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Good Reverberation? Teacher Influence in Music Composition since 1450

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Good Reverberation?
Teacher Influence in Music Composition since 1450

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Abstract:

Teachers and mentors in creative fields ranging from scientific research to the arts may shape their students' skills and views of the craft, and in turn the work they produce. How significant is this influence, how long does it last, and are there consequences for the variety and quality of students' inventive output? We study these questions in the context of Western music composition over five centuries, a historically important cultural institution, and in a setting where composers' musical lineage is well-documented, the content of their work can be directly compared, and its lasting value can be measured. We find strong evidence of influence, document when it arises and persists, and evaluate its consequences. The results provide insight into the production of creative or intellectual output, specifically around questions of where ideas come from, why certain ideas get produced as opposed to others, and what the ramifications might be.

JEL Classification: I21, J24, N30, O31, Z11

Keywords: teacher influence, creativity, cultural transmission, transmission of ideas, music history

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1 Introduction

Humans are a product of their environment, each a composite of countless influences accumulated over a lifetime. Teachers, in particular, can have a formative effect on the development of their students, one which has been documented in modern education vis-à-vis their effects on students' academic performance and later-life outcomes (e.g., Rivkin et al., 2005; Rockoff, 2004; Chetty et al., 2014a, 2014b) as well as historically (e.g., Waldinger, 2010). However, a distinct—and distinctive—potential impact of teachers that is especially important in creative professions is their *creative* or *intellectual* influence: how teachers shape students' skills and views of the craft, and in turn the nature of the work they later go on to produce. Teachers or professional leaders with wide reach can potentially even affect the direction in which entire fields move.

Academic researchers may recognize the potential for this influence, reflecting on how they themselves may have been shaped by where they did graduate work, the faculty who taught their courses or advised them, and even their peers, evidence of which is casually observed in their disposition to different questions, methods, and applications (e.g., Margo, 2018). On the one hand, instruction by subject matter experts is essential for transmitting basic principles and skills, and for the ability to discern good from low-quality work. But it may also imbue students with tastes and methods of an instructor who is out of the mainstream or who does not meet contemporary standards. At the extreme, this influence may even cause bad ideas to propagate. Whether or not teachers and mentors in creative fields leave an imprint on their students that shapes their future work is an empirical question. If the answer is yes, many questions follow, such as how extensive it is, how long it lasts, whether some teachers have more influence than others, and whether there are consequences for the variety and quality of these students' inventive output.

In this paper, we examine these questions in the context of Western music composition over the span of about five centuries from ca. 1450. Music composition is an attractive setting for studying these questions, for both phenomenological and practical reasons. First, composers were typically educated by other composers—in private lessons or conservatories, often locally, and at young ages—and this lineage is well-documented in biographies and other reference works. Second, the content of musical compositions is relatively structured and can be mathematically compared to generate similarity measures on key dimensions for pairs of composers or individual works. Third, musicologist- and market-based measures of quality are available as well as data on the lives and works of important composers. Fourth, music education was widely available to broad parts of society in many countries throughout most of the time covered, and it was closely related to the teaching of composition. And finally, until the latter half of the 20th century, the curriculum for music education was mainly determined by individual teachers or locally; only later came the standardization of curricula, instructional methodologies, and achievement standards.

To measure the similarity of two composers or musical compositions, we draw on data from two volumes (Barlow and Morgenstern 1975, 1976) that list 18,074 melodic themes from 6,352 classical works by over 750 composers. This source provides a list of themes in the form of lettered note sequences (conveniently transposed to a common key) as well as a staff for each theme showing the original key and time signatures. Though we acknowledge that this represents only a subset of the content of each work, it includes several of the most basic elements specified by the composer—with substantial variation across the sample—and we demonstrate that these observed dimensions of the works in our sample offer insight into the phenomenon, especially when viewed together. Using this information, we calculate similarity scores between pairs of composers and compositions on the observable dimensions of their work. Specifically, we measure similarity in the occurrence of subsequences of notes (duplets, triplets, quadruplets) in themes and overlap in the distribution of keys and time signatures of composition.

