judged by their "lawfulness" of their composition. In other words, the behavior of the internal musical object is now considered to have effect on the composition of the whole. As the quality of the composition is determined by its internal components, regulation of the internal

[58] The discussion as to what Kant meant by the word "purposiveness" is still on going. For the scope of my chapter, however, I am only pointing out that there exists a relationship between finitude, contingent, rule, and organic unity. For more in-depth survey on this topic, see Hannah Ginsborg's entry in *the Stanford Encyclopedia of Philosophy* (2014).

[59] There is debate on how to see this statement in relation to purposiveness. Some scholars claim that this statement is another definition of purposiveness while others claim that this statement is an aspect of purposiveness.

components became the main subject of the inquiry when discussing a compositional theory or analysis of a composition.

Kant continues his discussion on the relationship between the purposiveness and the concept to investigate the "beautiful art" as a concept and its relationship to the contingents. He writes,

> In a product of art one must be aware that it is art, and not nature; yet the purposiveness in its form must still seem to be as free from all constraint by arbitrary rules as if it were a mere product of nature. On this feeling of freedom in the play of our cognitive powers, which must yet at the same time be purposive, rests that pleasure which is alone universally communicable though without being grounded on concepts. Nature was beautiful, if at the same time it looked like art; and art can only be called beautiful if we are aware that it is art and yet it looks to us like nature. (2000, 185)

Kant's reference to natural form as an ideal structure for a product of beautiful art provides the framework in which the finished work can be compared with "nature." This requires an additional criteria for beauty of the finished work. Not only the "arbitrary rules" must seem natural, but also "art" must "looks to us like nature." In musical terms, not only should the chord connection follow the rules, but also the musical work should resemble a natural form.

Prior to Kant's idea, the finished work of art was considered to be a mere combination of objects, or A*rs Combinatoria*. The final form, therefore, does not impose any regularity to its constituents so long as the end result does not create logical incoherence; what was more important was the logical combination of one object to the other. This idea was most famously attributed to Gottfried Leibniz. For Leibniz, the final form, such as a

plant, an animal, or an idea, is a mere combination of essential parts. In paragraphs 1, 2, 3, and 11 of his *Monadology*, he writes,

> 1. The *monad*, of which we will speak here, is nothing else than a simple substance, which goes to make up compounds; by *simple*, we mean without parts.
>
> 2. There must be simple substances because there are compound substances; for the compound is nothing else than a collection or *aggregatum* of simple substances.
>
> 3. Now, where there are no constituent parts there is possible neither extension, nor form, nor divisibility. These monads are the true atoms of nature, and, in a word, the elements of things.
>
> 11. It follows from what has just been said, that the natural changes of the monad come from an *internal principle*, because an external cause can have no influence on its inner being. (Leibniz 1989)

This Leibnizian separation between an "external cause" and "its inner being" leads to the systemization of the inner components and treats the product as natural outcome as long as the mechanical connection between the internal parts are natural. Just like when knitting a scarf with the same pattern, the resulting scarf is guaranteed to be perfect no matter how long it becomes, as long as the pattern is followed correctly. This has a significant musical corollary in the eighteenth century where mechanical connection between two chords becomes the main concern of the composers and theorists.[60] The only criteria for the judgement that concerns the entire musical work is the coherence of the affect. As long as the finished composition projects the same types of affect, the coherence of the composition

[60] Rameau's theory is certainly part of this camp as Thomas Christensen observes, "With Rameau's new method, continuo playing was purely a mechanical process of chord placement and finger movement, or, as he proudly noted, just a 'mécanique des doigts'" (1993, 60).

would considered to be achieved. An extreme example of this is the "musical dice-game" (*Musikalisches Würfelspiel*), a popular compositional game throughout the eighteenth century.[61] In this type of compositional game, the chance element will determine the progression from one segment to the other. The outcome of this game would still be considered as a musical composition because, as Leonard Meyer observes, it would still result in "the claims of taste, coherent expression and propriety, given the genre of work being composed" (1989, 193). The musical form as a regulative entity was not discussed in music theoretical writing until the mid-eighteenth century with the works of Joseph Riepel and, later, of Heinrich Christoph Koch. The rise of regularity at the phrase level, therefore, marks the decline of the Leibnizian mode of formalization and the rise the Kantian mode.

With the coherence of affect as the regulative force of the musical work, the compositional theory of the eighteenth century sought its organizing principle from rhetoric. However, Kant's invocation of nature as the judgement of the finished form, later met with the systematized abstraction of life forms which was fueled by the rise of comparative anatomy and modern biology. As the conceptualization of a form in-general was going through this transformation, the way musical form was conceptualized also changed. Consequently, the tight relationship between the musical form and its internal components began to be understood in terms of a relationship between a living organism and its internal organs. The turn to organic structure as a guiding principle to understand musical form

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[61] For example, Johann Philipp Kirnberger's *Der allezeit fertige Menuetten- und Polonaisencomponist* (1757 and revised 1783), C. P. E. Bach's *Einfall einin doppelten Contrapunct in der Octave von sechs Tacten zu machen ohne die Regeln davon zu wissen* (1758), Maximilian Stadler's *Table pour composer des minuets et des Trios à la infinie; avec deux dez à jouer* (1780), and most famously, W. A. Mozart's *Instruction to compose without the least knowledge of music so much German Walzer or Schleifer as one places, by throwing a certain number with two dices* (K. 516f, 1787).

around the early nineteenth century has been observed by many music historians. For example, as Jack Boss summarizes, Mark Evan Bonds's observation that "the early nineteenth century's celebration of absolute, instrumental music as an autonomous entity…caused a split between inner, generative concepts of form … and notions of form as general categories that contain large groups of pieces (which he calls 'conformational' approaches)" (Boss 2014, 14)

The development in biology during this period, therefore, form a discursive relationship with the conceptualization of musical form. As observed by Foucault, Georges Cuvier's

> analysis of organisms, and the possibility of resemblances and distinctions between them, presupposes, therefore, a table, composed not of the elements, which may vary from species to species, but of the functions, which, in living beings in general, govern, complement, and order one another: not a polygon of possible modifications, but a hierarchical pyramid of importance. (Foucault 2005, 290)

Foucault observes that as Cuvier's comparative anatomy lays bare the commonality among all animals, he could reorient the classification of an internal organ based on its function. For example, under the function of digestion, different shapes of digestive organs could be classified across different animals. Under the function of circulation and respiration various organs from different animals could be thought of as residing in the same respective categories. This eventually shifted the focus away from what actual shape and form is the organ in and towards what function does the organ perform. This function-centric view of life forms generated the hierarchy of organs between the ones that are essential to life (e.g., heart, stomach, and lungs) and the ones that are of less importance (e.g., fingers, hairs, limbs). Foucault argues that this eventually lead to a new understanding of the living being

which is no longer seen "as a certain combination of particles bearing different characters." Cuvier's comparative anatomy "provides the outline of an organic structure, which maintains uninterrupted relations with exterior elements that it utilizes (by breathing and eating) in order to maintain or develop its own structure" (Foucault 2005, 298). This effectively distinguished the living being from its background environment and made possible the idea of a starting and ending point of a living being (i.e., the concept of extinction). Foucault continues this argument to claim that the concept of "historicity" of a living being was first introduced from this new mode of thinking alongside that of wealth and of language.

Considering the timing of Cuvier's theory (*Leçons d'Anatomie Comparée* published in 1800), similar epistemic shifts between biology and music theory (as well as economy and language, as Foucault includes) strongly suggest that these shifts of conceptualization were not localized for individual fields but were ramifications of the society which incubated such interest in functionality. In this regard, the influence of organicism in nineteenth-century musical theoretical writings may not be as strong as what theorists believed it to be. A source domain of the conceptual metaphor must prove to be more experiential and physical compared to the target domain. The investigation into the organic growth of an idea in nineteenth century philosophy (e.g., works by Goethe, Fichte, Hegel, and Schopenhaur, whose connection to compositional theory are well summarized in Boss) (Boss 2014, 15–20) may have been originally influenced by the study of life forms, which can have more experiential basis, but the philosophical introspection of it effectively eliminated the possibility to become a physical interaction with the life forms. Furthermore, the study of biology itself, from strong influence of Cuvier's theory, began to investigate aspects of living beings that are beyond visible. As Geoffroy Saint-Hilaire writes, "Organic structure is

becoming an abstract thing … capable of assuming numerous forms" (Foucault 2005, 287). Cuvier's theory, which became the foundation of today's biology, directed our attention from an organ (a visible thing) to the function (an abstract, non-visible concept). Foucault summarizes Cuvier as follows: "it is an error to believe that 'everything is important in an important organ'; our attention must be directed 'rather upon the functions themselves than upon the organs'; before defining organs by their variables, we must relate them to the functions they perform" (Foucault 2005, 288).

For this reason, I argue that it is industrial production—as a more visceral experience of form and its internal components—that became the source of the metaphorical conceptualization of the musical work beginning from around the mid-eighteenth century. The newly emerged industrial mode of production (e.g., the division of labor and use of machinery) became the framework in which any musical form began to be understood. In the following section, I will delve deeper into this metaphorical conceptualization of musical work as an industrial product and contrast it with the mode of conceptualization from the earlier period.

3.4. MUSICAL WORK AS AN INDUSTRIAL PRODUCT

3.4.1. Introduction

With the popular use of the terms such as "music production," "music industry," and "music business," there is no doubt that we consider some musical works to be an industrial product. But can we say that our understanding of any musical form is based on our understanding of an industrial product? I argue that, not just a musical form, but any abstract understanding of form that implies the function of its components is shaped by our

everyday experience as human beings in an industrial society. A musical work, as an inherently abstract concept, demonstrates this tendency visibly, but I believe that underneath our conceptualization of musical form lies a more fundamental framework in which we create meaning of concepts such as form, components, function, and ultimately the morality of contingents.

This mental framework emerged as the mode of production shifted from that of craftsmanship to the division of labor. In this section I will first investigate the new conditions in which the concept of functionality could have risen as the central idea of formal organization. I will then revisit the concepts discussed in the previous section in light of their counter parts in the industrial mode of production. This will show that what triggered the reconceptualization of form was the mechanization of human labor and the resultant replaceability of workers by machines. As workers are faced with the competition of machine labor, the worker's behavior begins to be situated within stricter regulation because, for the person who would ultimately possess the product, it is only the functionality that counts as potentially value-creating. This section will end with discussion of the concept of morality as it relates to the creation of value and its musical implication.

3.4.2. Rise of Functionality

Chinese political leader Deng Xiaoping's famous quote, "It doesn't matter whether the cat is black or white, as long as it catches mice," quite ironically, epitomizes the ideology of industrial society by stating the importance of functionality over identity. As the value of a product becomes quantifiable through the necessary labor-time (which itself is made possible through the quantification and standardization of time), it became possible to seek

maximal value by controlling the process of production. This created value is crystallized when the product enters into a market. This ultimately separated the concept of value from the product (from which the value originated), whereas, previously, the concept of value is somewhat hidden from cognition as it is entirely dependent on the product. In an older economic system that was largely based on exchanging of goods, for example, the value of a product is realized outside of the user at the moment of exchange. In other words, as two (or more) people agree on the value of the goods in exchange, the concept of value becomes external to the person. However, as soon as this moment passes, this value of the goods is back to becoming private to the person who owns and uses them.[62] In this system, therefore, the ending of production does not coincide with the determination of value. The value would be determined not only by the skills of the creator but also by the conditions of exchange (e.g., scarcity of the product and techniques of the merchants).

The change of the economic system transformed all of these relations. The new system considered value to be independent from the scarcity of the object. Foucault summarizes,

> Eighteenth-century economics stood in relation to a mathesis as to a general science of all possible orders; nineteenth-century economics will be referred to an anthropology as to a discourse on man's natural finitude. By this very fact, need and desire withdraw towards the subjective sphere – that sphere which, in the same period, is becoming an object of psychology. It is precisely here that in the second half of the

[62] The distinction between the values of an object as something useful ("use-value") and something exchangeable ("exchange-value") is famously made by Karl Marx in *Capital* (Marx 1990) I adopt Marx's summary economic theory of his time in this section.

> nineteenth century the marginalists will seek the notion of utility. (Foucault 2005, 280)

As "need and desire" becomes an object of psychology—the study of mind that is *internal* and *private* to the person—their tie with scarcity and scarcity's tie with value are simultaneously uncoupled. This effectively causes the determination of value to occur at the end of the production. This means that the process of production gets to be under stricter regulation as it is the sole determining factor of the value of the product. In this context, more attention would be given to the productivity and functionality of the workers, rather than the personality of the workers themselves. In the new economic system, therefore, the concept of functionality subsumed the identity of the individual workers. The personality of the workers "no longer matters" as long as they "catch mice," so to speak. The concept of function rises up to be the organizing factor of a product.

Attention to function, therefore, characterizes the society that makes it important; any discussion of function carries the vestiges of industrial production. Investigation into musical function, likewise, models after the industrial mode of production. In this context, a musical work becomes an industrial product, a commodity, and an object of value. As an industrial product, a musical work is understood to be a product of division-of-labor-like process of its internal components (i.e., any objects that are identifiable as objects such as note, chord, and formal section) where each part relates to the final form through its functionality. As a commodity, a musical work became intimately tied with ownership. As discussed earlier, this concept of ownership solidified the musical work-concept as a regulative entity. As an object of value, the process of creation of a musical work—that is, actually composing music as well as imagining its compositional process through analysis—

became understood as the process of creation of value. This, in turn, carried the notion of maximizing profit by stricter regulation into the realm of music theory.

