INTERSECTIONS OF MUSIC THEORY, PHILOSOPHY, AND PHYSICS IN *FIN-DE-SIÈCLE* VIENNA

by

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THESIS ABSTRACT

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This thesis is an interdisciplinary study to compare the simultaneous "revolutions" in music theory and physics during the early decades of 20th-century Vienna.

In my first case study, I situate music theorist Heinrich Schenker alongside physicist and philosopher of science Ernst Mach. Motivated by a postcard correspondence between them, I investigate their mutual involvement with the Philosophical Society of Vienna. Additionally, I read two essays—Schenker's "The Spirit of Musical Technique" and Mach's "On the Principle of Comparison in Physics"—and find shared emphases on communication and language, memory and psychology, the concept of "Spirit," and descriptions and formalism.

In my second case study, I investigate the parallel emergence of atonality in music and quantum theory in physics. I identify Kant's concepts of *Anschauung* [Intuition] and *Anschaulichkeit* [Visualizability or Intelligibility] in Schoenberg's twelve-tone composition method and Schrödinger's wave mechanics. Additionally, I emphasize the integral role of language in these developments.

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I. INTRODUCTION

It was the early decades of a new century in the vibrant, expanding city of Vienna. Arnold Schoenberg was perfecting his dodecaphonic style of composition, and had recently published his *Harmonielehre*, one of the most important music-theoretical treatises of the past century. Heinrich Schenker was dutifully studying the *Meisterwerke* (Masterworks) of tonal music, having published the second volume of his *Kontrapunkt* (Counterpoint) series, and begun to see the early stages of his *Ursatz*-based analytical technique come to fruition.[1] Meanwhile, in the world of physics, Erwin Schrödinger was proposing his theoretical model of wave mechanics to describe subatomic behavior—behavior that would directly challenge previous intuitions about the microscopic realm of Nature. And Ernst Mach—whose vast array of advancements in physics, physiology, and psychology laid the epistemological foundation for modern science—had accepted a new position of chair for the history and philosophy of the inductive sciences at the University of Vienna. Although seemingly unrelated, this collection of thinkers had more in common than one would assume—musicians and physicists were on the brink of fundamental shifts in their disciplines. New problems arose that seemed unsolvable without the adoption of an entirely new framework for thinking about the world. As a result, many sought to cut ties with the past to embrace the implications of a modern worldview.[2]

[1] Schenker's *Ursatz* (often translated as "fundamental structure") describes a structure of a tonal piece in its most abstract (or "background") form. The *Ursatz* is a basic elaboration of the tonic triad that consists of a fundamental melodic line accompanied by a bass arpeggiation; this basic structure is unfolded through elaborations by the composers throughout the piece.

[2] Historian Carl E. Schorske expands on this: "Modern architecture, modern music, modern science—all these have defined themselves not so much out of the past, indeed scarcely against the past, but detached from it in a new, autonomous cultural space. The modern mind grew indifferent to history, for history, conceived as a continuous nourishing tradition, became useless to its projects. […] The very process of modernization in the economy and society of the nineteenth century, with the unprecedented effects of

The interwar period in Vienna was fraught with uncertainty, instability, and rapid change. The Viennese were socially and politically factious, yet united by a well-established *bourgeoise* culture.[3] Constituents collectively shared in the benefits of frequent ideological exchange, whether at the local *Kaffeehaus* or as part of the newest informal philosophical society.[4] The young generation (often referred to as "*Die Jungen*") became progressively radicalized as these young people (many of whom were students at the University of Vienna) began to witness repeated failures of liberal policies and initiatives.[5] Artists of the so-called Secession[6] pushed the limits of acceptability and appropriateness, "seceding" from artistic conventions of decades prior in order to "[throw] off the veil of sublimation to express unmediated a raw and febrile existential truth that honored no cultural convention."[7] Witnessing the consequences turbulent time

industrial technology on land and people, paradoxically evoked this quickened quest for ties to the past. In an era of growing nationalism, collective identities were redefined as a summa of the convergent cultures of the past. The architecture of cities appropriated the styles of bygone times to lend symbolic weight and pedigree to modern building types from railway stations and banks to houses of parliament and city halls. The cultures of the past provided the decent drapery to clothe the nakedness of modern utility. Historicism in culture arose as a way of coming to grips with modernization by marshaling the resources of the past." In *Thinking with History: Explorations in the Passage to Modernism* (Princeton: Princeton University Press, 1998): 4.

[3] From Schorske, *Fin-de-siècle Vienna*, xxvi: "A general and rather sudden transformation of thought and values among the culture-makers suggested, rather, a shared social experience that compelled rethinking. In the Viennese case, a highly compacted political and social development provided this context."

[4] Ibid., xxvii: "In Vienna, by contrast, until about 1900, the cohesiveness of the whole elite was string. The salon and the café retained their vitality as institutions where intellectuals of different kinds shared ideas and values with each other and still mingled with a business and professional elite proud of its general education and artistic culture."

[5] From Schorske, *Thinking with History*, 143: "The failure in four different arenas, then – national unity, social justice, economic prosperity, and public morality – converged in the early seventies to produce a deep crisis of confidence in liberalism before it had had the chance to stabilize its newly won power. University youth, in anger and frustration at the comprehensiveness of liberalism's failure, sought not only a new politics but also new philosophic and cultural premises to replace the juridical rationalism of their fathers."

[6] The Secession—as its name implies—refers to a specific collection of modern artists who removed themselves from support of official institutional art or its administrators in the early 20th century. Schorske writes, "Artists who in the 1890's, under the name of 'Secession,' had engaged in a dynamic search for new instinctual truth, now turned away from their unsettling findings to the more modest and profitable task of beautifying daily life and the domestic environment of the elite." See Schorske, *Fin-de-siècle Vienna*, 325.

[7] Schorske, *Thinking with History*, 136.

characterized by intense contradictions, Austrians "engaged in critical reformulations or subversive transformations of their traditions that their own society perceived as radically new if not indeed revolutionary."[8] It was in this Vienna that Heinrich Schenker and Arnold Schoenberg developed their theories of music, formulating ideas, analyses, and compositions that would come to shape the discipline of music theory, and it was this Vienna in which Ernst Mach and later Erwin Schrödinger cultivated their ideas that would determine the course of modern physics from that point onward.[9]

The effects of modernization caused a strong desire to cut ties with the past, but the "revolutionary" thinkers and artists of this time and place had been originally immersed in tradition. In his book *Thinking with History: Explorations in the Passage to Modernism*, historian Carl E. Schorske writes:

> *There was no sudden leap out of history into modernism here. Rather the cultural innovators were in continuous dialogue with a present that was still tradition-laden. They were themselves engaged in transforming their cultural legacies as much as rejecting them.* Indeed, some of the most self-consciously radical creators of the "New" culture—such as Adolf Loos in architecture or Arnold Schoenberg in music—would temper their break from the past with claims of attachment to some aspect of tradition even as they shook its systemic foundations [emphasis mine].[10]

It is an attractive historical narrative to characterize bold ideas as emerging suddenly from seemingly out-of-the-blue. Schoenberg's foray beyond the limitations of classical harmony is especially susceptible to this view—after all, on first listen, it doesn't sound much like anything comprehensible, nor like anything that had come out of the Viennese

[8] Schorske, *Fin-de-siècle Vienna*, xxvi.
[9] For an interesting comparison between Schenker and Schoenberg in this shared historical context, see Matthew Arndt, "Schenker and Schoenberg on the Eye of the Genius," *Theoria: Historical Aspects of Music Theory* 20 (2013): 39–120.
[10] Schorske, *Thinking with History*, 11.

artistic culture before him. Nevertheless, as radical as Schoenberg's later compositions may have seemed, he adamantly maintained his place within the lineage of classical composers who came before him. Schoenberg certainly recognizes the work of those before him, but the narrative of a single lineage that shapes Western musical practice is too simplistic, and therefore, proves problematic.

Throughout this thesis, I draw from a particular framework that challenges the notion of the individual revolutionary—and, indeed, the concept of revolution itself: Thomas Kuhn's model of ideological revolutions in the sciences. Kuhn was a notable physicist and historian of science, whose seminal work, *The Structure of Scientific Revolutions*, provided a model of scientific progress that was itself—quite ironically—revolutionary.[11] The cycle of paradigm-shifting is based around periods of *normal science*, in which scientists operate within a particular *paradigm* that dictates their assumptions about the science they undertake. Limitations of the governing paradigm are discovered over time, which then leads to a crisis. The crisis can only to be resolved through a *revolution*. This structure is modelled in the figure below:

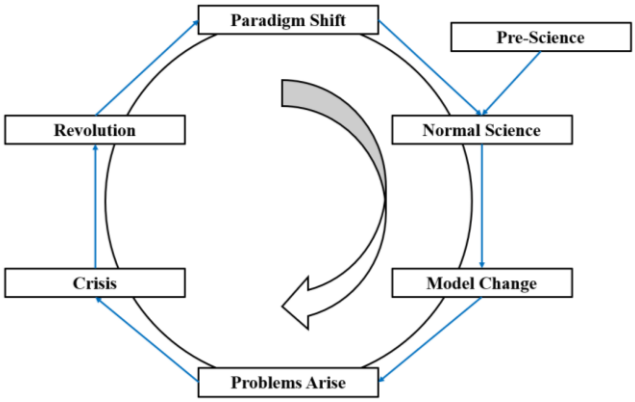

Figure 1. Model of Kuhn's structure of scientific progress.

[11] Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: The University of Chicago Press, 2012).

Kuhn's structure of scientific revolutions has also been applied to tracing the history of revolutions in disciplines outside the realm of science.[12]

I have turned to Kuhn's model in my own research because I am motivated by a desire to understand how ideas can be shared and exchanged across disciplinary, cultural, and linguistic boundaries. At the core of this work is an attempt to highlight the challenges and rewards of interdisciplinary communication and collaboration. Although the pursuits of art and science are characterized by different questions, methodologies, and ways-of-thinking, they are both linguistic tools in a sense: ways of speaking and interpreting the world that can be utilized to better understand aspects of our world and the human experiences beyond the limitations and inconsistencies of word choice. Historian of ideas Isaiah Berlin writes:

> There is no immutable structure of experience, to reflect which a perfect language could be invented, and into which imperfect approximations to such a language could be transposed. The language of so-called primitives is not an imperfect rendering of what later generations will express more accurately: it embodies its own unique vision of the world, which can be grasped, but not translated totally into the language of another culture. One culture is not a less perfect version of another: winter is not a rudimentary spring; summer is not an undeveloped autumn.[13]

Disciplinary boundaries shape the culture of a field; they define the language, vocabulary, and way-of-thinking. Moments of intersection between the arts and sciences demonstrate the importance of seeking understanding between unique visions of the world; they are examples of mutual cultural understanding. It is important to recognize, though, that

[12] For references to Kuhn's structure with regards to the discipline of music theory, see Thomas Christensen, "Music Theory and the Mainstream," *Intégral* 14/15 (2001/2000): 11–14.
[13] Isaiah Berlin, "The Divorce between the Sciences and Humanities," in *Against the Current: Essays in the History of Ideas*, ed. Henry Hardy (Princeton, New Jersey: Princeton University Press, 2013), 136.

disciplinary boundaries are fluid over time. The perceived art-science dichotomy that I've referred to is itself a consequence of a particular time and place: the modern American educational system. Such a division was likely not as stark (or perhaps didn't exist at all) in *fin-de-siècle* Vienna.

In my first case study, "Correspondence Across the Arts and Sciences: Shared Ideas in Schenker's 'Geist' and Mach's 'Vergleichung,'" I situate two influential thinkers side-by-side in their mutual *fin-de-siècle* shared context: Heinrich Schenker and Ernst Mach. I investigate the nature and extent of their interaction, the ideas Schenker voiced to Mach, and the possible reasons that Schenker had been invited to present a lecture on a musical topic at the *Philosophische Gesellschaft an der Universität Wien* (University of Vienna Philosophical Society) in March of 1895, in the midst of presentations in the disciplines of physics and philosophy.[14] In the process, I identify a number of shared themes in these two essays, including: (1) communication and language, (2) psychology and memory, (3) spirit and idealism, and (4) formalism. Although Schenker was concerned with musical problems and Mach with issues in the philosophy of science, they shared similar concerns; in short, they said similar things, but in different ways. Although there is a wealth of "back-to-Vienna" scholarship dedicated to situating Schenker in this time-and-place, my work offers a yet-to-be-undertaken comparison with Mach's writing. Effectively, I imagine a conversation between Schenker, whose music theories would go on to shape the study of music in the United States many years later,

[14] For a complete listing of presentations before the Philosophical Society of Vienna from 188-1936, see J. Blackmore, R. Itagaki, and S. Tanaka, eds., "Chapter Twelve: The University of Vienna Philosophical Society," in *Ernst Mach's Vienna 1895-1930, or Phenomenalism as Philosophy of Science* (Boston, MA: Kluwer Academic Publishers, 2001), 283-298.

and Mach, whose view of science would influence the establishment of the *Wiener Kreis*, as well as countless physicists and philosophers in the decades that followed.

In my second case study, "Beyond the Classical Paradigm: Schoenberg, Schrödinger and the Limitations of Language," I identify commonalities between the crises in music and physics in the early decades of the 20th century, situating Arnold Schoenberg and Erwin Schrödinger at the center of them. In doing so, I investigate how the parallel emergences of post-tonal music and quantum mechanics directly challenged pre-conceived intuitions, and therefore necessitated an expansion of the language of the classical paradigm. Viennese contemporaries Arnold Schoenberg and Erwin Schrödinger are often cast as individual revolutionaries in the respective fields, due to the implications of their contributions in the early 20th century. I challenge this notion, arguing that both Schoenberg and Schrödinger were educated and trained during the height of *fin-de-siècle* aestheticism, and that a mastery of convention contributed to the development of their proposed solutions to the disciplinary problems they and their colleagues faced. I draw on Kant's concepts of *Anschauung* (Intuition) and *Anschaulichkeit* (Visualizability, or Intelligibility) to interrogate Schoenberg's dodecaphonic composition method and Schrödinger's wave mechanics. I also discuss how the limitations of language are a prevalent theme shared between the early modernist crises in music and physics, considering the influential and related philosophical work of Wittgenstein.

What is the motif that weaves this historical narrative as an organic whole? It is a challenge to the often-assumed dichotomous relationship between the arts and sciences, as well as an attempt to highlight the critical role of language in the sharing of ideas. The progression of both music theory and physics in the latter half of the 20th-century was

significantly shaped by ideas produced during and within *fin-de-siècle* Vienna, particularly those of Schenker, Mach, Schoenberg, and Schrödinger. In his book *Fin-de-siècle Vienna: Politics and Culture*—a book that has largely been credited with establishing the discipline of Austrian cultural studies—Carl E. Schorske writes that "historical analysis could at least reveal the characteristics with which history had endowed that culture at its conception and birth. Illuminating the genesis, meaning, and limitations of ideas in their own time, we might better understand the implications and significance of our affinities for them in our time."[15] My attempt to understand two of the most influential music theorists—Heinrich Schenker and Arnold Schoenberg—in their historical-cultural context will hopefully illuminate the rich complexity of their individual contributions and how they may have shaped the music-analytical practices and methods that we use today.

In his book *Music, the Arts, and Ideas: Patterns and Predictions in Twentieth-Century Culture*, musicologist and music theorist Leonard B. Meyer writes:

> What makes historical events more difficult to describe, analyze, and explain is not merely the wealth of potentially pertinent data but the fact that, while the beginning and end of a musical work are decisively marked—by silence—historical events flow into one another, overlap, and coincide without any definitely defining articulation. There is no pause, no silence, in the flow of historical events.[16]

A true measure of wisdom is recognizing relevant lessons of events past; history is a vehicle for charting a dynamic progression of change. *Fin-de-siècle* Vienna was characterized by an exceedingly complex interweaving dialogue of ideological exchange,

[15] Schorske, *Fin-de-siècle Vienna*, xxv.
[16] Leonard B. Meyer, "History, Stasis, and Change," in *Music, the Arts, and Ideas: Patterns and Predictions in Twentieth-Century Culture* (Chicago, IL: University of Chicago Press, 1994), 95.

and this sort of dialogue was necessary for the cultivation and adoption of a changing worldview. I approach this study with a heightened sensitivity to the nuances of interdisciplinarity, as well as an elevated concern for the role of effective communication in fostering mutual understanding.

I hope the reader can come away not only with a new-found appreciation for two harmonious intersections of music theory, philosophy, and physics in *fin-de-siècle* Vienna, but also with a motivation to question any linear, one-dimensional model of change—whether disciplinary, cultural, or linguistic.

II. CASE STUDY ONE

CORRESPONDENCE ACROSS THE ARTS AND SCIENCES:

SHARED IDEAS IN SCHENKER'S "GEIST" AND MACH'S "VERGLEICHUNG"

On February 15, 1895, Heinrich Schenker—a lawyer, University of Vienna alum, and relatively-unknown composer and music critic—presented an essay titled "Der Geist der Musikalischen Technik" ("The Spirit of Musical Technique," henceforth referred to as "Geist"), to the *Philosophische Gesellschaft an der Universität Wien* (University of Vienna Philosophical Society). The Philosophical Society usually hosted hundreds of lectures on topics in philosophy, mathematics, and physics, and attendees enjoyed exposure to the latest, most innovative ideas and ample opportunity to engage in discourse and interactive discussion. Schenker's essay, however, was the first—and only one of few ever—to present and tackle musical questions. His "Geist" essay was scheduled back-to-back with lectures from Alois Höfler, the *Obmann* (leader) of the Society at that time, who led a presentation and discussion of Ernst Mach's lecture "Über das Prinzip der Vergleichung in der Physik" ("On the Principle of Comparison in Physics," henceforth referred to as "Vergleichung"), from his notable collection of *Populär-Wissenschaftliche Vorlesungen* (*Popular Science Lectures*). Mach was a prominent physicist, empirical psychologist, and philosopher of science, whose influence permeated many facets of thought in *fin-de-siècle* Vienna. Over the course of several meetings from December 1894 to March 1895, attendees of the Philosophical Society lectures—presentations that were often addressed to halls of nearly 600 people—were exposed to interweaving ideas and conversation about philosophical propositions in both music and physics.