We combine these measures with biographical information on the composers in our sample: when and where they lived, the conservatories they attended, and their musical genealogy, including teachers and students, from Grove Music Online (a modern update to the New Grove Dictionary of Music and Musicians, a leading reference work on Western music) and Pfitzinger (2017) (a recent, first-of-its-kind volume listing the teachers and students of more than 17,000 composers). We then supplement these data with measures of composer quality obtained from three different independent sources. We measure the individual composer's distinction (from Murray, 2003), the length of biographical entries in Grove, which correlates with importance, and modern consumption data (based on Spotify streams).

The composers in our sample are overwhelmingly ($> 85\%$) European, from all corners of the continent, and while some are household names today, many are less well-known. The majority were born and educated in the 18th or 19th centuries, spanning the Classical and Romantic eras of Western music. Within the Barlow and Morgenstern (BM) sample, we have a few hundred educational relationships to other BM composers, of which most were established when the student was under 20 years old. The likelihood of any two composers being connected is strongly increasing in their geographic and temporal proximity but appears to be only weakly, if at all, related to their underlying ability, suggesting that sorting was primarily driven by the (exogenous) place and timing of each composer's birth, especially in an era when geographic mobility was limited.

The first challenge in studying the effects of these relationships is establishing a control group of unrealized candidate teacher-student pairs for comparison. We begin with the universe of all pairs of composers in our data, and condition to pairs where the older of the pair was alive for at least one year when the younger was between the ages of five and 30, labeling the older the "candidate teacher" and the younger the "candidate student" (among realized pairs, the teacher is always older than the student). This condition establishes a risk set of 28,546 candidate pairs, of which 211 were in fact realized. Our first set of tests compares the similarity of realized pairs against unrealized pairs, conditional on various fixed effects and flexibly controlling for the two composers' birth distance in space and time, which may jointly affect the similarity of their work and the likelihood of connection. In a range of robustness checks we explore variants of this specification and sampling condition, such as restricting to European-only pairs or comparing similarities across composers located in the same city at the same time.

We find that students are on average roughly 0.2 to 0.3 standard deviations more similar to their realized teachers than to other, unrealized, candidate teachers.

A potential threat to the empirical approach is that composers may have chosen to teach or to study with a particular composer based on their style. This is a fairly unlikely concern in this historical setting and context since composers typically began lessons with their teachers at an early age and—according to our data—had almost never composed anything before meeting their teacher. Furthermore, information exchange and the possibility to travel were fairly limited in the time periods covered. Nonetheless, we pursue several additional and robustness approaches to mitigate the concerns, including within-conservatory natural experiments, which exploit teacher turnover at music conservatories and compares a student's similarity with his actual teacher at a given conservatory with that of candidate teachers who had recently departed from or had not yet arrived at that particular conservatory.[1] We also study influence at the composition level and demonstrate that the student's style after the initial training is more similar to the teacher's style from before it, but the similarity subsides with time. We then show that influence persists through the next generation in a composer's musical lineage, as many students went on to become composition teachers themselves, but the effect subsequently starts to fade. Finally, we study horizontal similarity and disclose that students who had a teacher in common were more similar to each other than to other unconnected composers. All these approaches consistently and collectively point to the importance of the teacher in the shaping of a student's style of work.

We then explore the conditions under which the influence arises. This effect is relatively stronger for higher quality teachers or for those who invest more time in the student but does not seem to

[1] As the study encompasses only male composers, the male form is used.

vary much depending on the student's subsequent career; put in another way, the student, once exposed to the teacher's influence, appears to have limited possibilities to depart from it in other ways than through the passage of time.

Finally, we evaluate the consequences of this influence and show that students who imitate high-quality teachers are themselves more likely to become higher-quality composers. On the other hand, imitation of teachers in the bottom quality quartile may have reduced students' chances of success later in life.

The results have implications for economists' understanding of the production of creative or intellectual output, specifically around questions of where ideas come from; why certain ideas get produced as opposed to others, and by whom; and what the consequences might be—questions that are of general interest and may be especially important to modern growth theory, economics of innovation, and cultural economics.

The paper is organized as follows. Section 2 presents the relevant literature. Section 3 summarizes the historical context. Section 4 describes the data sources. Section 5 provides the estimation framework. Section 6 shows the effects of connection on similarity. Section 7 outlines the conditions for influence. Section 8 shows the implications for composer's quality. Section 9 concludes.

