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First Draft of Thesis: Concept Over Craft: The Acceleration of Creative Peaks in Early 20th Century Modernism

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Abstract

This study identifies a historical shift in classical music from experimentalism to conceptualism, specifically from Late Romanticism and Impressionism to Early 20th Century Modernism. Our findings indicate that this transition was associated with a significant increase in the age at which composers produced their most influential works, contrasting with the patterns observed in the visual arts as documented in previous literature.

Keywords: Creativity; Innovation; Art

1 Introduction

Some artists achieve remarkable success from a very young age, while others require years to attain recognition. Wolfgang Amadeus Mozart (1756–1791) exemplifies the former, showcasing extraordinary musical talent as early as the age of five. By the age of six, he was already touring Europe, performing for royalty such as Empress Maria Theresia and King George III, captivating audiences wherever he went[1]. A true child prodigy with an unerring musical ear, flawless memory, and impeccable sight-reading ability, Mozart's sensitivity to sound was so acute that loud noises would make him physically ill. At the age of four, he could discern whether an instrument was out of tune and could master a piece in just half an hour. By the age of five, he was an accomplished clavierist. Unlike other children who began attending school at six, Mozart started touring and performing with his father, Leopold, and his sister, Maria Anna. He composed his first symphony at the age of eight and went on to become a prolific composer, with a legacy of over 600 works, including more than 50 symphonies, 27 concert arias, 26 string quartets, 25 piano concertos, 21 stage and opera works, 17 piano sonatas, 15 masses, and 12 violin concertos[2]. Consequently, Mozart has become synonymous with the notion of a child prodigy and genius.

In stark contrast to the early genius exemplified by Mozart, some composers achieve their career peak in their later years, with some even reaching their creative zenith just before death. Ludwig van Beethoven (1770–1827) is a prime example of this delayed triumph. His most groundbreaking works, such as the Ninth Symphony, were composed in the later years of his life, even after the complete loss of his hearing. The maestro's journey in composition can be seen as a series of experiments and failures. Many of his earlier pieces are considered flawed even by his most ardent admirers, when he strove to emerge from the

[1] Rosselli, J. (1998). The life of Mozart. Cambridge University Press.

[2] Ashoori, A., & Jankovic, J. (2007). Mozart's movements and behaviour: A case of Tourette's syndrome? *Journal of Neurology, Neurosurgery, and Psychiatry*, 78(11), 1171–1175. https://doi.org/10.1136/jnnp.2007.114520

shadow of Haydn and Mozart. In the middle or "heroic" period, he produced works that the popular imagination most closely associates with his name, such as the third (Eroica) through the eighth symphonies, the fourth and fifth (Emperor) piano concertos, and the Violin Concerto. These compositions are characterized by their powerful, majestic, and heroic qualities, reflecting Beethoven's fascination with the concept of the heroic individual genius, which gained him immense popularity[3]. However, it is his third, or late period, spanning roughly from 1817 until his death in 1827, that established Beethoven as perhaps the most exceptional composer in the history of music. While his middle period is known for its mass appeal, it is the works of his late period—most notably the final piano sonatas (Nos. 30, 31, 32) and the late string quartets—that critics regard as possessing a nearly divine quality, representing the pinnacle of musical achievement. During this time, Beethoven's increasing deafness isolated him both from society and from the musical conventions of his time, pushing his compositions toward a more contemplative, meditative, and philosophical direction. His late works possess an otherworldly quality, often imbued with a quiet, rustic humor that is rarely acknowledged. Though considered innovative and rule-breaking, it is important to note, however, that Beethoven's late style was not a complete break from his previous work. Many elements that are often seen as revolutionary are, upon closer inspection, evolutionary. His late period represents an intensification of qualities that were already present in his earlier compositions[4]. This point of view comes not from a single music aficionado but represents a common perspective among professionals. E. T. A. Hoffmann [1776–1822] wrote that Beethoven was not at all the wild, untamed genius that people think he is. He was actually the most sober and correct musician that ever lived[5]. He approached music composition as if it were a research. Although there is anguish, this period reflects an inner peace that Beethoven seemed to have attained. After years of persistent searching, trials, and errors, he seemed to approach his ultimate artistic vision and found a sense of inner peace.

After observing this stark contrast, we are prompted to ask: what accounts for this dichotomy? Is there a deeper mechanism that can explain the two archetypes of artists, or, more broadly, of innovators?

Galenson's research offers an answer. Drawing from his theory of two distinct types of artists, Galenson conducted extensive studies on artistic creativity. He connected this theory to pivotal moments in art history, such as the shift from Abstract Expressionism to a new paradigm spearheaded by Frank Stella and Sol LeWitt in the 1950s (Galenson and Weinberg, 2000), as well as the emergence of movements like Impressionism, which broke away from

[3] Michael De Sapio, The Mystique of Late Beethoven, 2020

[4] Michael De Sapio, The Mystique of Late Beethoven, 2020

[5] Tibbetts, J., Saffle, M., & Everett, W. (2018). *Performing Music History: Musicians Speak First-Hand about Music History and Performance.* Springer. https://doi.org/10.1007/978-3-319-92471-7

traditional techniques (Galenson and Weinberg, 2001). In essence, Galenson developed an empirical approach to observing and confirming such transformations: a trend in public taste emerged in the art market, placing greater emphasis on conception over technique. This shift diminished the value of experience, thus increasing the relative significance of ideas, which allowed newer generations of artists to make substantial artistic contributions at a younger age than their predecessors.

Applying a similar perspective to music history, if there were a shift where public taste moved away from experimentalism towards conceptualism, the value of accumulated experience would have similarly diminished. This would, in turn, lower the age at which composers reach their creative peak. Thus, in this thesis, we extend Galenson's framework to a relatively unexplored domain with a different expressive language: classical music. Our objective is to validate whether a parallel phenomenon can be observed in this field. We begin by substantiating that Late Romanticism and Impressionism align with an experimentalist approach, while Early 20th-century music reflects a more conceptual orientation, as evidenced by music history research. Subsequently, we examine whether the transition from Romanticism, marked by experimentalism, to Early 20th-century music, characterized by a conceptual focus, led to a decrease in the age at which composers produced their most groundbreaking works.

2 Related Literature

Closely related to the work on innovators and artistic creativity are the works of Galenson. This work is further supported by research in psychology and music history, although these are of lesser importance compared to studies on creativity and innovation. Since this is the first draft of the thesis, the related literature review from these fields will be added later.

Galenson's contributions to this field are summarized in two of his books, where he introduces and elaborates on the concepts of conceptual and experimental innovators. Galenson (2006) introduces the concept of conceptual and experimental innovators in painting, quantifying artistic success through auction prices, textbook illustrations, and museum collections and exhibitions. He explores key questions, such as whether the distinction between conceptual and experimental innovators is rigid (arguing instead that it is a continuous spectrum), whether an artist's categorization can shift over their career, and how anomalies in art history arise from interactions among artists. Galenson (2001) further examines the relationship between age and artistic productivity, focusing on the dichotomy between experimental and conceptual innovators in modern art. He addresses the challenge of evaluating artistic success through market values, critical reviews, auction prices, textbook illustrations, and museum collections. By studying American and French painters from the 19th and 20th centuries, he finds that older artists like Jackson Pollock and Cézanne created their most valuable work later in life, while younger artists like Jasper Johns and Picasso peaked early. The work also discusses the role of age, intergenerational conflict, and changing career trajectories in the art world.

Apart from his books, Galenson co-authored two papers with Weinberg that apply his theory to events in art history, examining shifts in artistic innovation and the factors influencing the age of peak productivity in modern art. Galenson and Weinberg (2000) identify a shift in the 1950s in American art, which led to a decline in the age at which artists produced their most successful works. This transition involved replacing the traditional, technique-driven Abstract Expressionism with a conceptual approach that emphasized ideas over craftsmanship. As a result, younger artists were able to create high-quality art earlier in their careers because success relied less on accumulated skill. In a related study, Galenson and Weinberg (2001) argue that modern painting emerged in response to growing demand for artistic innovation. The gradual departure from traditional techniques initiated movements like Impressionism, while subsequent generations accelerated this break with the past by prioritizing conception over technique. This shift reduced the value of experience, enabling younger artists to make significant contributions at an earlier age.

I have summarized the key differences mentioned by Galenson (2006) in his book *Old Masters and Young Geniuses: The Two Life Cycles* and listed them in the table below for easy comparison, which we shall use for categorizing the different schools in music history to experimentalism or conceptualism.

Table 1: Comparison of Conceptual and Experimental Artists

Archetype	**Conceptual**	**Experimental**
Motivation	Communicate specific ideas or emotions	Aesthetic criteria
Goal (before production)	Precise	Imprecise
Procedure	Immediate and complete execution	Tentative and incremental
Feel of success	Often with certainty, clarity	Rare, with frustration
Number of goals in a career	Numerous	One
Sketches/Plans	Yes	No
Relation to previous work	Discontinuous, independent	Continuous, dependent
Attitude towards own work	Normal	Casual
Planning procedures	Important	Unimportant
Working procedures	Execute plan directly, or transfer idea from sketch	Alternates between executing and examining
Stopping procedures	When finished	When unsure how to continue; rarely considers it finished
Peak creative age	Early	Late

In summary, Galenson's theory, introduced in his books, is expanded through empirical studies that combine theoretical insights with historical events in art. However, his framework has not been extended to the domain of classical music. This research seeks to address this gap by applying Galenson's theory to the field of classical music, thereby exploring an area previously left unexplored.

3 Changes in Artists' Careers: A Hypothesis

In this section we categorize each school to either experimentalism and conceptualism by music analysis.

3.1 Late Romanticism

The Romantic era, spanning most of the 19th century, was characterized by a strong emphasis on emotion, individualism, and the glorification of nature. It marked a departure from the structured forms of the Classical era, embracing more expressive and expansive compositions. Prominent figures of this period include Frédéric Chopin, Franz Schubert, and Hector Berlioz, who served as a bridge between Classical and Romantic music, infusing their works with personal expression and programmatic elements.