Of the hundreds of lectures offered by the Philosophical Society of the University of Vienna, Schenker's lecture was one of only a handful solely dedicated to music. Schenker wrote his "Geist" essay early in his career as a music critic, composer, educator, and theorist, and it seems reasonable to wonder why he was invited. Schenker would go on to systematically and fervently study the so-called "masterworks" of tonal music, relentlessly seeking the underlying structures and commonalities that united musical compositions in the Western classical tradition. He would eventually publish several treatises—including the famous *Harmonielehre*, *Kontrapunkt,* and *Der Freie Satz*—outlining his mature theories about music and proposing ideas that would significantly change musical analysis and discourse in Europe and the United States of America. Yet, before any of these later achievements, Schenker was invited to present ideas from his "Geist" essay in front of the Philosophical Society, to a sizeable audience, as the first contributor to discuss musical questions.

In this chapter, I zoom in on this point in history and explore three central questions about Schenker's interaction with Mach and the Philosophical Society of Vienna: (1) Why was Schenker invited to present his essay? (2) To what extent did his ideas in "Geist" compare with Mach's "Vergleichung"? (3) What can a study of Schenker and Mach reveal more broadly about *fin-de-siècle* Vienna and the positive consequences that resulted from sharing, disseminating, and discussing of philosophical concerns from different perspectives? It is my hope that by contextualizing Schenker in this way I can map an acknowledged yet untraversed historical intersection of music theory and the philosophy of science and shed light on the ideological complexity of *fin-de-siècle* Vienna.

I argue that there are deep connections between the shifts in the philosophy of modern science—specifically those catalyzed by Ernst Mach and debated by the Philosophical Society of Vienna—and Heinrich Schenker's early musical thought, and that these connections have not been sufficiently explored. These connections are especially evident in Schenker's "Geist" essay, and can be interrogated alongside Mach's "Vergleichung," just as the Philosophical Society did over a three-months span in 1895. I trace arguments common to both essays, noting Schenker's and Mach's shared emphasis on the importance of language and communication, on the function of memory, on the specific use of the concept of "Geist," and on formalism. I contextualize these similarities by exploring connections to the broader philosophical movement of German Idealism.

I first discuss Schenker's interdisciplinary education in law and music at the University of Vienna, and comment on his approach to music criticism during the establishment of *Musikwissenschaft*. Next, I discuss the establishment of the Philosophical Society of Vienna, and discuss Mach's epistemology and influence; in doing so, I also emphasize the breadth of influence of Mach's ideas on *fin-de-siècle* Viennese. I justify this claim by examining correspondences between Schenker, Mach, and several common associations between them. Lastly, I read "Geist" and "Vergleichung" side by side, and offer a comparison through the aforementioned lenses.

Schenker, Law, and Musikwissenschaft at the University of Vienna

Schenker's well-rounded, interdisciplinary education, covering both law and music, was formative for his development as a music critic and for constructing a foundation on which he could later tackle philosophical questions in music. Schenker

studied law at the University of Vienna from 1884 to 1888 and received his Doctor of Jurisprudence degree in 1890. In Europe in the late 1800s, legal study was central to a liberal education, and law students would typically be exposed to a range of subjects in their coursework, such as philosophy, finances, history, and economics. Music theorist Nicholas Cook writes that Schenker's legal studies offer an informative lens through which we can understand "the comprehensiveness of Schenker's thinking together of the musical and the social."[17] Both Cook and Robert Morgan recognize similar themes evident throughout Schenker's legal education—issues of state and individual, whole and part, and center and periphery—and contextualize them with respect to the other important identity-factors in Schenker's life, for example, his experience as an immigrant assimilating to Viennese culture.[18]

Wayne Alpern offers a lengthy discussion and analysis of Schenker's legal studies, particularly exploring the influences of Georg Jellinek, his most prominent law professor. Alpern interrogates Schenker's writing style from a legal perspective, noting that "Schenker's literary style has a lawyerly flair, bristling with the tenor of musical advocacy. He mercilessly cross-examines his adversaries like hostile witnesses on the stand, demolishing their testimony one by one."[19] Although Schenker had specialized in

[17] Nicholas Cook, *The Schenker Project: Culture, Race, and Music Theory in Fin-de-Siècle Vienna* (New York: Oxford University Press, 2007), 14.
[18] Robert Morgan elaborates on the relevance of Schenker's law education: "The fact that Schenker studied law was thus clearly important in the formulation of his musical theory. Yet the law of Schenker's time shared many basic assumptions with other disciplines and formed but one part of a larger intellectual mix. Many of the most critical legal ideas – for example, the significance of human interaction, a balance between unity and diversity, the interrelationship of parts within a collective whole, a belief in teleological historical development, and a single cause behind all events – had their source in the overall intellectual tradition of his time." In Robert P. Morgan, *Becoming Heinrich Schenker: Music Theory and Ideology* (Cambridge: Cambridge University Press, 2014), 5.
[19] Wayne Alpern, "Music Theory as a Mode of Law: The Case of Heinrich Schenker, Esq.," *Cardozo Law Review* 20 (1999): 1464.

legal philosophy, his four years of success through a variety of coursework—Roman Law, Criminal Law, International Law, Administrative Law, etc.—would encourage him to practice making well-structured—and convincing—justifications for his ideas, a skill that almost certainly contributed to his success as a music critic and theorist. Alpern emphasizes the importance of further investigation into these overlaps, as "the value of any intellectual congruence, in this regard, is not dependent upon any precise mapping or demonstrable causal connection; Schenker's legal education, like other early training, may have had a subtle if not direct influence upon his subsequent mode of thought."[20]

Beginning in 1887, and in the midst of his later years at the University of Vienna, Schenker was also enrolled at the Vienna Conservatory. He studied piano with Ernst Ludwig, harmony with Anton Bruckner, and counterpoint with Johann Neopmuk Fuchs. Morgan notes that Schenker "was [always] an outsider to the Viennese musical establishment," which may have contributed to his decision to withdraw from Conservatory without a certificate in order to pursue a freelance career as a music critic and composer.[21] As Schenker began to publish reviews of compositions and performances, with some of his earliest included in the Leipzig-based *Musikalisches Wochenblatt*, Berlin *Die Zukunft*, and *Viennese Neue Revue* and *Die Zeit*—his critical view of art was shaped over time by a scientific aura permeating musicology and music analysis near the turn-of-the-century.

Around the same time that Schenker was enrolled at the University of Vienna, the university began to see pressure from the Austrian government to allocate more resources to support scientific endeavors. Historical musicologists, consequentially, began to

[20] Ibid., 1467.
[21] Morgan, *Becoming Heinrich Schenker*, 6.

recognize the emergence of *Musikwissenschaft*, also as a result of Guido Adler's advocacy work. As Kevin Karnes writes "[Adler] would polemicize tirelessly on behalf of a scientific approach to music research and do whatever he could to galvanize those members of the musicological community who shared his views and concerns."[22] Adler believed that the purpose of *Musikwissenschaft* was to uncover objectively verifiable laws that govern the evolution of musical forms and styles, outlining a purposefully disengaged perspective of music analysis and discourse; music critic Eduard Hanslick, who will be discussed later, also shared this view.

Schenker, however, did not share Adler's views. This is evident from his first published article: an analytical review of Brahms's Op. 107 songs that appeared in the *Musikalisches Wochenblatt* in 1891. Analytical essays were a staple of the *Musikalisches Wochenblatt* feuilleton, and Schenker's choice to employ analytical tools as part of his music criticism would have been common practice. Schenker's aversion to and skepticism of the modernist wave of scientifically-inspired studies of music was clearly evident; as Karnes writes:

> The mode of analysis that Schenker espoused could hardly have been more different from the 'scientific' one that Adler prescribed. At a time when approaches such as those he would advocate were widely decided as hopelessly unscientific, Schenker held that there existed no better means than hermeneutic analysis to account for the impact of a musical work upon the mind of a listener. And it was precisely that impact, he insisted, rather than the dispassionate study of music's formal or stylistic development, that made the experience of music meaningful to a multitude of late-century listeners.[23]

[22] Kevin Karnes, *Music, Criticism, and the Challenge of History: Shaping Modern Musical Thought in Late Nineteenth-Century Vienna* (New York: Oxford University Press, 2008), 40.
[23] Karnes, *Music, Criticism, and the Challenge of History*, 82.

Indeed, Schenker's entry into the critical arena was prompted, at least in part, by his conviction that if music criticism were to retain a meaningful place in an increasingly rationalistic culture, critics would need to greet with skepticism calls to emulate the methods of the natural sciences in their work. The critic, Schenker held, must embrace subjective impression, indulge the hermeneutic impulse, and even probe the depths of the creative mind in his attempts to elucidate the effectiveness and work of the artworks he considers.[24]

By focusing specifically on the creative process, Schenker hoped to explore the realm of what constituted a "genius" composer. Was there evidence in the music itself that would suggest commonalities among these composers' approaches to the art? For Schenker, music criticism was about interrogating the *effectiveness* of the music by focusing on how a performance was experienced and understood by the listener. The listener becomes a necessary agent in what is to be deemed "musical." Disregarding listener subjectivity in favor of a detached, scientific methodology ignores the notion of music as a mechanism for communication; meaning is not often derived from grammar alone.

This emerging methodological divide in Viennese historical musicology near the turn of the century can be viewed as a reflection of the broader challenges that German idealist thought sought to reconcile. As a consequence of increasing modernity, people tended to lose their individual senses of belonging, as a participant connected to an inclusive and all-encompassing whole. Technological advances subordinated Nature to the effects of scientific analysis; consequently, the gap widened between people and their

[24] Ibid., 107–108.

access to—and subjective understanding of—the natural world.[25] The shifting relationship between the "objective" and the "subjective" caused a host of philosophers to interrogate the limits of such approaches, and we will explore one important interpretation of this philosophy later through Schenker's "Geist." Adler's *Musikwissenschaft* and Schenker's hermeneutics represent the dichotomous relationship between objectivity and subjectivity, and this aspect of music theory and analysis has been debated over the course of its history.

Schenker's early views on music criticism seem to contrast sharply with his later, "mature" theories sketching underlying formal structures that unite a composition at the background, middleground, and foreground levels. Karnes recognizes this significant switch in Schenker's musical thought, which seems to have occurred in the late 1890s, post-"Geist."[26] Schenker would later embrace the idea that theoretical structures were inherent in the "Masterworks," and the pervasiveness of such structures not only reflected the genius quality of the composer himself, but alluded to the existence of natural laws of music beyond the composer's individual conscious creativity. Schenker's dynamic music-theoretic evolution is worth exploring for this reason, as we can be reminded that ideas are a consequence of their time and culture and should be interrogated as such.

In sum, Schenker's interdisciplinary legal and music education at the University of Vienna and Vienna Conservatory fostered his growth as a critical thinker, writer, and music critic. His experience in law encouraged his later efforts to seek structure and rules

[25] Andrew Bowie, *German Philosophy: A Very Short Introduction* (New York, NY: Oxford University Press, 2010), 35.
[26] Karnes elaborates further: "And before long, [Schenker] would turn his back on his youthful experiments altogether, rejecting hermeneutic analysis as a critical tool and coming to embrace an empiricist ideal of music research before the end of the decade." *Music, Criticism, and the Challenge of History*, 82.

in music, all the while affording an opportunity for him to be exposed to a range of new ideas and philosophy; Alpern writes, "he portrays music as a complex body of acoustical legislation, replete with statutes, regulations, and ordinances governing different hierarchical levels of jurisdiction."[27] He then pursued music criticism during a crucial shift in the field of musicology, as the discipline was moving to embrace scientific methodology and practices. He was intertwined with this shift, as well as the influx of positivist thought more generally. Of course, there are many lenses through which to view Schenker, and many paths by which to trace a narrative about how he came to develop his music theories. However, it is especially valuable to consider this scientific shift in music scholarship during the same time, for Schenker's relationship to Mach and others still have yet to be explored from this perspective.

Interlude: Music Theory and the Challenge of History

As scholars of history we have a responsibility to adopt a heightened awareness of the narrative we craft, and practice a particular sensitivity to possible messages or implications underlying our rhetoric. Under the heading "Schenker's Revolution," Robert Morgan writes:

> …scientific development is oversimplified when viewed solely in terms of the 'great individuals' who shaped it. Advances did not come about simply because occasional thinkers with special ability produced epoch-making changes. […] Can something similar be said of Schenker? Certainly, he did not develop in a theoretical vacuum, for his work owes much to well-established theoretical conventions. In his case, however, I think the answer must be negative. Despite Schenker's widely shared intellectual background, his musical theory depends upon numerous principles that are

[27] Alpern, "Music Theory as a Mode of Law," 1463.

> fundamentally different in both general conception and procedure from those preceding it.[28]

In this excerpt, Morgan argues—correctly, I believe—that it is a debilitating disservice to the progression of scientific endeavors to perpetuate a narrative that outlines our most important scientific discoveries and achievements as wholly credited to a series of lone-genius agents (usually white men). In a Kuhnian manner, his subsequent acknowledgement that paradigm shifts are not catalyzed by a singular revolutionary represents a strongly-defended structural model of the history of science.

However, despite acknowledging the obvious—that Schenker did not (as no one does) develop in a theoretical vacuum, and that he was well-versed in a variety of intellectual pursuits—Morgan concludes that Schenker was immune to this model of history. Schenker was, nonetheless, a revolutionary on his own terms, a theorist who "defended his right to state his opinions in whatever manner he wished," and someone who, miraculously, overcame societal and ideological pressures to put forth an entirely unique music theory can only be credited to him and him alone.[29] Morgan takes it further:

> It thus seems highly unlikely that Schenker's mature theory, given his intellectual environment, would have emerged without him, in the way that Darwinian theory might have done in the absence of Darwin himself. This is not to claim that Schenker had no forerunners, but only that the particular musical solutions he confronted – the concepts of large-scale reduction, prolongation, and graphic representation – were largely unprecedented. Even if a similar music theory might eventually have appeared, it is difficult to imagine anything like it emerging until well after World War II, thus well after Schenker's death.[30]

[28] Morgan, *Becoming Heinrich Schenker*, 9–10.
[29] Morgan, *Becoming Heinrich Schenker*, 8.
[30] Ibid., 10.

Again, despite acknowledging that Schenker was operating within an active, challenging academic environment, enjoying frequent access to ground-breaking ideas and philosophical discourse, Morgan sticks by his narrative of Schenker as a lone-genius agent. Morgan offers little evidence for this view, especially considering his frequent reminders about the complexity and intricacies of Schenker's intellectual interests and pursuits.

To paint Schenker as a hero who conquered mountainous music-theoretic problems alone is to downplay the importance of ideas that shaped his thinking in complex ways. To assert that Schenker was immune to the influences around him implies that he possessed a super-human, even god-like, nature. If, instead, we examine the depths of his interactions within *fin-de-siècle* Vienna, his multi-faceted intellectual curiosity, the unexplored influences on his music theories, and the permeating influence of his ideas on music scholarship in the United States, we can treat him for what he was: a *human being*.

Ernst Mach and the Philosophical Society of Vienna

As I have suggested in the introduction to this chapter, *fin-de-siècle* Vienna was a unique and influential time and place for the unprecedented development of ideas, and scholars today still wonder what combination of cultural factors allowed for such a fervent culture of free and open ideological exchange. In his article "*Fin-de-siècle* Austrian thought and the rise of scientific philosophy," philosopher Dale Jacquette asks, "why did Austrian philosophy blossom with such opulence, and what can we learn from its successes, if we hope in the future elsewhere to duplicate its contributions to the

world's intellectual heritage?"[31] In this section, I address Jacquette's question by discussing Ernst Mach's activity and participation in the Society, and discuss his broadly influential epistemology of modern empiricism.

The Philosophical Society of Vienna provides an important case study for investigating the role that informal philosophical circles played in contributing to rampant ideological exchange within turn-of-the-century Vienna. Established in 1888 by a motivated group of Franz Brentano's students, the Society became the "centerpiece of reflective Vienna," hosting over 600 conferences and discussions throughout its decades-long tenure.[32] At its establishment, the Society boasted nearly sixty paying members, which later maximized to 217 twenty years later.[33] The Society brought together participants from both inside and outside philosophy, curious minds from many disciplines and pursuits, with discussions that "were dedicated to the free exchange of ideas on all sorts of contentious philosophical problems."[34]

Franz Brentano was a charismatic leader in *fin-de-siècle* Vienna academia. His students, who established the Society, shared his belief that scientific psychology was on its way to replacing philosophy in the pursuit to understanding the nature of knowledge acquisition.[35] Brentano himself gave the first official lecture to the Society, titled "Methods of Historical Investigation in Philosophical Fields" on April 27, 1888.[36] In its

[31] Dale Jacquette, "Fin de Siècle Austrian Thought and the Rise of Scientific Philosophy," *History of European Ideas* 27, no. 3 (2001): 308.
[32] Blackmore, Itagaki, and Tanaka, "Chapter Twelve: The University of Vienna Philosophical Society," 277.
[33] Ibid., 278.
[34] Denis Fisette, "Austrian Philosophy and Its Institutions: Remarks on the Philosophical Society of the University of Vienna (1888–1938)," in *Mind, Values, Metaphysics*, ed. Anne Reboul (Switzerland: Springer International Publishing, 2014), 9.
[35] Blackmore, "Chapter Twelve: The University of Vienna Philosophical Society," *Ernst Mach's Vienna*, 279.
[36] Ibid., 283.

infancy, the Society's philosophical motivations reflected a broader shift towards modernism and away from German Idealism, as participants embraced logical positivism—a branch of empiricist thought of which Mach is often cited as founder—and debated questions spanning a broad range of disciplines.

One particularly important quality of the Philosophical Society's meetings was the interdisciplinary nature of its lectures and discussions. The controversial topics—such as "Does Ethics Depend on Metaphysics?," "On the Crisis of Darwinism," and "Are There New Proofs of the Existence of God?"—coupled with ample opportunity for discussion, allowed participants to engage with a broad range of new ideas in the context of seemingly unrelated ones.[37] (An example of this, which I will investigate later, is the side-by-side presentation of Mach's lecture "Vergleichung" with Schenker's "On Geist.") The Society can be regarded as a "privileged witness" to ground-breaking evolutions in the history of both sciences and arts, and understanding its role in the *fin-de-siècle* intellectual movement is imperative to our discussion of Schenker and Mach.[38]

The Philosophical Society's encouragement of interdisciplinarity reflected, in some sense, the macrocosm of Vienna's international and diverse population. Jacquette writes, "it has sometimes been said that the sheer effort of accommodating so many peoples of distinctive ethnic backgrounds promoted nonsecretarian kinds of intellectual development, caused them to look beyond their own borders and strive for a truly international philosophical methodology."[39] In this Vienna, the expanding international population provided easy access to many different perspectives and worldviews.