In music theoretical literature of the eighteenth century, we can observe this turn from craftsmanship to industrial production as a conceptual model for a musical creation. Along this industrial turn, we can see the rise of musical function as the organizing principle. I will briefly compare two popular treatises during this period that demonstrate this change. A musical work as a result of the craftsmanship of the composer is best exemplified in Johann Joseph Fux's popular compositional treatise on counterpoint *Gradus ad Parnassum* (originally published in 1725). This treatise is useful particularly because it does not rely heavily on the rules of rhetoric to determine what a good composer should do to create beautiful music: "I have given very little space in this book to theory and much more to practice…" (Fux 1965, 18)[63] In this treatise, Fux looks back at more than a century prior to his time as the source of musical knowledge, as he states that Palestrina's style is a model for a good composition and as he employs a dialog form for a treatise, a reminiscence of ancient Greek writings. Structured as a dialog between Aloys (the master) and Joseph (the pupil), the entire treatise focuses on the skill building of the pupil. In this context, the quality of the composition is entirely dependent upon the technical competency of the composer which is only attained through tireless work: "to allow no day to pass without a line written" (Fux 1965, 48). In order to master the art of counterpoint, the pupil must follow the four fundamental rules of counterpoint which are introduced in book one of this treatise (book

[63] In the original Latin edition of this treatise, however, the dialogue is the part of the second book, which is preceded by the first book on the proportion and division of the monochord. The popular English version of this treatise, translated by Alfred Mann, omits this entirely. For the translator, Fux's treatise was entirely about counterpoint which provides a fundamental stepping stones for the study of fugal technique.

one is omitted in the popular English translation by Alfred Mann). As these rules are discussed as part of the first book, which discusses the arithmetic nature of the consonances and dissonances, they are not to be considered as rules that govern the behavior of the composer nor the musical intervals, but as logical extensions of natural laws. These are not the rules that describe what things should be, but describe what things naturally are. In this context, the pupil is the one who places notes above or below the *cantus firmus* according to the natural law. Similar to how gravity is considered to be a force that governs all objects with mass, this natural law of music is external to all musical objects and governs all musical motion.

This mode of conceptualization soon began to change as musical work became thought of as a result of the lawful behavior of the internal components. As musical objects become considered as independent entities, natural law began to be internalized to the musical objects themselves. The rules that the composer must observe are changed into the tendencies that the musical notes possess. Nearly all of the music treatises since the late eighteenth century consider music to be this way. Perhaps one of the earliest examples is Heinrich Christoph Koch's 1782 treatise, *Versuch einer Anleitung zur Composition* and his 1802 treatise, *Musicalisches Lexikon*. Koch's treatises differ significantly from Fux's. In addition to the obvious difference in terms of musical styles they model, what is particularly important is the orientation of the musical rules. They are no longer posited as the laws of nature (which are to be observed by the pupil) but as laws akin to grammatical rules where the notes themselves are under the jurisdiction. As Scott Burnham observes,

> Koch worked hard to demonstrate that musical phrases were analogous to grammatically sound sentences. Like sentences, musical phrases are both self-sufficient and flexibly configured; they possess subjects and predicates and are

> articulated by different strengths of punctuation; they can accommodate a variety of interpolations, extensions, and compressions without sacrificing their fundamental coherence and comprehensibility. (Burnham 2002, 881)

This reference to grammatical rules may seem like an extension of reference to rhetoric from the previous period (this is certainly what Burnham suggests), but it shows a markedly different relationship between the composer and the works. Put simply, the rules of rhetoric apply to the orator but those of grammar apply to the words. A similar distinction separates the musical rules from Fux's and Koch's treatises.[64] Fux's musical rules are extensions of natural laws whereas Koch's rules are extractions from music compositional practice.[65] While Fux's treatise presents the rules for the (prospective) composer, Koch's treatise investigates logical ways to align musical objects according to the tendencies of the musical objects themselves.[66] (This should remind us of Kant's definition of purposiveness as "lawfulness of contingent as such" discussed in page 88.) The law applies to the contingent, not the artist. This notion of the tendencies of the musical objects eventually granted the agential power to the musical notes.

Treating musical objects as having their own agency rests on two epistemological grounds that emerged during the eighteenth century. One is the aforementioned

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[64] This does not mean Koch did not apply any organizing principle from classical rhetoric as Joel Lester observes the similarity between Koch's three stage plan for a composition (*Anlage*, *Ausführung*, and *Ausarbeitung*) and classical rhetoric's *disposition*, *elaboration*, and *decoratio* (Lester 1992, 297).

[65] Burnham writes, [Koch] "extracts some generalized rules for continuations after various types of phrase-ending" (Burnham 2002, 881).

[66] It would be interesting to consider Joseph Riepel's theory treatises in light of this which was published between years 1752 and 1768, the period between Fux and Koch. Set in a dialog form (an obvious homage to Fux's treatise), Riepel's theory show heavy influence of Fux's idea; at the same time, Riepel's theory is closely associated with Koch's ideas in today's scholarship on the history of musical forms. Riepel's theory might prove to be situated as the role of a composer is changed.

solidification of musical object and the other is the metaphorical understanding of musical work as an industrial product. Contrasted to a craftsman who is in charge of the production from the beginning until the end, a factory worker (or an industrial machine) is only responsible for a single task but with higher efficiency. In this context, each step towards the completion of the production becomes visible to the cognition and articulated as functions towards a goal of manufacturing. In this regard, manufacturing of a product (or completion of an idea) is recontextualized as series of steps where each step is fulfilled by lawful behavior of the workers. In musical terms, the workers are not the composer but the musical objects with an imagined power to move and the prescribed pathways for a possible motion. A musical work is no longer a result of one un-segmented compositional process, but a result of the pre-determined steps, while each step is recognized by its purposes. Just as an industrial product does not assume one craftsman's skills, but a combination of specialized skills of different workers, a musical work is understood to be the result of the lawful behavior of the musical objects.

As soon as musical objects, with their agential power, are held responsible for creating music, the role of the composer is changed from that of the creator to the operator. This mental detachment of a composer from the work itself strengthens the possibility of ownership of musical work by the composer. As a manager of a factory which produces a musical work, the composer became the rightful owner of the musical work for which he oversaw its production. Composers saw themselves as the commander of musical objects; they began to equate their status to that of a factory owner. This provides the conceptual

framework to understand the emergence of the work-concept and the rise of copyright laws. Goehr observes that

> In the early eighteenth century, publishing houses acquired copyright over music, at least insofar as sheets of music were produced. For most of the eighteenth century copyright remained so defined. In 1793, however, copyright laws were passed in France to transfer ownership away from publishers to composers. Germany and England followed suit some years later. Though the new laws were not universally accepted, the rationale behind them was clear. The new laws reflected the basic idea that composers are the first owners of their works, for it is they who put the works in permanent form. (Goehr 2007, Kindle Location 2415–2417)

This change of ownership from the publishing house to the composer, according to Goehr, is due to the fact that "music came to be seen as a free person's labor" (Goehr 2007, Kindle Location 2413–2414). Her analysis only provides half of the explanation—that is the relationship between a composer and the society that sees him or her "as a free person." The other half, I argue, concerns the internal relationship between the composer and the work. Following the rise of industrial production and the reconceptualization of musical work as an industrial product, composers saw themselves as the rightful owner of music where the product is created by the labor of the musical objects—that is the fulfillment of function by the proper motion of the musical objects.

The concept of function of musical object made all musical objects resources for manufacturing. As an entity with agency, a musical object is considered as a worker in a factory; but as an entity that makes up a composition, a musical object is also treated as musical raw material; a raw material for which the manufacturer needs to know their property to efficiently use. Similar to how realizing tungsten's natural chemical tendency led to the modern incandescent lightbulb and how realizing the combustible nature of oil led to

oil refineries and the production of gasoline, realizing natural tendencies or functions of a musical object led to a more effective musical product. For example, in the late nineteenth century American English translation of Gottfried Weber's treatise, *The Theory of Musical Composition* (*Versuch*) the translator praises Weber's approach for its practicality.

> The subjects which he [Weber] takes up, he *treats*. He makes us fully understand them. He leads us all around them, and shows us how they look on every side. If they are buried up in rubbish, he clears them of that rubbish, and lets us see them in the naked light of simple truth; if they are beset with difficulties, he is sure to notice the fact, and either to remove those difficulties or to tell us how to estimate them. The effect of all this is to give us clear, well-defined, and practical ideas—a species of knowledge which we can *use*. It is only this full and perfect grasp of a subject that can give us a commanding power over it, and enable us to make a practical appropriation of it… (Weber 1851, vii)

In this regard, the analysis of the relationship between human and technology by Gilbert Simondon and Bernard Stiegler provides a broader context for the changing relationship between the composer and the work. Adopting Simondon's position that the separation of human and technology (or sometimes referred to as just "matter") is based on a poor understanding of both; the tools that we use not only show the human's creative power and tendency to cultivate nature, but also it shows the tools' shaping of human culture where the tools themselves become the carrier of the cultural norm. Instead of treating a culture as entirely human production, therefore, a culture is created with the ensemble of human and technology, for which both philosophers adopt a Greek term *technē* (τἐχνη) and, its adopted form, *technics*, to describe it. According to both, deep understanding

of human life, therefore, comes from critical reflection on the tools that are used. Stiegler writes,

> To know the essence of the machine, and *thereby* understanding the sense of technics in general, is also to know *the place of the human* in "technical ensembles." There is general agreement on the change in technics since the advent of the Industrial Revolution, insofar as it causes the appearance of machine apparatus of production that call into question the traditional relation of the human to the technical. (Stiegler 1998, 66)

The relationship between human and technology changed with the appearance of "industrial technical object," which "appeared somewhere in the eighteenth century" along with the Industrial Revolution (Stiegler 1998, 66). Stiegler summarizes Simondon's claim that

> In the explanation of technical evolution by the coupling of the human to matter, cut across by the technical tendency, an essential part of this tendency, coming from the ethnic interior milieu as intention, remains *anthropologically determined*. Simondon has this interior milieu becoming diluted. The tendency no longer has an anthropological source. Technical evolution stems completely from its own technical object. The human is no longer the *intentional actor* in this dynamic. It is the *operator*. (Stiegler 1998, 62)

As the object began to be produced by machine (i.e., another object), humans began to recede into the background of the process of production. For Stiegler, this does not mean devaluing of human agency. It simply replaces one type of human agency with another, that is, from that of a commander to that of an operator. He later elaborates as follows.

> The industrial technical object has brought us to the suppression of the intentional anthropological part of the

> techno-logical dynamic. But a part still remains, namely that the living, who no longer *commands*, *operates*. (Stiegler 1998, 78)

In the actual physical relation between human and matter, Stiegler's (and Simondon's) analysis would be enough to describe the nature of the changing relationship.

This new dynamic between human and matter became the dominant mode of understanding musical works through metaphorical adaptation. The rise of functionality of musical objects reflects that of industrial production where efficiency became the goal of the production. In the industrial production where human work is monotonous and repetitive, the introduction of machinery into the assembly line became a real threat to the labor market. This threat is still visible in today's society (e.g., computerization of a grocery store counter) but it first emerged with the Luddite movement around the late eighteenth century. This new relationship made the machine more human-like (so that it can replace error-laden human labor) and the human more machine-like (so that it can compete with the machine's precision and earn wages). And the two are both under the jurisdiction of functionality; whichever fails to be functional is discarded.

3.4.3. Organic Unity as Industrial Object

One remaining issue when claiming that a musical work is metaphorically conceptualized as an industrial product is the existence of a competing metaphor which adopts a living organism as a source of understanding the musical work. I argue that, however, this apparent competition between two conceptual models, in fact, converges as the functionality of the organism became the dominant mode of understanding. In other words, the concept of organic unity is understood, also, according to industrial production. As both musical work and living organism are viewed through the lens of functionality, the

competition of metaphor dissolves. I have discussed the emergent concept of function as organizing principle in the earlier section in light of Foucault's analysis of Cuvier's comparative anatomy.

Perhaps a detailed analysis of the influence of industrial production on the conceptualization of life forms is outside of the scope of the current discussion. However, it is within the scope to look into what features of organicism music theorists and composers adopted to be relevant to the study of music. As Scott Burnham observes, "one of the principal methodological manifestations of the organicist perspective [for music theorists and composers] is the analysis of formal functions" (Burnham 2002, 892). He continues to explain that "Musical form is here figured as an organism in which every part has a specific function" (Burnham 2002, 892).This somewhat dilutes the musical adaptation of organicism because the concept of musical organicism as well as the concept of organic structure itself are both interested in the functionality of internal parts. And the concept of functionality leads to the agency of each part. An internal component can only function as long as it is imagined to be capable of the act of functioning.

A telling example of treating a living organism as an industrial product is the German physician Fritz Kahn's infographic, *Der Mensch als Industriepalast* (1926). In this diagram (see Figure III-3), human body is depicted as an industrial complex where each section performs their own duty to maintain the life of a man. Under its assigned role, each organ is reduced to its function. For example, a liver (*Leber* in German) breaks down sugar (*Zuker*) and transports it to a kidney (*Niere*) or makes bile (*Galle*).