2 Literature

To place our study in context we use this section to summarize existing research on the creative process, innovation in history, teacher influence, cultural transmission, and musicians and music.

The creative process

The creative process depends on the knowledge of a creator. The two ways in which this knowledge emerges are formalized by Akcigit et al. (2018). First, knowledge is created from interaction with other people, and second, it stems from external sources related to own explorations over time. It is especially the former channel that is fundamental to the present paper, albeit the latter one—the age-dependent factor—is also explored here. With a focus on person-to-person transmission of tacit knowledge, de la Croix et al. (2018) show that the transmission of knowledge in master-student relationships was more important for technological creativity than transmission within extended families or clans in pre-industrial Europe.

Another approach to model the creative process is provided by Feinstein (2011): Creators explore and gather elements before finding ways to combine and reconfigure these elements into new creative forms. Teacher-student interactions may thus shape the creative process by directing the student towards elements that are familiar to the teacher.

Innovation in history

Creativity thrives in environments where individuals are free to pursue their own paths of inquiry and creative expansion (Feinstein, 2006, Aghion et al., 2008, Simonton, 2004). A culture of growth connected with inter-human interaction sparks innovation (Mokyr, 2016). Innovators play an important role, not only by creating but also by actively influencing others as they spread their improving mentality (Howes, 2017).

Our study is also motivated by the literature on upper tail human capital and economic development (Mokyr, 2009; Meisenzahl and Mokyr, 2011; Squicciarini and Voigtländer, 2014) or growth literature, which defines economic growth as a function of the generation and transmission of new ideas (e.g., Lucas, 2008, Jones, 2005). These strands build on the notion that ideas are transmitted across individuals and that (creative) people are able to influence each other. However, so far direct evidence on how this transmission from person to person occurs is very limited. This is not surprising, given how elusive the concept of an idea is.

Several authors have mapped and quantified creative activity over time and place. Murray (2003) selects and ranks leading innovators in the arts and sciences from 800 to 1950. Gergaud et al. (2016) document the geographic expansion of talented individuals and creative clusters. In such clusters human interaction increases the innovativeness of visual artists (Hellmanzik, 2010) and music composers (Borowiecki 2013, 2015).

Teacher influence

The literature on how teachers influence students deals with students' academic performance and later-life outcomes (e.g., Rivkin et al., 2005; Rockoff, 2004; Chetty et al., 2014a, 2014b; Jackson et al., 2014). One of the more prominent works in a historical context is provided by Waldinger (2010), who explores whether the quality of a teacher matters for the future performance of a PhD student. The dismissal of Jewish professors in Nazi Germany is used as a source of exogenous variation, which allows the author to conclude that faculty quality is an important determinant of short- and long-run PhD student outcomes. Azoulay et al. (2017) explore the influence of advisors on graduate students and postdocs. By showing that young scientists do not consider their advisers' patenting behavior in establishing the match, the authors find that the transmission of patenting behavior is a causal social influence. Others approach teacher-student relationships from a network perspective. For example, Tol (2018) constructs a professor-student network of Nobel laureates in economics.

The learning and teaching of musical composition plays a central role in musicology (see Viig, 2015, for a review). Long-lasting influence of composition teachers is common knowledge, as "music teachers enjoy an almost genealogical immortality through their students" and "teachers imprint their students with the specific physical traits of their craft: gestures, tics and preferences that those students may in turn pass on to yet another generation". All this allows teachers to "exist as sound" (Fonseca-Wollheim, 2017) in the future work of their students. However, systematic, quantitative evidence in support of such claims is missing.

Cultural transmission

Bisin and Verdier (2011) define culture as something representing those components of preferences, social norms, and ideological attitudes that "depend upon the capacity for learning and transmitting knowledge to succeeding generations". Children acquire preferences through adaptation and imitation of a parent as well as role models like teachers (Bisin and Verdier, 2001).[2] The exposure to ideas and influence of certain teachers may shape a person's norms and preferences (Bordo and Istrefi, 2018).

Our analysis relates to this literature by providing insights into the transmission of knowledge to succeeding student generations. Furthermore, although not yet explicitly studied, the transmitted preferences may also be directed towards a creative product of a certain type.[3] Acquired taste determines, for instance, why some find delight in contemporary art, while others detest it; or—in the context of our study—why certain composers compose what they do.