[37] Ibid., 280.
[38] Fisette, "Austrian Philosophy and Its Institutions," 31.
[39] Jacquette, "Fin de Siècle Austrian Thought and the Rise of Scientific Philosophy," 311.

Ernst Mach was an incredibly influential physicist, empirical psychologist, and thinker, whose work before the turn of the century would challenge fundamental conceptions about the nature of science, inspire debates about the limitations of language, and lay the foundation for the discipline of the philosophy of science. His lifelong work was motivated by his dual interest in experimental physics and sense physiology, studies that he initially undertook at the University of Vienna from 1855 to 1859. From 1864 to 1867, Mach was appointed first as a Professor of Mathematics, then Professor of Physics at the University of Graz. He later returned to Vienna, appointed Professor of History and Philosophy of the Inductive Sciences in 1895, just as the Philosophical Society was thriving (and had already presented a few of Mach's lectures). Mach's scientific contributions include, but are not limited to, his Mach bands, early suggestions of *Gestalt* phenomena, explanation of the equilibrium function of the ear, Mach number (relationship of speed of travelling object to the speed of sound), and discoveries in empirical psychology and tone perception alongside Hermann von Helmholtz.

Mach wrote extensively on philosophical issues (initially inspired by his accidental early discovery of Kant's *Prolegomena*), and his philosophy of science was controversial to say the least. He is normally regarded as a *phenomenalist*, and his scientific conception can be summarized as such: the world consists of sensations ("elements"), and through experiencing sensations, scientists develop descriptions about the world. Proper science asserts only that for which there is evidence, and we are limited fully to our bodily sensations as the source of such evidence. Mach asserted a principal of *Denkökonomie*, or "economy of thought," that stressed the scientific method as objective, leading to fundamentally subjective conclusions. For Mach, science attempts to "to

provide descriptions of the 'elements' in a language of functional dependence, economically, comprehensively, simply."[40] He concluded that "science is not an attempt to understand the world as it is but only to describe the world as we experience it; and epistemology, to be scientific, must likewise be not an attempt to understand the phenomenon of science but only a description of it."[41]

Many aspects of "Machism" were rejected by other ideological movements in Austria and Germany during that time. Famously, Mach did not subscribe to the new theory of atoms and was reluctant to accept Einstein's theory of relativity. (Despite initial enthusiasm, Einstein himself later denounced Mach's conception of science.) However, his ideas were largely incorporated into the fundamental discourse of the Vienna Circle—an informal group of mathematicians and philosophers during the 1920s—and are regarded as having established the trend of Logical Positivism.[42] Mach became well-known throughout Europe and America the republications of his books. His writing was widely regarded to be more accessible than other philosophers of his time, as it was free from jargon and, therefore, more easily understood by non-philosophers and even non-native German speakers. As we can see, effective communication played a significant role in the dissemination of Mach's epistemology, and thus contributed to his wide-spread influence, particularly within *fin-de-siècle* Vienna and the Philosophical Society.

[40] Robert S. Cohen, "Ernst Mach: Physics, Perception and the Philosophy of Science," *Synthese* 18, no. 2/3 (1968): 134.
[41] Ibid., 138.
[42] Logical Positivism—developed by the Vienna Circle and in part inspired from the work of Ernst Mach—is an ideology centered around the claim that the only meaningful statements are ones that can be empirically verified. From Mach's philosophy of science, they held that sensory experience is the root of basic science; we are limited to verification via our own senses and perceptions. Logical positivists would consider things unobservable—take atoms, for example—to be a metaphorical or abstract description of something we experience directly.

Mach corresponded with many of the most active leaders of the Society, including Franz Brentano, Ludwig Boltzmann, Christian Freiherr von Ehrenfels, Alois Höfler, Friedrich Jodl, and Otto Neurath, to name a few. His influence ranged widely, including in philosophy, psychology, physics, Gestalt theory, pedagogy, and physiology. When Mach later left Vienna for Prague, he remained a corresponding member to the Society because, according to Blackmore, "he knew where the action was."[43] Blackmore's historical record of the Philosophical Society lectures show that the highest number of discussion sections were devoted to "Mach's lecture: On Comparison in Physics" from 1894 to 1895, and "On Mach's Inertial & Philosophical Views" from 1916 to 1917 (four sessions).[44] His ideas were indeed in the air, and, as we will investigate later, overlapped Schenker's "Geist" lecture and discussion section.

Schenker and Mach

Thus far, I have positioned Schenker and Mach independently in relation to the University of Vienna and the Philosophical Society. What justifiable reasons could I have to examine and compare them as relatable historical figures? Besides the fact that Schenker and Mach corresponded with one another directly, Schenker had also corresponded with scientists, philosophers, and music historians who were also all acquainted with Mach and involved with the Philosophical Society of Vienna in some way. Below I offer a map of these correspondences to perhaps help music scholars more

[43] Blackmore, "Chapter Twelve: The University of Vienna Philosophical Society," 278.
[44] Ibid., 280.

clearly navigate Schenker's discussions, and the general complexity of idea-sharing and interactions in his historical context of *fin-de-siècle* Vienna.

In 1896, Schenker received a personal postcard from Mach. This postcard has been subject to considerable debate: some music scholars argue that it proves a personal acquaintance between the two thinkers, while other have downplayed its significance (or dismissed it entirely).[45] It is unclear whether Schenker wrote first to Mach or responded to him (although the postcard implies that he did), but Federhofer suggests that Mach had participated in Schenker's "Geist" presentation, noting that "perhaps the sender (Mach) had already participated in the university lecture."[46] This postcard is an insightful data point for further contextualization, and it is useful to explore more deeply Hellmut Federhofer's positioning of this recorded correspondence relative to their mutual friend and colleague: Eduard Hanslick.

Hanslick's seminal book *Vom Musikalish-Schönnen* (*On the Musically Beautiful*), published in 1854, is often referred to as the foundation of musical aesthetics. Similar to Schenker, Hanslick's academic background was in law, and upon moving to Vienna he became a music critic for the *Wiener Musik-Zeitung* and *Neue Freie Presse*. According to Karnes, "Hanslick, it is generally held, was a formalist, who boldly prepared the philosophical ground for a century of structuralist analysis and positivist historical inquiries to come."[47] His *On the Musically Beautiful* was a reaction to what he perceived

[45] For scholars who address this postcard and disagree with one another about its significance, see Cook, *The Schenker Project: Culture, Race, and Music Theory in Fin-de-Siècle Vienna* and Kevin Korsyn, "Schenker's Vienna: Nicholas Cook on Culture, Race and Music Theory in Fin-de-Siècle Austria," *Music Analysis* 28, no. 1 (2009): 153–79.
[46] Original German: "Vielleicht nahm der Absender schon an dem bereits erwähnten Universitäts-vortrag Schenkers teil." Hellmut Federhofer, *Heinrich Schenker: Nach Tagebüchern und Briefen in der Oswald Jones Memorial Collection*, (New York: Georg Olms Verlag, 1985), 15.
[47] Karnes, *Music, Criticism, and the Challenge of History*, 21.

as a lack of "dispassionate discourse" about music, and the book encouraged readers to listen for "its sounding form in motion."[48] Hanslick's empirical description of music was out of line with many of his German-Idealist contemporaries, as he sided with philosophers who argued for absolute objectivity. He realized later, however, that he would be unable to characterize a fully systematic, unobjective methodology to study music, and published another book *From the Concert Hall* (1870), a subjective history of Viennese musical life. Later in 1911, Hanslick presented an essay titled "Lawfulness in the Evolution of Culture" to the Philosophical Society of Vienna.

In his book *Heinrich Schenker: Nach Tagebüchern und Briefen in der Oswald Jonas Memorial Foundation*, Federhofer describes several of Schenker's correspondences with Hanslick. At the time, Hanslick had been speaking to and meeting with Mach, discussing ideas about psychology and acoustics, when he wrote to Schenker to express his interest in Schenker's ideas about the evolution of melody published in "Geist," and from there they wrote several letters back and forth. According to Federhofer, Schenker's plan to bring together "Geist" and other publications into a work titled *History of Melody*, and he submitted his early ideas and plans for these texts to Hanslick.[49]

Hochgeehrter Herr Doctor!	Best Greetings, Doctor!
Vielen dank für Ihre freundlichen Zeilen und das Zeichen von Vertrauen, das dieselben enthalten!	Thank you for your friendly note and the signs (ideas) that you have trusted, and that we share the same!

[48] Ibid., 30.

[49] Federhofer, *Nach Tagebüchern*, 12: "Offenbar sollte das ganze Werk den Titel *Geschichte der Melodie* tragen, deren grundlegende Idee er Eduard Hanslick unterbreiten wollte. Dass dieser Schenker günstig gesonnen war, lassen sowohl Ort und Forum des in obiger Anmerkung erwähnten Vortrags als auch an ihn gerichtete Karten (1894 – 1899) erkennen, z.B. dessen Antwort auf ein – auch als Konzept – nicht nachweisbares Schreiben von Schenker."

Ihre Idee einer, „Geschichte der Melodie“ interresiert mich sehr, oder richtiger: wird mich sehr interessieren, bis ich etwas freieren Geistes und Gemüthes sein werde. [...]	Your ideas in, “History of Melody” interest me greatly, or rather, they would interest me if I was of freer mind and spirit. […]
Sie würden mich also sehr verbinden, wenn Sie die mir versprochene Darlegung Ihres Planes bis zur Osterwoche verschreiben möchten, wo ich hoffentlich wieder aufnahmefähig bin für ernste theoretische Gespräche. Hochachtungsvoll ergeben Dr. Ed Hanslick	If you would like to connect with me another week when I can speak more about your plans, I would hopefully be more receptive to theoretical discussion. Giving my highest regards, Dr. Ed Hanslick[50]

Hanslick later wrote to Schenker, commenting on his Smetana-review article for the feuilleton section in an upcoming issue of *Neuen Freien Presse*:

„Hochgeehrter Herr Doctor!	Highest greetings, Doctor!
Ihr Brief hat mich nach vielen Umwegen soeben hier erreicht. Mit gro(ss)em Vernügen sehe ich Ihrem Smetana-Feuillton entgegen und beeile mich...	Your letter has made its way to me. With much enjoyment I look forward to seeing your Smetana-Feuillton article…
Mit bestem Gru(ss), Ihr aufrichtig ergebener Ed. Hanslick“[51]	With best greetings, Your sincere, loyal friend, Eduard Hanslick

Two later correspondences are recorded between Schenker and Hanslick. Federhofer offers several additional correspondences between them, in which they expressed mutual admiration for one another’s ideas.[52] Interestingly, in reference to the postcard to

[50] Translation mine. The word “Zeichen” usually means a “sign,” although in this context it might be used to refer to Schenker’s ideas.
[51] Federhofer, *Nach Tagebüchern*, 13.
[52] Ibid., 14. Original German: “Zwei Visitenkarten aus späteren Zeiten – zugleich die letzten Mitteilungen an Schenker – sprechern für die unverminderte gegenseitige Wertschätzung.“

Schenker from Mach, Federhofer suggests that Hanslick referred Schenker's ideas to Mach around 1895 at the University of Vienna.[53] The postcard from Mach to Schenker reads:

"...Es scheint mis, dass die Ansichten, welche Sie zur Sprache gebracht haben, einen gesunden Kern haben und verdienen, verfolgt zu werden. Die Discussion wird jedenfalls förderlich und anregend sein, auch wenn Sie nicht in allen Punkten Recht behalten sollten."[54]	"It seems to me that the opinions you have voiced are essentially sound and deserve to be followed up. However, the discussion will be beneficial and stimulating even if you are not correct on every point."[55]

As previously noted, Federhofer suggests that maybe Mach had already taken part in Schenker's "Geist" lecture; he continues to say that "Richard Wallaschek was situated near E. Mach and Friedrich Jodl, working also in psychology and tone-aesthetics at their shared alma mater (UniWien)."[56] Federhofer offers an important connection here, by directly linking Schenker, Hanslick, and Mach to one another.

Earlier I explored the emergence of *Musikwissenschaft*, which developed out of Guido Adler's empirically-minded musicological work at the University of Vienna during this same time. Adler—Hanslick's mentee—took it upon himself to advance a scientific agenda to shape the future of musicology. Karnes writes:

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[53] Ibid. 14, Original German: "Welcherart Schenkers Antrag war, ist unbekannt. – Vermutlich kam Letztegenannter durch Hanslick zu dem 1895 an die Universität Wien berufenen Physiker Ernst Mach in Beziehung."
[54] Ibid., 14-15.
[55] Geoffrey Chew, trans., "Schenker Documents Online," Handwritten postcard from Ernst Mach to Schenker, dated December 2, 1896, 2006, http://www.schenkerdocumentsonline.org/documents/correspondence/OJ-12-47_1.html.
[56] Federhofer, *Nach Tagebüchern*, 15. Original German: "Richard Wallaschek habilitierte sich damals bei E. Mach und Friedrich Jodl für die Fächer Psychologie und Ästhetik der Tonkunst an der dortigen Alma Mater."

> In the spring of 1985, […] Ernst Mach moved from Prague to Vienna, and by the following year he has made his way onto the committee charged with naming Hanslick's successor. […] Convinced that they recognized what ailed the faculty of music at their new institution, Jodl and Mach also believed that they knew how the situation might be remedied and who would be the right person to do it. *With the hiring of Adler in 1898, the migration of Prague's musicological minds to the Austrian capital was complete, and the transformation of the university's curriculum officially got under way*. In the field of *Musikwissenschaft*, it seemed, a new age had finally dawned. [emphasis mine][57]

Musicology at the University of Vienna was turning towards an empiricist direction for a number of reasons—one already mentioned, being the redistribution of academic resources in favor of the sciences—and Mach recognized that Adler would be a critical influence during this shift. Mach and Hanslick were connected in their shared study of aesthetics and perception, although their methodologies differed. Like both Schenker and his mentor, however, Adler would come to later abandon his positivist approach to musicology, and advocate for focusing on the beauty of the music itself.

The wave of modernism in the later 19th century threatened the pursuit of art. Adler himself wrote, "the spread of a scientific study of any art is a sure sign that art is in decline."[58] Hanslick, Mach, Adler, and Schenker were interconnected historical figures facing this mountainous challenge: how to come to understand natural, artistic beauty in a world of increasingly less access to it. My aim here was only to scratch the surface of their deeply-shared ideological connections, in an effort to place Schenker and Mach side-by-side in the midst of this musical crisis.

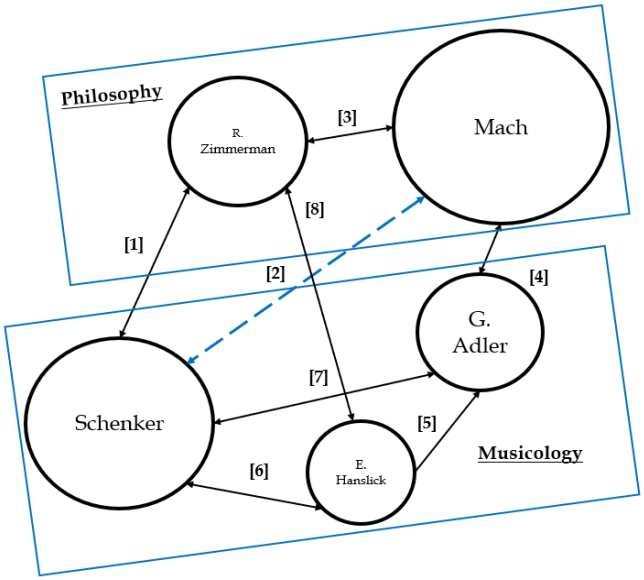
One additional connection between Schenker and Mach is Robert von Zimmermann, an influential philosophy professor at the University of Vienna beginning

[57] Karnes, *Music, Criticism, and the Challenge of History*, 44.
[58] Ibid., 134.

in 1861. In fact, as part of Schenker's legal studies, he learned Practical Philosophy from Zimmerman during his first year at the university in 1884. Zimmermann was also serving as the *Obmann* (leader) of the Philosophical Society of Vienna when Schenker presented "Geist" in 1885. Philosopher Denis Fisette writes that "many of the Society's annual reports emphasize Zimmermann's major contributions to the Society: not only was he responsible for the Society's institutional foundation, but he was also very active within the organization and presided over it for nearly a decade."[59] Zimmermann had also played a decisive role in Mach's hiring as the chair of the philosophy department at the University of Vienna in 1895. Zimmermann was also aware of Hanslick's work, and wrote at least once on his musical aesthetics.[60]

Schenker and Mach shared a number of mutual acquaintances: Eduard Hanslick, Guido Adler, and Robert Zimmermann, all of whom actively participated in the Philosophical Society of Vienna at one point or another during its tenure. To summarize and conclude this section, I offer a map of the previously discussed correspondence between Schenker, Mach, Zimmermann, Adler, and Hanslick, and suggest how these thinkers may have influenced one another in Figure 2 below. This is but one small representative example of the incredible breadth of discourse and expertise the Society was established to encourage.

[59] Fisette, "Austrian Philosophy and Its Institutions," 6.
[60] Karnes, *Music, Criticism, and the Challenge of History*, 43.



[1] Alpern, "Music Theory as a Mode of Law," 1460.
[2] Federhofer, *Nach Tagebüchern*, 14-15.
[3] Blackmore, "Chapter Twelve: The University of Vienna Philosophical Society," 279, 283-284.
[4] Ibid., 298.
[5] Hanslick was Adler's mentor.
[6] Federhofer, *Nach Tagebüchern*, 12-15.
[7] "AdlerG ~ HSchenker." *SchenkerDocumentsOnline*.
[8] Karnes, *Music, Criticism, and the Challenge of History*, 43.

Figure 2: A map of correspondences and influences between Schenker's and Mach's shared acquaintances and colleagues.

As disciplinary boundaries continue to define and mold academic discourse, the ability to visualize the flow of ideas and communication across arbitrary borders is invaluable for interdisciplinary work. The Philosophical Society of Vienna was an important force in the rampant ideological exchange characteristic of *fin-de-siècle* Vienna, and in the pursuit of interrogating the history of ideas, I would argue that progress occurs within the areas in-between such boundaries, for a boundary is not defined by what it confines, but by what it does not.