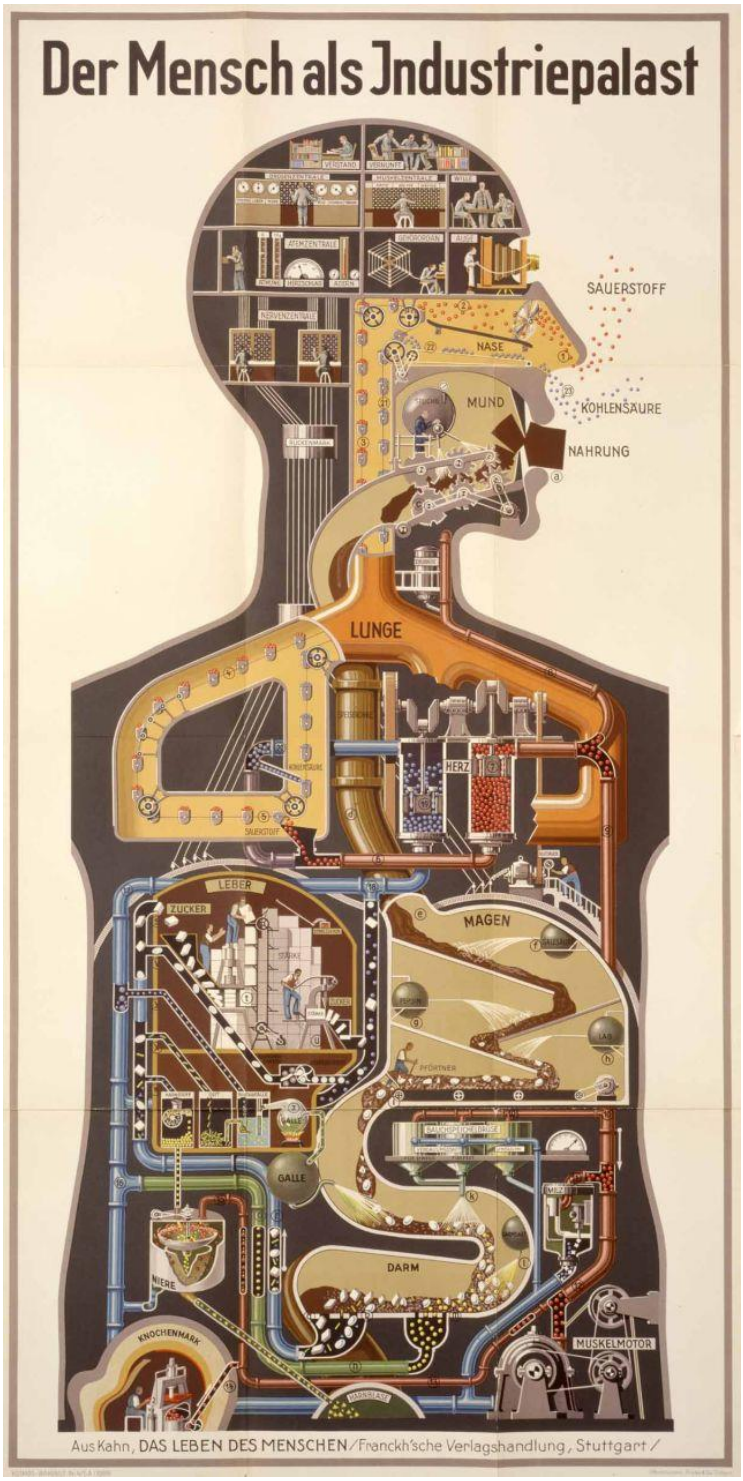

Figure III-3. Fritz Kahn, Der Mensch als Industriepalast (Man as Industrial Palace). Stuttgart, 1926. Chromolithograph. National Library of Medicine

In this diagram—and to a large extent, in the naïve understanding of the public—this is all that matters to the sustenance of life. Other features of the liver do not matter as much because they do not count into the function of a liver. This way of thinking made possible a diagnosis of diseases according to the function of the internal organ. For example, a liver failure is considered to be a form of disease that mainly concerns a liver. Wherever the function breaks down stands out as the identity of the disease. So is the case of cancer where the type of cancer is determined by where the tumor is located, for example, lung cancer, skin cancer, and so on.

A musical parallel for this type of diagnosis emerged as a musical composition is considered to be a collection of different functioning parts. This led to an impulse to revise earlier composition; a tendency that seemingly contradicts the *Werktreue* movement, but is nevertheless founded on the same epistemological ground. Both *Werktreue* and revision movements underlie the assumption that a change in a part affects the quality of the whole, an "organicist" view of musical composition. In case of *Werktreue*, this assumption works as a regulative force. In case of the revision movement, this assumption works as a diagnosis of a disease where it must be cured to restore the quality of composition. For example, when Carl Czerny inserted a measure in J. S. Bach's *C Major Prelude* in book one of the *Well-Tempered Clavier*, his intention was clear in terms of voice-leading (see Figure III-4). The awkwardness of bass motion from F-sharp to A-flat is fixed by the addition of G in

between.[67] This notion that one can fix a malfunctioning part is not readily available in one's encounter with a lifeform without a mechanistic understanding of the part.

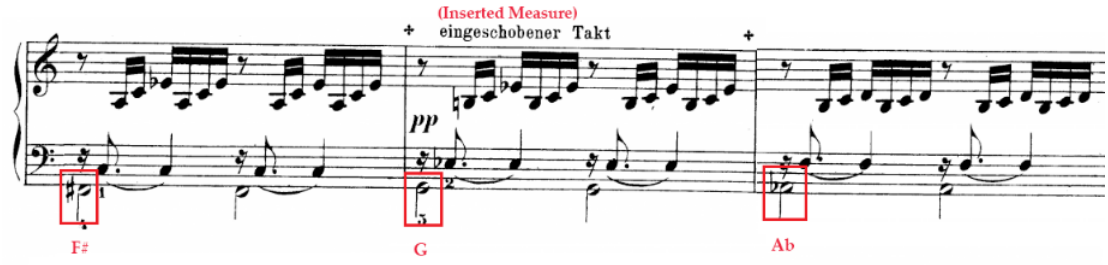

Figure III-4. Czerny's Revision of J. S. Bach's Well-Tempered Clavier Book 1 Prelude in C major.

3.5. CHAPTER SUMMARY

In this chapter, I have investigated the philosophical, social, and historical context in which the concept of musical function emerged as the central idea of organization for a musical work since the eighteenth century. My main claim is that a musical work, reimagined as a result of industrial production, started to be understood in terms of the lawful behavior of its internal components. This shifted the focus of music's theoretical investigation from what things are (in relation to either nature or the tonal space) to what things do (i.e., how do they function in relation to the formal boundaries). Along this shift towards functionality, emerged the uncoupling of location and function. In the earlier mode, a musical object is assumed a role purely by where it is located in the musical space; whereas in the new mode, a musical object is expected to move according to the prescribed pathways, but the actual

[67] The same passage also bothered Heinrich Schenker for the same reason. He, however, did not insert an additional measure. Instead, he claimed that the F-sharp does not move to A-flat, instead moves to G in the next measure. The Ab is considered an inner-voice (Schenker 2012, 37).

movement is considered to be the responsibility of the object, not the composer. This eventually reconfigured the relationship between a composer and his or her musical work. Under the new mode, the composer was no longer a craftsman who is responsible for the entire process of creation, but a factory operator who oversees the behaviors of the musical objects. This reconfigured relationship granted a sense of ownership to the composer. The institution of copyright law in the eighteenth century marks this change. And the continued existence of the copyright law and the industrial production solidifies this new relationship between the work and the creator.

In the realm of musical objects, the rise of functionality introduced two related concepts: structural motion and colorful elaboration. Conceptualized as the workers in the production line, a musical object's behavior is judged according to that object's prescribed function. Only the functional progression is considered value-creating and other non-functional progression is considered as either simply wrong or colorful (thereby not moving). Since only the functional progression contributes to the completion of the product, the musical work is considered to maintain its essence even if the non-functional progression is eliminated. The functional/non-functional divide and the resultant essentiality of musical object operate within a similar mental framework as industrial production.

In both musical and industrial production, all contingents are necessary to create the finished form. However, within these contingents, some are more essential than others because the essential parts are considered to be contributing more to the production. Inessential parts are replaceable and replacing them does not affect the overall quality of the product. In the meantime, it is preferable to minimize the use of inessential materials because it would result in unnecessary use of labor and resources. This is why the sentences,

for example, "all the notes in this music are there for a specific purpose" and "there is no excess of notes in this composition" qualify as praise, not a testament for the lack of flourishing.

As the history of modern music theory coincides with the development of industrial society, the functionality of the musical object became the dominant mode of understanding a musical work. To analyze a musical work became synonymous with knowing the function of the internal musical objects. As Hugo Riemann observes,

> Es bedarf wohl nicht des Hinweises, dass der eigentliche Wegweiser durch den Labyrinth der moglichen Harmoniefolgen seit Aufstellung der Funktionsbezeichnung nicht mehr die Nomenklatur der Harmonieschritte sondern vielmehr diejenige der Funktionen ist.
>
> It goes without saying that since the introduction of the taxonomy of function, the actual signpost through the maze of possible harmonic successions is no longer the nomenclature of root-interval progressions but rather that of functions. (Rehding 2008, Kindle Location 617–618)

This provides an opportunity to critically reflect on today's music theoretical discourse. Can today's music theory stand without the concept of function? Given the inter-dependent relationship between form and function, what can we say about the growing interest in musical form such as Sonata Theory? Isn't Schenker's notion of fundamental structure (*Ursatz*) a particularly industrial way of looking at a composition? For example, when he says all (good) music is a composing out of the fundamental structure, how much of his idea of the relationship between the fundamental structure and composing out resembles the relationship between designing of an industrial product and execution of the design?

How about the case of non-functioning chords? In today's music theoretical discourse, are they, perhaps, serving a function of "not-functioning"? Within this dichotomy

of functioning and non-functioning, every musical object operates. Arnold Schonberg's criticism of the term "non-harmonic tones" and his emancipation of dissonance can be reconsidered in light of this dichotomy as many music theorists have observed. Perhaps he was envisioning a mode of conceptualization that does not reduce musical elements down to their functions, thereby accessing beyond what functional analysis can offer. Be that as it may, the recent discussion of the prolongation of atonal music shows how strong our assumption of functionality is because even in the music that is potentially composed to do away with functionality, or at the very least, composed with dimensions of functionality that transcends the conventional notion of prolongation and elaboration, some music analysts still try to find the functional relationship of structural and embellishing notes in the conventional sense.

More broadly, the assumption of function is not limited to musical objects. We can consider it as a ramification of our everyday assumptions within industrial society. For example, we do not leave a tree as its own being but treat it as a functioning object by focusing on its process of photosynthesis or its use as a raw material for manufacturing. Food is not merely something we eat, but now we consider it as a source of nutrients and energy as well as diseases. We ourselves are also under the domain of functionality. Every single member of the society is serving social functions. We readily determine who we are by what we do or what we are supposed to do. This can be applied to Karl Marx's famous "social division of labor," but can also be applied to more naïve description such as being a teacher or a father. When we say someone is a teacher, we refer to that person's role in a

community, in other words, a social function; and by realizing that he or she is a teacher, we claim to know something about who he or she is.

However, being a teacher does not fully correspond to the being of that person. It only highlights one aspect of the person. Nevertheless, knowing the function of a person satisfies our curiosity to a certain extent. Similarly, knowing the function of a musical object may not fully correspond to the knowing of what the musical object is, but it nevertheless satisfies our desire to know music. Consequently, since knowing the function of a musical object satisfies our urge to know the musical object, it does not drive us further to seek what the musical object really is. In other words, knowing the function of a musical object does not lead to the sonic nature of the musical object; the investigation for the knowledge of music, therefore, does not account for the aspects of musical sound that are not formalized as the family of functions such as timbre and dynamics. In this account, the analysis of musical function always falls short.[68] Yet the existence of function passed the threshold of positivity. We no longer question whether or not there is a function; we question what the function of a musical object is. Even in the case that the function is not clearly recognizable, we do not release the object from the network of functionality.

This may make us feel that perhaps our tendency to look for functionality is hard-wired to our brain—but, this is not the case. There are instances that we do not impose functionality upon a series of ordered objects such as in the case of a rainbow. Even though Western culture recognizes seven different colors of a rainbow in an ordered succession, we

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[68] This discussion is modeled after Martin Heidegger's discussion on Dasein. Against the strong presence of the other mode of being (Present-at-hand and Ready-to-hand) the Dasein always recedes into the background making it harder to grasp (Heidegger 2001, 402).

do not impose function onto the colors. No matter how transitory the color indigo may seem, for example, we do not assign that indigo's function is to transit from one color to another.[69] By comparing this with our understanding of the function of a leading-tone, we can see that our concept of function is culturally, and we will soon see historically, constructed.

Coming back to music theory, the fact that the discussion of function is only possible after the identification of the musical object, and the fact that, once at the stage of analyzing functional relationship between musical objects, we avert our attention away from the identity of the musical object, may explain the lack of interest in the study of timbre and other sonic features of music. I believe that the pervasive discussion of musical function does not lead us back to the stage where the critical investigation of identification occurs. The heavily systematized theoretical model of musical motion and relative lack of analytic tools for investigation of timbre, chordal color, and other "non-functional" objects in today's music theoretical discourse shows that, perhaps, it is time for us to move away from finding and constructing function in music.

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[69] It is interesting to see how much our ideas of color are different from earlier periods. For example, Immanuel Kant, in his *Critique of the Power of Judgement*, relates the color indigo (the sixth color) with "constancy." The seven colors from red to violet, as written by Kant, "seem to suggest the ideas of (1) Sublimity, (2) Audacity, (3) Candor, (4) Friendliness, (5) Modesty, (6) Steadfastness, [and] (7) Tenderness." In this case the associated ideas of color is different from our understanding of function because these ideas do not form a relationship between each other as a function would (Kant 2000, 181).

CHAPTER IV

REFLECTION ON (AND IN) STRUNK'S *TONNETZ*[70]

4.1. INTRODUCTION

During my personal meeting with Steven Strunk in 2011 at the national meeting of the Society for Music Theory at Minneapolis, he told me that the use of the word "flip" in the contemporary Neo-Riemannian literature needs to be rethought.[71] He said that nowhere in the world of geometric operations do we find the word "flip." Instead, he advocated the use of terms such as "translation," "rotation," and "reflection," borrowed from the field of transformational geometry, when describing operations on the Neo-Riemannian *Tonnetz*. In his article, "Wayne Shorter's *Yes and No*: An Analysis" (2003), he applies this rethought version of the Neo-Riemannian operations to a post-bop jazz composition, which, according to a jazz music theorist Henry Martin, "pioneered the application of Neo-Riemannian concepts to jazz theory" (2012, 2). Strunk treats the Neo-Riemannian operations (parallel,

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[70] I presented an earlier version of this chapter at the 2011 meeting of the Music Theory Society of Mid-Atlantic.