As the century progressed, the Late Romantic period emerged, focusing on heightened emotional expression, experimentation, and a search for originality. Composers like Richard Wagner and Franz Liszt became almost mythic figures, often regarded as musical "scientists" due to their experimental approaches to composition. Wagner, in particular, expanded the boundaries of harmonic language, orchestration, and thematic development, influencing generations of composers that followed.[6]

The height and the final phase of Romanticism is marked by prominent figures like Tchaikovsky and Rachmaninoff. This period is characterized by a deep commitment to expressive, emotional content, often achieved through an experimental approach that focused on refining existing musical forms rather than seeking conceptual breakthroughs. Rachmaninoff, in particular, exemplifies the traits of an experimentalist, which is typical of the late Romantic era. His works, while emotionally profound and technically sophisticated, largely adhered to the stylistic norms established by his predecessors.

There is a widely shared view among music professionals that, unlike his early 20th-century contemporaries who pursued radical innovations, Rachmaninoff remained firmly committed to the Romantic idiom. His compositions are often described as stylistically

[6]Tibbetts, J., Saffle, M., & Everett, W. (2018). *Performing Music History: Musicians Speak First-Hand about Music History and Performance*. Springer. https://doi.org/10.1007/978-3-319-92471-7

conservative, especially when contrasted with figures like Stravinsky, Schoenberg, and Debussy, who were actively redefining the boundaries of tonality and musical form. Many believe that Rachmaninoff was perceived as somewhat out of step with the avant-garde movements of his time, focusing on perfecting traditional forms rather than embracing the more disruptive tendencies of the era.

Despite the shifting musical landscape around him, Rachmaninoff's career was dedicated to refining the expressive potential of Romantic music. His approach was often incremental, emphasizing exploration and emotional depth over radical formal experimentation. The general perspective is that, while his music is celebrated for its lyrical beauty and virtuosic demands, it did not align with the groundbreaking techniques that characterized modernist compositions. Unlike contemporaries such as Schoenberg and Stravinsky, who sought to dismantle established tonal systems and explore entirely new forms of musical expression, Rachmaninoff's works retained a more accessible and melodic quality that resonated deeply with general audiences.

However, this accessibility, while securing his enduring popularity, has sometimes led to his music being viewed by some as lacking the progressive edge that characterized the work of his more avant-garde peers. It is often suggested that, within academic circles, there was a preference for the study of composers who ventured into uncharted musical territory, thus making Rachmaninoff's refined Romanticism appear less significant in the narrative of musical progress.

Ultimately, Rachmaninoff's position within the late Romantic period exemplifies the characteristics of an experimentalist composer focused on the perfection of existing forms. His contributions are often seen as pushing the boundaries of emotional expressiveness within a familiar framework, rather than seeking to break away from it. This emphasis on technical mastery and the refinement of established musical traditions aligns with the broader tendencies of late Romanticism, where innovation was less about conceptual breakthroughs and more about achieving greater depth within known artistic boundaries.

3.2 Impressionism

The categorization of Impressionist composers, particularly figures like Claude Debussy and Maurice Ravel, presents an interesting case when considered against the traits of experimental and conceptual artists. While both Debussy and Ravel were known for their innovations in sound and form, the nature of their creative processes aligns more closely with the characteristics of experimental artists rather than conceptual ones.

Debussy's work focused heavily on exploring the qualities of sound itself. He pushed the boundaries of traditional Western harmony, emphasizing sonic textures and the use of complex timbres in orchestration, often blurring the lines between music, theater, visual arts, and other creative domains. This focus on sound for its own sake, rather than the communication of a specific concept or message, reflects a motivation rooted in aesthetic exploration. Unlike conceptual artists, whose work is driven by the need to communicate precise ideas, Debussy's approach was oriented toward the sensory experience and atmospheric effects of music. Thus, his emphasis on the aesthetic qualities of sound indicates an experimental orientation.

Maurice Ravel, on the other hand, was renowned for his meticulous pursuit of technical perfection. Despite his remarkable skills, Ravel was known to refine his compositions relentlessly, as he once confided to his biographer, Roland-Manuel: "My objective is technical perfection; knowing that this goal is unattainable, I compel myself to continually approach it." This statement reveals Ravel's belief in the unattainability of perfection, yet his continuous efforts to approximate it exemplify the experimental trait of iterative refinement. Igor Stravinsky even humorously referred to Ravel as a "Swiss watchmaker," highlighting his precision and dedication to craft.

Ravel's compositional approach, as demonstrated in his famous work *Boléro*, further illustrates the experimental mindset. While *Boléro* was based on a single theme repeated with increasing orchestral complexity, Ravel himself described it as "an experiment in a very special and limited direction." Although he completed the piece relatively quickly, he emphasized that its significance lay in exploring how a simple theme could be developed through harmonic and instrumental ingenuity. This approach indicates that, while *Boléro* had a clear concept, Ravel treated it more as an exploration of musical technique than a purely conceptual statement. Ravel's acknowledgment that "any conservatory student could have done as well" once the idea was discovered further underscores his experimental focus on technical execution rather than on the conceptual novelty.

Unlike conceptual artists who typically work with a well-defined plan and execute their ideas directly, both Debussy and Ravel displayed creative processes that were imprecise and evolving. Their compositions often underwent numerous revisions, indicating an iterative approach driven by exploration and refinement rather than the realization of a predetermined concept. For example, Ravel's decision to abandon the orchestration of Albeniz's *Iberia* in favor of developing an original score suggests a willingness to adapt and refine his work based on evolving artistic choices.

The relationship between their works also reflects a continuous and dependent development, as both composers built upon their previous experiments to refine their unique styles over time. This gradual evolution contrasts sharply with the discontinuous and independent nature of conceptual art, where each piece stands on its own with little reference to previous works. Furthermore, Debussy and Ravel typically reached their creative peaks later in their careers, after years of refining their techniques and exploring new harmonic textures, a hallmark of the experimental archetype.

In terms of stopping procedures, Ravel, despite his occasional ability to complete works quickly, as in the case of *Boléro*, was often reluctant to consider his pieces truly finished. This reflects the experimental trait of continuous refinement and the difficulty in knowing when to stop, in contrast to the more decisive approach typical of conceptual artists, who complete their work once the concept is fully realized.

Overall, while Impressionist composers like Debussy and Ravel may exhibit some elements associated with conceptual thinking, particularly in their exploration of specific musical ideas, their predominant approach aligns more closely with the traits of experimental artists. Their creative processes were characterized by continuous refinement, an emphasis on aesthetic exploration, and a late career peak, which fits the profile of the experimental archetype as defined in the earlier sections of this thesis.

3.3 Early 20th Century Modernism

In the final decade of the 19th century, the Romantic era in music entered its late phase, marked by significant changes and innovations that signaled its eventual transition into the early modernist period. Historically, art has evolved by challenging and redefining existing conventions. Prior to the emergence of early Modernism, Western classical music was largely confined to the seven classical modes, with few exceptions, such as the use of the harmonic minor scale.

One of the most significant shifts at the turn of the century was the gradual dissolution of the traditional tonal system. Composers like Gustav Mahler began to incorporate progressive tonality into their compositions, stretching the boundaries of the tonal structure that had governed Western music for centuries. In parallel, the Impressionists, particularly Claude Debussy, explored ambiguous tonality and the use of exotic scales. As one scholar notes, “The perception of Debussy’s compositional language as decidedly post-romantic/Impressionistic—nuanced, understated, and subtle—is firmly solidified among today’s musicians and well-informed audiences.”[7]

While experiments with tonality were not entirely new—evident in Richard Wagner’s *Tristan und Isolde*[8] and Franz Liszt’s *Bagatelle sans tonalité*[9]—such practices became far more prevalent during the late Romantic period. This gradual break with traditional tonality reached a critical point in 1908 with Arnold Schoenberg’s composition of the *Second String Quartet*, Op. 10, which included a soprano. The last movement of this quartet notably lacks a key signature, representing a decisive shift from Romanticism into Mod-

[7] de Médicis, F., & Huebner, S. (Eds.) (2018). *Debussy’s Resonance.* Boydell & Brewer.
[8] Millington 1992, p. 301.
[9] Searle, New Grove 11:11:39.

ernism.[10]

The advent of the Modernist era was marked by the emergence of several new parallel movements that reacted against the excesses of late Romanticism. Expressionism, championed by Arnold Schoenberg and the Second Viennese School, sought to break free from established musical conventions. Schoenberg's pioneering rejection of tonality, seen in his chromatic post-tonal and twelve-tone compositions, exemplifies the radical break with the past. Musical expressionism is closely associated with the music of the Second Viennese School during their "free atonal" period from 1908 to 1921.[11] One of the main goals of this movement was to avoid "traditional forms of beauty" to convey powerful feelings in their music.[12] In essence, Expressionist music often features a high level of dissonance, extreme contrasts of dynamics, constant changing of textures, "distorted" melodies and harmonies, and angular melodies with wide leaps.[13] The term *avant-garde* (literally, "ahead of the troops") became synonymous with Schoenberg and his followers, who were celebrated as musical radicals of the 20th century.[14]

Primitivism, most famously championed by Igor Stravinsky, embraced raw, rhythmic elements that challenged the symmetry and predictability of earlier musical forms. Stravinsky's break from symmetrical rhythmic structures exemplified the modernist drive toward innovation. This movement sought to revive the most archaic regional folklore through a modernist lens. While similar to nationalism in its desire to preserve local traditions, primitivism distinguished itself by incorporating irregular meters, accents, expanded use of percussion, diverse timbres, modal scales, and polytonal harmonies. Notable works in this style include *The Firebird* (1910), *Petrushka* (1911), *The Rite of Spring* (1913), and *The Miraculous Mandarin* (1926). Though Stravinsky and Béla Bartók are often associated with primitivism, their contributions extended far beyond this label, reflecting their broader impact on 20th-century music.