Musicians and music

The lives and works of famous music composers have been studied in various contexts and across several disciplines, perhaps in reflection of the importance of the institution of music in history (e.g., Bonds, 2006) or as an acknowledgment of the contribution musicians have made to the cultural heritage. Psychologists—most prominently Dean K. Simonton—have explored musical structure

[2] See also early applied work in psychology on the extent and mechanisms of intergenerational transfer of personality traits (Simonton, 1983) and intergenerational influence (Simonton, 1984).

[3] Our validity tests also shed some light on how acquired taste depends on the country of birth (see Appendix D.3): Composers born in the same country compose more similar works than composers born in different countries.

and whether it can reveal the psychology of musical aesthetics and creativity (e.g., Simonton, 1980, 1984). Musicologists explore the structure of musical works in order to categorize them (e.g., Serra et al., 2012), explore how they changed over time (e.g., Foster et al., 2014) or analyze their role for the evolution of popular taste (Mauch et al., 2015). Styles of individual musicians have also been explored (e.g., Smith and Georges, 2014). These studies typically emphasize musical characteristics of one or a few individual composers, but typically do not explore how a composer's background or the environment matters for the development of a particular style.

3 Historical context: Music education and originality in music

It is beyond the scope of this section to present a detailed account of the music history context, but in what follows we sketch out the key developments in music that are most relevant to this paper. In doing so, we focus on music education and how it has changed over time as well as on the perception of originality in music.

In Medieval Europe, the tradition of music education was based at monasteries, cathedrals, and parish schools.[4] It often began at young ages, as was the case with our earliest composer—Josquin des Prez, born in 1450—who was taught singing as a choirboy at a church. Later he may have studied counterpoint under a lesser known composer, who is not covered in this study. Coinciding with Prez's lifetime, the five-line staff became more widely used and, hence, music could be written as it was to be performed. This was an important development, which enabled composers to write music and increased the value of the ability to read and write music. As a result, notation became a major subject of study, and the better students continued to study composition (Mark, 2008). The popularity of music education contributed to a further development of the methods of writing music and later brought along the detailed notation of Renaissance polyphony.

Teaching of singing and instrumental music was advocated and facilitated further by Protestant Reformers. Consequently, the curricula in the newly established schools included formal music education from as early as the 17th century. Students at the elementary level studied music principles, while those at the intermediate level progressed to music theory and composed music in class (Livingstone, 1971).

Along with the rising popularity of composition, theoretical considerations emerged about what constitutes the composing of music. The French composer Jean-Benjamin de Laborde (not covered

[4] This is the first, but not the last, mention of a religious institution in this section. The reader may thus expect that the role of religious denomination is more closely discussed and examined. We pursue this in Appendix D.4.

in this study) proposed in 1780 that "composition consists (...) [of] the ordering and disposing of several sounds in such a manner that their succession pleases the ear. This is what the Ancients called melody." This definition has been regarded as accurate throughout most of history (Forte, 1979), and it is also clearly reflected in the methodological approach of this paper.

The Protestant model of music education was successful not only in revealing the most talented students, who proceeded to receive individual tuition, but also by influencing schools abroad; for example, including in 19th century America (Mark, 2008). The 19th century, a golden age for classical music, was also an important period for music education with its formalization and secularization in the newly founded conservatories across the world. The earliest conservatories have been in existence in Naples since the 16th century, but it was not before the turn of the 19th century that conservatories were founded in most of European cities, and later also in the Americas.

Throughout the centuries covered in this study, instructional methodologies were largely determined by the music teacher. It was also usually the individual teacher who locally determined the curriculum for music education. This began to change in the second half of the 20th century with the onset of standardization in music education, especially with regard to recently developed instructional methods, which were disseminated more widely (Costanza and Russel, 2017). Perhaps not surprisingly, several composers played important roles in advancing instructional methods of music teaching, including Zoltan Kodaly, Carl Orff, and Émile Jaques-Dalcroze. It was also in the latter half of the 20th century that assessment standards were developed and introduced. The use of standards provided guidance on the performance of teachers and had become a common practice in most countries by the late 20th century (Abril and Gault, 2016). Assessment standards typically included criteria related to composing and arranging music within specified guidelines.