[71] In his article, Strunk also expresses his frustrations over theorists' use the term "flip" without a proper definition (2003, 49n21). Perhaps the most famous example of using the word "flip" in the context of Neo-Riemannian literature is David Lewin's article "Cohn Functions" (1996). Lewin defines the term *Cohn flip* as follows: "A mod N function is *Cohn flipped* when an exchange of different (NB) values at adjacent (NB) arguments gives rise to a rotated retrograde of the original function" (Lewin 1996, 183). Take a C-major triad for example. Cohn-flipping it will generate two minor triads: C minor and E minor (strictly speaking, E-minor triad in second inversion). In the case of C major to C minor, E is "exchanged" with the "argument" that is "adjacent": Eb. The result is a C-minor triad, which is a rotated retrograde of C major (the major third and minor third from the bass note is now a minor third and major third). The Cohn flip is based on the operation called contextual inversion, which was conceived as part of harmonic dualism in nineteenth-century German music theory. The contextual inversion of a C-major triad will generate the above two minor triads, *as well as an A-minor triad*. However, in the case of C major to A minor, G is exchanged with A. This operation is not a Cohn flip because G and A are not adjacent in mod-12 space. Later in this article, I will discuss contextual inversion in depth.

leading-tone exchange, and relative) as operations on a purely geometric surface instead of treating them as operations on the surface of a musical staff. In this way, Strunk envisions a musical space that is different from the one corresponds to notation, which I consider the "next step" in the development of the musical space historically. Instead of referring to the music theoretical writings which formed the basis of Neo-Riemannian analysis, Strunk refers to a college geometry text when introducing his version of Neo-Riemannian analysis. Since "Strunkian" method of the *Tonnetz* application preserves the appearance of the operations on paper, the difference between the two methods may not seem obvious. The difference hinges on the preservation of the set-class. The conventional method of applying P, L, and R operations maintains the set-class of the chord before and after the application of the operations, whereas Strunkian maintains the *function* of the chord; the set-class may or may not change after the operations, but it does not matter either way. In other words, although he kept the appearance of the Neo-Riemannian operations, he altered what these operations can do.

In this chapter, I argue that the unique relationship between notation and music in the jazz context led Strunk to rethink the conventional use of the *Tonnetz*. I believe that Strunk's insistence on proper terminology is informed by jazz performance practice, which has an entirely different conceptual origin from that of conventional Neo-Riemannian methodology. Instead of relying on notationally based contextual inversion and parsimonious voice-leading (the two "foundational topic[s] for Neo-Riemannian literature") (Straus 2011, 44n7), Strunk focuses on the function of the chord—in other words, how the chord *sounds* in context. This consideration for the sonic dimension can be observed not only

in Strunk's analysis but also in the field of jazz analysis in general.[72] By reflecting on Strunk's use of the *Tonnetz*, I investigate Strunk's reconceptualization of Neo-Riemannian theory in order to shed light on the loose relationship between notation and music in a jazz analysis.

This chapter is in two parts. In the first half, I investigate the methodological difference between the conventional and Strunkian uses of the *Tonnetz* by focusing on the degree to which they rely on notation. Second, I explore the weaknesses of Strunk's method by demonstrating the potential inconsistency of treating the *Tonnetz* as a purely geometric surface, and also its strengths by demonstrating new relations made possible by Strunk's method. In particular, the Strunkian *Tonnetz* is especially powerful to draw a visual connection between two Z-related sets when they are represented as asymmetrical figures on a *Tonnetz*. More broadly, I show that a more geometrically grounded conception of the *Tonnetz* allows us to visualize the inner-interval structure of pitch-class sets.

4.2. PRELIMINARY QUESTION: HOW DO WE ANALYZE JAZZ?

Before we go further, we first need to consider the overarching characteristics of jazz analysis. To analyze jazz, a theorist must transcribe. This process of converting sound into notation pries open the connection between the act of notating music and the act of making

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[72] This is not to say that the conventional Neo-Riemannian analysis does not consider the sonic dimensions of their subject. However, Strunk is the only theorist among the Neo-Riemannian circle who supported his theoretical extension with performance practice. To give a brief example, he writes that his extension of the Neo-Riemannian operations to include seventh and ninth chords is "reasonable for the analysis of jazz, because in jazz, the degree to which a chord is extended is variable and is determined on an *ad hoc* basis by the pianist (or whoever is playing the chords)" (Strunk 2003, 48). Later in this article, I will investigate the foundation of Strunk's *Tonnetz* application in detail.

it.[73] Therefore, in a jazz context, a musical work is not represented by its written notes, but by something more non-visual in nature, such as the recorded performance, a chord-progression, or an improvisation. In any case, the material basis crucial for the formation of work-concept is unstable in jazz compared to classical music. If we treat the concept of musical work as an amalgam of various constituents (such as notation, performance, sound, background historical information, etc.), a large part of what constitutes a jazz composition would depend upon the specific performers and the sounds they create. For example, the essence of Miles Davis's "So What" lies not in the notated score (if there is any) but in the recording that appears on the first track of *Kind of Blue*—in the sounds performed by his group. In any case, notation rarely plays a role in the representation of a jazz composition. On the other hand, in conventional music analysis, the notated score is often considered the sole representation of the musical work. For many, the notation *is* the musical work. In the context of classical music, the performance becomes an interpretation of the musical work; in the context of jazz music, however, the interpretation of the musical work is actually the transcription. Even a most detailed transcription of a jazz performance cannot diminish the status of the performance.[74]

In short, analyzing jazz music usually involves applying analytical tools that were originally developed for the analysis of classical music. Practically speaking, this means that

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[73] There is a significant amount of discussion regarding the use of notation in jazz. Many scholars, including Larson (2005), Prouty (2006), and Rinzler (2008), approach the issue in light of an improvisation–versus–composition dichotomy. This discussion of notationality can be seen as a part of a larger discussion of theory versus practice. Henri Martin (1997) was perhaps the first scholar to recognize this distinction when he categorized music theory as "musician-based" and analytical.

[74] It is not a coincidence that a similar argument has been made in the field of historical performance practice. For both jazz and historical performance practice, improvisation plays a crucial role. In a

the analysis of jazz music often requires the notated score. The sounds need to be written down. At the same time, applying these "classical" tools in the analysis of jazz music requires adapting them to a new context. This adaptation transforms both the tool and the music. The fact that an analytical tool is being applied to a type of music that it was not originally designed for brings out a new potential for the analytical tool that was not previously explored. In other words, if we recognize classical music and jazz music as two different objects, the interaction between the analytical tool and each style should also be considered as fundamentally different.[75] Steve Larson's Schenkerian analysis of jazz music, for example, transformed Schenkerian analysis itself as a tool applicable to jazz music . To be more specific, within the space created by the interaction of Schenkerian analysis and jazz music, the ninths, elevenths, and thirteenths of a chord (or the sounds represented by these names) became unresolved suspensions. By doing so, the sounds that were recognized as suspension

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recent book, Barthold Kuijken advocates that notation "direct[s] itself toward the wrong physical sense: toward the eye instead of the ear" (2013, 12). The title of the book (*The Notation is Not the Music*) should be enough to clarify his position on notation.

[75] This description of the relation between two objects (an analytical tool and a musical style) may resemble the philosopher Graham Harman's understanding of the relationship of objects named "vicarious causation" (Herman 2007). He maintains that "every relation is itself an object" (2007, 207). When I encounter a pine tree, for example, the two separate objects (the pine tree and me) reside "on the interior of a third [object]: the [Husserlian] intention as a whole" (2007, 197). Within the space created from this encounter, I sense the pine tree. However, the pine tree that I experience is not the fully accounted being of the pine tree. There will always be a certain aspect of the pine tree that is beyond my senses. Therefore, the pine tree within this intentional space is merely a sensual being. The *real* pine tree stays outside of this space. This intentional space usually contains one real object (me) and one sensual object (the pine tree). Since the third object—the intention—is defined by its constituents and the hierarchy of the constituents (i.e., which one plays the dominant role by being the real object), different objects create the different intention. Applied in the context of my argument, the interaction between analysis and classical music generates conventional analysis which is independent from both the analytical impulse and classical music; the interaction between analysis and jazz music generates a jazz analysis which may be considered as a sibling of the conventional analysis, but nevertheless different from it.

are stripped of their (Herman 2007) stylistic origins. It no longer matters if one hears the sounds (i.e., the suspensions) in classical or jazz contexts once they are identified as objects independent from their backgrounds.[76] Through the use of the Schenkerian analysis, the sound of the unresolved suspension is isolated from its contexts and becomes a quality that is recognizable through our (i.e., the readers of Larson's articles) perception. This, I believe, is the relationship between an analytical tool and music. An analytical tool casts a ray of light into its musical raw material to illuminate a quality embedded deeply in the music; a quality that is, perhaps, not yet available to our perception. Through the application of the new analytical tool, listeners are given new ears to hear the music differently from before; and hearing the music differently requires a new analytic tool. This interaction between the tool and music therefore reveals new aspects of both. This brings us back to the question: "How do we analyze jazz?" My answer is, by reinventing both analysis and jazz. Strunk's reinvented Neo-Riemannian theory stands as a testimony for the uniqueness of the relationship between analysis and jazz.

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[76] This observation is inspired by the phenomenological analysis of color perception by the French philosopher Maurice Merleau-Ponti (2002). Throughout the book, he frequently offers his analysis on color as a representative for a sense perception in general. According to Merleau-Ponti, our concept of color emerges from our encounters with different colored objects. Therefore, there is no pure concept of color independent from our perception. For example, he writes, "If, on looking at a mountain scene, we adopt a critical attitude and isolate part of the field, then the colour itself changes, and this green, which was meadow green, when taken out of its context, loses its thickness and its colour as well as its representative value" (Merleau-Ponti 2002, 364–365). In other words, the greenness of the meadow and, say, the greenness of a traffic signal are two different qualities. However, when they are taken out of their respective contexts, a relatively general concept of greenness emerges, which is different from meadow green and traffic-signal green. Applied in context of my argument, the sound of the unresolved suspension in context of classical music and that of jazz music are two fundamentally different objects, and they contribute to the emergence of new concept of the sound of the unresolved suspension that is detached from its backgrounds.

4.3. METHODOLOGICAL DIFFERENCE

4.3.1. Notationality in Conventional Neo-Riemannian Literature

To investigate the methodological difference between conventional and Strunkian use of the *Tonnetz*, we first need to understand how integral the role of notation is in Neo-Riemannian theory. Only then, can we appreciate the idiosyncrasy of Strunk's application of the *Tonnetz*. In this section, I will first show the prevalence of contextual inversion and parsimonious voice-leading in the Neo-Riemannian literature and then show their reliance on notation. I will continue by demonstrating the mechanism in which the *Tonnetz* operates in conventional Neo-Riemannian analysis. As we shall see, although the *Tonnetz* seemingly provides a new system of visualizing musical sound, it is still heavily dependent upon notation because the *Tonnetz*, in its original form, is the visualization of parsimonious voice-leading and contextual inversion, two operations that are grounded on notation. Finally, I will end the section by analyzing Strunk's methodology and contrasting it with the conventional use of the *Tonnetz*.

As mentioned earlier, contextual inversion and parsimonious voice-leading are the two foundational topics of Neo-Riemannian theory. Nearly all of the early Neo-Riemannian literature begins by considering either or both of these two concepts. We can deduce the foundational role they play when we look at theorists' attempt to expand the analytic potential of Neo-Riemannian theory. The reason why these new attempts are considered as extensions of the original and not a new theory altogether is because they maintain the use of contextual inversion and/or parsimonious voice-leading.

Adrian Childs (1998), for example, treats parsimonious voice-leading as a generating principle for new relationships between seventh-chords. He devised eight new

transformations that preserve two notes of a seventh chord while moving the other two into either similar or contrary motion by a half-step. Each transformation is defined based on which two notes are held and which two notes are moved. Richard Cohn (1996) developed a new system of organization based, also, on parsimonious voice-leading. His "hyper-hexatonic system" categorizes all available major and minor triads into four groups based on four hexatonic super-sets which can produce the six distinct major and minor triads. Edward Gollin (1998), on the other hand, based his theory on contextual inversion when considering a network of dominant and half-diminished seventh-chords. The result is a three-dimensional *Tonnetz* within which the two seventh chords are related according to the conventional Neo-Riemannian operations: P, L, and R (Figure IV-1).

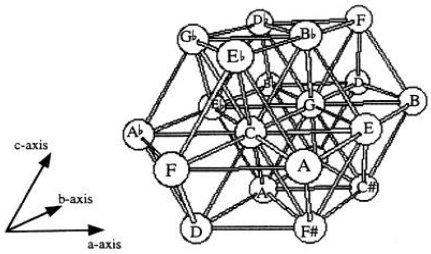

Figure IV-1. Three-Dimensional Tonnetz (Gollin 1998, 198)

The main reason why these two chords are used is not just because they are commonly used sonorities in tonal music, but also because they are applicable within the same mechanism of contextual inversion. In other words, the system that generates the relationship is left untouched and only the raw material is changed from the triad to the seventh chord. For example, the root-position dominant seventh-chord consists of major-, minor- and minor-third from the bottom up; and the root-position half-diminished seventh chord has the same intervals from the top down. As a result, flipping one chord type will generate the other type. Some of the other commonly-used seventh chord sonorities, such as the minor-minor

seventh chord, may not involve two distinct sonorities because they consist of a symmetrical ordering of the intervals (for minor-minor seventh, the inner-intervals are minor, major, minor thirds from the bottom up). These chords will generate the same sonority upon contextual inversion because of the vertically symmetrical structure of the intervals (see Figure IV-2).