Additionally, the Futurist movement, represented by figures like Luigi Russolo, sought to capture the energy of the industrial age through unconventional sounds and experimental techniques.

Moreover, musical nationalism paralleled the ethos of Modernism by rejecting old models of expression that were no longer seen as relevant in an industrialized society. Some composers, like Charles E. Ives, turned to the celebration of the rural, primitive, and his-

[10] Simms, B. R. (2000). *The Atonal Music of Arnold Schoenberg, 1908-1923*. Oxford University Press. Retrieved from https://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=169211

[11] Schoenberg (1975), pp. 207–208.

[12] Sadie (1991), p. 244.

[13] Anon. (2014).

[14] Tibbetts, J., Saffle, M., & Everett, W. (2018). *Performing Music History: Musicians Speak First-Hand about Music History and Performance*. Springer. https://doi.org/10.1007/978-3-319-92471-7

torical. Ives, considered one of America's foremost art composers, drew extensively on patriotic and traditional melodies, infusing them with modernist techniques. By blending elements of the past with innovative approaches, Ives and other nationalists contributed to a uniquely modernist musical language that both looked back to tradition and forward to new possibilities.

The shift to modernist principles during this era was not merely a stylistic evolution but a fundamental rethinking of music's purpose and possibilities. As the demands of an increasingly industrialized and urban society grew, composers sought to create music that reflected the complexities of their time, moving away from the emotional excesses of Romanticism towards a more abstract and conceptually driven approach.

3.4 Summary

In summary, the categorization of musical schools into experimental and conceptual frameworks highlights the evolving approaches to composition from the late Romantic period to early 20th-century Modernism. Late Romantic composers like Rachmaninoff exemplified the experimental archetype, focusing on refining and perfecting existing forms with an emphasis on emotional expressiveness and technical mastery. Their music, while deeply resonant with audiences, adhered to traditional Romantic structures rather than breaking new conceptual ground.

In contrast, early Modernist composers such as Schoenberg and Stravinsky embraced a conceptual approach, actively rejecting established conventions to explore novel forms and techniques. This period was defined by a commitment to innovation, with a focus on creating new musical languages that reflected the complexities of the modern world. The Impressionist movement, while often seen as a bridge between these two eras, displayed elements of both experimental and conceptual tendencies, with figures like Debussy and Ravel exploring the aesthetic possibilities of sound while also pushing the boundaries of harmonic language.

Overall, the shift from the experimental refinement of Romanticism to the conceptual innovations of Modernism underscores a broader transformation in the artistic landscape, where the emphasis moved from perfecting existing traditions to redefining the very essence of musical expression.

4 Data and Econometric Analysis

4.1 Data

Our dataset is constructed from three primary sources, with specific details potentially subject to change, though the overall framework remains stable: the IMSLP website, music streaming platforms (primarily Spotify, with Qobuz as a potential addition), and Operabase.[15] The IMSLP website offers extensive data on composers and their works across different time periods. We begin by retrieving IMSLP pages to extract information on compositions (e.g., instrumentation, musical form, average duration) as well as composer-specific details, such as birth and death dates. Once a comprehensive database of compositions is established, we search music streaming platforms for play count data, aligning it with our existing database entries.

We are aware that the downloads data on IMSLP and the number of plays on Spotify can only serve as metrics of popularity, and there exists a gap between popularity and innovation (or influence), which is our primary focus. For an innovation indicator, we plan to use the frequency with which a composition is performed by ensembles (orchestras, symphonies) worldwide. This is a valid indicator for innovation because it reflects the enduring impact and perceived value of a work within the professional music community. Frequent performances suggest that the composition has introduced new techniques, structures, or aesthetics that continue to inspire and influence contemporary programming choices, distinguishing innovative works from merely popular ones.

Table 2 presents the list of composers included in this study, categorized by their birth periods. The table is divided into two groups: composers born between 1806 and 1873, and those born between 1874 and 1966. These groupings allow us to analyze differences in compositional styles, innovations, and the subsequent influence of works across different historical and cultural contexts. Each entry includes the composer's country of birth, along with their birth and death years, providing additional context for understanding the historical background against which their compositions were created. The cutoff year of 1874 was chosen objectively based on the distribution of composers' birth years, as illustrated in Figure 1. The scatter plot clearly shows that 1874 serves as an optimal breaking point.

The choice to rely solely on empirical data for classification, rather than subjective historical periods, aligns with the approach taken by Galenson in his works (Galenson and Weinberg, 2000; Galenson and Weinberg, 2001). While any specific cutoff year may not perfectly distinguish between categories of innovators, we are confident that the trend from experimentalism to conceptualism remains clear, even with the limitations of a single-

[15]The Operabase dataset has yet to be acquired due to its requirement for institutional access. We are seeking funding from the Departments of Economics or Music at the University of Chicago to secure access.

Table 2: Composers Included in This Study

	Country of Birth	Year of Birth	Year of Death
	Composers Born 1806–1873		
Brahms, Johannes	Germany	1833	1897
Bruckner, Anton	Austria	1824	1896
Debussy, Claude	France	1862	1918
Delius, Frederick	England	1862	1934
Dukas, Paul	France	1865	1935
Dvořák, Antonín	Czechia	1841	1904
Fauré, Gabriel	France	1845	1924
Grieg, Edvard	Norway	1843	1907
Janáček, Leoš	Czechia	1854	1928
Liszt, Franz	Hungary	1811	1886
Mahler, Gustav	Austria	1860	1911
Saint-Saëns, Camille	France	1835	1921
Satie, Erik	France	1866	1925
Smetana, Bedřich	Czechia	1824	1884
Scriabin, Aleksandr	Russia	1872	1915
Sibelius, Jean	Finland	1865	1957
Strauss, Richard	Germany	1864	1949
Tchaikovsky, Pyotr	Russia	1840	1893
Verdi, Giuseppe	Italy	1813	1901
Wagner, Richard	Germany	1813	1883
Wolf, Hugo	Austria	1860	1903
	Composers Born 1874–1966		
Bartók, Béla	Hungary	1881	1945
Berg, Alban	Austria	1885	1935
Falla, Manuel de	Spain	1876	1946
Gershwin, George	United States	1898	1937
Ives, Charles	United States	1874	1954
Prokofiev, Sergey	Russia	1891	1953
Rachmaninoff, Sergei	Russia	1873	1943
Ravel, Maurice	France	1875	1937
Respighi, Ottorino	Italy	1879	1936
Schoenberg, Arnold	Austria	1874	1951
Stravinsky, Igor	Russia	1882	1971
Szymanowski, Karol	Poland	1882	1937
Vaughan Williams, Ralph	England	1872	1958
Webern, Anton	Austria	1883	1945

year classifier. This strategy also helps to mitigate concerns regarding data manipulation, ensuring that our analysis remains objective.

It is worth noting that the categorization of artists has been historically contentious, with disagreements among scholars and, at times, even the artists themselves. A notable example is the case of Claude Debussy and Maurice Ravel, who are often associated with Impressionism. However, both resisted this label: Debussy, in a 1908 letter, criticized the term as inaccurately applied to his work, arguing that it was an ill-fitting label borrowed from visual art critics who misused it even for painters like Turner.[16] Similarly, Ravel expressed discomfort with the term, at one point claiming that it was not applicable to music at all.[17] This example illustrates the inherent difficulty of assigning composers to rigid stylistic categories, which can be subjective and contested. Thus, our decision to base the classification strictly on empirical data rather than imposed historical labels is aimed at maintaining objectivity and avoiding potential biases.

[16] Claude Debussy, in François Lesure and Roger Nichols, *Debussy Letters* (Harvard University Press, 1987), p. 188, ISBN 978-0-674-19429-8.

[17] Maurice Ravel, in Arbie Orenstein (ed.), *A Ravel Reader: Correspondence, Articles, Interviews* (Columbia University Press, 1990), p. 421, ISBN 978-0-231-04962-7; Dover Publications, 2003 reprint, ISBN 978-0-486-43078-2.