I have introduced Heinrich Schenker and Ernst Mach—two seemingly-independent historical figures whose ideas significantly shaped their disciplines—and mapped their mutual participation in the Philosophical Society of Vienna. I now discuss "Geist" and "Vergleichung" side-by-side, as the attendees of the Philosophical Society of Vienna meetings in February and March of 1895 would have done.

Shared Ideas between Schenker's "Geist" *and Mach's* "Vergleichung"

Schenker's "Geist" essay was published in a series through the Leipzig-based *Musikalisches Wochenblatt*, a weekly journal "für Musiker und Musikfreunde" ("for musicians and friends of music"). "Geist" appeared on the front page from early May through the end of June in 1895, distributed in sections through several issues of this weekly publication. Because printed dissemination of Schenker's "Geist" essay occurred after his Philosophical Society of Vienna presentation, it is even more worthwhile to question why he was invited to present this essay, and potentially, by whom.

Throughout his essay, Schenker discusses several dimensions of music: (1) Melody, (2) Repetition, (3) Polyphony, (4) Harmony, and (5) Moods, Forms, and the Organic.

Melody. Schenker talks about the evolution of Melody, from initially a "spontaneous outburst of unaccumulated emotional or physical delight" to a state of disassociation, such that humans had to learn "how to excite and inspire the musical imagination with mere mental representations, with images of objects and emotions."[61] Schenker continues to outline principles of music, and how their interactions govern the content of musical art. He notes that early self-indulgent musical impulses were "sheltered … under the protection of language and its laws."[62] Language and music are intricately intertwined as complex and multi-layered mediums of communication, and the emergence of the concept of 'melody' arose out of a desire to efficiently and reliably express a self-contained musical idea.

[61] Heinrich Schenker, "Heinrich Schenker, 'The Spirit of Musical Technique' (Der Geist Der Musikalischen Technik)," in *The Schenker Project: Culture, Race, and Music Theory in Fin-de-Siècle Vienna*, by Nicholas Cook, trans. William Pastille (Oxford: Oxford University Press, 2007), 319.
[62] Ibid., 320.

Repetition. Repetition is a unique characteristic of music, and differs significantly from language. Schenker asks, "where did music get the idea of subjecting portions of melodies—some short, some long—to repetition, when language, its model, prefers exactly the opposite—namely, a continuous, non-recurring flow?" [63] Repetition, to Schenker, is the element of music that implies a long-ago established need for sonic organization. Schenker seemingly adopts a rhetorical analogue to his stance on the nature of musical repetitions, writing that "although instrumental music appears to be unfettered by language, it nonetheless observes laws analogous to those governing language, and its effect is the more powerful the more it makes use of the idea-associations and operative principles of language."[64]

Polyphony. Polyphony emerged originally as a musical principle because it encouraged participation from several voices (especially with the initial use of only fourths and fifths, so that all could sing the melody as he or she knew it). Although polyphony continued and was adapted over time, the "spirit of counterpoint" remained.[65] Schenker draws on our imagination's ability to see "infinitely many perspectives," to adapt in order to comprehend a melody in several parts.[66] He comments on theorists' inability to communicate the spirit of counterpoint underlying increased used of polyphonic technique, and expresses a tension between 'harmony' and 'counterpoint', noting that "the totality of all these interests constitutes the piece."[67]

[63] Ibid., 321.
[64] Ibid., 321-322.
[65] Ibid., 322.
[66] Ibid., 322.
[67] Ibid., 324.

Harmony. Schenker aims to explain the nature of harmonic prescriptions "almost solely in terms of their psychological origins and impulses,"[68] and restore the word 'harmony' to mean the *melody itself*.[69] He describes 'harmony' as a totality of musical elements functioning together to constitute the harmonic framework of a piece. He writes, "no matter how much ingenuity, diversity, or variety one may subsequently employ in reinterpreting harmonically the relations among the several melodic tones, the spirit of the original harmony, foreshadowed by the melody itself, hovers above all the profuse variations and above all the new relationships established by harmonic regrouping."[70] This comment, perhaps, could foreshadow Schenker's later interpretation of harmony through *Stufen* and large-scale structural prolongations of tonic and dominant. Later, writing "harmony helps music to deceive both itself and its listener about its lack of logic and causality, because harmony behaves as though it possesses a force of logic."[71]

Moods, Forms, and the Organic. Schenker discusses the concept of *mood* in music, asserting that it requires sufficient duration for the listener to establish. He draws a strong connection between our memory and mood-establishment through analogies I will outline later in my comparison between "Vergleichung" and "Geist." To continue his music-language overlap, he notes that, "in all cases where language joins together with music, it is language, thanks to its exceptional ability to produce associations of ideas, that immediately reveals the mood and plainly defines its character."[72] Forms emerge in

[68] Ibid., 324.
[69] Ibid., 325.
[70] Ibid., 325.
[71] Ibid., 325.
[72] Ibid., 327. For the original German, see Heinrich Schenker, "Der Geist Der Musikalischen Technik," in *Musikalisches Wochenblatt* (Leipzig, Germany: E.W. Fritzsch, 1895), 286: "In allen Fallen, wo das Wort mit dem Ton sich verbindet, ist es das Verdienst des Wortes, dass es, dank seiner überlegenen Fruchtbarkeit an Ideenassociationen, die Stimmung sofort erschliesst und ihren Charakter deutlich umschreibt."

Schenker's discussion of musical logical construction, pointing out people's belief that such musical structures arise organically. He states bluntly, "…people possess little understanding about the fundamental nature of what is commonly called 'form'. As a matter of fact, no musical content is organic. It lacks any principle of causation, … it is part of the work of shaping content for the composer to obtain from his imagination a variety of similarities and contrasts, in order to ultimately select his best option."[73] Schenker goes on to discuss the destructive effects of formalism, a view that I will elaborate alongside Mach in my comparison.

Kevin Korsyn acknowledges some overlap between Mach's "Vergleichung" and Schenker's "Geist" through the Philosophical Society, but he takes his analysis no further.[74] He makes an effort to identify gaps in Nicholas Cook's *The Schenker Project*, writing, "although Cook mentions the fact that Schenker first read 'Geist' to the Philosophical Society of the University of Vienna, he provides no other details, nor did he investigate the history of the Society itself,."[75] Yet Korsyn himself does not attempt to read or interpret these essays, as was undertaken by the Society.

Ernst Mach's "Vergleichung" was originally given as an address to the General Session of the German Association of Naturalists and Physicians in Vienna on September 24, 1894. Soon after his presentation, "Vergleichung" was published in English via *The Open Court*, a weekly Chicago journal "devoted to the religion of science" on November 8, 1984.[76] "Vergleichung" was later included in Mach's seminal *Populär-*

[73] Schenker, "The Spirit of Musical Technique," 328.
[74] Kevin Korsyn, "Schenker's Vienna: Nicholas Cook on Culture, Race and Music Theory in *Fin-de-Siècle* Austria," 167.
[75] Ibid., 166.
[76] Ernst Mach, "On the Principle of Comparison in Physics," The Open Court, November 8, 1894, No. 376, Vol. VIII edition.

Wissenschaftliche Vorlesungen (Popular Scientific Lectures), a collection of his essays and lectures published as a book in the original German by Johann Ambrosius Barth in Leipzig, 1903. The fact that the Philosophical Society of Vienna devoted several meetings to this essay and its discussion is notable for our discussion, especially because Schenker's "Geist" presentation intertwined with these sessions.

As the title suggests, in his address to the German Association of Naturalists and Physicians, Mach argues that the limitations of language—through which we assign descriptions and make comparisons—significantly shape the progression of science. Mach summarizes his thesis when he asks, "what can mere description accomplish? What has become of explanation, of our insight into the causal connexion of things?"[77] According to Mach's epistemology, our senses are the limited mechanism through which we can understand scientific facts; he therefore holds that communication by language is an indispensable factor in the establishment of scientific principles. As we assign labels, structures, and formulations to physical phenomena, their meanings can change over time as we make new discoveries and technology evolves.

Mach elaborates on the effects of assigning descriptions and the function of our memory as responsible for our ability to form connections and comparisons. He argues that "comparison, as the fundamental condition of communication, is the most powerful inner vital element of science. […] Like all other science, physics lives and grows by comparison."[78] He defines a *direct description* as a "verbal report that uses purely abstract implements," for example, a color.[79] An *indirect description,* according to Mach,

[77] Ibid., 4283.
[78] Mach, "On the Principle of Comparison in Physics," *The Open Court*, 4284.
[79] Ibid., 4284.

is like a theoretical idea, a reference to a description already properly formulated. Throughout his address, he argues the necessity of interrogating the process in which we formulate ideas and comparisons (through memory), and how labels and ideas are established in physics (through language, descriptions, and comparisons).

Mach asks, "Now, how does it happen that we yield our assent so reluctantly to the philosophical opinion of an inquirer for whose scientific achievements we have only unqualified praise?"[80] I wonder precisely the same. In my attempt to navigate the historical context of *fin-de-siècle* Vienna, a time and place in which many influential thinkers came into fruition, I recognize the significant task that is to weave through the complexities of even *suggesting* ideological influence, while also pushing back at the perpetuated narrative that certain thinkers, scientists, or musicians do not warrant inquiry.

Below I offer a comparative reading of Schenker's "Geist" and Mach's "Vergleichung." I outline their similar emphases and discourse on (1) communication and language, (2) memory and psychology, (3) the concept of "Spirit," and (4) descriptions and formalism. I am not implying a direct influence in making this comparison; my aim is more so to provide further justification for researching Schenker's and Mach's correspondences and interactions, and investigate possible reasons why Schenker's lecture was scheduled in between discussions about Mach's ideas. I will also relate each of these ideas to similar claims in the broader context of German Idealist thought.

Communication and Language. The Philosophical Society of Vienna meetings have been considered by some scholars to be the first Vienna circle. The Vienna Circle,

[80] Ibid., 4283. Original German: "Woran mag es nun liegen, dass man dem philosophischen Gedanken des Forschers so widerstrebend nachgibt, dessen naturwissenschaftlichen Erfolgen niemand die freudige Bewunderung versagen kann?" Ernst Mach, "Über Das Prinzip Der Vergleichung in Der Physik," in *Populär-Wissenschaftliche Vorlesungen*, vol. 3 (Leipzig: Johann Ambrosius Barth, 1903), 264.

established in the 1920s by Moritz Schlick, Rudolph Carnap, among others, was vastly influenced by Mach's work, and formed with the primary objective to marry natural science and philosophy through a theory of meaning. Philosophers at the turn-of-the-century were highly concerned with the limits of language, as language is our mechanism for communicating meaning. This was especially true for Edmund Husserl, regarded as the founder of modern phenomenology. Husserl had, like Schenker, also studied at University of Vienna, and finished one year before Schenker began his law studies. He claimed that for an idea to be intelligible, it has to be communicated through language, which is "inter- rather than intra-subjective."[81] In the midst of this 'linguistic turn', thinkers sought to reconcile the nature of meaning, concluding that "language use must, therefore be holistic, such that words gain their meaning by their connections to human practices and by their sharing relations to other words."[82]

In both "Geist" and "Vergleichung," Schenker and Mach discuss the crucial limiting effects that language can have on the progression of music and science. They share a common emphasis on *words* as descriptors, and both refer to them as signs ("Zeichen") which stand for facts or objects.

Schenker	**Mach**
"If a word is only a sign for something—that is, for an object or for a concept in which objects are assimilated—then the musical motive is only a sign for itself; or,	"…so also, the words of human language, which is only more highly specialized, are names or signs for universally known facts, which all can observe or have observed."[84]

[81] Bowie, *German Philosophy*, 94.
[82] Ibid., 90.
[84] Mach, "On the Principle of Comparison in Physics," 4284. For the original German, see Mach, "Über das Prinzip der Vergleichung in der Physik," 265-266: "…so sind auch die Worte der nur viel weiter spezialisierten Menschen-sprache Namen oder Zeichen für allgemein bekannte, gemeinsam beobachtbare und beobachtete Tatsachen."

to put it more accurately, it is nothing more
and nothing less than itself."[83]

Schenker specifically emphasizes the deep interconnection between language and music, and repeatedly implies that music behaves similar to language in its logical construction. Although physics is a discipline rooted in mathematics, the labels we prescribe to physical phenomena are limited by language.[85] Progression in both music and science is shaped by those who can effectively communicate ideas, whether through the music itself, or in sharing scientific interpretations and ideas. Both Schenker and Mach elaborate:

Schenker	**Mach**
"…[Music] had to learn to suggest convincingly the impression of self-contained thought. Through its association with language, music learned to mimic accurately all of thought's vicissitudes—its striving, its self-organisation, its closure—and through habituation over what was perhaps many centuries, the art of music eventually began to fancy that it possessed	"…then shall we feel what a stupendous and indispensable factor in the formation of science communication is. Not the dim, half-conscious surmises of the acute observer of nature or critic of humanity belong to science, but only that which they possess clearly enough to communicate to others."[87]

[83] Schenker, "The Spirit of Musical Technique," 321. For the original German, see Schenker, "Der Geist der musikalischen Technik," 257: "Ist das Wort eben nur ein Zeichen für Etwas, d.h. einen Gegenstand oder einen Begriff, der in sich die Gegenstände verarbeitet, so ist das musikalische Motiv nur ein Zeichen für sich selbst oder, besser gesagt, Nichts mehr und Nichts weniger, als es selbst."

[85] Philosopher Andrew Bowie elaborates on this idea using photons as an example: "Seeing indeed involves photons hitting the retina, which can be explained in terms of scientific laws, but the experience of seeing something cannot be explained in such terms, and is both prior to and necessary for scientific explanation. Seeing something means that what is seen presents itself as something significant, because we attend to what we need it for, or to what it reminds us of, and so on, none of which are given in the form of photons and retinas." *German Philosophy: A Very Short Introduction*, 94.

[87]Mach, "On the Principle of Comparison in Physics," 4283. For the original German, see Mach, "Über das Prinzip der Vergleichung in der Physik," 265: "…so fühlen wir, welch gewaltiger, wesentlicher Faktor beim Aufbau der Wissenschaft die Mittelung ist. Nicht, das, was der feine Naturbeobachter oder Menschenkenner an halbbewußten Konjekturen in seinem Innern birgt, sondern nur was er klar genug besitzt, um es mitteilen zu können, gehört der Wissenschaft an."

an intrinsic logic similar to that of language."[86]

Philosopher Andrew Bowie writes, "what modern science tells us is to be reconciled with decisions on what should be done by finding ways of communication and evaluating knowledge that engage the aesthetic and moral imagination of all levels of society."[88] The gap between what modern science was capable of and the general populace's understanding of it widened significantly during the turn of the century, and as modernization and urbanization decreased accessibility to Nature, a 'sense of belonging to a coherent whole' became difficult to sustain.[89]

Psychology and Memory. As mentioned, the Philosophical Society of Vienna was established by students of Franz Brentano, who "mostly agreed with him that scientific psychology was well along in the process of replacing psychology, which may partly explain why so many of the early lectures were on research discoveries in psychology and physiology."[90] Mach was not only a physicist and philosopher of science, but an incredibly influential empirical psychologist. Several scholars have noted Schenker's particular early interest in psychology, and shaped much of his later music-theoretical ideas through a psychological framework.[91] Schenker, almost surely, was

[86] Schenker, "The Spirit of Musical Technique," 320. For the original German, see Schenker, "Der Geist der musikalischen Technik," 246: "[Musik] musste er lernen, analog nachzubilden, was dem Wort am eigenhümlichsten ist, nämlich die Schaffung des Gedankens, der befriedigend abgeschlossen in sich ruht. Durch die Verbindung mit dem Wort lernte der Ton, auch alle Wechselfälle des Gedankens treu zu begleiten, das Aufstrehen, das Sich-Gliedern und Schliessen, und durch die Gewohnheit von veilleicht vielen Jahrhunderten bildete sich endlich die musikalische Kunst ein, eine ähnliche Logik wie die Sprache von Haus aus zu besitzen."
[88] Bowie, *German Philosophy*, 35.
[89] Ibid., 35.
[90] Blackmore, "Chapter Twelve: The University of Vienna Philosophical Society," 279.
[91] For a detailed study into overlaps between Schenker's writings and psychology during his time, see Leslie David Blasius, *Schenker's Arguments and the Claims of Music Theory* (New York: Cambridge University Press, 1996).

aware of his audience at the Philosophical Society, and even went as far as to "explain the nature of harmonic and contrapuntal prescriptions almost solely in terms of their psychological origins and impulses."[92]

Schenker	**Mach**
"…it is incumbent on the performer or listener to approach the piece more than just once. Each time he does so, his memory will send out in advance, so to speak, a prologue to proclaim the mood—namely, the impression it formed quickly upon first exposure or previous hearings."[93]	"Memory is always ready to put forward for comparison known facts which resemble the new event, or agree with it in certain features, and so renders possible that elementary internal judgement which the mature and definitively formulated judgement soon follows."[95]
"This facility of artificially extending a mood by means of the mood already deposited in memory provides, I think, the most persuasive justification of the fundamental axiom that we should only 'judge', as we say, an artwork when we have listened to it more than once."[94]	

[92] Karnes, *Music, Criticism, and the Challenge of History*, 324.
[93] Schenker, "The Spirit of Musical Technique," 327. For thoe original German, see Schenker, "Der Geist der musikalischen Technik," 286: "Es suche der Spieler oder Hörer, mehr als blos einmal dem Stück gegenüber zu treten. So oft er es dann thut, sendet die Erinnerung sozusagen einenr Prolog von Stimmung voraus, jenen Eindruck nämlich, den es in kurzer Manier zum ersten oder früheren Male gemamcht, und es stellt sich somit das Dauerverhältniss der Stimmung im Hörer (alles Subjektive abgerechnet), fast genau so, wie beim Componisten selbst."
[94] Ibid., 327. For the original German, see Schenker, "The Spirit of Musical Technique," 286: "In der Möglichkeit der künstlichen Verlängerung der Stimmung durch den in der Erinnerung schon deponirten Stimmungskreis liegt, wie ich glaube, am schicklichsten motivirt das unumgängliche Postulat, ein Kunstwerk erst dann, wie man sagt, zu ‚beurtheilen' wenn man es mehr als blos einmal gehïrt hat."
[95] Mach, "On the Principle of Comparison in Physics," 4284. For the original German, see Mach, "Über das Prinzip der Vergleichung in der Physik," 266: "Die Errinerung ist stets bereit, solche bekannt Tatsachen, welche der neuen ähnlich sind, d. h. In gewissen Merkmalen mit derselben übereinstimmen, zur Vergleichung darzubieten, und ermöglicht so zunächst das elementare innere Urteil, dem bald das ausgesprochene folgt."