Another important development in music relates to the perceived value of originality. Until the 18th century, music was composed for a particular occasion. Once performed it was often not used again. Therefore, composers would regularly rewrite their own music in order to accommodate a new circumstance or audience. Similarly, music by others was often appropriated for re-use, and such borrowing would not raise any concerns of plagiarism. Originality became increasingly praised from the mid-18th century and eventually became regarded as superior to imitation. In consequence, the quality of a composer was assessed by the inventiveness of new music as opposed to skillful manipulation of existing material.

Alongside these cultural shifts, several other developments shaped the nature and value of music making. First of all, there emerged a popular interest in music, reflected in the demand for sheet music and music teaching for the offspring of the rising middle class. Public performances gained popular appeal and were staged in newly built concert halls and opera houses across European cities. The standing of a composer was promoted from artisan to artist, while music became an art form, exercised for its own sake.

These changes created an unprecedented array of opportunities for music composers and enabled them to seek employment on their own, as opposed to remaining dependent on their patrons. Wolfgang Amadeus Mozart, born in 1756, has been suggested as one of the first entrepreneurial composers who was able to compose what he wanted and supply his services as he pleased (Scherer, 2004). This was possible after Mozart parted from his patron Archbishop Colloredo having received a notorious "kick in the butt".

Self-promotion and branding of one's own name became important for the composer, as this enabled the artist to distinguish himself from others. This also raised the interest in the composer as a person and led to more careful ascription of ownership of a musical work. As a result, originality grew in importance. Borrowing remained acceptable, but existing music had to be placed in a new, different context. Existing work, especially musical classics, but also less prominent earlier work, was emulated by composers in their education and training. However, it has became increasingly recognized that "only sly allusion, like a wink to the connoisseur, or addressing the same musical issues in a new and original way could allow the younger composer to reach a level equal with his predecessors" (Burkholder, 2001).

4 Data

We draw information from several databases: dictionaries of musical themes, encyclopedias of music and musicians, and modern music consumption data. This section describes these data sources and pursued approaches to estimation.[5]

4.1 Musical themes

We collect data on musical themes from two volumes of the extensive "Dictionary of Musical Themes" by Barlow and Morgenstern (BM, 1975, 1976). The data contain information on 18,074 melodic themes from 6,352 classical works by over 769 composers. We digitize more than 1,200 pages that list themes from individual compositions, showing lettered note sequences, staff, key signature, and time signature (see Appendix Figure A.1 for a sample theme). All themes are

[5] More details on the extensive data collection process are provided in Appendix C.1.

transposed to a common key of C (major/minor), which enables standardized comparisons. The note sequences vary in length and contain between three and 15 notes. As a baseline we consider all provided notes. However, we conduct robustness tests by truncating the note sequences and consider instead only the first six notes of a theme (>99.8% themes contain at least six notes). We complement this with manually collected information on the original key and time signatures. A key signature indicates notes that are to be played higher or lower than the corresponding natural notes (see Appendix C.2 for details on how we identify key signatures). Time signatures specify how many beats are to be contained in each measure (segment of time) and which note value is equivalent to one beat. The information available for each theme represents only a subset of the content of each work; however, it includes several of the most important characteristics of a music composition specified by the composer.[6] This enables us a unique possibility to quantify some of the main characteristics of a creative product and to measure the similarity between compositions and pairs of composers.

Similarity is calculated in several different ways using N-gram based measures, where an N-gram is defined as a group of N consecutive notes (e.g., duplet, triplet, quadruplet), as well as cosine similarity measures of key signature and time signature distributions. We begin by estimating similarity coefficients for pairs of composers by compiling all of the N-grams, key signatures, and time signatures for each composer into a corpus. This information is then used to, first, calculate the Jaccard index, which is given by the percentage of collective n-grams shared by a pair of composers: $|T_{1n} \cap T_{2n}|/|T_{1n} \cup T_{2n}|$, where $N = n$, and T_{in} is the sets of n-grams in themes by composer i. Second, we calculate the cosine similarity of the N-gram distribution: $(P_{1n} \cdot P_{2n})/(||P_{1n}|| \, ||P_{2n}||)$, where P_{in} is the probability mass function of n-grams by composer i. Third and fourth, we calculate the cosine similarity of distribution of common key signature and time signature, respectively. Appendix Table B.1 shows the similarity measures for BM composer pairs.