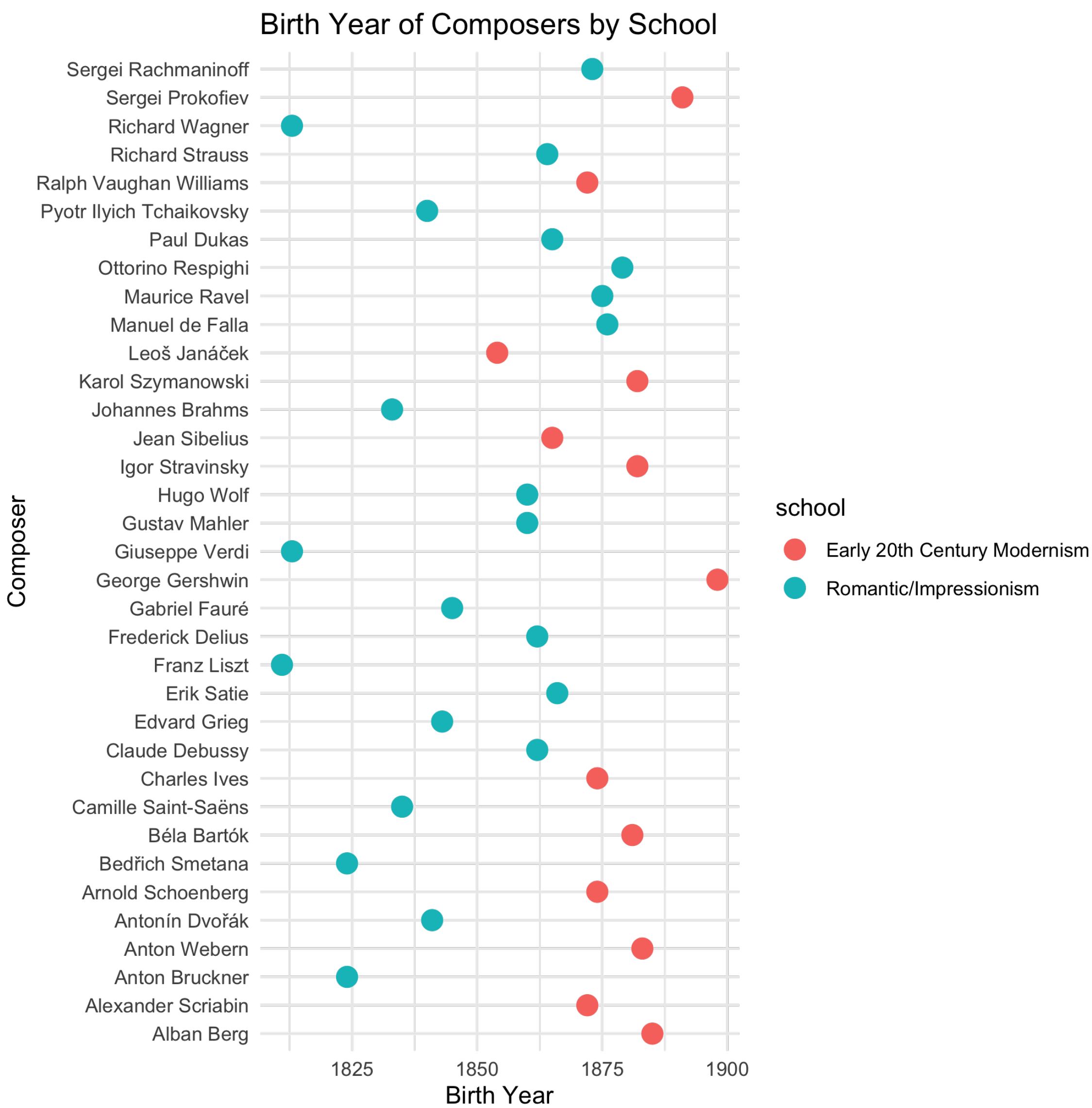

Figure 1: Scatter plot for birth years of composers

In our analysis, we categorized the instrumentation of musical compositions into broader categories to facilitate quantitative analysis. This process involved grouping individual instruments and vocal types into comprehensive categories based on their characteristics and common use in classical music ensembles. Specifically, we identified 14 main categories: Piano, Orchestra, Violin, Cello, Voice, Strings, Woodwinds, Brass, Percussion, Keyboard, Chorus, Plucked, Electronic, and Other. Each category encompasses a range of related instruments; for instance, the Strings category includes instruments such as the viola, double

Table 3: Summary Statistics for Composers

	All ($N = 4,395$)		Pre-1874 Cohort ($N = 1,109$)		Post-1874 Cohort ($N = 3,286$)	
Variable	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Year of birth	1853.43	23.48	1844.28	19.41	1881.56	6.18
Year of composition	1893.12	27.69	1884.30	24.89	1920.23	15.66
Age at composition	39.69	15.82	40.02	16.18	38.67	14.63
Popularity	8,069.59	15,385.22	7,364.93	13,511.26	10,235.78	19,935.87
Duration (minutes)	21.78	26.58	22.92	28.69	18.44	18.71
Piano	0.53	0.50	0.54	0.50	0.51	0.50
Violin	0.11	0.31	0.09	0.28	0.17	0.37
Cello	0.08	0.27	0.07	0.25	0.11	0.32
Orchestra	0.31	0.46	0.29	0.45	0.38	0.49
Chorus	0.19	0.39	0.20	0.40	0.14	0.35
Voice	0.30	0.46	0.30	0.46	0.32	0.47
Strings	0.11	0.32	0.09	0.29	0.18	0.38
Woodwinds	0.11	0.31	0.09	0.29	0.16	0.36
Brass	0.11	0.31	0.10	0.30	0.12	0.33
Percussion	0.08	0.27	0.07	0.26	0.09	0.29
Keyboard	0.05	0.22	0.06	0.24	0.02	0.14
Plucked	0.00	0.06	0.00	0.03	0.01	0.10
Electronic	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.01	0.07	0.00	0.05	0.01	0.12

bass, and harp, while Woodwinds includes flutes, clarinets, and bassoons.[18] To operationalize this classification, we created binary dummy variables for each category. For each composition, we examined the instrumentation descriptions and assigned a value of 1 to the corresponding category if an instrument or vocal type from that category was present, and 0 otherwise.

Table 3 presents summary statistics for our data, distinguishing between the pre-1874 and post-1874 cohorts. Several patterns are notable. In terms of popularity, measured by downloads or play counts, the post-1874 cohort has a notably higher mean (10,235.78) compared to the pre-1874 cohort (7,364.93), along with a larger standard deviation (19,935.87 vs. 13,511.26). This difference suggests that works by later composers are more frequently accessed, potentially reflecting evolving audience preferences toward more recent compositions.

The data also indicate a trend toward shorter compositions, with the average duration decreasing from 22.92 minutes in the pre-1874 group to 18.44 minutes in the post-1874 group. This shift may suggest an adaptation to changing audience tastes, possibly influenced by the constraints of modern performance contexts, which often favor more concise pieces.

[18]For a full categorization of instrumentation, see Appendix

There is also a noticeable shift in instrument usage between the two cohorts. Pre-1874 composers show a higher prevalence of piano compositions (0.54), while the post-1874 cohort features a greater emphasis on violin (0.17 vs. 0.09), strings (0.18 vs. 0.09), and woodwinds (0.16 vs. 0.09). This indicates a relative decline in the dominance of the piano, signaling a shift towards a broader exploration of timbre and ensemble variety in later compositions. Additionally, orchestra compositions become more prominent in the post-1874 group (0.38 compared to 0.29), reflecting the expanding role of orchestral music in the late 19th and early 20th centuries.

Overall, these shifts may reflect a broader transformation in compositional priorities, moving away from the heavily piano-focused works of earlier periods toward a more diverse and exploratory use of instrumentation, as composers responded to evolving artistic and cultural influences.

4.2 Model

We are interested in comparing the relationship between the success indicator of a composition and the composer's age at the time of its creation across different cohorts. To achieve this, we estimate a regression where the success indicator of a music piece is modeled as a polynomial function of the composer's age, with an interaction term for whether the composer was born after 1874.

Some clarifications about the selection of the year 1874 are necessary. First, a specific year is needed to classify composers into two cohorts: Late Romanticism/Impressionism and Early Modernism. Following Galenson's methodology, we choose the most suitable year such that composers born before this point are categorized under Late Romanticism/Impressionism, and those born in or after this year fall into Early Modernism.[19] Accordingly, 1874 is selected as the dividing line between Late Romanticism/Impressionism and Early Modernism. Composers born before 1874 are considered part of Late Romanticism/Impressionism, while those born in or after 1874, such as Arnold Schoenberg (1874), are categorized as Early Modernists. However, this method for categorizing composers is not perfect, because a few composers are misclassified. One prominent exception is Maurice Ravel (1875), whose work remained firmly rooted in Impressionism.[20]

We now return to the regression:

[19] We group Late Romanticism with Impressionism, even though Impressionism is often considered a subcategory or a transitional movement towards Early Modernism. This decision is based on our analysis of the methods and styles used by Impressionist composers, such as Ravel, whom we identify as a typical experimentalist.

[20] For a complete list of composers along with their birth and death years, please refer to the table in the Appendix.

$$
\begin{aligned}
\ln(\text{popularity}_{ij}) = {} & \beta_1 \text{pre}_i \text{age}_{ij} + \beta_2 \text{pre}_i \text{age}_{ij}^2 + \beta_3 \text{pre}_i \text{age}_{ij}^3 \\
& + \gamma_1 \text{post}_i \text{age}_{ij} + \gamma_2 \text{post}_i \text{age}_{ij}^2 + \gamma_3 \text{post}_i \text{age}_{ij}^3 \\
& + \phi \ln(\text{duration}_{ij}) \\
& + \sum_m \delta_m I(\text{instr}_{ijm}) \\
& + \sum_{k=1}^{K} \psi_k I(i = k) \\
& + \sum_{y=1806}^{1966} \theta_y I(\text{comp\_year}_{ij} = y) \\
& + \epsilon_{ij},
\end{aligned}
$$

The model includes several variables to capture the impact of age, cohort, and other factors on the success of compositions. The age and cohort variables consist of age_{ij}, which represents the age of composer i at the time composition j was created; pre_i, a binary variable equal to 1 if the composer was born between 1806–1873; and post_i, a binary variable equal to 1 if born between 1874–1966. Interaction terms, such as $\text{pre}_i \cdot \text{age}_{ij}$ and $\text{post}_i \cdot \text{age}_{ij}$, along with their higher-order polynomials, are included to capture non-linear age effects on success, such as peaks or declines. In addition to age and cohort effects, the model includes several control variables: $\ln(\text{duration}_{ij})$, which denotes the natural logarithm of the composition's duration to control for size, and $\sum_m \delta_m I(\text{instr}_{ijm})$, which represents dummy variables for different types of instrumentation (e.g., orchestral, solo). To account for unobserved heterogeneity, fixed effects are included: $\sum_{k=1}^{K} \psi_k I(i = k)$ captures composer-specific factors, while $\sum_{y=1806}^{1966} \theta_y I(\text{comp\_year}_{ij} = y)$ controls for the calendar year in which the composition was created. Together, these variables and fixed effects help isolate the impact of age, cohort, and other characteristics on the success of compositions.

A few points of clarification are necessary. First, the results presented below are based on a third-degree polynomial in the composer's age. The selection of this polynomial degree was informed by tests for the statistical significance of higher-order terms. Similar results are observed when estimating the age-price profiles using either a second-degree or fourth-degree polynomial.

Second, rather than using a standard regression model, the analysis accounts for differences in the variability of composers' composition popularity by weighting each composer's works by the inverse of the mean square error (MSE) specific to that composer. The number of observations varies across composers, and treating each composition as an independent observation tends to give more weight to composers with higher popularity since they have more recorded compositions. This means that each observation, corresponding to a composition's popularity score, is weighted by a factor that is inversely proportional to the MSE of all compositions by the same composer. By assigning weights based on the MSE, this method controls for the variability in composition popularity across different composers.