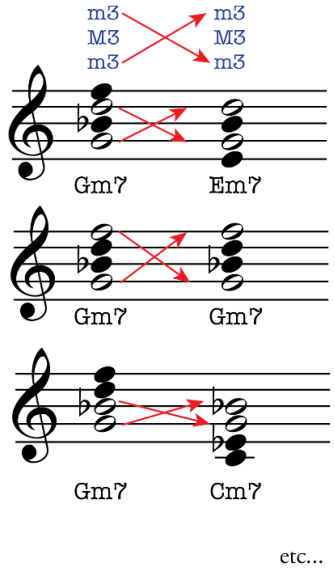

Figure IV-2. Contextual Inversion of G minor Seventh Chord

Joseph Straus also adopts contextual inversion as a generating principle for a *Tonnetz* and constructs what he calls the "contextual-inversion space for trichords" (Straus 2011). He later applied this to create a *Tonnetz* based on a set-class (014) and uses it to analyze the second movement of Anton Webern's *Concerto for Nine Instruments*, op. 24. Considering how Neo-Riemannian theory first began, Straus's analysis resides far from the early forms of the theory. However, the operational consistency between Straus's work and early Neo-

Riemannian theory generated a *Tonnetz* that looks nearly identical irrespective of the musical style. (see Figure IV-3 and Figure IV-4)

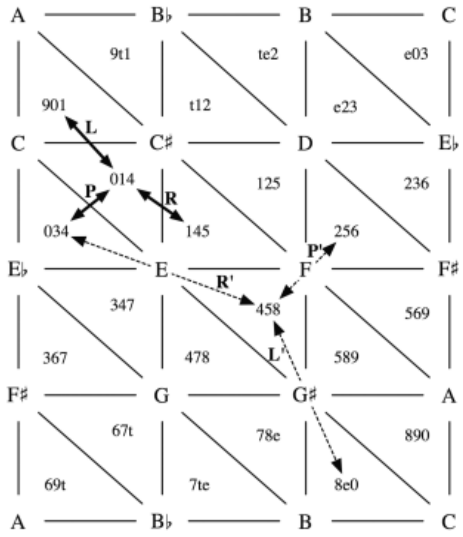

Figure IV-3. "Tonnetz for sc(014)" (Straus 2011, 55)

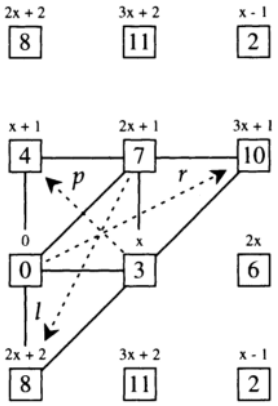

Figure IV-4."Oettingen / Riemann Tonnetz" (Cohn 1997, 15)

Depending on the theorist, the definitions of contextual inversion and parsimonious voice-leading can change slightly. However, the underlying assumption remains mostly unchanged; both are defined as operations on a notated score. For the scope of this article, I

will only consider the versions of parsimonious voice-leading and contextual inversion which are closely related to the *Tonnetz* that Strunk used in his analysis. This version of the *Tonnetz* is one of the most commonly used by theorists such as Brian Hyer (1995), Richard Cohn (1997), Robert Morris (1998), and Julian Hook (2006). The contextual inversion flips the chord upside-down by taking a triad as a single, unified entity (so that the notes within the triad do not move independently). As a result, the inner-interval structure of the chord (major- and minor-third in the case of a major triad) is also flipped. (see Figure IV-5) No matter how the result may seem, it is important to remember that the contextual inversion is originally conceived as an inversion of a chord, not a stepwise motion of a chord-tone. Since the operation only rearranges the intervals within the chord, and does not create a new interval of a different size, the process preserves the set-class and the interval-vector before and after the operations.

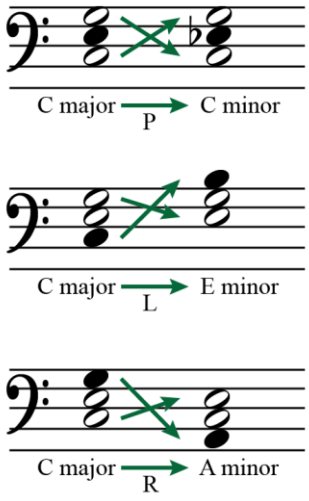

Figure IV-5. Contextual inversion of C major triad

The pervasiveness of the contextual inversion in Neo-Riemannian theory can be observed from the term "flip" because the motion it describes more closely resembles

contextual inversion on a staff than reflection in a *Tonnetz*. The term flip captures the nature of the implied motion of the Neo-Riemannian operations because the one-dimensional, vertical orientation of a chord on a staff resembles a flip of a coin (even though there can be different versions of the flip). If the operations were to be conceptualized geometrically in a *two*-dimensional space, however, the term flip would not have been the first word that comes to mind, because the associated gestures that result from the Neo-Riemannian operations do not depict an action that we colloquially associate with the word flip. We can highlight this distinction by imagining the different actions associated with "turn a page" and "flip a page." Flip generally describes an action which takes an object, reverses its orientation, and puts it back to its original location. Of course, the relationship between the word and the harmonic motion described as P, L, and R is not strictly causal. However, the widespread use of the word does hint at the origin of the Neo-Riemannian operation, which is the contextual inversion on a musical staff.[77]

Parsimonious voice-leading originally began as a concept dependent on contextual inversion. Instead of focusing on the inversion of the chord in its entirety, parsimonious voice-leading focuses on the resultant offset of the chord tone. For example, in the case of L-transformation of a C-major triad, instead of considering the mapping of all three notes (E to G, G to E, and C to B), the parsimonious voice-leading embraces only the C to B mapping. Since E and G map onto each other, there is no net effect of the motion of the

[77] When introducing the term "Cohn-flip," Lewin does not use a staff, but uses letter names (1996, 181–182). But the mental image still follows the logic of contextual inversions in that he treats the letter names the same way as notes on a staff.

two pitches (see Figure IV-5).[78] In the literature that concentrates on parsimonious voice-leading, its contextual-inversion origin is sometimes omitted altogether.[79] The premise of parsimonious voice-leading is that with just a few half-step motions of the chord tones, the chord can travel to a harmonically distant area from its origin. For example, just with the two half-step motions generated by the L- and P-transformation (in order), a C-major chord can become an E-major chord, a chromatic mediant from the original chord. If the same pair is applied again to the E-major chord, the outcome will be a G#-major chord. Underneath this concept of parsimony lies the concept of voice-leading distance. To say that a certain voice moves parsimoniously means that the chord takes less effort to travel a long distance. In this case, the chord is metaphorically understood as the object that moves, and the note as the object that leads. If the chord quality were to change before and after the operation, the operation no longer generates a motion, let alone a parsimonious voice-leading, because the concept of motion is disintegrated as the object in motion is altered. For example, only when the shape of a triad is maintained before and after the operation can the triad be considered as moved. In this context, the set-class plays a role of identity. If, for any reason, the set-class is different before and after the operation, the underlying condition of parsimonious voice-leading would not be fulfilled. There is no motion. It is as if when a pebble turns into a tree, their location is of less importance. Only when a pebble is still a pebble after the movement, can we perceive it as having moved. Parsimonious voice-leading, then, works like a portal. If we consider that the energy it takes to move a chord is determined by the degree of

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[78] Cohn calls this "double common-tone retention" (1997, 2).

[79] In one of Cohn's articles which focuses on parsimonious voice-leading, he (perhaps unknowingly) redefines the P, L, and R operations by only showing the movement of the voices (1997).

transposition of each chord tone, parsimonious voice-leading offers a far-more energy-efficient motion of a chord. For example, to transpose a C-major triad up a major third, it takes total of twelve half-steps (four half-steps per chord tone). However, the L- and P-transformations will generate the same E-major triad but with only two half-step motions. In the end, efficiency is calculated by the distance on the musical staff. Without the underlying space and energy, the concept of parsimonious voice-leading is not possible.

In fact, the terms "inversion" and "voice-leading" would not make sense if Western musical notation were not spatially oriented. It is only because spatial musical notation is considered as the *a priori* mode of representing musical sound that any terms with spatial connotation can be considered meaningful. The combination of these two concepts is at the foundation of the conventional *Tonnetz* operation. Therefore, any operation on the *Tonnetz* is, in fact, performed on the musical staff and the result is re-represented onto the *Tonnetz*. The conventional *Tonnetz* is not the surface in which Neo-Riemannian operations take place. The *Tonnetz* is merely a representational surface within which these operations are visualized. And these operations are devised to target specific types of harmonic relation. In other words, the theory began with the intention to relate chords that are relatable with P, L, and R operations—to generate some new mechanism that encompasses the chromatic mediant relationship. This is why the Neo-Riemannian *Tonnetz* operations do not include a reflection over the antidiagonal axis (i.e., the line generated by the equation "y$= -x$"). If the conventional *Tonnetz* is a truly a geometric surface, this exclusion would seem highly irregular (see Figure IV-6).

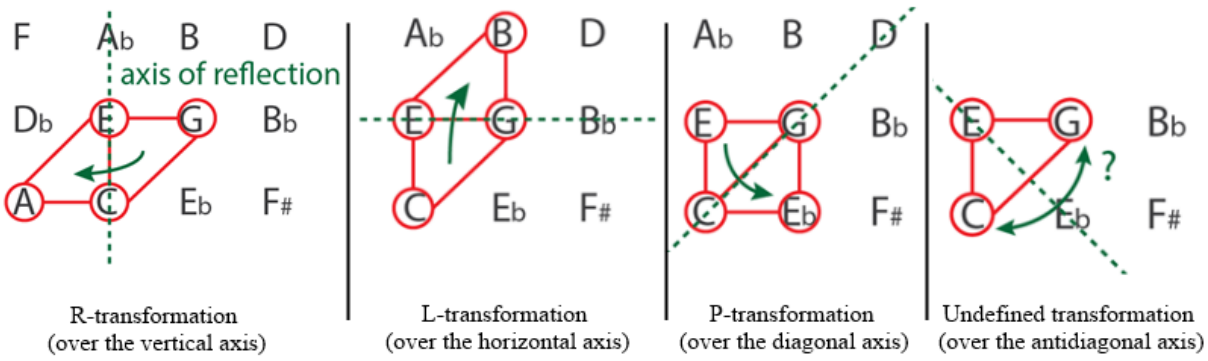

Figure IV-6. Exclusion of reflection over antidiagonal axis

Furthermore, although P, L, and R are considered as operations within the same category, the *Tonnetz* representation of the P operation takes one step less than the other two.[80] For example, the L operation on a C-minor triad is represented as the reflection of the isosceles right triangle over the horizontal axis. However, a reflection alone would generate the trichord {0, 3, 11} as it is reflected around the 0–3 line. It must be followed by another reflection over the vertical axis to arrive at the desired Ab-major triad.[81] (Figure IV-7) The reason why there is discrepancy between how the P, L, and R are conceptualized as equal and how they are represented on a *Tonnetz* as unequal is because it did not concern the theorists who devised the system. The P, L, and R operations are not meant to be performed on the *Tonnetz* but on the musical notation.

[80] Robert Morris also points out that a single flip-operation is not enough to map the operations L and R (1998, 187). He calls the motion in the *Tonnetz* "flip-with-twists" (1998, 187). Strunk was aware of the twist as he explicitly mentions Morris's description (2003, 50n23).

[81] In earlier Neo-Riemannian literature, there were two configurations of a *Tonnetz*. One treats a triad as an isosceles right triangle (1998, 172), and the other represents a triad as a (quasi-) equilateral triangle with major and minor thirds having an equal length without a right angle. When we just use the *Tonnetz* as a surface in which to represent an operation that is done on a staff, this difference does not affect the outcome of the analysis.

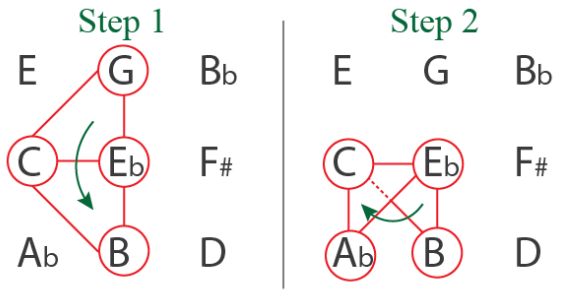

Figure IV-7. L-operation on C minor triad as two-step process

4.3.2. Strunk's Reconceptualization of the *Tonnetz*

From the foregoing investigation, it is most important to remember that the set-class must be preserved to maintain the integrity of the motion. In order for a chord to be considered as moved, the chord itself must remain unaltered. In this respect, the Strunkian *Tonnetz* operations are groundbreaking because they alter the set-classes of a certain chord group before and after the operation. For example, he establishes the relationship between a minor-minor-seventh chord (set-class 4–26) and a major-major-seventh chords (set-class 4–20) via P, L, and R operations in his 2003 article (Strunk 2003). (Figure IV-8) This is possible because he introduced the *Tonnetz* operations as geometrical in nature. Instead of referring back to the contextual-inversion origin and the retention and motion of chord tones, he defines the operations according to interval class when he first introduces the Neo-Riemannian operations. As a result, the two set-class-preserving operations (contextual inversion and parsimonious voice-leading) were not taken into consideration of the P, L, and R operations. He writes, "The parallel operation holds interval class 5 invariant between the

two chords, the relative holds interval class 4, and the leading-tone exchange (or *Leittonwechsel*) holds interval class 3" (Strunk 2003, 47).

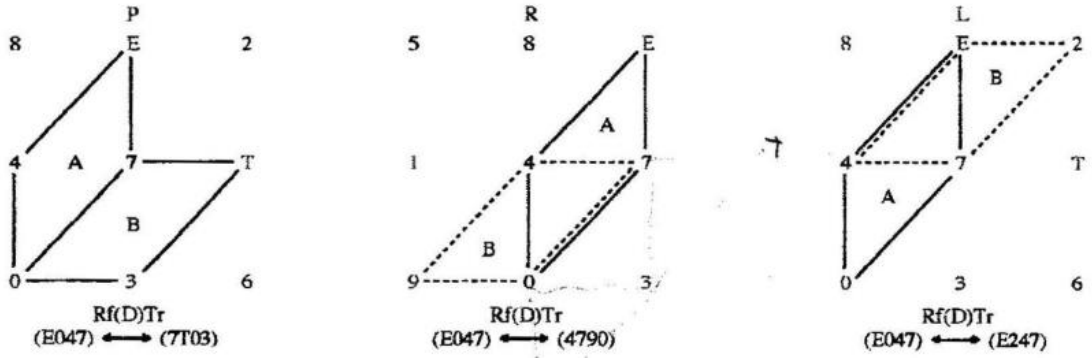

Figure IV-8. P, R, and L operations for seventh chords; A = major seventh, B = minor seventh (Strunk 2003, 47).