Both Schenker and Mach discuss memory's role in our ability to formulate comparisons and recognize structures. Our memory compiles past experiences, and thus we draw on it to make sense of something new—one particularly relevant example being language-learning. Schenker and Mach both recognize that proper 'judgements' are made after repetitive exposure to the idea, concept, or music in this case, we are trying to comprehend.

Fin-de-siècle Vienna was a revolutionary time in the science of psychology. As thinkers interrogated the idea of philosophy as a first-order discipline, some philosophers were led to argue that discoveries about the nature of knowledge should be left to psychology. Korsyn writes that "the psychology of Schenker's day was not exclusively tied to the laboratory, because some schools of thought were interested in mental states which are not accessible to external observation and which cannot be repeated to allow for replicated measurement and observations."[96] In comparison to German Idealism, our mind and our experiences shape reality. Schenker and Mach expand on this:

Schenker	**Mach**
"The imagination sees how infinitely many perspectives there are from which to develop a given idea, and it learns to recognize how an alteration in one element brings with it a corresponding change in expression; and, most important of all, through such prolific education it develops the ability to select, from the infinite multitude of developments that it	"Besides, it is in the power of the idea to offer us more than what we actually see in the new fact, at the first moment; it can extend the fact, and enrich it with features which we are at first induced to seek from such suggestions, and which are often actually found. It is this rapidity in extending knowledge that gives to theory a preference over simple observation."[98]

[96] Korsyn, "Schenker's Vienna," 168.
[98] Mach, "On the Principle of Comparison in Physics," 4284. For the original German, see Mach, "Über das Prinzip der Vergleichung in der Physik," 269: "Ja die Idee kann mehr bieten, als wir in der neue Tatsache augenblicklich noceh sehen, sie kann dieselbe erweitern und bereichtern mit Zügen, welche erst zu suchen

> envision, precisely the one that best suits the artist's disposition at a particular time."[97]

In these excerpts, both Schenker and Mach are alluding to our subconscious ability to recognize familiarity in the presentation of new ideas, and suggest that we draw on our past experiences to do so. I find particularly compelling their shared use of language having to do with *vision*—discussing what we can see, seek, or envision through our imaginations. A typical English translation implies the word "idea," but Schenker uses "Gesicht" ("face") or "Ausdruck" ("expression"), as though suggesting that the idea appears to the imagination as a form or image. In a way, this visual allusion aligns with Mach's idea that, via scientific inquiry, our limited sensations and experiences allow us to describe and interact with the world.

Spirit and Idealism. Schenker and Mach both draw on the idea of a "Geist," or a spirit. For Schenker, it is the 'spirit' of counterpoint, the 'spirit of harmony,' and of course, the title "The Spirit of Musical Technique." Mach references a spirit, too, implying a 'spirit' which acts according to fixed laws that we cannot experience directly, due to our limited sensations.

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wir veranlasst werden, und die sich oft wirklich finden. Diese Rapidität der Wissenserweiterung ist es, welche der Theorie einen quantitivitaten Vorzug vor der einfachen Beobachtung gibt..."

[97] Schenker, "The Spirit of Musical Technique," 322. For the original German, see Schenker, "Der Geist der musikalischen Technik," 258: "Die Phantasie sieht, wie unendlich viele Gesichtspuncte es gibt, ein Gegebenes auszugestalten, lernt einsehen, wie ein Wechsel des Gesichtspunctes einen Wechsel im Ausdruck mit sich führt, und, was am allerwichtigsten ist, sie wird durch einen so reiche Schulung befähigt, von den unendlich vielen Ausgestaltungen, die sie gesehen, schliesslich Jene zu wählen, die dem Charakter des Künstlers zu einer gewissen Zeit am besten zusagt."

Schenker	Mach
"The strangest thing of all is that even those composers and theorists who wrote about counterpoint and fugue, and who, in their creative activity, were certainly aware of the subjective significance of these techniques, were unable to communicate clearly the *spirit of counterpoint*."[99]	"The ingenious man, who finds in his will, as his most familiar source of power, the best facilities for comparison, conceives a species *spirit in the magnet."*[101]
"No matter how much ingenuity, diversity, or variety one may subsequently employ in reinterpreting harmonically the relations among the several melodic tones, the *spirit of the original harmony*, foreshadowed by the melody itself, hovers above all the profuse variations and above all the new relationships established by harmonic regrouping."[100]	"The demoniac character of the event vanishes, *for the supposed spirit acts not by caprice, but according to fixed laws*."[102]

The concept of a "spirit" is particularly relevant in German Idealism. This ideological movement was catalyzed by several philosophers—Immanuel Kant, Johann Gottlieb Fichte, Friedrich Wilhelm Joseph Schelling, and Georg Wilhelm Friedrich Hegel—who sought to bridge the divide between rationalism and empiricism during the turn-of-the-century. Hegel, whose 1807 book *Phenomenology of Spirit* (*Phänomenologie des*

[99] Schenker, "The Spirit of Musical Technique," 323. For the original German, see Schenker, "Der Geist der musikalischen Technik," 259: "Das Seltsamte ist, dass nicht einmal jene Componisten und Theoretiker, die über den Contrapunkt und die Fuga schreiben und in der Uebung des Schaffens den subjectiven Werth dieser Technik gewiss fühlten, deutlich den Geist des Contrapunctes mitzutheilen vermochten."
[100] Ibid., 325. For the original German, see Schenker, "Der Geist der musikalischen Technik," 273: "Mag mann später noch so geistvoll, mannigfaltig und detaillirt die Beziehungen der einzelnen Melodietöne zu einander harmonisch ausdeuten, es schwebt über all dem Detailreichthum und den harmonischen Verwandtschaftsgruppen jener ursprüngliche Geist der Harmonie, denn die Melodie durch sich selbst verkündet."
[101] Mach, "On the Principle of Comparison in Physics," 4285. For the original German, see Mach, "Über das Prinzip der Vergleichung in der Physik," 270: "Der naive Mensch, dem sich zur Vergleichung sein eigener Wille als bekannteste Kraftquelle arbietet, denkt sich in dem Magnet eine Art Geist."
[102] Mach, "On the Principle of Comparison in Physics," 4285. For the original German, see Mach, "Über das Prinzip der Vergleichung in der Physik," 271: "Der dämonische Charakter der Tatsache verschwindet, denn der vermeintliche Geist wirkt nicht nach Willkür, sondern nach festen Gesetzen."

Geistes) was incredibly influential and profoundly shaped the tradition of German Idealism. Several scholars have investigated several of Schenker's works, including "Geist," through a Hegelian philosophy, and have proposed conflicting interpretations. Regardless, to deny Hegel's influence entirely would be inaccurate and incomprehensive, for acknowledging these similarities offers a lens to justify Schenker's and Mach's similar use of the "Geist" idea.

Hegel's *Phenomenology of Spirit* (or "Mind," as "Geist" can be translated both ways) is written from the standpoint that the mind appears to nature, rather than nature appearing to the mind. The concept of an object is not just identifying something, but instead includes all the ways in which that things is grasped by our engagement with it.[103] We've seen this before: for example, influencing shifts in the practice of psychology at the turn-of-the-century, as explored in the previous section. For Hegel, there exists an *absolute idea*, an explanation for why all particular truths depend on their relationships to other truths for their justification.[104] The *Geist* is perhaps in some way reflective of the *absolute*.

Formalism. German idealist philosophers upheld that although changes in nature are determined by laws—for example, Mach describes the *spirit* acting *according to fixed laws*—the fact that nature is structured at all is not determined in the same way.[105] The formal patterns we trace and design are inherently a product of our subjective experiences. As mentioned earlier, Schenker would argue that this aspect of the

[103] Bowie, *German Philosophy*, 49.
[104] Ibid., 46.
[105] Ibid., 33-34.

compositional process is the nature of true artistic criticism—recognizing that formal musical structures are realized subjectively, rather than consciously imposed.

Schenker	**Mach**
"The only fruitful significance of 'form' seems, in my opinion, to be this: that the mere notion of a 'form' can influence the creative imagination, and that from the perspective of a model—let us say, for instance, any of Beethoven's sonatas—the imagination can do its work."[106]	"From the frequent repetition of such comparisons, however, made under the most manifold circumstances, that inconstant features, get so obliterated that the latter acquire a fixed significance independent of every object and connexion, or take on as we said an abstract or conceptual image."[107]

Schenker and Mach both compare the concept of *form* to an abstract image of something, and express concern that the overuse of a form may construe its self-consistency. Formal structures are useful mechanisms for modelling, especially in music theory and theoretical physics contexts, but as formal structures are repeatedly utilized over time, its definition and applicability can expand over time. Schenker later re-emphasizes this exact point:

> Now I ask, is Liszt's sonata the same as Beethoven's, Beethoven's the same as Kuhnau's, and so forth? Or does it not appear more likely here that the empty, meaningless term 'sonata' is a terrible medium comparationis?![108]

[106] Schenker, "The Spirit of Musical Technique," 331. For the original German, see Schenker, "Der Geist der musikalischen Technik," 326: „Der einzige productive Werth der ‚Form' scheint nämlich meiner Ansicht nach der zu sein, dass die blosse Vorstellung einer ‚Form' die schaffende Phantasie beeinflussen kann, und dass unter dem Gesichtspunct einesMusters, sagen wir z. B. irgend seines Sonatenmusters von Beethoven, die Phantasie ihre Arbeit liefern kann."
[107] Mach, "On the Principle of Comparison in Physics," 4284. For the original German, see Mach, "Über das Prinzip der Vergleichung in der Physik," 267: "Durch die häufige Anwendung solcher Vergleichungen unter mannigfaltigen Umständen haben sich aber den überinstimmenden Merkmalen gegenüber die wechselnden so verwischt, dass erstere eine selbständige von jedem Objekt, jeder Verbindung, unabhängige, wie mann sagt, abstrakte oder begriffliche Bedeutung gewonnen haben."
[108] Schenker, "The Spirit of Musical Technique," 331.

This shared concern regarding the abuse of formal definitions over time is a symptom of Mach's and Schenker's shared concern for effective communication and the limitations of language. The spread of ideas—and their interpretations—ultimately rests on how they are communicated through language. Schenker was especially concerned about this; according to Cook, "the excerpts from articles and other sources in the scrapbook which Schenker maintained from 1902 to the end of his life show how carefully he followed the dissemination of his ideas, sometimes underlining explicit or what he took to be implied references to his theories."[109] As we saw earlier, Mach too stressed the critical role that science communication plays in the progression of scientific endeavors, particularly in our theoretical understanding of physical phenomena.

Conclusion

In this chapter, I have investigated two seemingly unrelated historical figures in their shared *fin-de-siecle* Vienna context: music theorist Heinrich Schenker and physicist Ernst Mach. On the surface, one could argue that, despite their temporal and geographic similarity, an attempt to plumb the depths of their ideological overlaps could easily prove nothing other than empty speculation. For, as a German Idealist would prescribe, there exists no objective truth *out there*, and it is rational to accept that we simply cannot know the extent to which Mach may have influenced Schenker, or vice versa. Experiences, fundamentally, shape our conception of the world. A brief moment in history—when a music-theoretic essay was presented to an audience of scientifically-minded

[109] Cook, *The Schenker Project*, 25.

philosophers—could have been an inconsequential blip on two otherwise unrelated art and science timelines that happened to intersect for a moment.

I choose, however, to see this intersection as consequential, and as an inspiration to examine *fin-de-siècle* Vienna through an overlapping music-science discourse. Karnes writes: "the writer of history must endeavor to grasp and describe the nature of the *spirit* that pervades, underlies, and gave rise to the artifacts and phenomena under consideration."[110] The cultural value of ideological exchange that characterized Vienna cultivated an environment in which ideas arose that would shape the course of modern music theory and physics. That Schenker and Mach had even one correspondence is fascinating and worth investigating in this light.

Music theory offers an important perspective to a timeless conversation about culture. Those inspired to question the nature of beauty that emanated through this medium offer profound insight into underlying processes through which we come to express ourselves and our ideas beyond the limitations of language. Similar values, I think, are true in the sciences; although scientists employ a different methodology to answer different questions, physics is a discipline concerned with the behavior of nature, and physicists search relentlessly for formal structures and patterns through which mathematics can reveal beauty in a subtle way. It is worthwhile to interrogate the *Zeitgeist* such that we are equipped with a nuanced understanding of the past, in order to better utilize the theoretical tools to describe and understand music and science of the present.

[110] Karnes, *Music, Criticism, and the Challenge of History*, 54.

III. CASE STUDY TWO

BEYOND THE CLASSICAL PARADIGM:

SCHOENBERG, SCHRÖDINGER, AND THE LIMITATIONS OF LANGUAGE

In his 1946 essay titled "New Music, Outmoded Music, Style and Idea," Arnold Schoenberg, composer, music theorist, and—occasionally—Emancipator of Dissonance, writes, "I believe that composition with twelve tones and what many erroneously call 'atonal music' is not the end of an old period, but the beginning of a new one."[111] Similarly, Erwin Schrödinger, a theoretical physicist whose development of wave mechanics was an important catalyst for the onset of the modern quantum era, in a 1935 essay titled "Science, Art, and Play," writes, "it is sometimes said that physics is today in a stage of transformation and revolution; a stage described by some as a crisis."[112]

Fin-de-siècle Viennese culture cultivated a number of thinkers, artists, scientists, and the like, producing ideas and contributions have remained influential in many fields of study; it was a time of free-flowing conversation encouraged at the nearest *Kaffeehaus* or as part of yet another newly established academic society (for example, the *Philosophische Gesellschaft an der Universität Wien*, which I discussed in the last chapter). Schoenberg and Schrödinger each came to prominence in the early decades of the 20th century, and, although enduring very different experiences within Viennese culture and society, both nonetheless developed intellectually in a manner consequential

[111] Arnold Schoenberg, "New Music, Outmoded Music, Style and Idea," in *Style and Idea* (New York: Philosophical Library, 1950), 45–46.
[112] Erwin Schrödinger, "Science, Art, and Play," in *German Essays on Science in the 20th Century*, ed. Wolfgang Schirmacher (New York: The Continuum Publishing Company, 1996), 28.

of the *Zeitgeist*. It is evident from even these short excerpts that both Schoenberg and Schrödinger had a keen awareness that they were in a process of disciplinary upheaval.

This chapter considers how Schoenberg and Schrödinger independently—yet similarly—attempted to reconcile the modernist crises in their respective disciplines. At the turn of the century, both the practices of physics and music composition faced similar breakdowns of intuition, when physicists realized that atomic behavior could not be described according to coherent, orderly models of classical physics, and composers begrudgingly approached music composition in accordance with an exhausted and limited Western traditional harmonic vocabulary. What was ultimately necessary to confront these correlated frustrations was a new—or expanded—language. Their solutions—Schoenberg's twelve-tone method of composition and Schrödinger's wave mechanics—were the catalysts that set the disciplinary "revolutions" in motion.

Direct comparisons between the parallel emergences of twelve-tone composition and quantum mechanics have yet to be undertaken in music scholarship or in the history of science.[113] However, precedent has been established for such an undertaking. Historian Yehuda Elkana writes, "[Schrödinger] was humanistic in the classical, sophistic sense; in comparing cultures, he saw man and his intellectual products as being determined by context. … A longer study could show in more detail the intellectual and cultural links between Schrödinger and Wittgenstein, but also ones that are less obvious, i.e., *the affinities to the Schoenberg School of music,* the Vienna expressionists, and the

[113] For a comparison of Schoenberg's and Schrödinger's ideas as a means to interpret Goethe's *Faust,* see Joseph A. Zabinski, "Was Die Welt Im Innersten Zusammenhält: Schrödinger's Form, Schoenberg's Idea, and Goethe's Faust" (Honors Thesis, Boston College, 2010).

'uprooted' geniuses of language like Franz Kafka and Karl Kraus" (emphasis mine).[114] At least one extensive study has been put forth by James K. Wright that situates Schoenberg directly alongside a related crowd, in his book *Schoenberg, Wittgenstein, and the Vienna Circle.*[115] If Schoenberg and Schrödinger have been compared to similar groups of intellectuals and cultural figures from their shared time and place, then it seems that there is something to be learned from comparing them directly.

This investigation exists at the intersection of several different pursuits—the history of music theory, philosophy of science, Austrian society and culture—and, as with any historical undertaking, it is obviously impossible to fully grasp every dimension of the situation in question. However, a common trend among my endeavors is an underlying motivation to rethink the past, and interrogate prevailing narratives about *the way things were* (or are, for that matter).[116] I stress several caveats for the reader to keep in mind: I hold that revolutions arise from the culmination of small discoveries made by many experts, and I hesitate to view Schoenberg and Schrödinger as individual revolutionaries in their own right. Often the idea of singular, genius-agents as the purveyors of revolutionary thought is not stated explicitly, but is perpetuated as an underlying theme in the way that history is framed and taught—particularly in both the disciplines of music and physics. This chapter is motivated by a desire to challenge this idea.

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[114] Yehuda Elkana, "Erwin Schrödinger as Historian - Notes Towards An Interpretation," in *Erwin Schrödinger's World View*, ed. Johann Götschl, vol. 16, Series A: Philosophy and Methodology of the Social Sciences (Boston: Kluwer Academic Publishers, 1992), 115.
[115] James K. Wright, *Schoenberg, Wittgenstein, and the Vienna Circle* (New York, NY: Peter Lang AG, European Academic Publishers, 2005).
[116] For very recent scholarship addressing new interpretations of Schoenberg's writings, see Áine Heneghan, "Rethinking Repetition: Interrogating Schoenberg's Writings," *Perspectives of New Music* 56, no. 2 (2018).

Additionally, I hold that music theory and physics—although differing in practice and thought-processes—are both mechanisms communicating an understanding or interpretation of an idea about the world or our place in it. Language is the medium to decipher and communicate meaning; the persistent questioning of the limitations of language (most notably from the work of Wittgenstein and the Vienna Circle) is an issue that underlies these crises. For my purposes, I acknowledge these related ideas, but I do not attempt to trace those connections (i.e. between Schoenberg, Schrödinger, Kant, Wittgenstein, and/or the Vienna Circle), for that is beyond the scope of my task at hand. Rather, my aim is to examine the changes in music and physics during this time period focusing on the integral role of communication.