Let MSE_i denote the mean square error for composer i, calculated as:

$$MSE_i = \frac{1}{n_i}\sum_{j=1}^{n_i}(y_{ij} - \hat{y}_{ij})^2,$$

where n_i is the number of compositions by composer i, y_{ij} is the actual popularity score of the j-th composition, and $\hat{y}_{ij}$ is its predicted score. The weight assigned to each observation (i, j) is then defined as:

$$w_{ij} = \frac{1}{MSE_i}.$$

The use of these weights modifies the estimation process through a weighted least squares (WLS) approach. Instead of minimizing the unweighted sum of squared residuals, WLS minimizes the weighted sum of squared residuals:

$$\min_{\beta,\gamma,\phi,\psi,\theta} \sum_{i=1}^{N}\sum_{j=1}^{n_i} w_{ij}\left(\ln(\text{popularity})_{ij} - \ln(\widehat{\text{popularity}})_{ij}\right)^2.$$

This adjustment ensures that the model gives greater importance to observations from composers whose compositions have lower variability in popularity scores (i.e., lower MSE_i), while reducing the influence of those with higher variability.

The weighted regression model can thus be expressed as:

$$\begin{aligned} w_{ij}\cdot\ln(\text{popularity}_{ij}) = w_{ij}\Bigg[&\beta_1\text{pre}_i\text{age}_{ij} + \beta_2\text{pre}_i\text{age}_{ij}^2 + \beta_3\text{pre}_i\text{age}_{ij}^3 \\ &+ \gamma_1\text{post}_i\text{age}_{ij} + \gamma_2\text{post}_i\text{age}_{ij}^2 + \gamma_3\text{post}_i\text{age}_{ij}^3 \\ &+ \phi\ln(\text{duration}_{ij}) \\ &+ \sum_m \delta_m I(\text{instr}_{ijm}) \\ &+ \sum_{k=1}^{K}\psi_k I(i=k) \\ &+ \sum_{y=1806}^{1966}\theta_y I(\text{comp\_year}_{ij} = y)\Bigg] + w_{ij}\epsilon_{ij}. \end{aligned}$$

In this adjusted model, each term is scaled by w_{ij}, leading to regression coefficients

$\beta, \gamma, \phi, \psi, \theta$ that reflect the impact of these weights. This approach addresses the issue of heteroskedasticity, which arises due to differences in variability among composers. By reducing the influence of outliers, especially those with highly variable popularity scores, the WLS method produces more reliable estimates of the relationship between factors.

4.3 Regression Results

Table 4: Regression Results for only Pre/Post Age Interaction Terms

	Model 1_1	Model 1_2	Model 1_3
(Intercept)	7.739 (0.091)***	7.090 (0.202)***	7.349 (0.308)***
pre_age_ij	0.009 (0.002)***	0.046 (0.010)***	0.027 (0.023)
pre_age_ij2	–	-0.0005 (0.0001)***	-0.00003 (0.0005)
pre_age_ij3	–	–	-0.000003 (0.000004)
post_age_ij	0.015 (0.003)***	0.040 (0.012)***	0.00001 (0.029)
post_age_ij2	–	-0.0002 (0.0002)	0.0012 (0.001)
post_age_ij3	–	–	-0.00001 (0.00001)
Residual Std. Error	1.150 on 2522 DF	1.147 on 2520 DF	1.147 on 2518 DF
Multiple R-squared	0.0109	0.0180	0.0190
Adjusted R-squared	0.0101	0.0165	0.0166
F-statistic	13.92 on 2 and 2522 DF	11.57 on 4 and 2520 DF	8.11 on 6 and 2518 DF
p-value	9.707e-07	2.596e-09	1.051e-08

The results show that Model 1_2 provides the best fit among the three models. The inclusion of quadratic terms significantly improves the model, as indicated by a higher adjusted R^2 (0.0165 compared to 0.0101 in Model 1_1). The positive coefficient for `pre_age_ij` (0.046, $p < 0.001$) and the negative coefficient for `pre_age_ij2` (-0.0005, $p < 0.001$) highlight a non-linear relationship where popularity increases with age up to a certain point before declining. This diminishing returns effect is particularly notable for the pre-1874 cohort.

In contrast, Model 1_3, which includes cubic terms, does not show additional significance, and the coefficients for these higher-order terms are not statistically meaningful. Thus, adding complexity with cubic terms does not enhance the explanatory power, as evidenced by the minimal change in adjusted R^2.

In the next model we try to add the natural logarithm of duration of compositions. We found that including `log_duration_ij` substantially improves the model fit, with a consistently positive and highly significant coefficient (around 0.42, $p < 0.001$) across all models, indicating that longer compositions are associated with higher popularity. However, adding log duration almost eliminated all the significance in the models. Among all three models, only `pre_age_ij` in Model 2_1 is statistically significant ($p < 0.01$); apart from

Table 5: Regression Results for Pre/Post Age Interaction Terms with log_duration_ij

	Model 2_1	Model 2_2	Model 2_3
(Intercept)	6.816 (0.161)***	6.705 (0.296)***	7.063 (0.371)***
pre_age_ij	0.011 (0.003)**	0.019 (0.014)	-0.009 (0.025)
pre_age_ij2	–	-0.0001 (0.0002)	0.0005 (0.0006)
pre_age_ij3	–	–	-0.000005 (0.000005)
post_age_ij	0.007 (0.004)	0.006 (0.016)	-0.052 (0.036)
post_age_ij2	–	0.00008 (0.0002)	0.0021 (0.001)
post_age_ij3	–	–	-0.00002 (0.00001)
log_duration_ij	0.425 (0.039)***	0.423 (0.039)***	0.420 (0.039)***
Residual Std. Error	1.110 on 1180 DF	1.111 on 1178 DF	1.110 on 1176 DF
Multiple R-squared	0.1035	0.1045	0.1070
Adjusted R-squared	0.1013	0.1007	0.1017
F-statistic	45.43 on 3 and 1180 DF	27.50 on 5 and 1178 DF	20.14 on 7 and 1176 DF
p-value	$< 2.2e-16$	$< 2.2e-16$	$< 2.2e-16$

that, none of the interaction terms are significant, and the adjusted R^2 does not improve, indicating that adding higher order interaction terms does not enhance explanatory power.

A potential explanation for the regression results is that the duration data sourced from the IMSLP website is incomplete. Since the data is manually maintained, it is likely that more popular compositions are prioritized for data entry, resulting in non-random missingness when observations with null duration values are excluded.

To assess whether excluding compositions with missing duration data introduces bias, we compared `max_downloads` between deleted (i.e., missing duration) and retained observations. The summary statistics in Table 6 show that deleted observations (N = 1499, Mean = 7636.05, SD = 16239.17) have a slightly lower mean than those with available data (N = 1361, Mean = 8547.09, SD = 14376.98). A Welch Two Sample t-test yielded a t-statistic of -1.5912 with df = 2856.2 and a p-value of 0.1117. This indicates that, although the difference in means did not strictly meet the 90% confidence level, it reached an 88.83% confidence level, suggesting with moderate confidence that compositions with missing duration data may indeed be less popular.

Table 6: Summary Statistics for Deleted vs. Undeleted Observations

	Number of Observations	Mean	Standard Deviation
Deleted Observations	1499	7636.05	16239.17
Undeleted Observations	1361	8547.09	14376.98

4.4 Age-popularity profiles

Before plotting the age-popularity profiles, it is essential to explain the method for calculating the deviation of log popularity, as this metric is required for constructing the profiles.

Recall Model 1_2:

$$\begin{aligned}\ln(\text{popularity}_{ij}) = {} & \beta_1 \text{pre}_i \text{age}_{ij} + \beta_2 \text{pre}_i \text{age}_{ij}^2 + \beta_3 \text{pre}_i \text{age}_{ij}^3 \\ & + \gamma_1 \text{post}_i \text{age}_{ij} + \gamma_2 \text{post}_i \text{age}_{ij}^2 + \gamma_3 \text{post}_i \text{age}_{ij}^3 \\ & + \epsilon_{ij},\end{aligned}$$

The fitted value for the log popularity, denoted as $\ln(\hat{\text{popularity}})_{ij}$, is computed using the estimated coefficients β and γ along with the age-related polynomial terms. To analyze the effect of age on composition popularity, it is necessary to calculate the cohort mean for each group (pre-1874 and post-1874). The cohort mean of the fitted log popularity, denoted as $\text{Mean}_{\text{cohort}}$, is calculated as:

$$\text{Mean}_{\text{cohort}} = \frac{1}{n_{\text{cohort}}} \sum_{j=1}^{n_{\text{cohort}}} \ln(\hat{\text{popularity}})_{ij},$$

where n_{cohort} represents the number of compositions within the given cohort. This cohort mean reflects the average fitted log popularity for all compositions within a cohort, adjusted for composer-specific and year-specific effects.

The deviation from the cohort mean is then computed to assess how individual compositions deviate in terms of popularity relative to their cohort. The deviation, denoted as Deviation_{ij}, is defined as:

$$\text{Deviation}_{ij} = \ln(\hat{\text{popularity}})_{ij} - \text{Mean}_{\text{cohort}}.$$

This deviation measures how much the log popularity of a specific composition diverges from the average log popularity within its respective cohort. By plotting this deviation against the age of the composer at the time the composition was created, we can examine the relationship between the age of the composer and the popularity of their work, capturing any non-linear patterns that may exist across different cohorts.