Nowhere in his introduction of the Neo-Riemannian operations has he referred to the original contextual inversion on a staff or parsimonious voice-leading. This introduction shifts the emphasis from the points to the lines. What was previously invisible (i.e., the intervals in a musical notation) is made visible as the emphasis shifts from the points to lines of a *Tonnetz*. This shift leads to the later, more geometrically oriented, use of the *Tonnetz*.

When applied to a triad, this re-grounding does not seem to result in an outcome that is different from the conventional way. However, when extended to incorporate different pitch-class sets, the discrepancy between the conventional and Strunkian becomes evident. To highlight the methodological difference, I will apply the two different versions of the P-operations to a G major seventh chord. (Figure IV-9) The conventional P-operation will generate an Eb major seventh chord because the P-operation in this context holds the

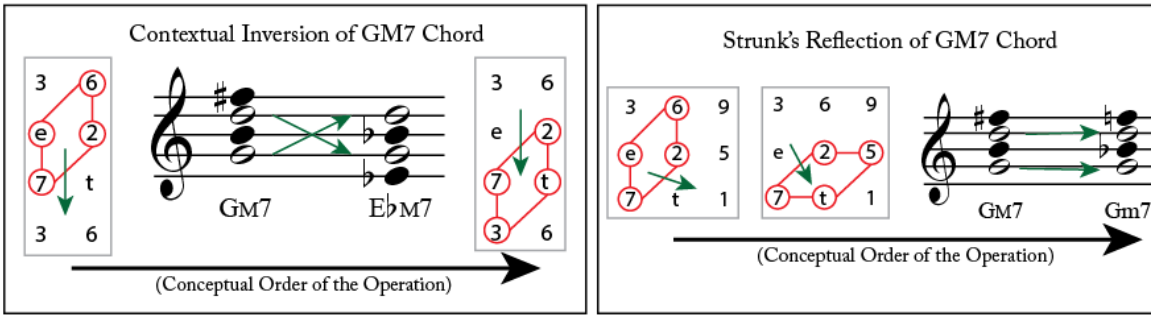

Figure IV-9. Contextual inversion of G major seventh chord

notes G and D on a staff as a constant and inverts the intervals around it.[82] The Strunkian P-operation, however, generates a G minor seventh chord because the Strunkian P-operation reflects the chord over the G-D line of the *Tonnetz*. In this case, G and D are mapped onto themselves (not flipped to each other) while B moves to Bb and F# moves to F. As a result, the set-class is changed from 4–20 (0158) to 4–26 (0358). At the heart of this set-class alteration, lies the transformation of interval-class 3 into interval-class 4, resulting from the geometric reflection.

Strunk's treatment of the *Tonnetz* as the operational surface (as opposed to treating it as the representational surface as in the case of the conventional method) enabled the transformation of one interval-class into another.[83] As long as any two intervals are visualized as same length on a *Tonnetz*, we can relate them with various geometric operations. In case of the particular *Tonnetz*-orientation that Strunk used in his analysis, the interval-

[82] This method is identical to Gollin's application (1998).

[83] The concept of the operational surface is similar to Robert Morris's concept of "the compositional space" (1995). Morris defines the compositional space as "out-of-time structures from which the more specific and temporally oriented compositional design can be composed." The main difference between my operational surface and Morris's compositional space is that mine is a descriptive surface with the purpose of analysis while Morris's is a prescriptive surface with the purpose of composition or improvisation.

classes 3 and 4 are relatable as well as the interval-classes 1 and 5 because each interval in the pair is visualized as occupying the same distance. Any reflection over the diagonal axes will transform interval-class 3 to 4 and vice versa; any reflection over the vertical or horizontal axes will transform interval-class 5 to 1 and vice versa. For example, we can hypothetically represent the C-major seventh chord and a pitch-class set {0, 1, 4, 5} as a reflection over the C-E line. (Figure IV-10) It is rare in the music theoretical literature to have an operation which treats these two pitch-class sets as relatable and, thus, equivalent at some level.[84] Particularly for this rarity, an operation on a *Tonnetz* without the reference to the notation may seem arbitrary.

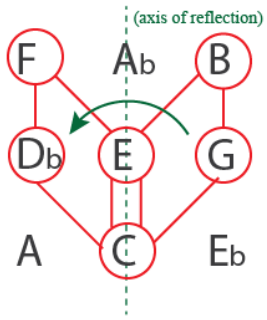

Figure IV-10. C major seventh chord into {0, 1, 4, 5}

Underneath this feeling of arbitrariness lies music analysis's reliance on notation. Throughout the history of Western music, notation has been the primary mode of representing musical sound. This made notation a symbol of the music itself. The *Tonnetz*

[84] However, the pairing of interval-classes 1 and 5 (the two interval-classes that are involved in this operation) in post-tonal music has gained meaningful scholarly attention. See Brown (2013) and Heetderks (2011). On the other hand, Clifton Callender (2007) devises an operation that treats the two perfect fifths within a major seventh chord (e.g., C-G and E-B) as slide-able pair. Therefore, in his theoretical model, C major and C minor seventh chords are relatable if we slide the E-B pair down a half-step. A possible extension of this method would be to slide the pair even further to arrive at C-G and Db-Ab.

representation of a musical sound, in this context, must be mediated by the notational consistency because the operations on the *Tonnetz* are always tethered to the musical notation. In other words, the validity of contextual inversion, parsimonious voice-leading, and the P, L, and R operations all hinge upon the preservation of set-class because all of these operations are not direct manipulations of the musical sounds but manipulations of the musical notation. And the set-class stands as the way to verify that the pitch content is essentially unaltered before and after the operations. In the conventional flow of operations, no operation on a *Tonnetz* can bypass its music-notational operation. Strunk's *Tonnetz* operations upset this flow. The transformation of a C major seventh chord into a pitch-class set {0, 1, 4, 5} does not make any notational sense because it violates the preservation of the set-class, while it is represented beautifully in the Strunkian *Tonnetz*. If we consider the conventional *Tonnetz* as a computer monitor (i.e., a representational surface) and the notation as the CPU (i.e., the operating mechanism), Strunk's operations are painting on a monitor. This, however, is the strength of Strunk's *Tonnetz* operations. Influenced by the jazz tradition's privileging of sound over notation, Strunk could liberate the *Tonnetz* from its notational underpinnings.

In Strunk's use of the *Tonnetz*, the role of the set class as the identity-granting property is replaced by the function of the chords, that is, how the chord sounds in context. A chord is considered as essentially identical when the function remains unchanged. Sometimes the set-class may also remain unchanged, but it does not play as critical role as the chordal function. Strunk's decision to consider the chordal function instead of the pitch-class content is a clear and conscious departure from the conventional method, but more importantly an inevitable extension to suit jazz performance practice. He writes, "Riemann

dealt only with triads, and the extensions of transformations to the seventh chords explored in recent publications do not discuss the functional equivalences desirable for the analysis of jazz" (Strunk 2003, 48n19). In a jazz performance, the piano or guitar player treats major-triad, major-seventh chords, and major-ninth chords interchangeably when they function as a tonic. Similarly, minor-triad, seventh, and ninth chords are used interchangeably when functioning as II chord in a major key. Strunk writes, "Because of this interchangeability of voicings [in the jazz performance practice], a correspondence between neo-Riemannian operations relating those triads, seventh chords, and ninth chords which function equivalently in jazz contexts is highly desirable" (Strunk 2003, 48). In other words, it is of less importance what exact notes were used for chords as long as the function of the chords is clearly articulated. Strunk's emphasis on the functional equivalence of a chord, therefore, led him to redefine the *Tonnetz* operations as purely geometrical because the set-class can no longer provide the consistency of his theoretical model. And this is why he refers to a college geometry text. Since he can no longer rely on the geometry of the notation, he co-opted the mathematical geometry to ground the internal consistency of his theory that takes functional equivalence into account. In the meantime, as the operations are redefined as purely geometric, the objects are also redefined as purely geometric in nature.

This recontextualization, in turn, shows the status of notationality in a jazz analysis. Because the notation itself is seen as an interpretation of the musical work in a jazz context, the conceptual closeness between the notation and the music would be similar to the conceptual closeness between the *Tonnetz* representation and the music. The music is simply transcribed onto the *Tonnetz* instead of the notation; and doing so does not evoke the sense of arbitrariness previously mentioned. We can observe the loose sense of notationality in

Strunk's article. Early in this article, he writes that "When attempting to analyze jazz, one music first locate the thing that is to be analyzed" (Strunk 2003, 40). He, then, goes on to consult four sources: the Library of Congress copyright deposit, *The Real Book*, Jamey Aebersold's *Wayne Shorter Jazz Classics*, and the first recording of the composition, *Juju* (1964, Blue Note B248514, CDP 7243 8 37644 2 6).[85] If any music notational representation of the composition were to be thought of as authoritative, the Library of Congress version would suffice to begin his analysis. His considering of the other three (two of which include the recorded performance[86]) could be thought of as considering the performance of the composition. For Strunk (and many other jazz music theorists), one notational representation is not enough to capture the essence of the composition. By considering the sources that the jazz musicians would consider when preparing for the performance, Strunk attempts to more closely establish the "thing that is to be analyzed" (2003, 40). Even with this effort, he admits that his transcription is "perhaps arbitrary" (2003, 41). It is not because he was not thorough in constructing the lead-sheet (any jazz performer would consider his version as a fair representation of the tune), but because of the inherent arbitrariness of the notation in the context of jazz tradition. The same intellectual impulse which questioned the suitability of Schenkerian analysis for jazz music is now giving more flexibility to the Neo-

[85] He gives following bibliographical information for *The Real Book* and Aebersold's version. *The Real Book*, 5th ed. Illegal fake book, No credits, 1988; Jamey Aebersold, *Wayne Shorter Jazz Classics*, New Albany, IN 1985 (Strunk 2003, 40).

[86] Jamey Aebersold's version accompanies a cd which provides the rhythm section performance without the lead instrument.

Riemannian analysis of jazz music; it is the impulse which grows out of the promiscuous relationship between music and the notation in the jazz context.

4.4. WEAKNESSES AND STRENGTHS OF STRUNK'S METHOD

Treating the *Tonnetz* as a standalone notation independent from the staff notation brings a new set of weaknesses and strengths. In this section, I will first show the inherent problems of Strunk's method and then show the potential strengths of it. By highlighting both weaknesses and strengths of Strunk's method, we can hone in what kind of musical behavior this new approach is most suitable for.

One of the biggest challenges comes from the fact that it is impossible to construct a *Tonnetz* on a two-dimensional plane whose grid lines are segmented proportionally to the size of the interval. In order for the *Tonnetz* to be reasonably useful without being too complicated, the *Tonnetz* most commonly incorporates four lines: horizontal, vertical, diagonal and (often unarticulated) antidiagonal. Each of these lines are segmented and the different lengths of the line segments are treated as the size of the interval. However, it is geometrically impossible to construct a *Tonnetz* on a two-dimensional surface so that the proportional length of each line segment matches the size of the interval. As seen in Figure IV-11, if we call the two line segments that are created by the intersection of the grid lines as "X" and "Y," we can manipulate the length of X and Y by adjusting the width of the lines. If we call the diagonal line connecting the two points created by the intersection (bottom-left and top-right) as "Z," the length of Z can be adjusted by the angle in which X and Y intersect. Since the length of the antidiagonal line segment—which I will call "W"—is also

determined by the same angle and inversely proportional to the length of Z, we can only control the length of either the diagonal or the antidiagonal line segment.

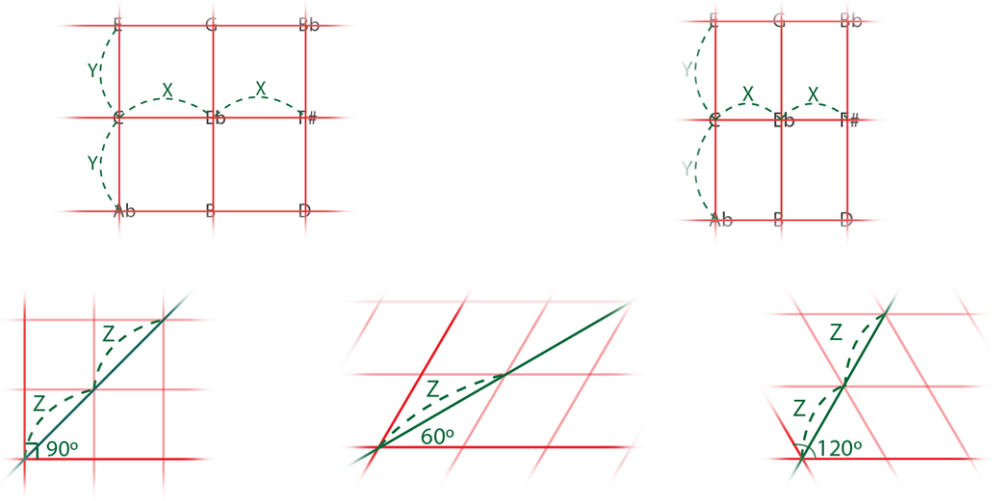

Figure IV-11. Manipulating the length of X, Y, and Z

Now we need to determine the angle in which the length of Z is proportional to the implied intervals. In the case of any *Tonnetz* representation, the musical interval represented by Z equals the addition of the musical intervals represented by X and Y. This means that in order to represent this music-notational relationship without distortion, the lengths of X plus Y should be equal to that of Z. The only angle which satisfies this relationship is 180 degrees, which does not form any geometric shape other than a line. In order to form a polygon, the length of Z must be smaller than X+Y (Figure IV-12). In other words, it is impossible to construct a *Tonnetz* that is proportional to the size of the interval without approximation.