We complement the composer-pair level approach with an analysis of similarity at the composition-level. In analogy, we calculate similarity coefficients for pairs of compositions by considering the percentage of collective n-grams shared by two compositions and cosine similarity of the distributions of n-grams, key signature, and time signature of two compositions. The composition-level approach could potentially enable us insights into the timing of a teacher's influence, but requires the knowledge of the years when a work has been composed. Unfortunately, this information is limited (see Appendix C.3 for details), which will constrain to some degree the composition-level explorations.

[6] Melody (linear succession of musical notes) and tonality (key signature) are key features of classical music that enable listeners, among others, to identify the historical period or the composer of a work (Weiss et al., 2014).

4.2 Composer and composition data

Data on music composers is collected from the New Grove Dictionary of Music and Musicians (Grove), the leading encyclopedia for musicology offering comprehensive coverage of music and musicians. The data covers 349 composers, who have at least five themes listed in the dictionary by Barlow and Morgenstern.[7] We have collected information on the birth and death years, birth city and cities visited over the lifetime of composers, along with the approximate years, and reasons for the move. Appendix Figure A.2 shows the distribution of composers' birth locations. The map illustrates the concentration of music activity in Western Europe and the United States. There is, however, a large variation in locations in these two regions and especially across Europe (see Appendix Figure A.3). Appendix Table B.2 presents the distribution of composers by century of birth.

The data also contain a list of conservatory affiliations, including an indication of whether the composer was a student or faculty, and approximate dates of enrollment or employment. We also obtained for each composer a detailed list of teachers and students, along with an indication of how they met. Knowing the teacher-student relationship is crucial for our analysis. It is thus encouraging that this information is relatively well preserved and reliable. This is due to the prominent role played by a composition teacher in a composer's life and career, where being part of the lineage of a particular musician is often used to help establish one's own credentials, even more so than, for example, in science. Given this importance, Pfitzinger (2017) has dedicated much of his career to listing teachers and students of 17,460 composers in the extensive volume "Composer Genealogies, A Compendium of Composers, Their Teachers, and Their Students".[8] Combining all connections from Grove and Pfitzinger (2017) delivers 211 connections for the sample of composers from BM. Table 1 shows the distribution of BM composers by the number of teachers and students also included in BM.

It is important to remark that composers typically began lessons with their teachers at very early ages. The mean age is less than 16 years and 75% of composers met their teacher before the age of twenty (see Appendix Table B.3). Moreover, the first meeting with a teacher nearly always (>96% of pairs) took place before the student began composing.[9] In other words, the subjects of our study

[7] This covers approximately half of the composers listed by BM, and includes 94.5% of all the themes. In robustness tests, we confirm with more rudimentary, automatically collected data, that the main results presented in this study would not be different, if instead all 769 composers from BM were used.

[8] We assess and discuss the reliability of this source in Appendix D.5. There we also explore the potential difference between the influence of a composition teacher vs. an instrumental music teacher.

[9] This is estimated for student-teacher pairs where we have the year of their first meeting and the year of composition for at least one of the students' works in our data.

were typically connected with composition teachers before they became composers. This mitigates to some degree the concern regarding self-selection based on a particular style of composition.

4.3 Quality measures

To evaluate the quality of a composer we collect four different metrics from three independent sources. In particular, we obtain expert-based measures, which enable us to rank composers or quantify their importance based on what and how much musicologists have written about each composer. Furthermore, we compute market-based measures from modern consumption data.

First, we obtain an achievement index from Murray (2003), who ranks leaders in several fields of human accomplishment, including Western music. The achievement index reflects the coverage a composer receives in a large number of international reference works, which is useful as it mitigates the concern of country-specific biases and, hence, has often been used interdisciplinarily in studies of creativity (see Simonton, 2004). Murray's procedure is well-established in historiometric scholarship and the reliability of the indices is "favorably comparable with the best seen" (Simonton, 2014, p. 55). The index is normalized on a scale from one (lowest) to 100 (highest) and covers 189 composers from the BM sample. To those who have not been prominent enough to be included by Murray we assign an index equal to zero.