The first section addresses parallels between the simultaneous disciplinary crises in music and physics that captivated many influential thinkers in early 20th-century Vienna. Following, I offer a brief introduction to Kant's concepts of *Anschauung* and *Anschaulichkeit,* and I adopt these ideas as lenses to interrogate aspects of Schoenberg's twelve-tone composition method and Schrödinger's wave mechanics. Last, I elaborate on the issue of language in both cases of Schoenberg's and Schrödinger's work, specifically how this translated to broader consequences of misinterpretation. From the coffeehouse to the newest intellectual society, there were many ideas circulating in the air of *fin-de-siècle* Vienna. Although it has proven a difficult and complex task to parse through them, it is my hope that this strategy offers one angle for examining ideological exchange in this incredibly rich historical context.

Parallels in the Modernist Crises and "Revolutions" in Music and Physics

For the composer and physicist in the early 20th century, there was a shared anxiety about implications of recent developments in their respective disciplines: new insights into a quantum reality, whose systems behave according to statistical probabilities, and an expansion of the Western-classical harmonic paradigm, with an increased implementation of chromaticism in the musical syntax catalyzed in part by Schoenberg. Musicologists Mark Delaere and P.H. Daly summarize these tensions in the following excerpt:

> It is not easy to let go of a musical system in which masterpieces of indescribable beauty have been produced for centuries, nor is it easy to abandon a theory which was believed to be as absolutely true as a law of nature, just as it was no easy task to jettison a system of physics which from time immemorial had offered an explanation of all reality and, through its practical application, had rendered incalculable services to humanity. When a system's time is up, when it has had its innings, when new phenomena raise their heads and cannot be either understood or treated by the old theory, […] it is high time for a handful of creative people to branch out from the well-trodden paths and search for a new system, for a new perspective on reality which appears capable of incorporating the new modes of experience and experiential data.[117]

We are diving directly in to a point in history in which scientists and artists alike faced a critical turning point, searching within the depths of the complex cultural *Zeitgeist* that housed it. Independent of the fact that music and physics are entirely different disciplines, similar aspects of the physicists' and composers' changing worldviews can be identified. The correlation between the tensions surrounding the fundamental crises in physics and

[117] Mark Delaere and P.H. Daly, "Mutations in Systems in the Natural Sciences and Music in the First Half of the Twentieth Century," *International Review of the Aesthetics and Sociology of Music* 21, no. 1 (1990): 23.

music can be framed through a direct challenge to intuitions [*Anschauung*] determined from experience and visualizability [*Anschaulichkeit*] through models about the world, with such an upheaval demanding a shift in scientists' and musicians' worldviews to interpret and comprehend the proposed solutions put forth by Schrödinger and Schoenberg. I investigate these concepts in the context of Schoenberg's twelve-tone composition method and Schrödinger's wave mechanics.

I should emphasize that I am not implying a direct, one-to-one conceptual mapping of the innovations in modernist music practice and theoretical physics in this work. My aim is to point out striking similarities between the composer's and physicist's shared challenge of confronting new ideas that—on the surface—demanded a fundamentally reoriented way of thinking about the world; these ideas especially challenged both the role of intuition and experience, visualizability and coherence, and the interconnections between language and reality in the scientific process of constructing models and the musical process of composition. Independent yet simultaneous crises within the shared historical, cultural, and geographic *fin-de-siècle* Vienna context is unique precedent for investigating the possibility of an easily overlooked yet highly integrated pattern of thought, especially one so intertwined to a precise historical time and place.

In the early decades of the 20th century, the disciplines of both music (in the Western-classical tradition) and theoretical physics were characterized by questions that directly challenged the history of the practice. Composers desperately required an expanded harmonic syntax to express their changing musical ideas, insights perhaps derived as a reaction to new societal forces such as increased urbanization and

technological advancement. Physicists couldn't fathom how the statistical behavior of subatomic systems went against previously established conceptions of space as a continuum, for in quantum mechanics, particles were now independent events, and it was impossible to know anything about what happens in between measurements. Both composers and physicists faced unexplored territory in the post-tonal and quantum realms of their craft, and it wasn't clear at all what insights that further exploration (and manipulation) would yield. Thus, their prior intuitions were directly challenged.

Brief Introduction to Kant's Anschauung *and* Anschaulichkeit

The concepts of *Anschauung* and *Anschaulichkeit* were originally put forth by the philosopher Immanuel Kant in his monumental book *The Critique of Pure Reason*.[118] *Anschauung* is often translated to mean "intuition," referring to an intuition that results from a combination of cognition and perception. *Anschaulichkeit* refers to the *visualizability* of an object; it is less abstract than *Anschauung*. *Anschaulichkeit* describes what is immediately grasped by our perceptions and confirmed by our intuitions. In other words, the visualizability [*Anschaulichkeit*] is a property of the object itself, its ability to be perceived and interact with our senses, and visualization [*Anschauung*] of an object comes from our *ability* to perceive, and therefore come to know the object.

Anschauung and *Anschaulichkeit* have been explored related to Schrödinger's wave mechanics and the emergence of quantum theory more generally, but have been relatively unexplored related to Schoenberg's musical thinking. This makes sense—as

[118] For an explanation of *Anschauung* and *Anschaulichkeit* in the context of imagery in physics, see Arthur I. Miller, "Imagery and Representation in Twentieth-Century Physics," in *The Cambridge History of Science*, ed. Mary Jo Nye, vol. Volume 5: The Modern Physical and Mathematical Sciences (Cambridge: Cambridge University Press, 2003), 191–215.

music unfolds sonically over time, what could visualization of an object have anything to do with this? The answer lies partially in our music-theoretic thinking; analogous to the model-construction aspect of physics, music analysis is—to some degree—a process that utilizes *visually*-aesthetic models in accordance to the score. In the tradition of Western music analysis, theorists often employ directional language and visual diagrams to outline and support their analyses; visualizability has played a significant role in shaping the discipline of music theory. In my approach to Schoenberg's work, I will focus more on the intelligibility of his music, as it was understood from the perspective of the audience.

Anschauung *and* Anschaulichkeit *in Schrödinger's Wave Mechanics*

Earlier in this chapter, I discussed several of the fundamental, seemingly unsolvable problems that arose in physics near the turn of the century, the culmination of which laid the groundwork for the necessity of a radical shift in thinking—the concepts of classical physics simply did not suffice to explain the recently explored atomic realm of Nature. Principal among these solutions to the problem, though, were the competing models attempting to explain the nature of atoms and their behavior, specifically those put forth by Danish physicist Niels Bohr, German physicist Werner Heisenberg, and Austrian physicist Erwin Schrödinger. Schrödinger's wave mechanics—his theoretical solution to this problem—remains the most successful of the proposed atomic models, and this can be attributed in part to Schrödinger's heightened concern for the interrelationship between language and reality, and the necessity of such a model to be visualizable and intuitive. These concerns are reflective of the broader thematic parallels shared between the simultaneous crises in physics and music outlined earlier—

Anschauung (Intuition) and *Anschaulichkeit* (Visuality, or Intelligibility)—and I will address evidence of these concepts specifically with regards to Schrödinger's wave mechanics.

In 1926, Schrödinger outlined the principles of his wave mechanics in a series of four papers, all sharing the title, "Quantisierung als Eigenwortproblem," or "Quantization of the Eigen-Value Problem." Simply put, Schrödinger's wave mechanics suggested that the behavior of subatomic systems can be described by a *wave function*, denoted with $\Psi(x,t)$. According to Max Born's statistical interpretation, the wavefunction represents the *probability* of finding a particle at a particular point in space at a certain time. This is understandably troublesome; Born's statistical interpretation introduces a fundamental *indeterminacy* regarding the behavior of subatomic systems. According to classical models in physics, we can mathematically predict physical phenomena; for example, if we know the speed at which a car is travelling at one moment, we could calculate the exact location where that car would be after some time has passed. But Schrödinger's wave mechanics is based on the premise that in the subatomic world, we cannot predict exact outcomes; we can only make a *guess* about where the particle *could be*, according to some calculated probability.

So, if we can't predict where the particle is going to be, then surely, we know where it had come from, right? In the quantum world, this is also not the case. Schrödinger's wavefunction represents *all possible theoretical states* in which the subatomic system could exist, and we cannot realize its physical state until we take a measurement; this is the concept of the *principle of superposition*.[119] The act of taking a

[119] *Schrödinger's cat* is a widely known thought-experiment that demonstrates this concept. A cat, vile of poison, and a lever are put into a box. If the lever is pressed, the vile will be broken, and the cat would be

measurement disturbs the quantum system, and we say that the wavefunction *collapses* to a spike at the position where the particle was measured. Rather than a continuous wavefunction representing all possible theoretical states, upon measurement, the wavefunction represents one possible state, the state that was measured.

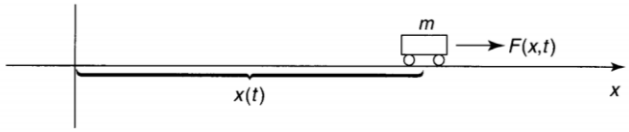

Figure 3. A classical picture of a car in motion as a function of position. Given initial conditions, we could predict the location of the car at some future time.[120]

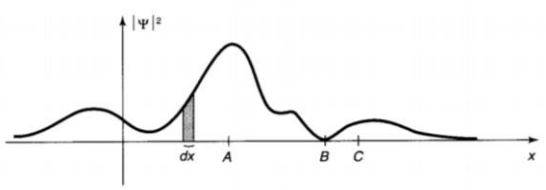

Figure 4. A typical wavefunction as a probability curve.[121]

Although we retain the ability to take measurements on the subatomic, the very act of measurement inherently *changes* the quantum system itself—this is known as the *observer effect*. If our aim was to measure the position of a particle at some time, then, because measuring that quantity affects the system itself, then we cannot know other properties of the particle at that position in space (i.e. its momentum). This idea was

exposed to the poison. After the box is sealed, you are asked: is the cat dead or alive? You cannot know for sure until you open the box—analogous to taking a measurement. Until you as the experimentalist do so, the cat can be thought to exist simultaneously in a state of being alive or being dead; this is the principle of superposition.

[120] David J. Griffiths, *Introduction to Quantum Mechanics* (Upper Saddle River, NJ: Prentice Hall, Inc., 1995): 2.

[121] Ibid., 3.

shown by Heisenberg through his Uncertainty Principle, and adds another philosophical complication regarding the issue of indeterminacy at the heart of quantum mechanics.

The premises of quantum theory and implications of Schrödinger's wave mechanics are understandably difficult to grasp, and I have only barely scratched the surface of the deeper physical problems at hand. Our macrocosmic experience with the physical world—such experience from which we derive our intuitions and assumptions about how things work—simply does not align with the atomic realm. Schrödinger's wave mechanics was his solution to a physical problem, but led to a host of new philosophical questions. Our inability to grapple with the notion of indeterminacy of quantum theory has repercussions that continue today—physicists and philosophers continue to debate what constitutes a measurement, or other interpretations of Schrödinger's wave function idea. My aim at this point, however, is to highlight the concepts of *Anschauung*, *Anschaulichkeit*, and *Auslegung* found in these discussions.

***Anschauung* (Intuition).** One of the major problems here is that quantum theory fundamentally does not align with our intuitive ideas about the physical laws of Nature. Rudolph Peierls, a theoretical physicist who studied directly under early quantum pioneers, said that, "our intuition, of course, has developed from the experience of everyday life, which is on such a different scale from the atom, that these quantum effects – these complications – are unimportant."[122] As physicists probed the depths of the microscopic, they would emerge with more questions. What are we to make of the notion that subatomic systems are inherently probabilistic? Can we make sense of behavior that is so unlike our everyday experiences?

[122] P.C.W. Davies and J.R. Brown, eds., *The Ghost in the Atom: A Discussion of the Mysteries of Quantum Physics* (Cambridge: Cambridge University Press, 1986): 71-72.

The concept of *Anschauung* (often translated as "intuition") is intrinsically part of Schrödinger's wave-mechanical formulation. Burwell writes, "because Schrödinger's wave theory of matter has its physical grounding in our embodied experience of matter as continuous in time and space, assuming an unbroken line between the macrocosmic realm, the microcosmic realm, and classical concepts, it is available to the customary intuition that enables us to understand our world and our place within it."[123] We intuit that there cannot be a time or place in which matter does not exist, for there are events and things that connect to one another, continuously. Schrödinger argued that this unbreakable continuity between the macro- and microcosmic realms was an especially important prerequisite for a classically tenable physical theory, because our intuitions are rooted in our experiences with the macrocosmic.[124]

The concept of *Anschauung* was also an important characteristic of the broader quantum-interpretation debates. The camp of quantum pioneers—including Schrödinger, Heisenberg, Bohr, among others—debated and disagreed strongly "over how intuitive a legitimate theory of atomic matter had to be."[125] The notion that intuitiveness as a necessary characteristic of a successful atomic theory was a central argument between Schrödinger and Heisenberg. Shortly before Schrödinger proposed his theoretical wave

[123] Jennifer Burwell, "The Physics of Visualizability, Intuition, and Aesthetics," in *Quantum Language and the Migration of Scientific Concepts* (Cambridge, MA: The MIT Press, 2018), 95.
[124] "So, the facts of observation are irreconcilable with a continuous description in space and time; it just seems impossible, at least in many cases. On the other hand, from an incomplete description—from a picture with gaps in space and time—one cannot draw clear and unambiguous conclusions; it leads to hazy, arbitrary, unclear thinking… What is to be done? The method adopted […] amounts to this: we do give a complete description, continuous in space and time without leaving any gaps, conforming to the classical ideal—a description of *something*. But we do not claim that this 'something' is the observed or observable facts; and still less do we claim that we thus describe what nature (matter, radiation, etc.) really is. In fact, we use this picture (the so-called wave picture) in full knowledge that it is neither." In Erwin Schrödinger, *Science and Humanism: Physics in Our Time* (Cambridge: Cambridge University Press, 1961): 40.
[125] Burwell, "The Physics of Visualizability," 72.

mechanics, Heisenberg offered a solution to the quantum problems in the form of a *matrix* mechanics. Heisenberg's and Schrödinger's quantum theories were theoretically equivalent (as Schrödinger demonstrated in his 1928 paper, "On the Relations Between the Quantum Mechanics of Heisenberg, Born, and Jordan, and that of Schrödinger"), but presented in different ways: Heisenberg formulated his description of atomic behavior according the mathematical *matrices* that evolved in time, whereas Schrödinger formulation was according to the *wavefunction*.

The crux of the argument, then, was centered around which conceptualization was inherently more intuitive. Partly because Schrödinger's solution relied on the classical concept of a *wave* as a springboard for physicists to draw upon their intuitions, his wave mechanics became much more widely accepted in this physics community. A wave is something we can draw on our experiences to visualize and comprehend; what can we intuit of matrices? Burwell expands on this, in her chapter on "The Physics of Visuality, Intuition, and Aesthetics":

> While both Bohr and Schrödinger anticipated some degree of evolution in our language and in our concept formulation, Heisenberg's formal model hung on this evolution, just as it hung on establishing the primacy of mathematics over more perception-based experimental evidence as the intuitive point of entry to the microcosmic realm.[126]

One of the main challenges of physics is utilizing the language of mathematics as a tool in order to formulate a model for physical phenomena, a model that arguably depends on—or is consequential of—our collective strive towards an aesthetic order in the pursuit of science. Although there are many facets of quantum mechanics that seem to break with our intuitive understanding of the world, Schrödinger's wave mechanics solution draws

[126] Burwell, "The Physics of Visualizability," 100.

on aspects of our intuition, affording us the opportunity to grasp on to something we know as we traverse new territory. If intuitions develop from our sense-perceptions, and if intuition is a prerequisite for a successful physical theory, then what of the concept of *Anschaulichkeit* in this debate?

***Anschaulichkeit* (Visualizability or Intelligibility).** In classical physics, the visualizability of a theory was not a concern, because theories were formulated in the macrocosmic spatio-temporal framework in which we interact with the world and develop our intuitions. With the emergence of quantum theory, however, physicists were forced to grapple with the question: is visualizability a *necessary* condition for an appropriate, successful physical theory? Assuming that it is implies that the pursuit of physics is ultimately about describing Nature, and our sense-perception mechanisms are the limitations of what is knowable. Schrödinger argued that visualizability is importance because physics is about describing phenomena for the purpose of *understanding*, and understanding is derived from our experiences.[127]

As we saw earlier, Schrödinger argued that his wave mechanics was more intuitive than Heisenberg's matrix formulation, partially because the concept of a wave was not only recognizable as a classical concept, but also because it is visualizable. Schrödinger argued that "mathematically equivalent theories may differ in their possible extensions, and that they can differ in their *fruitfulness*. […] He contends that *anschauliche* theories are preferable because they are heuristically more powerful."[128] I

[127] Schrödinger writes that he was "deeply imbued at the time with the writings of Spinoza, Schopenhauer, and Mach." In Erwin Schrödinger, *My View of the World*, trans. Cecily Hastings (Cambridge: Cambridge University Press, 2008), viii. He was aware of Mach's philosophy of science, and adopted a similar view of neutral monism, that minds and bodies do not differ in their intrinsic nature, but the difference is in how their common material is arranged; see Henk W. de Regt, "Erwin Schrödinger, *Anschaulichkeit*, and Quantum Theory," *Studies in the History and Philosophy of Modern Physics* 28, no. 4 (1997): 467.
[128] Regt, "Erwin Schrödinger, *Anschaulichkeit*, and Quantum Theory," 470.

can't help but recall here traces of Mach's principle of *Denkökonomie* underlying the notion that visualizable physical theories would, in some sense, be regarded as intrinsically more useful and elegant.