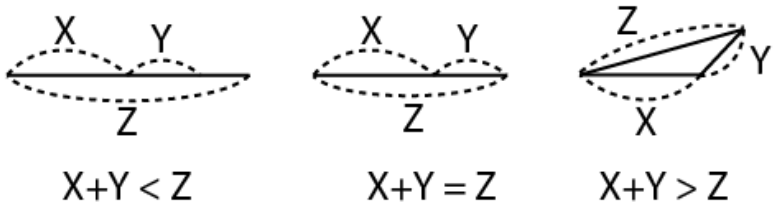

Figure IV-12. "Z must be smaller than X+Y."

This means, any geometric operations on a *Tonnetz* will eventually generate inconsistent results. Additionally, the fact that the *Tonnetz* is in mod-12 space further contributes to this inconsistency. For example, in Strunk's *Tonnetz*, reflection of a C fully-diminished seventh chord over the diagonal axis will result in a C augmented triad. (Figure IV-13)

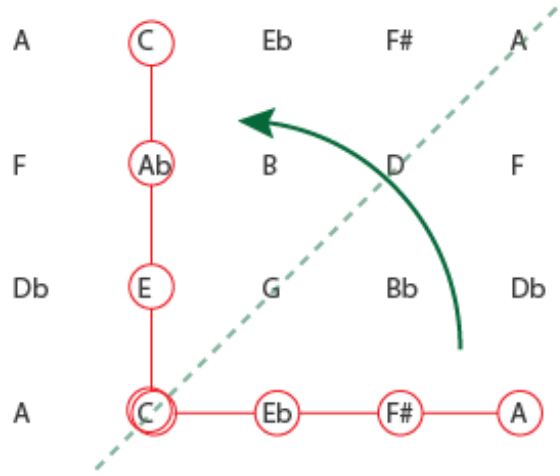

Figure IV-13. Transformation of C fully diminished seventh chord into C augmented triad

Also, some line segments end up representing multiple intervals. For instance, if we call the diagonal line segment which is bounded by 0 and 2X+Y and the translation, reflection, and rotation of it as "V," V represents the (unordered) interval-classes such as 1, 2, and 5.

(Figure IV-14) One could even consider the transformation of interval class 3 into 4 and 1 into 5 as an inconsistency of the method although Strunk uses this property advantageously.

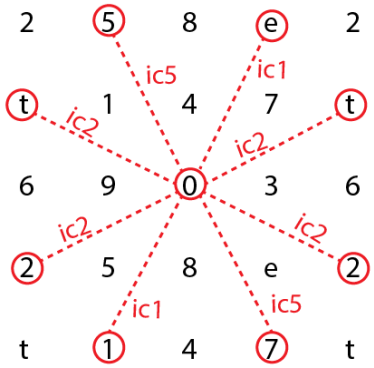

Figure IV-14. Multiple interval classes representation of "V"

Since the difference between conventional and Strunkian methods is in the application of the *Tonnetz*, and not how the *Tonnetz* is configured, this inconsistency is also present in conventional use. However, because the *Tonnetz* is used only as a representational surface, the inconsistency of representation is not articulated in the conventional method. In order for the Strunkian method to become a truly reliable analytic tool, there needs to be a well-thought-out regulation that can mediate these inherent problems. Strunk seems to be aware of the necessity for such regulation because he mentioned that "passages making use of other types of seventh chords would require further theoretical underpinning" (2003, 48). Despite this inconsistency, Strunk uses the *Tonnetz* because of its strengths as a tool for visualization of the chord progressions that are not easily explainable through Schenkerian and post-tonal set-class analyses. The strength outweighs the weakness. Every analytic tool has weakness and strength in terms of its explanatory capability; and we do not need to abandon this tool for having a weakness.

The strength of Strunk's method is that he treats the function and the preservation of shape as the deciding factors of his operation. To explore the new possibilities of his *Tonnetz*, we first need to clarify which precepts of the conventional methodology are altered by the Strunkian method. The foregoing discussion shows that the preservation of set-class is no longer observed in Strunk's method as long as the two chords are functionally equivalent. Additionally, Strunk's method also suggests that the chords that are represented on the *Tonnetz* are no longer limited to triads, but can be extended to seventh and ninth chords. Since he treats the chords as directly representable on the *Tonnetz* without the mediation of notation, the fact that certain chords are triads, seventh chords, and ninth chords no longer seems to matter. In other words, we can treat the *Tonnetz* as a standalone spatial representation of musical sound in which any pitch-class sets can be represented, not *based on* staff notation but *in place of* it, so to speak. Taking these two new rules, we can represent any pitch-class sets with similar functions on the *Tonnetz*.

The word function can mean different things in musical context, but as Strunk used it, it implies how a certain sonic element sounds in context.[87] Taking the word function as how the chord sounds, we can expand the potential of the Strunkian *Tonnetz* to draw new relationships between two chords. In particular, the Strunkian *Tonnetz* operation can

[87] For example, he writes that the major triad, seventh, and ninth chords will express "tonic function" which describes the role of these chords play in context of a phrase, as part of a phrase model. He, later, writes that the minor triad, seventh, and ninth chords can function as "II in major." In this case, the fact that it is not called the "pre-dominant function," implies that these chords are conceptualized not as part of a phrase model, but as part of the scale-step (2003, 48).

represent some Z-related pairs as identical shapes in reflection.[88] There are nineteen Z-related pairs of tetrachords, pentachords, and hexachords. Among them, six Z-related pairs can be represented this way.[89] For example, take 4-z15 (0146) and 4-z29 (0137), one of the Z-related pairs within this category. We can represent these two tetrachords as identical shapes in reflection over the vertical axis because, upon reflection, the interval-class 1 (the antidiagonal line segment) and the interval-class 5 (the diagonal line segment) switch places and this results in no net effect on the inner interval structure. (Figure IV-15) The other five Z-related pairs work similarly. When these types of Z-related pairs are used in music, we can easily visualize the progression on the *Tonnetz* clearly. (See Figure IV-16 and Figure IV-17)

There are five Z-related pairs whose two pitch-class sets are not represented as identical geometric shapes.[90] The reason for this is that every set in this group is represented as a symmetrical shape on the *Tonnetz*, which, upon reflection, generates itself in translation. (see Figure IV-18) The remaining eight pairs (they are all hexachords) create a complex of four hexachords which are in Z-relationship as well as interval-similarity relationship (Figure IV-19). [91]

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[88] A Z-related pair is a pair of two pitch-class sets whose set-classes are distinct but have identical inner interval structure.

[89] The six pairs in this category are: 4-z15/4-z29, 5-z17/5-z37, 5-z18/5-z38, 6-z6/6-z38, 6-z11/6-z40, and 6-z19/6-z44.

[90] The five pairs in this category are: 5-z12/5-z36, 6-z12/6-z41, 6-z17/6-z43, 6-z23/6-z45, and 6-z28/6-z49.

[91] The eight pairs in this category are: **6-z3**/6-z25:**6-z36**/6-z47, **6-z4**/6-z26:**6-z37**/6-z48, **6-z10**/6-z46:**6-z39**/6-z24, and **6-z13**/6-z50:**6-z29**/6-z42. I wrote these in a way that the pair in each side of the colon shares the same geometric shape on the *Tonnetz* while the pairs which are written with same typeface are in Z-relation. For example, in the first entry, 6-z3 and 6-z25 are represented as an identical shape on the *Tonnetz*; 6-z3 and 6-z36 are in Z-relation.

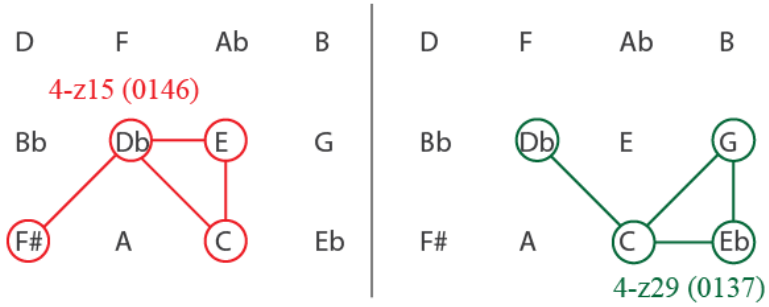

Figure IV-15. Tonnetz representation of 4-z15 and 4-z29

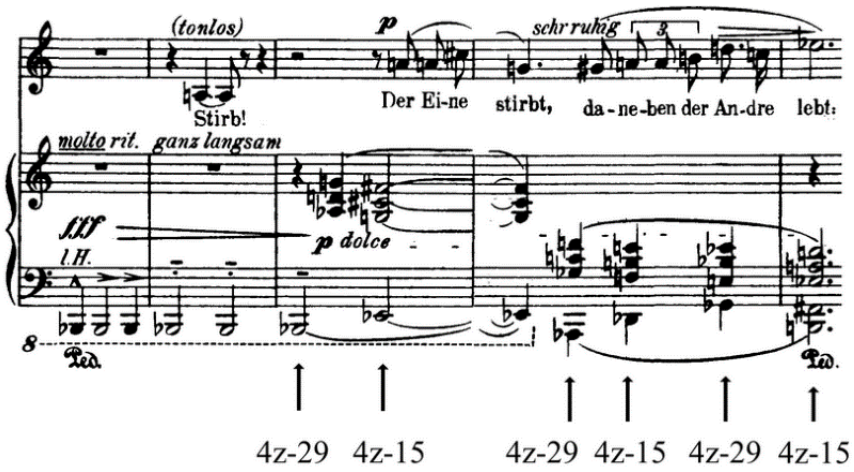

Figure IV-16. Alban Berg, 4 Gesänge, Op. 2, No. 4 "Warm die Lüfte," mm. 19–22.

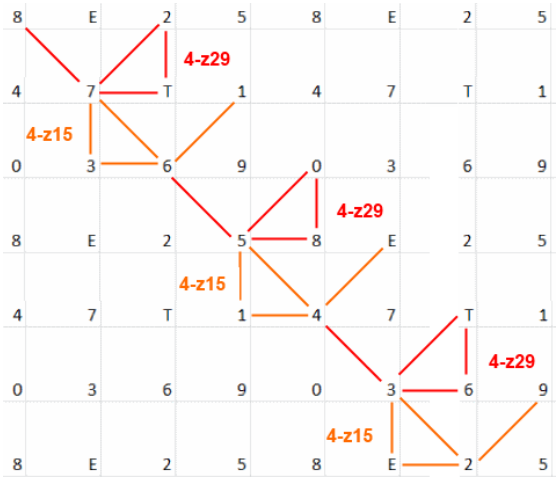

Figure IV-17. Strunkian *Tonnetz* Representation of the Above Passage

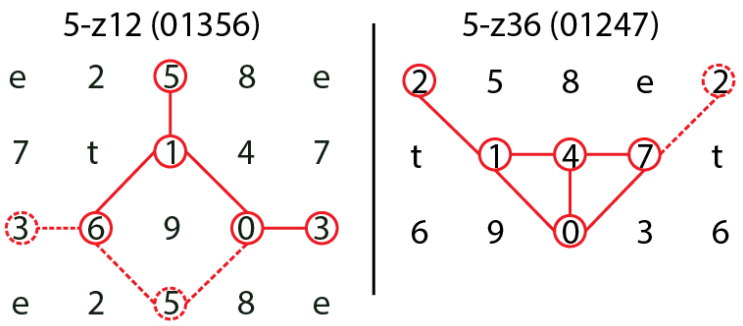

Figure IV-18. Symmetrically represented pitch-class sets

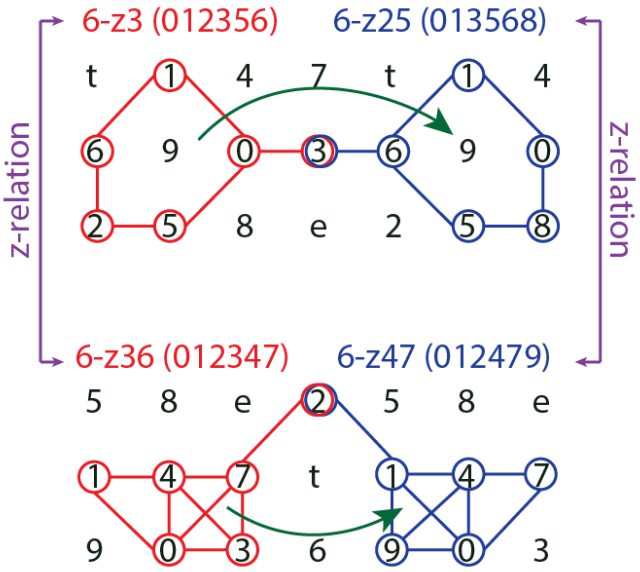

Figure IV-19. Z- and interval-similarity relationship between four hexachords

In Figure IV-19, the two hexachords 6-z3 and 6-z25 are represented as identical geometric shape in reflection. The interval-class 5 in 6- work in such a way that the one geometric shape represents two non-Z-related pitch-z3 is transformed into interval-class 1, thereby generating 6-z25, a hexachord which is *not* in Z-relationship with 6z-3. In the meantime, their Z-related partners also share an identical geometric shape. The main reason why we can

form a complex of two Z-pairs is because the two hexachords involved are complements of each other.[92]

In general, the reflection over the horizontal or vertical axes exchanges the cardinality (i.e., how many times the given interval is contained inside the pitch-class set) of interval-classes 1 and 5. The reflection over the diagonal or antidiagonal axes would exchange the cardinality of interval classes 3 and 4. However, this operation is more prone to inconsistency for two reasons. First, the ordered pitch-class interval 9 will map into the ordered pitch-class interval 12 and vice versa, which ultimately eliminates the interval from the pitch-class set (as shown in the transformation of a fully-diminished seventh chord into an augmented triad in Figure IV-13). This means that when a pitch-class set is represented on the *Tonnetz*, the represented shape should not contain two nodes that are three steps apart horizontally or vertically. Second, the behavior of the line segment V (e.g., the line between C and Bb) is more stable with the vertical/horizontal reflections than diagonal/antidiagonal reflection. As mentioned earlier, V can represent the interval-classes 1, 2, and 5 (Figure IV-14). Upon reflections over vertical and horizontal axes, interval-class 1 can become 5 and vice versa, and interval-class 2 maps onto itself. (Figure IV-20) As a result, reflections of V over the vertical and horizontal axes generate a net effect that is identical to the reflection of the other line segments W, X, Y, and Z: the exchange of cardinality of interval-class 1 and 5. On the other hand, the reflection of V over the diagonal and antidiagonal axes will transform the interval-classes 1 into 2 or 5, 2 into 1 or 5, and 5 into 1 or 2. (Figure IV-21)

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[92] Blau's hexachord theorem proves that any two hexachords that are complements of each other must share the same interval vector (Blau 1999).