Second, from Grove we automatically extract word count measures from different sections of a composer's biography - that is, life, works, bibliography, and writings. The word count in the life section is a commonly used measure of the importance of a historical figure and correlates particularly closely with the length of entries in the works and bibliography sections.

Third, we use modern consumption data based on Spotify streams. For each composer we retrieve the total number of Spotify followers and a proprietary popularity score (measured on a scale from zero to 100). Some music may be seasonal, and hence the collection took place over a 12-month period from October 2016 to September 2017 and was then averaged out. The positive correlation between Spotify followers and popularity score is reported in Appendix Figure A.4.

Figure 1 plots the correlation between logged Spotify followers and logged Murray quality index. It is clear that composers with a greater coverage in historical reference works are also more often listened to nowadays. It is unsurprising that composers like Ludwig van Beethoven, Wolfgang Amadeus Mozart, and Johann Sebastian Bach are placed in the top-right corner, followed by many household names and ending in the bottom left with somewhat lesser known composers (see Appendix Figure A.5 for similar positive patterns among the other quality measures).

A recurring concern in the literature on teacher's value-added is self-selection based on quality: better teachers tend to select better students, and vice-versa. Therefore, a relevant concern is the quality of connected teachers and students.[10] Figure 2 shows scatterplots using our four different quality variables for connected pairs. Interestingly, the relationship appears insignificant: good teachers were teaching both better and worse students, and worse teachers also had both better and worse students. This suggests for our sample that students and teachers were not connecting based on considerations about quality. Previously, we have also observed that matching was unlikely to take place based on composition style since students had almost never composed anything before connecting with a teacher. The connections may thus have been created based on other characteristics, possibly related to chance. After all, in the historical period covered, information was relatively scarce and traveling difficult. Random-like matching may have been inefficient for the composers studied but comes useful for our identification strategy.

5 A framework to study influence

This section proposes a simple framework to study influence, which is followed by a presentation of the empirical setup. We begin by defining the style of a creative person and by conceptualizing what determines it. Most broadly, style is a manner or custom of behaving or conducting oneself. Therefore, the concept of style is of general interest and has been studied in recent years in various contexts, including in economics (e.g., leadership styles by Bertrand and Shoar, 2003) and management science (e.g., styles in product design by Chan et al., 2018).

A narrower definition suggests that style is a particular manner or technique by which something is created, written, or performed. It is a distinctive characteristic of a person, group of people, place, or period. Accordingly, style plays a particular role in the creative industries because it permits the grouping of creative output or the producers thereof into categories. Thus, the classification of style can be useful in the study of, among others, architecture, advertising, publishing, video games, or the arts, including music.

A creative output has to contain at least some unique attributes (otherwise it would be a replication and not creative), but the remaining attributes may resemble other existing outputs. Based on this resemblance it is possible to classify creative output into a certain category of style. The style can be captured as a function of key attributes. For example, in architecture such attributes may include the shape of a building, a method of construction, or building materials. On the other

[10] Scherer (2004) invited "more systematic statistical research" into the question of whether "youngsters exhibiting talent are attracted to and attract talented teachers". In this sense, Figure 2 provides the requested test.

hand, classical music style attributes may include specific sequences of music notes or a particular key and time signature.

We propose that style is a function of indirect and direct influences:

$$\textit{Style} = \textit{f(Indirect influence, Direct influence)} \tag{1}$$

Indirect influences are external factors, the *zeitgeist*, or something ”in the air”, and such influences are a function of the place where and time when a creative was born and the interaction of the two. Direct influences depend on other individuals that the creative person learns from or interacts with. The framework could be used to study the influence of any single individual or group of people that may have influenced the creative person. However, a particularly formative effect on the development of a creative stems from the interaction with a teacher, which is also the focus here. Conditional on two individuals being connected as teacher and student, the extent of the direct influence of an educator will be a product of the teacher's investment of time in the student and the student's subsequent career—the time dedicated to compose as well as exposure to other influences.

5.1 Estimation strategy

Building on the previously presented theoretical considerations, we proceed to an empirical measurement of similarity. Considering what determines style, as seen in Equation 1, we construct similarity measures between two creatives i and j. In principle, we difference out creative i's style from creative j's style. This results in similarity measures that are a function of differences in the indirect influences, which can be captured via pairwise overlap in time and place, and direct influences, which can be determined based on indicators showing whether a pair has been connected or not.