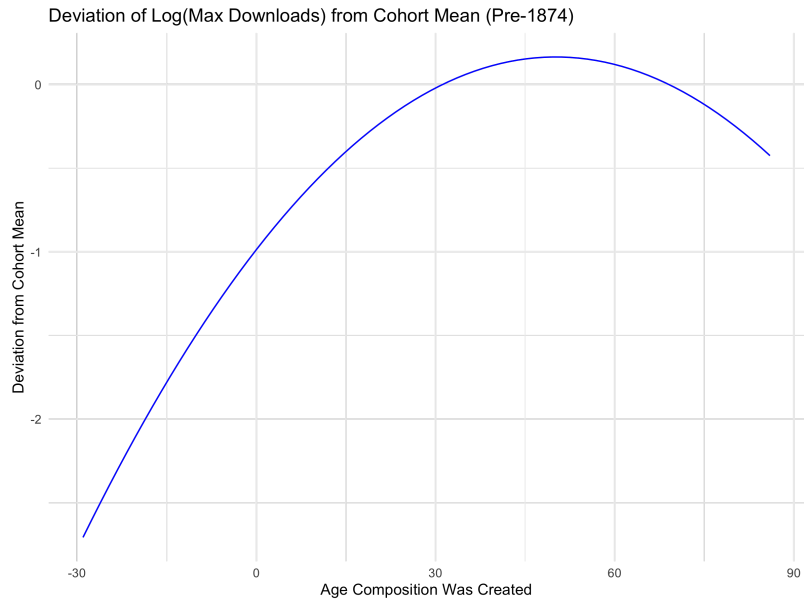

Figure 2: Pre-1874 cohort

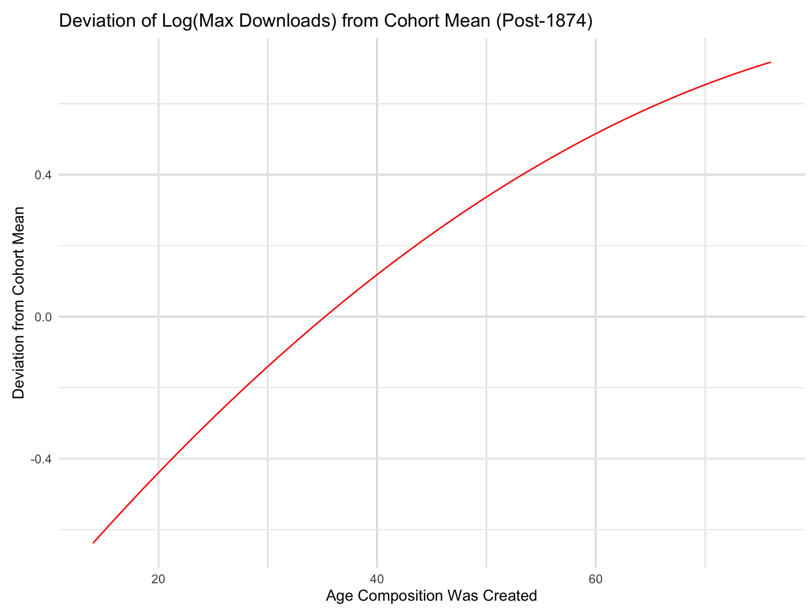

Figure 3: Post-1874 cohort

Figures 2 and 3 plot the age-popularity profiles for the two cohorts based on the estimates from Model 1_2 in Table 4. For the pre-1920 cohort, the curve reveals that compositions created at younger ages exhibit negative deviations from the cohort mean, suggesting that these works are generally less popular. The deviation gradually increases, reaching zero around the age of 30. As the composer's age continues to rise, the deviation becomes positive, peaking near the age of 50, before gradually declining again as age increases further. In contrast, the profile for the post-1920 cohort shows a different pattern. The deviation starts negative for younger ages but rises steadily with age. The curve crosses the zero line at approximately age 35, indicating that compositions gain popularity relative to the cohort mean as composers age, reaching the highest deviations shortly before the end of their lives.

The results for the pre-1874 cohort align with our expectations, indicating that composers of the late Romanticism and Impressionism periods are generally late achievers, likely due to their emphasis on technique over conceptual innovation. In contrast, the findings for Early 20th Century Modernist composers diverge significantly from our initial hypothesis. The profile suggests that these composers' later works achieve the highest popularity, contradicting the assumption that conceptual innovators typically reach their career peaks at a younger age.

Several factors may contribute to this unexpected result, which requires further exploration in subsequent drafts of this thesis. One possible explanation lies in the limitations of our chosen popularity metric, specifically the music score downloads from an online platform. This metric is imperfect for several reasons. First, downloads reflect a willingness to practice a piece rather than an appreciation of the work itself. More technically challenging compositions are less likely to be downloaded due to the limited number of musicians capable of practicing them, leading to lower download counts compared to simpler pieces. Second, the data is biased towards solo works since the website's user base consists primarily of individual users rather than institutional ensembles. This means that compositions requiring ensembles, such as symphonies, are less likely to be downloaded, while solo piano pieces receive disproportionately higher downloads. Lastly, using downloads as a proxy for popularity does not necessarily capture a work's innovative impact. Ideally, we would measure the frequency with which compositions are performed by professional ensembles worldwide. However, such data from sources like Operabase is currently unavailable. As a result, this analysis is preliminary, and the conclusions drawn here must be revisited once more comprehensive data becomes accessible.

5 Conclusion

The analysis conducted in this study reveals significant differences in the age-popularity profiles of composers across historical cohorts. For the pre-1874 cohort, encompassing composers of the Late Romanticism and Impressionism periods, our findings align with the hypothesis that these composers were late achievers. The focus on technical mastery rather than conceptual innovation appears to have delayed their peak creative output, with compositions gaining popularity predominantly in their later years. Conversely, the results for the Early 20th Century Modernist composers diverge from our initial expectation that these conceptual innovators would reach their career peaks at a younger age. Instead, the age-popularity profile for this cohort indicates that their compositions achieved the highest popularity later in life. This finding challenges existing literature on conceptual innovators and suggests a more complex relationship between age and creative output in early modernist music.

These unexpected results may, in part, be attributed to the limitations of our chosen metric for measuring composition popularity, which relies on downloads from an online music score platform. This metric primarily reflects the willingness to practice rather than a true appreciation of the work itself, potentially favoring simpler, solo compositions over more complex ensemble pieces like symphonies. The bias towards individual users may thus undervalue larger-scale works, skewing the results. Moreover, the download metric does not necessarily capture a composition's innovative impact. Ideally, a more accurate measure would involve the frequency with which compositions are performed by professional ensembles worldwide. Unfortunately, the necessary performance data from sources like Operabase is not currently available, rendering this analysis preliminary.

Given these limitations, this study represents a first draft of my thesis. I acknowledge that further refinements are needed to resolve the contradictions in the results, especially concerning the early modernist cohort. In subsequent drafts, I will address these issues by incorporating more representative metrics, such as performance frequency data, and by exploring additional factors that may influence the age at which composers gain recognition. These adjustments will aim to provide a more comprehensive understanding of the relationship between age, creativity, and popularity in classical music.

Data and Code Availability Statement

This section provides datasets and replication code to reproduce the figures and tables in the thesis.

5.1 Code

The replication files have been prepared to be run with R, and are confirmed to execute for R 4.4.1.

- The `composers.py` file in the `Code` directory will run the code to web-scrape composer-info data from the IMSLP website.
- The `compositions.py` file in the `Code` directory should be run **after** running `composers.py`, and it will run the code to web-scrape composition-info data from the IMSLP website for each of the composers.
- The `Data_cleaning.r` file in the `Code` directory will run the code to process web-scraped data from the IMSLP website.
- The `Regression.r` file in the `Code` directory will run all of the code to create the figures and tables in the body and appendix of this paper.

Code is available on GitHub: https://github.com/CanaanCui/GradThesis.git

5.2 Data

Data is accessible on Dropbox: https://www.dropbox.com/scl/fo/0nlffgazbjs7yqqhlz30f/AMBIQmBKRvHGYJuVoNL3AQI?rlkey=2d6ix1g3glxb0oag29lhdiepl&st=5pvntgdc&dl=0

The Operabase data is available by institutional subscription. I am planning on obtaining the dataset through my university and will try to seek for funding in winter. For access, please contact `contact@operabase.com`.

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Appendix

Appendix 1: Weighted Regression Results

Model 1 (WLS)

Table 7: Regression Results for only Pre/Post Age Interaction Terms

	Model 1_1	Model 1_2	Model 1_3
(Intercept)	7.739 (0.091)***	7.090 (0.202)***	7.349 (0.308)***
pre_age_ij	0.009 (0.002)***	0.046 (0.010)***	0.027 (0.023)
pre_age_ij2	–	-0.0005 (0.0001)***	-0.00003 (0.0005)
pre_age_ij3	–	–	-0.000003 (0.000004)
post_age_ij	0.015 (0.003)***	0.040 (0.012)***	0.00001 (0.029)
post_age_ij2	–	-0.0002 (0.0002)	0.0012 (0.001)
post_age_ij3	–	–	-0.00001 (0.00001)
Residual Std. Error	1.150 on 2522 DF	1.147 on 2520 DF	1.147 on 2518 DF
Multiple R-squared	0.0109	0.0180	0.0190
Adjusted R-squared	0.0101	0.0165	0.0166
F-statistic	13.92 on 2 and 2522 DF	11.57 on 4 and 2520 DF	8.11 on 6 and 2518 DF
p-value	9.707e-07	2.596e-09	1.051e-08

Model 2 (WLS)

Table 8: Regression Results for Pre/Post Age Interaction Terms with log_duration_ij

	Model 2_1	Model 2_2	Model 2_3
(Intercept)	6.816 (0.161)***	6.705 (0.296)***	7.063 (0.371)***
pre_age_ij	0.011 (0.003)**	0.019 (0.014)	-0.009 (0.025)
pre_age_ij2	–	-0.0001 (0.0002)	0.0005 (0.0006)
pre_age_ij3	–	–	-0.000005 (0.000005)
post_age_ij	0.007 (0.004)	0.006 (0.016)	-0.052 (0.036)
post_age_ij2	–	0.00008 (0.0002)	0.0021 (0.001)
post_age_ij3	–	–	-0.00002 (0.00001)
log_duration_ij	0.425 (0.039)***	0.423 (0.039)***	0.420 (0.039)***
Residual Std. Error	1.110 on 1180 DF	1.111 on 1178 DF	1.110 on 1176 DF
Multiple R-squared	0.1035	0.1045	0.1070
Adjusted R-squared	0.1013	0.1007	0.1017
F-statistic	45.43 on 3 and 1180 DF	27.50 on 5 and 1178 DF	20.14 on 7 and 1176 DF
p-value	$< 2.2e-16$	$< 2.2e-16$	$< 2.2e-16$