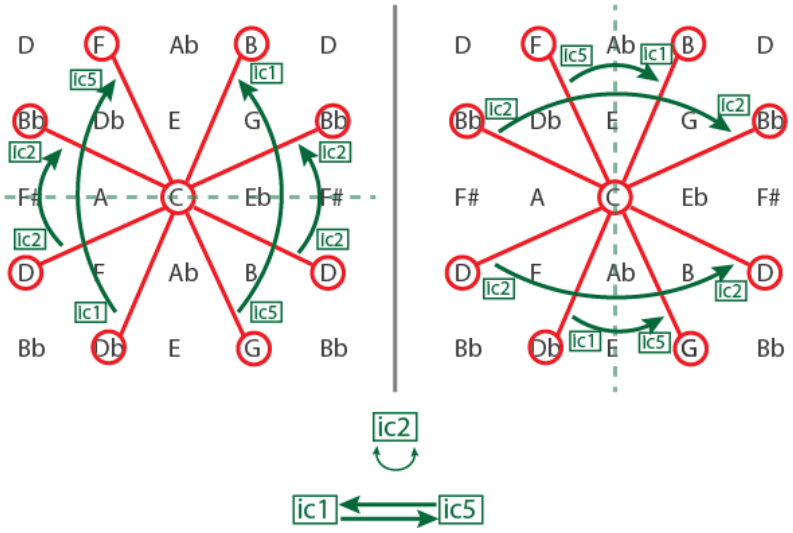

Figure IV-20. "Stable" transformations of V over vertical and horizontal axes

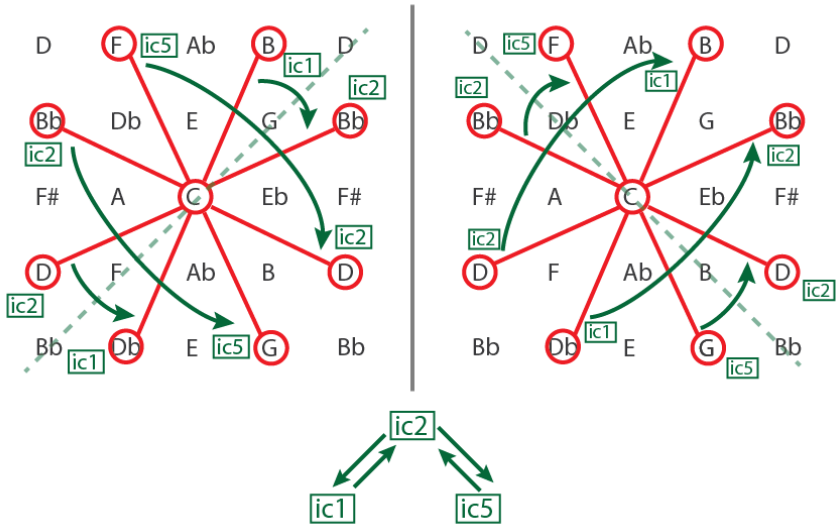

Figure IV-21. "Unstable" transformations of V over diagonal and antidiagonal axes

The resultant transformations therefore interfere with each other because interval-class 2 can be transformed into either interval-class 1 or 5. Therefore, the result of reflection over the diagonal and antidiagonal axes is not always consistent.

4.5. CONCLUSION

What is clear from Strunk's method is that the status of notation cannot be taken for granted. As jazz performance practice considers harmony as a concept that is separate from actual notes that are involved, the one-to-one relationship between notation and sound in conventional music analysis is no longer assumed in jazz analysis. This does not mean that there is some other non-notational visualization that satisfies the one-to-one relationship. Instead, any stable visualization which creates a direct relationship between sound and the representation would go against the underlying principle of the jazz voicing, that is, a chord can be—and ultimately should be—articulated with different notes in order to spontaneously respond to the musical sound of the collaborating musicians or the mood of the performance space. If you hear a live jazz performance being performed the same way over and over again, you would hear it as somehow less sincere and genuine.

Reflecting on Strunk's treatment of the Neo-Riemannian *Tonnetz*, in turn, shows how deeply ingrained the concept of notation is in conventional music analysis. As the analytical tools that are developed within the conventional canon necessitate written notation, the application of these tools in a jazz context is always at the risk of being an analysis of the transcription rather than the analysis of the music. This raises a critical question to all music analysts regardless of their background and interest: how much of our analysis can we call an analysis of the music, and how much can we call an analysis of the notation? Strunk's flexible adaptation of Neo-Riemannian theory and constant consideration for jazz performance practice suggest that analysis, performance, and notation are always in flux creating and re-creating the musical experience as they influence each other. More broadly, Strunk's own thoughts embedded in his analysis force us to rethink the way that particular forms of

notation afford certain analytical normativities. The conventional Neo-Riemannian *Tonnetz* operations, for example, visualize the chromatic mediant relationship; the Strunkian operations visualize the chord progression commonly used in post-bop jazz; my extension of Strunkian operations visualize intervallic relationship between two Z-related (and possibly other) sets; and, finally, notation visualizes sound. As Strunk shows in his adaptation of Neo-Riemannian theory, we music theorists have a duty to critically inspect the foundations of our analytical methods, including those that are rooted in somewhat arbitrary graphisms we adopt to represent music. Strunk might answer the above question regarding analysis, notation, and music with another question: "Aren't they all music?"

CHAPTER V

CLOSING REMARKS

The three chapters of this dissertation cover a vastly long history of Western music theory. This consequently left large gaps of history between each chapter. This, in turn, shows the historical depth of today's music theoretical thinking. Every musical idea, no matter how benign it seems, is constructed through humans' interaction with nature and society. And a musical idea, once constructed, goes through a transformation as the society goes through philosophical, technological, and social change. The fact that we consider certain musical sound to be angelic, demonic, soothing, complex, and so on does not mean that these qualities are within the musical sound but are within our heritage as a social and musical being.

The three main chapters of this dissertation can be summarized as the study of the three essential concepts: spatiality, functionality, and notationality of musical sounds. Of course, there are other essential concepts that form the basis of our understanding of musical sound. For example, there was a definite conceptual shift during Renaissance period when so-called "Arabic numerals" began to spread among the European public—a change that was first instigated by the merchants of Italy. Because music was still largely considered as part of Quadrivium (the study of numbers), the change of conceptualization of number inspired by the new system also changed how musical notes and intervals are conceptualized. I believe that these changes could be clarified by investigating the music theories following this period (such as Nicola Vicentino's *L'Antica Musica Ridotta alla Moderna Prattica*, 1555 and Vincenzo Galilei's *Dialogo della Musica Antica et Musica Moderna*, 1581). Likewise, as we continue our investigation into the historical dimensions of the essential musical concepts,

we will discover even more seemingly primordial assumptions that we bring when we listen to music. Moreover, the historical dimensions of these assumptions will show that any musical meaning that we construct, no matter how personal or empirical it may seem, has within itself the embedded historicity. Musical ideas, in this context, become an engraving surface for an ideology that reflects the society, philosophy, and technology of the time.

In each chapter, I investigated how some of the most fundamental musical ideas were constructed and how these process of construction absorbed the ideologies of the historical periods in question. In the chapter on spatiality, I showed how the Western world developed its distinct conceptualization of musical sound as an entity in space that is capable of being located "high" or "low" and move "up" or "down." I investigate the early stages of this formation: (1) institution of numerical basis of sound by Pythagorean-Platonic ontology, (2) Aristoxenian introspection of sound as an entity in its own right independent from words and number, (3) combination of these two philosophical strands with the introduction of the Greek monochord, (4) the physical experience of shifting the bridge of the monochord and its influence on the reconceptualization of musical motion as change of quantity into change of location—this is my central claim, and (5) the emergence of the underlying space as a by-product of this reimagined musical motion. From these steps, I argue that the Western spatial organization of music is not the *a priori* mode of understanding music, but a historically constructed idea. This assumption of the spatiality of music is often too uncritically accepted by the academic community. Even some recent research publication that claims to be an empirical study of perception takes the spatiality of musical sound as universal for all human perception. The uncritical adaptation of spatiality of music will not

only lead to the false data, but it will also place what is the particularly Western mode of conceptualizing as the norm—a potentially devastating political claim about music.

In the chapter on functionality, I showed how the Western world developed its distinct conceptualization of musical form and function. Here, I presented the historical construction of the notion that a musical element has a purpose (i.e., a function) as constituents of a musical work. To show that the adaptation of functionality in music has its basis on the mode of thinking newly emerged along the industrial production, I discussed that: (1) function is not inherent in the object, (2) recognition of function is only possible when the identity of the object is previously recognized, (3) the function and identity were originally merged as one unified concept, (4) the separation emerged as Roman numeral system was implemented as a primary systems for chordal identification, (5) between function and identity, the function became the primary avenue to the understanding of a musical work, (6) it is because musical work is metaphorically conceptualized as an industrial product—this is my central claim, and (7) all other abstract conceptualization of organic structure models after our understanding of an industrial product. From these steps, I argue that our extensive analysis of the function of musical objects only partially explains the musical work. Moreover, since the function of a chord is defined according to the horizontal motion of the chordal root, the root-motion takes the place for the essential event. All other musical behaviors are considered as subsidiary and elaborative. Our preoccupation on the functionality—which perpetuates itself as we live in the industrial society—often leads to a false characterization of musical work. In particular, some people's prejudice towards the musical work that does not involve functional motion of the chordal root as a work with less

value or a "garbage" has its basis on the assumption that function is intrinsically tied to value-creation.

In the chapter on notationality of musical sound, I showed how modern configurations of musical space assume staff notation as the *a priori* basis for musical sound. I did this by close-reading Strunk's implementation of Neo-Riemannian *Tonnetz*. Strunk, as a theorist sensitive to jazz tradition, began his analysis of Wayne Shorter's *Yes and No* by compiling various written and recorded sources. This is an analytical step unique in jazz analysis because of the nature of a work-concept of jazz music. A theorist must begin by transcribing the audible into the visible. By doing so, I argue that, Strunk's (and possibly all other jazz music theorists') relationship with music staff notation is rendered arbitrary as any other method of representation. This enabled him to reimagine the Neo-Riemannian *Tonnetz* as an operational surface. Contrast to the conventional use where the Neo-Riemannian operations are performed on a staff and represented on a *Tonnetz*, Strunk performs the operations directly on a *Tonnetz* thereby establishing a new connection between two pitch-class sets. Strunk's treatment of a *Tonnetz* and a staff notation raises a critical question on the field of music theory. Is music analysis possible without notation?

In today's system, musical sound is only analyzable when it is converted from sonic to visual entity. To take Riemann's position, to analyze music is perhaps to visualize sound. Hyer summarizes Riemann's position that "the decisive factor in the cognition of music—the moment music comes alive—is visual rather than aural" (Hyer 1995, 104). By investigating Strunk's distinct departure from the conventional use of the Neo-Riemannian operations, I problematized the methodology of conventional Neo-Riemannian graphisms. No matter how elaborate the geometric configurations may seem, their theoretical

foundation is grounded on the system of staff notation. Treating such configurations as if they are founded on the empirical reality of musical sound will, therefore, ultimately lead to a labyrinth of arbitrary signification without a pathway leading back to the experience of music. The so-called "geometry of music" (Tymoczko 2011), therefore, may not be music theory *per se* but the theory of staff notation.

In future research, I hope to investigate how music was conceptualized in East Asia prior to the introduction of Western music. This project is particularly interesting because the musical time progresses from top to bottom in the traditional musical notation of China and Korea. This, I hypothesize, is due to the use of bamboo as a writing surface in ancient China. Similar to how the writing practice of the ancient Greeks shaped the way music was originally notated, the vertical orientation of bamboo not only determined how music was notated in East Asia, but also how music is conceptualized. I believe that this conceptual origin of music, which is based on bamboo's one-dimensional surface, eventually resulted in largely monophonic textures of the court music of China and Korea. As one section of bamboo only allows for the writing of one Chinese character, the juxtaposition of two or more musical notes would require an institution of a more complex apparatus of notation. This project will not only provide conceptual framework of East Asian music, but also establish a firm point of comparison for my investigation of Greek music theory. The fact that prior to the popularity of the monochord, the early Greek music theory relied heavily on wind instruments such as aulos and the fact that early Greek music notation used discrete

characters similar to the traditional East Asian music notation seem to suggest that comparing the two cultures will show deeper understanding of both.

As a historian of music theory, I believe that music is a way into understanding the ideology of the society in which it is produced. In this project, I seek to uncover how society shapes the way we think about music. Growing interest on critical theory in music theory and musicology shows that the field of music theory is ripe for a project like this. By focusing on the historical formation of the elemental concepts of the Western musical thinking, I was able to investigate the social conditions that incubated the ways the Western world thinks about music. This investigation will prove that the practice of music, no matter how distant it seems from social conditions, is in a discursive relationship with society and the development of science and technology.

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