Regt writes that "in 1926 the leading quantum physicists believed that quantum theory required the renunciation of any visualization, and Schrödinger's theory, if presented in the 'more *anschaulich* manner,' might have seemed a reactionary attempt to return to classical physics."[129] This is significant, because although even today we are still reckoning with the counter-intuitive implications of quantum theory, Schrödinger demonstrated the value in drawing on experience in the process towards scientific understanding. In his book *Science and Humanism: Physics in Our Time*, Schrödinger elaborates:

> In this we must, of course, take shape (or Gestalt) in a much wider sense than as geometrical shape. *Indeed there is no observation concerned with the geometrical shape* of a particle or atom. It is true that in *thinking* about the atom, in drafting theories to meet the observed facts, we do very often draw geometrical pictures on the black-board, or on a piece of paper, or more often just only in our mind, the details of the picture being given by a mathematical formula with much greater precision and in a much handier fashion than pencil or paper could ever give. That is true. But the geometrical shapes displayed in these pictures are not anything that could be directly observed in the real atoms. The pictures are only a mental help, a tool of thought, an intermediary means, from which to deduce, out of the results of experiments that have been made, a reasonable expectation about the results of new experiments that we are planning.[130]

Although advocating for the importance of *Anschaulichkeit*, Schrödinger held that whatever image or picture a model outlined did not necessarily have to explain reality exactly; the wavefunction is not actually a physical wave propagating in time at the

[129] Ibid., 476.
[130] Schrödinger, *Science and Humanism*, 22.

microscopic level.[131] Pictures or models were not only useful as mechanisms for understanding, but allowed physicists to turn again the "rather gross dichotomy of true and false statements."[132] By emphasizing the concept of *Anschaulichkeit* in his wave mechanics, Schrödinger solved the quantum problem through an expansion of the classical paradigm, rather than a revolution.[133]

Anschauung *and* Anschaulichkeit *in Schoenberg's View of Art*

In his 1937 essay titled, "How One Becomes Lonely," Schoenberg reminisces—in an almost bitter tone—about his gradual adoption of chromaticism, and the changing tides of audience reception to his "new" method of presenting his musical ideas, swaying from near revolt to warm embrace. He writes, boldly:

> It was the first step towards a style which has since been called the style of 'atonality.' Among progressive musicians it aroused great enthusiasm. New sounds were produced, a new kind of melody appeared, a new approach to expression of moods and characters was discovered. *In fact, it called into existence a change of such an extent that many people, instead of realizing its evolutionary element, called it a revolution.* Although the word revolution has not, at this time (about 1907), exclusively the ominous political flavor which is attributed to it today, *I always insisted that the new music was merely a logical development of musical resources*. But of what use can theoretical explanations be, in comparison with the effect the subject itself makes on the listener? What good can it do to *tell* a listener, 'This music is beautiful', if he does not *feel* it? [emphasis mine][134]

[131] Along with Mach, Schrödinger was also influenced by Ludwig Boltzmann's philosophy of science, specifically regarding his concept of *Bild* (picture). An interpretation of the Schrödinger equation is also commonly referred to as the "Schrödinger picture," see Erhard Scheibe, "Erwin Schrödinger and the Philosophy of the Physicists," in *Erwin Schrödinger's World View*, ed. Johann Götschl, vol. 16, Series A: Philosophy and Methodology of the Social Sciences (Boston: Kluwer Academic Publishers, 1992): 25.
[132] Scheibe, "Erwin Schrödinger and the Philosophy of Physicists," 28.
[133] For musical comparison, Schoenberg viewed his "atonal" music as not really atonal at all; he considered his twelve-tone composition technique as within the realm of harmony. It was through the expanded definitions of the classical concepts of consonance and dissonance (or, rather, the elimination of dissonance), that his "revolutionary" approach could be considered an expansion of the classical paradigm.
[134] Arnold Schoenberg, "How One Becomes Lonely," in *Style and Idea: Selected Writings of Arnold Schoenberg*, ed. Leonhard Stein, trans. Leo Black (Berkeley, CA: University of California Press, 1975): 49-50.

What contemporary listeners and critics failed to recognize, Schoenberg argues, was that his composition methods were the next logical step in the progression of music. His implementation of chromaticism was not in itself revolutionary, but grounded in the classical paradigm composers set forth before him, an almost formulaic model governing the ebb and flow of music by resolutions of dissonance to consonance in time.[135] The solution that Schoenberg needed to address the "problem of tonality" was an expanded harmonic syntax to effectively and accurately express his modernist musical ideas; the limitations of the classical model of harmony were insufficient to do so.

The phenomenon of atonality is often described as beginning with a "birth," or similarly, as an "emancipation of dissonance." This rhetoric implies a singular moment or individual to whom we can attribute as its source. A tendency remains to assign Arnold Schoenberg to this role, despite his dislike of the term "atonal" and insistence that his twelve-tone composition method was the next logical step in the progression of the German music tradition. I hold this conviction in my approach to understanding Schoenberg; he was grounded in the work of composers before him, with a particular admiration for Beethoven and Brahms.[136] He writes, "Analysts of my music will have to realize how much I personally owe to Mozart. […] This will not help them to appreciate my music, but to understand Mozart. And it will teach young composers what are the

[135] Schoenberg writes that publication of his *Harmonielehre* treatise was an important factor in convincing critics that his methodology was rooted in classical foundations, see Schoenberg, "How One Becomes Lonely," 50-51: "But just because I was so true to our predecessors, I was able to show that modern harmony was not developed by an irresponsible fool, but that it was the very logical development of the harmony and technique of the masters."
[136] Arnold Schoenberg, "Brahms the Progressive," in *Style and Idea* (New York: Philosophical Library, 1950), 52-101.

essentials that one has to learn from the masters and the way one can apply these lessons without the loss of personality."[137]

From our vantage point of the present, it is difficult to imagine how the Western musical tradition may have developed any other way during this time. Atonality did not *necessarily* have to happen; it is not certain that composers would have experimented and expanded musical language in this way without him. Many composers around 1900 recognized an exhaustion of tonality and anticipated that substantive changes were on the horizon. Music theorist Ethan Haimo writes that, "if indeed the idea of atonality was not so much the product of anonymous historical forces as it was the specific notion of a single thinker, then we are faced with a basic problem in the epistemology of music: What was there in Schoenberg's though that brought about the birth of atonality?"[138] In this section, I suggest that resonance with *Anschauung* and *Anschaulichkeit* in Schoenberg's thinking could shed light on one aspect of this complex historical question.

***Anschauung* (Intuition).** Schoenberg was immersed in the German-Idealist philosophical tradition, particularly with regards to aesthetics. This tradition stems all the way back to Immanuel Kant, whose aesthetic views resonate with Schoenberg's conception of art. It is conceivable, too, that Schoenberg was well aware of Kant's aesthetics—his personal library contained eleven of Kant's publications, including his *Kritik der reinen Vernunft* (*Critique of Pure Reason*) in which Kant discusses *Anschauung*. For Schoenberg, art was an image presented for the immediate experience,

[137] Ibid., 71.
[138] Ethan Haimo, "Schoenberg and the Origins of Atonality," in *Constructive Dissonance: Arnold Schoenbergand the Transformations of Twentieth-Century Culture*, ed. Juliane Brand and Christopher Hailey (Berkeley: University of California Press, 1997), 71.

a vehicle for creative expression to be understood directly by the senses. This resonates with Kant's notion of *Anschauung*, because art should be experienced and understood *without the intervention of conceptual thought.*[139] According to Schoenberg, the musical idea is a concrete thought [*Gedanke*], rather than an abstraction. Music theorist John Covach writes,

> It is entirely possible that Schoenberg wanted, through music, to explore the possibilities of unfolding the vision presented to him through *intuition.* The vision is of something otherworldly; but references to tonality or to traditional forms draw the mind back to culture, to the world of man [emphasis mine].[140]

His heightened concern for twelve-tone composition as a method for logical, clear communication of the musical idea—his artistic vision—is rooted in an effort to do-away with subjective interpretation of the music itself; atonality was a dream of an absolute musical language for immediate understanding.

There is a subtle connection here, too, with the idea of Schoenberg as a singular revolutionary. His twelve-tone composition method seems to dispose of previous assumptions about musical conventions and how those conventions were so reliant on previous standards of aesthetic beauty. Schoenberg didn't believe that art was meant for pleasure or entertainment (among others in the Secession in the decades after the turn of the century) but was fundamentally a mechanism for communicating Truth. We continue to ascribe the role of "revolutionary" to Schoenberg in part because it seems as though his twelve-tone method contradicted everything listeners had come to *expect* from music;

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[139] Arnold Schoenberg, *The Musical Idea and the Logic, Technique, and Art of Its Presentation*, ed. Patricia Carpenter and Severine Neff (New York: Columbia University Press, 1995), 2.
[140] Covach, John, "The Sources of Schoenberg's 'Aesthetic Theology,'" *19th-Century Music* 19, no. 3 (Spring 1996): 261.

their intuitions no longer applied. When a listener can no longer identify a tonic, the center around which Western musical had been based up until this point, the new music was incomprehensible. Similar to the emergence of quantum mechanics, composers began exploring a new realm of musical possibilities, a realm in which the intuitions we had developed could no longer guide our judgements. In order to get there, Schoenberg had to rewrite the grammar of the musical language—but he did not invent an entirely new vocabulary.

Schoenberg's insistence that his music was a logical continuation of what came before stemmed from a deeper desire for it to be understood and comprehended. If he could identify how his compositional method related to the music of before, not only could this increase his credibility, but demonstrate its relatability to the logic and intuitions aligned with prevailing musical practices. In fact, rather than using the word "atonal," Schoenberg had suggested terms like "polytonal" or "pantonal," terms that "imply an expansion or evolution of past procedures, not their utter abrogation."[141] In his critical essay outlining his dodecaphonic compositional process, Schoenberg writes:

> Composition with twelve tones has no other aim than comprehensibility. In view of certain events in recent musical history, this might seem astonishing, for works written in this style have failed to gain understanding in spite of the new medium of organization.[142]

Schoenberg's music challenged listeners' intuitions because he rewrote grammatical rules of musical syntax. Our intuitions are rooted in tradition, and by situating his music in the

[141] Ethan Haimo, *Schoenberg's Transformation of Musical Language* (Cambridge: Cambridge University Press, 2006), 2.
[142] Arnold Schoenberg, "Composition with Twelve Tones," in *Style and Idea* (New York: Philosophical Library, 1950), 103.

lineage of his composer predecessors, he sought to frame his music as the next logical development in the progression of the Western classical tradition.

***Anschaulichkeit* (Visualizability or Intelligibility).** Kant's notion of *Anschaulichkeit* involves the capability of an object to be understood or comprehended via our senses; it is the recognition of something visually, or perhaps aurally, from an interaction through immediate experience. Although music itself isn't a visual art, Schoenberg once said that "what a painting meant to [him] … was the same to [him] as making music."[143] Additionally, music theorists in the Western tradition historically have a tendency to draw upon visually aesthetic models to derive structures underlying musical pieces (Schenker's *Ursatz* structures as one example). We map and speak of musical relationships visually—pitches are *high* or *low*, we transpose *up* or *down*. Schoenberg—who was also an amateur painter—employed language rooted in visual references to describe his music-theoretical ideas. In his essay, "New Music, Outmoded Music, Style and Idea," he writes:

> Style is the quality of a work and is based on natural conditions, expressing him who produced it. In fact, one who knows his capacities may be able to tell in advance exactly how the finished work will *look* which he still *sees* only in his *imagination*. But he will never start from a preconceived *image* of a style; he will be ceaselessly occupied with doing justice to the idea. He is sure that, everything done which the idea demands, the *external appearance* will be adequate [emphasis mine].[144]

[143] Reinhold Brinkmann, "Schoenberg the Contemporary: A View from Behind," in *Constructive Dissonance: Arnold Schoenberg and the Transformations of Twentieth-Century Culture*, ed. Juliane Brand and Christopher Hailey (Berkeley: University of California Press, 1997), 199.
[144] Schoenberg, "New Music, Outmoded Music, Style and Idea," 47.

However, it is the issue of *intelligibility* on which I aim to focus. Schoenberg's new compositional method suggested that traditional notions of harmony need not be the sole guarantor of musical coherence. In his essay, "My Evolution," he elaborates:

> Coherence in classic compositions is based – broadly speaking – on the unifying qualities of such structural factors as rhythms, motifs, phrases, and the constant reference of all melodic and harmonic features to the center of gravitation – the tonic. Renouncement of the unifying power of the tonic still leaves all the other factors in operation.[145]

By shifting his focus away from a tonic-centric construction, he forced other musical aspects into prominent, organizational roles. The root of intelligibility of his music is evident from his heightened concern for musical comprehensibility and coherence.

According to Schoenberg, comprehensibility and coherence of a musical piece were intimately related, and these qualities were generated by musical form. Because composition is a process of communicating a musical idea, it was imperative that a musical work is composed in its entirety as an organic whole.[146] To Schoenberg, comprehensibility—like intelligibility—is the condition that allows listeners to grasp the completeness of a musical work. Carpenter and Neff write, "although Schoenberg usually describes it as an attribute of objects, it is an activity, an ability of the subject [*Auffassungvermögen*] to bind impression into a form. In general, he says, a thing is comprehensible when it is surveyable and suitably articulated."[147] In his essay, "Eartraining through Composing," Schoenberg elaborates further:

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[145] Arnold Schoenberg, "My Evolution," *in The Musical Quarterly 75th Anniversary Issue: Highlights from the first 75 Years*, no.4 (Winter 1991), 152.
[146] The tradition of organicism is a significant part of Schoenberg's thinking about music. Organicism is the idea that individual parts of a system are related to one another in a natural, coherent way. This shaped Schrödinger's worldview is some ways, too; both were highly concerned with the relationship between whole and part.
[147] Schoenberg, *The Musical Idea and the Logic, Technique, and Art of Its Presentation*, 23.

> The principal function of form is to advance our understanding. […] And though the object of form is not beauty, by providing comprehensibility, form produces beauty. […] Forms are primarily organizations to express ideas in a comprehensible manner.[148]

In Schoenberg's view, musical coherence (or, intelligibility) derives from unifying qualities; a musical message is communicated when all aspects of the piece relate to one another and bind together via an organic whole. Additionally, his work on the twelve-tone method "confirmed [his] belief that the nature of coherence in any piece of music (tonal, atonal, twelve-tone, and so forth) is the expression of a musical idea."[149] By shifting the musical grammar away from a tonic-centric focus, other musical dimensions become the formal guarantors. This is the logic underlying his compositional process.

Schoenberg's music was initially widely criticized by the public; on several occasions, riots broke out at concerts. On the surface, Schoenberg's music at first may reasonably sound like nonsense, for it seems to lack structure or coherence, although Schoenberg was actually very concerned about these musical aspects. From my own experience, I was initially frustrated with his music, because his dissolution of the classical harmonic paradigm was a direct challenge to the intuitions that I (and audience members at the time) had subconsciously developed over time. Like the experience of immersing oneself in a new language, encountering words to describe something

[148] Arnold Schoenberg, "Eartraining through Composition," *Style and Idea* (New York: Philosophical Library, 1950), 149-150.
[149] Patricia Carpenter and Severine Neff, "Schoenberg's Philosophy of Composition: Thoughts on the 'Musical Idea and Its Presentation,'" in *Constructive Dissonance: Arnold Schoenberg and the Transformations of Twentieth-Century Culture*, ed. Juliane Brand and Christopher Hailey (Berkeley: University of California Press, 1997), 147.

differently than in your native language opens the doors to a new sonic world previously unexplored.

Schoenberg insisted his dodecaphonic approach to composition was indeed in line with prior Western styles, positioning himself as next in a line of influential composers. Not only was this belief his personal conviction, it also represents a subtle point—that our ideas arise from a combination of our experiences, interactions intuitions, assumptions, and biases. Schoenberg's ideas about art were not new nor revolutionary; his lasting impact is contributed to his unique synthesis and application of his multifaceted interests that led him to develop this approach. His music "is at once a subject of [the Viennese] state of mind and its complex symbolic representation;" it serves as a social-cultural mirror held up to face a Vienna on the brink.[150] By aligning himself with tradition, his aim was to advocate that his music as understandable, intelligible, and an expansion of the classical paradigm. In the next sections, I examine more closely the analogy to language and communication common to both Schoenberg's music and Schrödinger's physics, and highlight how this problem is exemplary of a broader challenge felt during this time.

Problems of Interpretation and the Limitations of Language

In order to embrace the implications of the parallel crises, there was a necessity for an expanded language to express new ideas about the world. In the arts, composers previously immersed in the conservative Western tradition had grown tired of the classical harmonic paradigm, and began experimenting with increased chromaticism as a

[150] Brinkmann, "Schoenberg the Contemporary: A View from Behind," 197.

mechanism for expression in order to express their new ideas, anxieties, or concerns consequential of modernism. In physics, new exploration of the subatomic level—a world in which our intuitions no longer apply—the models of classical physics could not account for such strange phenomena. Composers and physicists lacked the words to comprehend the implications of these discoveries, because the intuitions from the pre-revolution paradigm no longer applied. This was most evident through the limitations of languages.

Schoenberg and Schrödinger were both immersed in the aestheticism of the *fin-de-siècle,* a cultural movement in which Mach and Schenker were both also influenced and influential. This aestheticism was characterized with a heightened concern for interactions between sensations and the physical world, and more specifically, how those interactions guide our ability to recognize and derive structures. Schoenberg's composition roots stemmed directly from the German Romantic tradition and aestheticism of the *fin-de-siècle.*[151] His early period of composition is mostly characterized with pieces that adhere to the classical conceptions of harmony. Schoenberg wrote of his fondness for tonal practice:

> A longing to return the older style was always vigorous in me; and from time to time I had to yield to that urge. This is how and why I sometimes write tonal music. To me stylistic differences of this nature are not of special important. I do not know which of my compositions are better; I like them all, because I liked them when I wrote them.[152]

[151] "He shared with his older contemporaries, intellectual pioneers of Vienna's élite—a diffuse sense that all was in flux, that the boundary between ego and world is permeable. For him as for them, the firm traditional coordinates of ordered time and space were losing their reliability, perhaps even their truth." In Schorske, *Fin-de-siècle Vienna*, 345.

[152] Arnold Schoenberg, "On Revient Toujours," in *Style and Idea* (New York: Philosophical Library, 1950): 213.

Likewise, Schrödinger learned physics initially as an experimentalist which surely affected his philosophy of science.[153] Historian of science Walter Moore, in his comprehensive biography about Schrödinger, notes that "his work as a laboratory assistant helped to determine the philosophical framework that he was willing to accept as physical theory," and that "physics is not based upon mathematical fantasies but on a solid ground of experimental observations."[154] Their mutual development while immersed and practiced in the classical traditions paved the way for them to understand the limitations. The emergences of the serialism and quantum mechanics were consequence of a shared reaction against the *fin-de-siècle* aestheticism, which itself necessitated new (or, expanded) mechanisms for understanding a world that went against preconceived ideas of beauty.