Model 3 (WLS)

Table 9: Adding Instrumentation Dummies

	Model 3_1	Model 3_2	Model 3_3
(Intercept)	6.504 (0.189)***	6.311 (0.303)***	6.545 (0.374)***
pre_age_ij	0.011 (0.003)***	0.025 (0.014).	0.002 (0.024)
pre_age_ij2	–	-0.0002 (0.0002)	0.0005 (0.0006)
pre_age_ij3	–	–	-0.000005 (0.000005)
post_age_ij	0.006 (0.004)	0.009 (0.016)	-0.011 (0.035)
post_age_ij2	–	0.00003 (0.0002)	0.0006 (0.001)
post_age_ij3	–	–	-0.000004 (0.00001)
log_duration_ij	0.457 (0.043)***	0.453 (0.044)***	0.450 (0.044)***
instr_piano	0.491 (0.119)***	0.479 (0.119)***	0.480 (0.119)***
instr_orchestra	0.267 (0.126)*	0.268 (0.126)*	0.265 (0.126)*
instr_violin	-0.068 (0.174)	0.187 (0.177)	0.169 (0.178)
instr_cello	0.390 (0.190)*	0.390 (0.190)*	0.401 (0.190)*
instr_voice	-0.460 (0.105)***	-0.460 (0.105)***	-0.463 (0.105)***
instr_strings	-0.068 (0.174)	-0.062 (0.174)	-0.053 (0.174)
instr_woodwinds	0.101 (0.235)	0.124 (0.236)	0.124 (0.237)
instr_brass	0.260 (0.275)	0.233 (0.276)	0.235 (0.276)
instr_percussion	-0.425 (0.267)	-0.420 (0.268)	-0.426 (0.270)
instr_keyboard	0.174 (0.206)	0.185 (0.207)	0.197 (0.208)
instr_chorus	-0.495 (0.127)***	-0.518 (0.129)***	-0.517 (0.129)***
instr_plucked	1.481 (0.515)**	1.445 (0.516)**	1.434 (0.520)**
instr_electronic	NA	NA	NA
instr_other	0.083 (0.928)	0.039 (0.930)	0.064 (0.934)
Residual Std. Error	1.071 on 1167 DF	1.071 on 1165 DF	1.071 on 1163 DF
Multiple R-squared	0.1760	0.1775	0.1785
Adjusted R-squared	0.1647	0.1648	0.1644
F-statistic	15.58 on 16 and 1167 DF	13.97 on 18 and 1165 DF	12.63 on 20 and 1163 DF
p-value	2.2e-16	2.2e-16	2.2e-16

Model 4 (WLS)

Table 10: Adding Composer Fixed Effects

	Model 4_1	Model 4_2	Model 4_3
(Intercept)	5.541 (0.762)***	5.234 (0.782)***	5.431 (0.798)***
pre_age_ij	0.014 (0.003)***	0.037 (0.014)**	0.017 (0.021)
pre_age_ij2	–	-0.0003 (0.0002).	0.0003 (0.0005)
pre_age_ij3	–	–	-0.000005 (0.000004)
post_age_ij	-0.002 (0.007)	0.026 (0.035)	0.081 (0.150)
post_age_ij2	–	-0.0003 (0.0004)	-0.0017 (0.0035)
post_age_ij3	–	–	0.00001 (0.00003)
log_duration_ij	0.391 (0.044)***	0.388 (0.044)***	0.386 (0.044)***
instr_piano	0.283 (0.106)**	0.276 (0.106)**	0.281 (0.107)**
instr_orchestra	0.140 (0.113)	0.130 (0.113)	0.126 (0.113)
instr_violin	0.072 (0.151)	0.080 (0.151)	0.064 (0.152)
instr_cello	0.144 (0.162)	0.129 (0.162)	0.134 (0.163)
instr_voice	-0.564 (0.092)***	-0.580 (0.092)***	-0.586 (0.092)***
instr_strings	-0.061 (0.150)	-0.058 (0.150)	-0.045 (0.150)
instr_woodwinds	0.068 (0.199)	0.086 (0.200)	0.094 (0.200)
instr_brass	0.251 (0.236)	0.237 (0.236)	0.245 (0.237)
instr_percussion	-0.249 (0.234)	-0.250 (0.234)	-0.268 (0.235)
instr_keyboard	0.125 (0.177)	0.138 (0.177)	0.153 (0.178)
instr_chorus	-0.473 (0.113)***	-0.481 (0.113)***	-0.483 (0.113)***
instr_plucked	0.299 (0.447)	0.243 (0.450)	0.246 (0.450)
instr_electronic	NA	NA	NA
instr_other	1.311 (0.784).	1.371 (0.787).	1.345 (0.791).
Composer Fixed Effects	Yes	Yes	Yes
Residual Std. Error	0.897 on 1133 DF	0.896 on 1131 DF	0.896 on 1129 DF
Multiple R-squared	0.4383	0.4401	0.4410
Adjusted R-squared	0.4135	0.4144	0.4142
F-statistic	17.68 on 50 and 1133 DF	17.10 on 52 and 1131 DF	16.49 on 54 and 1129 DF
p-value	2.2e-16	2.2e-16	2.2e-16

Model 5 (WLS)

Table 11: Adding Composition (Calendar) Year Fixed Effects (Part 1)

	Model 5_1	Model 5_2	Model 5_3
(Intercept)	-172.40 (157.50)	-125.70 (159.40)	-121.90 (165.30)
pre_age_ij	1.975 (1.746)	1.503 (1.766)	1.504 (1.834)
pre_age_ij2	–	-0.000462 (0.000238).	-0.00162 (0.00147)
pre_age_ij3	–	–	0.00000840 (0.0000105)
post_age_ij	1.984 (1.747)	1.544 (1.760)	1.456 (1.878)
post_age_ij2	–	-0.001017 (0.000582).	-0.0000441 (0.00448)
post_age_ij3	–	–	-0.00000692 (0.0000338)
log_duration_ij	0.3679 (0.04838)***	0.3655 (0.04829)***	0.3652 (0.04833)***
instr_piano	0.3003 (0.1153)**	0.2915 (0.1151)*	0.2855 (0.1155)*
instr_orchestra	0.1791 (0.1208)	0.1671 (0.1207)	0.1645 (0.1208)
instr_violin	0.0049 (0.1627)	-0.0056 (0.1625)	-0.0071 (0.1626)
instr_cello	0.2198 (0.1756)	0.2109 (0.1753)	0.2120 (0.1756)
instr_voice	-0.5559 (0.0967)***	-0.5774 (0.0969)***	-0.5777 (0.0970)***
instr_strings	0.0054 (0.1620)	0.0235 (0.1618)	0.0206 (0.1621)
instr_woodwinds	-0.1073 (0.2185)	-0.0885 (0.2190)	-0.0991 (0.2195)
instr_brass	0.4198 (0.2555)	0.4188 (0.2552)	0.4201 (0.2554)
instr_percussion	-0.3694 (0.2528)	-0.3960 (0.2527)	-0.3908 (0.2531)
instr_keyboard	0.2059 (0.1915)	0.2236 (0.1917)	0.2218 (0.1919)
instr_chorus	-0.5409 (0.1218)***	-0.5443 (0.1216)***	-0.5484 (0.1219)***
instr_plucked	0.6449 (0.4768)	0.6058 (0.4761)	0.6015 (0.4768)
instr_electronic	NA	NA	NA
instr_other	0.8979 (1.0480)	0.7999 (1.0470)	0.8001 (1.0480)
composer fixed effects	Yes	Yes	Yes
calendar year fixed effects	Yes	Yes	Yes
Residual Std. Error	0.893	0.891	0.891
R-squared	0.5035	0.5065	0.5069
Adjusted R-squared	0.4190	0.4214	0.4207
F-statistic	5.96 on 172 and 1011 DF	5.95 on 174 and 1009 DF	5.88 on 176 and 1007 DF
p-value	2.2e-16	2.2e-16	2.2e-16

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Appendix 2: Unweighted Regression Results

Model 1

Table 12: Regression Results for only Pre/Post Age Interaction Terms

	Model 1_1	Model 1_2	Model 1_3
(Intercept)	7.457 (0.097)***	6.558 (0.211)***	6.769 (0.305)***
pre_age_ij	0.011 (0.002)***	0.059 (0.010)***	0.044 (0.022)*
pre_age_ij2	–	-0.0006 (0.0001)***	-0.0002 (0.0005)
pre_age_ij3	–	–	-0.000002 (0.000004)
post_age_ij	0.024 (0.003)***	0.073 (0.013)***	0.037 (0.030)
post_age_ij2	–	-0.0006 (0.0002)**	0.0007 (0.001)
post_age_ij3	–	–	-0.00001 (0.00001)
Residual Std. Error	1.762 on 2522 DF	1.755 on 2520 DF	1.755 on 2518 DF
Multiple R-squared	0.0236	0.03255	0.03324
Adjusted R-squared	0.02283	0.03102	0.03094
F-statistic	30.49 on 2 and 2522 DF	21.2 on 4 and 2520 DF	14.43 on 6 and 2518 DF
p-value	8.279e-14	2.2e-16	3.019e-16

Model 1 (filtered, using observations with non-empty duration values)