Music Beyond Harmony: Issues of Syntax

A debilitating sense of impending destruction hovered above Vienna like a storm cloud in the early decades of the 20th-century; this cultivated a common desire for authentic communication and expression, a desire to understand one another in the wake of uncertainty and rapid change.[155] The buildings of the *Ringstrasse* were evidence of a past Austrian affluence, now representing a thinly veiled (rather, disguised) sense of refinement and stability. In the 1920s, Schoenberg moved beyond the aestheticism of the

[153] Regt, "Erwin Schrödinger, *Anschaulichkeit*, and Quantum Theory," 464.
[154] Walter Moore, *Schrödinger: Life and Thought* (Cambridge: Cambridge University Press, 1989), 59.
[155] See Schorske, *Fin-de-siècle* Vienna, 362: "Traditional aesthetic culture until the turn of our century had placed structure on the surface, to control nature and the life of feeling that pressed up from below. Schoenberg as psychological Expressionist confronted his listener with an art whose surface was broken, charged with the full life of feeling of man adrift and vulnerable in the ungovernable universe; yet beneath it he posited out of his own powers a subliminal, inaudible world of rational order that would integrate the chaos."

fin-de-siècle, upending the pre-established conventions of traditional harmony through his twelve-tone method of composition. For Schoenberg, the art of composing was about communicating the musical idea purely and simply in a manner beyond subjectivity, his artistic creed was concerned with "the breakthrough of the work of art from its inner existence to the world outside."[156] Music, to Schoenberg, was a mechanism for communicating Truth clearly and comprehensibly, and his task, ultimately, was the codification of a new musical language, in order to free music from the limiting conventions that had lost their meaning in the modern world.

Others in this same *fin-de-siècle* Vienna context grappled with the limitations of language, most notably including philosopher and Ludwig Wittgenstein and the Vienna Circle (*Wiener Kreis*). Wittgenstein's seminal work, the *Tractatus Logico Philosophicus*, is unlike any other work in the history of Western philosophy because he interrogated underlying structures of language through a series of statements rather than arguments. The implications of his work can be summarized in the following proposition: *Die Grenzen meiner Sprache bedeutet die Grenzen meiner Welt* (The limits of my language means the limits of my world). The Vienna Circle interrogated language through the foundations of logical positivism.[157] It is beyond the scope of my purpose here to trace potential direct or indirect connections between Schoenberg and Wittgenstein or the Vienna Circle; my aim here is to show that criticizing language was a cornerstone value of modernist Vienna. The purification of language was the last best hope for

[156] Brinkmann, "Schoenberg the Contemporary: A View from Behind," 202.
[157] The Vienna Circle was originally named *Verein Ernst Mach* (Ernst Mach Association) because they were also inspired by Mach's *Analysis of Sensations* and other writings on the nature of empiricism and the goals of science, see Karl Sigmund, *Exact Thinking in Demented Times: The Vienna Circle and the Epic Quest for the Foundations of Science* (New York, NY: Basic Books, 2017).

understanding and connecting with one another, especially in a fragmented society on the brink of a second World War.[158] The nuanced complexities of communication were revealed in the midst of rapid technological advancements, a quickly expanding city, and increasing political polarization. Symptoms of these issues were at the heart of the parallel crises in music and physics in this time and place.

Composers needed new methods for communicating their modernist musical ideas, and Schoenberg's system answered the demand. His re-writing of the rules of musical harmony dramatically challenged listeners' ability to derive cohesive structures or extract meaning from the music. Michel Philippot and Marcelle Clements write, "among composers who have chosen to alter the rules of assemblage rather than the alphabet, we must salute Arnold Schoenberg as one of the greatest. Through the invention of a new syntax, he invented an equally new language."[159] It was as though the audience was forcibly immersed in an entirely new language for the first time—it is understandable that at first his compositions sounded like nonsense! The audiences' perceptions had been unconsciously trained in the conventions of the classical paradigm—the constant ebb and flow between consonance to dissonance as music unfolds in time. Schoenberg's twelve-tone method of communicating his music ideas was a direct challenged to their intuitive musical experiences and, in a way, directly calling out their overreliance on *fin-de-siècle* aestheticism. Yet over time, audiences began to accept—even praise—his work. Returning to his essay, "How One Becomes Lonely," Schoenberg writes, "if previously my music had been difficult to understand on account

[158] Christopher Nupen, *The Language of the New Music*, Documentary (YouTube, 1985), https://www.youtube.com/watch?v=DRI_ZSh6iF4&t=157s.
[159] Michel P. Philippot and Marcelle Clements, "Arnold Schoenberg and the Language of Music," *Perspectives of New Music* 13, no. 2 (1975): 29.

of the peculiarities of my ideas and the way in which I expressed them, how could it happen that now, all of a sudden, everybody could follow my ideas and like them?"[160]

Mechanics Beyond Words: Issues of Interpretation

Intuition and intelligibility are inherently interconnected with one another: visualization provides an opportunity for developing intuition, and intuition guides our ability to visualize models and pictures. We consider now the challenge of *interpreting* a theoretical model, and specifically how the pluralism of interpretations prevailing nearly a century after Schrödinger's wave mechanics reflects Schrödinger's heightened awareness for the importance of effectively communicating scientific ideas, and the limitations of language in that process.

My aim here is to connect the emergence of the pluralism of quantum interpretations as symptomatic of the limiting role that language and communication play in the scientific process. The history of Western science has tended to operate under the assumption that language is useful to convey scientific concepts in a referential manner; for example, an "electron" is an electron because *that's what we English-speakers call it*. This was a particularly crucial concern for Schrödinger, Bohr, and Heisenberg, as they "spent so much time talking and writing about what quantum physics revealed about the nature of language, what language revealed about quantum physics, and why any attempt to describe quantum concepts in language was likely to end in failure."[161] Schrödinger exuded a heightened concern for the importance of language as a mechanism for mutual

[160] Schoenberg, "How One Becomes Lonely," 51.
[161] Burwell, "The Physics of Visualizability," 40-41.

understanding; language is the tool through which all humans can experience a common possession of the world.

Burwell writes that, "quantum behavior defies fundamental aspects of our experience, which means that any attempts to describe this behavior in language, which derives from perceptions tied to everyday experience, necessarily strays toward misrepresentation."[162] Earlier in this section, I discussed several ideas related to Schrödinger's wave mechanics, namely Born's statistical view of the wavefunction, the principle of superposition, and Heisenberg's uncertainty principle. These exegeses stem from a broader interpretation of Schrödinger's wave mechanics: The Copenhagen-Göttingen interpretation.[163] Although this view predominantly prevails in physicists current understanding of Schrödinger's wave mechanics, many other ideas have emerged, causing physicists to debate what understanding we are to make of a wave-mechanical description. Is there one correct interpretation of Schrödinger's wavefunction? Does prescribing to a particular interpretation of quantum mechanics necessarily influence our ability to use it as a model?

Schrödinger's wave mechanics—his solution to the quantum-theoretical problems following the turn of the century—contributed to the fundamental changes in physics as a discipline that prevailed throughout the rest of 20th century. In his book *Science and Humanism*, Schrödinger writes, "At the moment I wish to try and explain the radical change in ideas about matter that has taken place in the course of the last half-century. It came about gradually, inadvertently, without anybody aiming at such change. We

[162] Ibid., 10.
[163] The history and development of the Copenhagen interpretation is beyond my purpose here. The Copenhagen interpretation of quantum mechanics remains a prominent view of Schrödinger's wavefunction, although Schrödinger himself was unsettled by its assertions.

believed we moved still within the old 'materialistic' frame of ideas, when it turned out we had left it."[164] Revolutions are traced in hindsight; we cannot point to one individual moment, idea, or person in the history of modern physics as the singular turning point catalyzing the quantum revolution. The emergence of quantum mechanics took place over time and as a consequence of many experimentalists and theoretical physicists working together to describe and understand modern problems in physics, both newly-discovered physical phenomena and philosophical issues the discipline faced. Although one of many leaders of the quantum movement, Schrödinger's solution to the quantum problems has prevailed a pivotal model of subatomic behavior, and important to study in the broader contexts of the crisis in physics as a whole, and in conjunction with the simultaneous crisis in music in *fin-de-siècle* Vienna.

Conclusion

In this chapter, I investigated the parallel crises in music and physics alongside one another within the context of *fin-de-siècle* Vienna, specifically the post-tonal and quantum revolutions. I interrogated Arnold Schoenberg's twelve-tone compositions and Erwin Schrödinger's wave mechanics through Kant's notions of *Anschauung* and *Anschaulichkeit*. I discussed the limitations of language as a common motivator for Schoenberg's and Schrödinger's contributions. In doing so, it was my aim to show that, despite the many differences between the pursuit of art and science, common values or influences may weave through an interconnected fabric of scientific and creative

[164] Schrödinger, *Science and Humanism*, 12.

processes, and especially as our intuitions and interpretations about them change over time.

Underlying this work is a direct challenge to a pervading narrative that history is shaped by a succession of individual genius-agents. The crises in music and physics came to fruition due to the contributions of many; composers had been gradually implementing more chromaticism in their tonal language since the Romantic period, and it was from the steps taken by many physicists—theorists and experimentalists alike—that culminated in the emergence of quantum mechanics. Kuhn addresses the complexity of this historical challenge, writing:

> That is why a new theory, however special its range of application, is seldom or never just an increment to what is already known. Its assimilation requires the reconstruction of prior theory and the re-evaluation of prior fact, an intrinsically revolutionary process that is seldom completed by a single man and never overnight. No wonder historians have had difficulty in dating precisely this extended process that their vocabulary impels them to view an isolated event.[165]

Arnold Schoenberg and Erwin Schrödinger were situated in analogous positions to re-evaluate prior assumptions about the world, facing a realm of new possibilities for exploration. Both thinkers shared heightened concerns for broader, yet deeper questions about the world and the role of art and science in shaping how we interact with it. Although there is no evidence that they ever met, and have yet to be compared in depth, the common values they shared that aided in their approach to the crises of their time are profound and worth investigation. Music and physics are mechanisms for commenting on reality; progress in art and science is in accordance to the prevailing paradigms of the

[165] Kuhn, *The Structure of Scientific Revolutions*, 7.

time and place. As we consider the progression of music theory and discourse, it is important—perhaps, even necessary—to consider its connections to a broader *Zeitgeist*.

In this chapter my aim was to highlight the common problem both artists and physicists faced in Vienna during this time—it was a crisis of communication. We saw in this chapter an emergence of two very different ideas: one dealing with the process of composing with twelve-tones, and the other an attempt to describe behavior of the subatomic world. Schoenberg and Schrödinger share similar ideological roots, to Kant for example, and this comparison demonstrates one fascinating possibility for how ideas can be interpreted, utilized, and applied in drastically different ways. Following the turn of the century, both musicians and physicists were entering new territories, and had only their prior assumptions and intuitions to rely on in order to navigate it. Despite the diverging consequences of Schoenberg's and Schrödinger's work, they nonetheless shared similar values about the world, and both engaged with, guided, and motivated their respective disciplinary crises.

IV. CONCLUSION

Over the past several years, I have wondered about deeper connections between the arts and sciences. Could they share similar roots in in mathematics? Are they both consequences of an inherent desire to describe our experiences of reality (or whatever we deem that to mean)? Are they, in fact, unrelated entirely? Or, perhaps, are they intertwined via something broader, something all-encompassing? I have come to realize that, of the many ways to tackle such complex queries, one effective route is through the eyes and minds of the artists and scientists themselves. Perhaps looking to history could provide some answers to these questions.

It is unfortunate that the history of music and of physics have been similarly and separately characterized. In general, we are taught that music and physics have both progressed according to the substantial accomplishments of a select few, while ignoring or discounting many of those who may have inspired, encouraged, or influenced them. A history of science and music to which I aim to contribute is not one-dimensionally linear and characterized by a succession of genius-agents; rather, it is a history whose structure and strength come from the interactive strands of different, complex worldviews. This master's thesis is my attempt to parse through a moment of intertwined complexity between two seemingly independent threads.

My first case study was inspired by a single postcard in 1896, addressed to music theorist Heinrich Schenker from physicist and philosopher of science Ernst Mach. I couldn't help wonder what prompted such a letter; how did they know one another? Had they met before? What could they have talked about? A correspondence is a piece of evidence that allows us to trace the pathway of travelling ideas, and I aimed to understand

both the ideas that were shared by two prominent historical figures whose contributions have shaped my education so significantly, and also the means by which those ideas were shared. Addressing these questions meant exploring the fact that Schenker presented his "Geist" essay at a meeting of the *Philosophische Gesellschaft an der Universität Wien*, a society Mach helped establish. I examined the ideas of several of their mutual acquaintances and colleagues, including Eduard Hanslick and Guido Adler. I also read Schenker's "Geist" essay alongside Mach's "Vergleichung," identifying similarities in their thought processes and values, just as attendees at the Philosophical Society of Vienna may have done during the back-to-back meetings at which these two essays were presented.

Some music theorists, such as Nicholas Cook or Kevin Korsyn, have suggested that this postcard may not be so meaningful. Schenker, after all, corresponded with many of his contemporaries in Vienna—both in music and outside of it—and his liberal law school education and curiosity about science could have affected his thinking about music in any number of ways. I felt, though, this particular correspondence demanded further investigation, for it demonstrated, in a powerful and concrete way, that the history of ideas can unite seemingly disparate pursuits, crossing disciplinary boundaries in the process. That postcard is but one example of the potential consequences of ideological exchange, a quality attributed to *fin-de-siècle* Vienna culture and often cited as a catalyst for the ground-breaking discoveries and innovations that emerged from it. Schenker's and Mach's ideas would respectively go on to influence the evolution of music theory as a discipline (particularly in the United States) and the paradigm-shifting changes in modern physics that occurred in the early decades of the 20th century.

In my second case study, I traveled slightly forward in history to examine another curious intersection of music theory, philosophy, and physics: the work of music theorist Arnold Schoenberg and physicist Erwin Schrödinger. This case study was initially inspired by my simultaneous enrollment in post-tonal theory and quantum physics. I experienced firsthand a direct challenge to the intuitions I had developed from years as a musician and physicist trained to base my judgments on classical rules. All at once, it seemed as if my intuitions no longer applied, and in a deep sense I felt as though I didn't understand what music or physics was communicating to me about the world anymore. This loss of intuition is one reason why the emergence of post-tonal music and quantum theory proved so controversial.

Following the turn of the century, composers and physicists faced a number of difficulties. Their intuitions about classical harmony or our seemingly deterministic world were challenged by increased post-tonal experimentation and exploration into the atomic realm. Music theorists and physicist were confronted with the challenge of trying to explain entirely new phenomena; as a result of all of this, physicists attempted to develop visualizable models to identify underlying structures of inherently unpredictable behavior, while composers had to develop new forms of musical syntax to convey modern artistic ideas. In physics, Schrödinger's wave mechanics implied a statistical world fundamentally constructed by uncertainties. Schoenberg's twelve-tone composition method dissolved the dichotomy between consonance and dissonance, the most influential guarantor of musical coherence to date. Pre-conceived notions of a deterministic, structured, and predictable world had vanished, and artists and physicists were left to assemble a new world-view among the shattered pieces.

It was in Schoenberg's rewriting of musical grammar and Schrödinger's wave mechanics—their solutions to the epistemological problems of their respective disciplines—that I found shared values. Despite being *fin-de-siècle* Vienna contemporaries, these two thinkers have rarely been compared. Yet Schoenberg's twelve-tone composition method and Schrödinger's wave mechanics are consequential of strikingly similar ideas, and are born of similar influences and impulses. Both exhibit qualities that resonates with Kant's idea of *Anschauung* (intuition) and *Anschaulichkeit* (visualizability or intelligibility).

Theses core issues—the failure of intuition and limitations of language—were a common concern shared between all four thinkers interrogated in this thesis. Just before the turn of the century, Schenker and Mach foresaw their significance, mutually illuminating them through their writings about music and philosophy of science, respectfully. In the decades after, Schoenberg and Schrödinger were dealing with the delayed implications. As physics and music can both be considered ways-of-thinking to describe our experiences with the world, it is worthwhile to highlight how these shared concerns were so fundamental between two different disciplinary cultures.

In my mind, music theory in large part involves constructing models to describe how music "works" and why we experience it as we do. An analogous claim could be made of physics. Like music theory, it too involves constructing models to explain how something works, and how we experience it—in this case, though, that "something" is the physical world itself. Further, in both disciplines, we are motivated by a preference for aesthetic simplicity. Of course, any example of such overlapping motivations could reasonably derive from broader questions, including subject-object relationships to the

limitations of language, understanding our senses, and what we deem knowable through them. Nonetheless, this similar motivation is significant, and has partially influenced my own simultaneous pursuit of both art and science.

In his book *Music, Criticism, and the Challenge of History: Shaping Modern Musical Thought in Late Nineteenth-Century Vienna*, music theorist Kevin Karnes notes that, "the writer of history must endeavor to grasp and describe the nature of the spirit that pervades, underlies, and gave rise to the artifacts and phenomena under consideration."[166] Although I hope the reader can come away with a newfound curiosity for the interweaving history of physics and music, I hope even more to have shown the usefulness of cross-disciplinary communication and interaction for developing a deeper understanding of so many modes of thought—not just music theory and physics. The ability to express oneself—in words, in music, or maybe even in numbers—is something to value highly and hold closely. The limitations of disciplinary boundaries should not determine the applicability or usefulness of knowledge that can be drawn from another line-of-thinking. Additionally, geographical or cultural borders should not be barriers to something we all share—a desire to learn more about our world.[167] Music in particular is a force beyond words, and viewing it as a form of social commentary on the culture and society of its time is necessary work if we are to complicate and interrogate the historical time-and-place from which it came.

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[166] Karnes, *Music, Criticism, and the Challenge of History*, 54.

[167] Schrödinger beautifully reflects on this, see Erwin Schrödinger, *Science and Humanism*, 4-5: "I am born into an environment—I know not whence I came nor whither I go nor who I am. This is my situation as yours, every single one of you. The fact that everyone always was in this same situation, and always will be, tells me nothing. Our burning question as to the whence and whither—all we can observe about it is the present environment. That is why we are eager to find out about it as much we can. That is science, learning, knowledge, that is the true source of every spiritual endeavor of man. We try to find out as much as we can about the spatial and temporal surrounding of the place in which we find ourselves put by birth. And as we try, we delight in it, we find it extremely interesting."

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