Table 13: Regression Results for Filtered Models

	Model 1.1	Model 1.2	Model 1.3
(Intercept)	7.669 (0.151)***	7.378 (0.310)***	7.792 (0.369)***
pre_age_ij	0.0116 (0.0037)**	0.0279 (0.0151).	-0.0072 (0.0249)
pre_age_ij2	–	-0.0002 (0.0002)	0.0007 (0.0006)
pre_age_ij3	–	–	-0.00001 (0.000005)
post_age_ij	0.0117 (0.0045)**	0.0254 (0.0178)	-0.0476 (0.0394)
post_age_ij2	–	-0.0001 (0.0003)	0.0024 (0.0014).
post_age_ij3	–	–	-0.00002 (0.00001).
Residual Std. Error	1.756 on 1181 DF	1.757 on 1179 DF	1.755 on 1177 DF
Multiple R-squared	0.0085	0.0095	0.0135
Adjusted R-squared	0.0068	0.0062	0.0085
F-statistic	5.038 on 2 and 1181 DF	2.832 on 4 and 1179 DF	2.692 on 6 and 1177 DF
p-value	0.0066	0.0236	0.0134

Model 2

Table 14: Adding log_duration

	Model 4_1	Model 4_2	Model 4_3
(Intercept)	6.477 (0.172)***	6.450 (0.302)***	6.689 (0.360)***
pre_age_ij	0.0086 (0.0035)*	0.011 (0.014)	-0.0054 (0.023)
pre_age_ij2	–	-0.00004 (0.00017)	0.0003 (0.0006)
pre_age_ij3	–	–	-0.000002 (0.000005)
post_age_ij	0.0083 (0.0043).	0.0057 (0.017)	-0.046 (0.037)
post_age_ij2	–	0.00007 (0.00024)	0.002 (0.0013)
post_age_ij3	–	–	-0.00002 (0.00001)
log_duration_ij	0.521 (0.043)***	0.521 (0.043)***	0.518 (0.043)***
Residual Std. Error	1.655 on 1180 DF	1.656 on 1178 DF	1.656 on 1176 DF
Multiple R-squared	0.1202	0.1205	0.1223
Adjusted R-squared	0.118	0.1167	0.117
F-statistic	53.75 on 3 and 1180 DF	32.26 on 5 and 1178 DF	23.4 on 7 and 1176 DF
p-value	2.2e-16	2.2e-16	2.2e-16

Model 3

Table 15: Adding Instrumentation Dummies

	Model 3_1	Model 3_2	Model 3_3
(Intercept)	6.118 (0.202)***	5.952 (0.311)***	6.146 (0.364)***
pre_age_ij	0.010 (0.003)**	0.021 (0.014)	0.004 (0.023)
pre_age_ij2	–	-0.0001 (0.0002)	0.0003 (0.0005)
pre_age_ij3	–	–	-0.000003 (0.000004)
post_age_ij	0.010 (0.004)*	0.014 (0.017)	-0.015 (0.036)
post_age_ij2	–	-0.0009 (0.0002)	0.001 (0.001)
post_age_ij3	–	–	-0.000009 (0.00001)
log_duration_ij	0.564 (0.047)***	0.561 (0.047)***	0.558 (0.047)***
instr_piano	0.587 (0.130)***	0.583 (0.130)***	0.583 (0.130)***
instr_orchestra	0.269 (0.136)*	0.274 (0.137)*	0.273 (0.137)*
instr_violin	0.195 (0.194)	0.205 (0.194)	0.186 (0.195)
instr_cello	0.494 (0.214)*	0.484 (0.215)*	0.496 (0.215)*
instr_voice	-0.650 (0.119)***	-0.649 (0.119)***	-0.650 (0.120)***
instr_strings	-0.273 (0.194)	-0.268 (0.195)	-0.259 (0.195)
instr_woodwinds	-0.093 (0.260)	-0.078 (0.260)	-0.084 (0.261)
instr_brass	0.344 (0.295)	0.334 (0.295)	0.334 (0.295)
instr_percussion	-0.184 (0.302)	-0.194 (0.303)	-0.193 (0.305)
instr_keyboard	0.186 (0.232)	0.201 (0.232)	0.205 (0.233)
instr_chorus	-0.563 (0.137)***	-0.579 (0.138)***	-0.575 (0.138)***
instr_plucked	1.308 (0.729).	1.284 (0.730).	1.232 (0.734).
instr_electronic	NA	NA	NA
instr_other	0.495 (1.134)	0.454 (1.141)	0.550 (1.150)
Residual Std. Error	1.586 on 1167 DF	1.586 on 1165 DF	1.587 on 1163 DF
Multiple R-squared	0.2011	0.2018	0.2026
Adjusted R-squared	0.1901	0.1895	0.1888
F-statistic	18.36 on 16 and 1167 DF	16.37 on 18 and 1165 DF	14.77 on 20 and 1163 DF
p-value	2.2e-16	2.2e-16	2.2e-16

Model 4

Table 16: Adding Composer Fixed Effects

	Model 4_1	Model 4_2	Model 4_3
(Intercept)	5.517 (0.588)***	5.189 (0.617)***	5.342 (0.633)***
pre_age_ij	0.012 (0.004)***	0.037 (0.015)*	0.021 (0.021)
pre_age_ij2	–	-0.0003 (0.0002)	0.0002 (0.0005)
pre_age_ij3	–	–	-0.000004 (0.000004)
post_age_ij	0.006 (0.008)	0.049 (0.039)	-0.017 (0.167)
post_age_ij2	–	-0.0005 (0.0005)	0.0011 (0.004)
post_age_ij3	–	–	-0.00001 (0.00003)
log_duration_ij	0.482 (0.048)***	0.474 (0.048)***	0.469 (0.048)***
instr_piano	0.255 (0.123)*	0.249 (0.123)*	0.251 (0.123)*
instr_orchestra	0.117 (0.128)	0.107 (0.128)	0.105 (0.128)
instr_violin	0.119 (0.175)	0.140 (0.175)	0.126 (0.175)
instr_cello	0.304 (0.193)	0.289 (0.193)	0.296 (0.193)
instr_voice	-0.722 (0.111)***	-0.739 (0.111)***	-0.742 (0.111)***
instr_strings	-0.161 (0.177)	-0.158 (0.177)	-0.145 (0.177)
instr_woodwinds	-0.081 (0.234)	-0.063 (0.234)	-0.055 (0.234)
instr_brass	0.354 (0.267)	0.356 (0.267)	0.359 (0.267)
instr_percussion	-0.110 (0.278)	-0.123 (0.278)	-0.140 (0.278)
instr_keyboard	0.128 (0.212)	0.136 (0.212)	0.152 (0.212)
instr_chorus	-0.671 (0.130)***	-0.671 (0.130)***	-0.668 (0.130)***
instr_plucked	0.177 (0.673)	0.102 (0.674)	0.081 (0.674)
instr_electronic	NA	NA	NA
instr_other	1.388 (1.013)	1.531 (1.019)	1.579 (1.025)
composer fixed effects	yes	yes	yes
Residual Std. Error	1.402	1.401	1.401
R-squared	0.3937	0.396	0.3967
Adjusted R-squared	0.3669	0.3682	0.3678
F-statistic	14.71 on 50 and 1133 DF	14.26 on 52 and 1131 DF	13.75 on 54 and 1129 DF
p-value	2.2e-16	2.2e-16	2.2e-16

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Model 5

Table 17: Adding Composition (Calendar) Year Fixed Effects (Part 1)

	Model 5_1	Model 5_2	Model 5_3
(Intercept)	-179.03064 (147.86259)	-141.20000 (149.50000)	-120.80000 (154.70000)
pre_age_ij	2.04692 (1.63835)	1.67500 (1.65500)	1.51200 (1.71600)
pre_age_ij2	–	-0.00051 (0.00025)*	-0.0022 (0.0015)
pre_age_ij3	–	–	0.000012 (0.00001)
post_age_ij	2.05684 (1.63850)	1.70500 (1.64900)	1.34400 (1.76200)
post_age_ij2	–	-0.00093 (0.0006)	0.0022 (0.0046)
post_age_ij3	–	–	-0.000023 (0.00003)
log_duration_ij	0.48309 (0.05249)***	0.47500 (0.05248)***	0.4737 (0.0525)***
instr_piano	0.28009 (0.13164)*	0.27100 (0.13140)*	0.25750 (0.13190)
instr_orchestra	0.13031 (0.13476)	0.11820 (0.13460)	0.11130 (0.13470)
instr_violin	0.03660 (0.18610)	0.03680 (0.18580)	0.03620 (0.18590)
instr_cello	0.39571 (0.20456)	0.38630 (0.20420)	0.37880 (0.20520)
instr_voice	-0.73723 (0.11470)***	-0.75790 (0.11490)***	-0.75580 (0.11490)***
instr_strings	-0.12511 (0.18769)	-0.09899 (0.18760)	-0.09839 (0.18780)
instr_woodwinds	-0.26719 (0.24673)	-0.24120 (0.24700)	-0.26460 (0.24790)
instr_brass	0.44989 (0.28097)	0.46470 (0.28060)	0.47170 (0.28070)
instr_percussion	-0.14616 (0.29251)	-0.20020 (0.29290)	-0.19360 (0.29300)
instr_keyboard	0.27040 (0.22533)	0.29330 (0.22570)	0.29340 (0.22570)
instr_chorus	-0.71674 (0.13809)***	-0.71600 (0.13810)***	-0.71930 (0.13810)***
instr_plucked	0.53660 (0.69512)	0.48720 (0.69410)	0.44920 (0.69600)
instr_electronic	NA	NA	NA
instr_other	0.69364 (1.49155)	0.57540 (1.48900)	0.57220 (1.48900)
composer fixed effects	yes	yes	yes
calender year fixed effects	yes	yes	yes
Residual Std. Error	1.388	1.385	1.386
R-squared	0.4695	0.4728	0.4737
Adjusted R-squared	0.3793	0.3818	0.3817
F-statistic	5.202 on 172 and 1011 DF	5.2 on 174 and 1009 DF	5.15 on 176 and 1007 DF
p-value	2.2e-16	2.2e-16	2.2e-16

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1