With a focus on music composers, we estimate similarity measures between composers i and j by using variants of the following specification:

$$\begin{aligned} \textit{Similarity}_{ij} &= \gamma_0 + \gamma_1 * \textit{Connected}_{ij} + \\ &+ \gamma_2 * \textit{Ln(Geographic birth distance)}_{ij} + \gamma_3 * \textit{Ln(Temporal birth distance)}_{ij} + \\ &+ \gamma_4 * \textbf{Commonality controls}_{\boldsymbol{ij}} + \textit{ComposerFE}_{ij} + \textit{TimeFE}_{ij} + e_{ij} \end{aligned} \tag{2}$$

where $\textit{Similarity}_{ij}$ measures the pct. of collective n-grams shared or the cosine similarity of n-

grams, key, and time signature for a given pair of composers, i and j. $Connected_{ij}$ is an indicator of connected pairs, $Ln(Geographic\ birth\ distance)_{ij}$ is the logged geographic distance between birthplaces measured in kilometers, and $Ln(Temporal\ birth\ distance)_{ij}$ is the logged temporal distance between birthplaces measured in years. $Commonality\ controls_{ij}$ is a vector of dummies for common birth country, common time period measured in 25-year intervals, and their interaction, common nationality, and common family. Composer fixed effects control for time-invariant differences across teachers. Time fixed effects control for time-variant differences that affect all composers within a quarter century.

We condition to pairs of composers (connected or not) where the older of the two composers in a pair was alive for at least one year while the younger was between the ages five and 30. The condition holds for all connected composers and ensures that the older composer in the pair (*candidate teacher*) could have met the younger (*candidate student*). Implicitly, comparing only contemporaneous composers leads to the mitigation of time-related differences, including, for example, changes in compositional style. In Appendix D.1 we explore a number of alternative conditions that restrict our samples to the same time period and geographic proximity in several different ways, including a highly restrictive condition that requires realized/unrealized pairs to be located at the same time in the same city. The results that follow hold for all the variants of conditions pursued.

A concern may relate to non-random matching, which could be an issue if students (or teachers) self-selected into relationships based on styles of their output.[11] Ideally, if the degree of similarity was measured before and after the student was exposed to the influence of the teacher (see Section 6.3). Alternatively, one could exploit random-like incidence of connecting (see Section 6.2). Of interest is also the consideration of the intensity of creative influence, which may differ depending on teacher's effort and skill, and student's subsequent career (see Section 7).[12]

6 Effects of connection on similarity

6.1 Connection and similarity: Baseline results

The starting point of our empirical investigation is a comparison of the similarity between a student composer and his actual teacher (realized pair) with his candidate teachers; that is, composers who

[11] As we have seen previously, this is a limited concern in our context of music composition, since composers typically began lessons with their teachers at early ages and before they composed anything themselves. It is also encouraging to observe that teacher student pairs have not been formed based on quality considerations (see, for example, Figure 2).

[12] In the Appendix we also explore and test other sources of contemporaneous direct influences (E.1), and discuss in more detail why the influence of past masters does not affect our results (E.2).

were alive during the student's formation age, but were not connected (unrealized pairs).[13] Table 2 summarizes the results based on Equation 2 in eight regressions—one for each of our measures of similarity: percentage of collective 2-/3-/4-grams shared and cosine similarity of 2-/3-/4-grams, key signature, and time signature. Each regression includes a set of commonality controls to identify pairs that share birth country, time period (and their interaction), nationality, and descent.

All point estimates for *Connected* are positive and estimated with high precision. Connected composers are more similar to each other by ca. 0.1 to 0.3 standard deviations than to unconnected composers. It is encouraging to observe that the size of the effect is comparable across all our measures.

The results are robust to a number of alternative specifications, including truncating themes at six notes, measuring the similarity with logged coefficient, or sub-sampling to European composers only or those born after the mid-18th century when originality became more valued. See Appendix D.2 for details.

6.2 Within-conservatory natural experiments

The concern that students may self-select into a relationship with a particular teacher based on his compositional style is limited. As we have observed previously, composers typically began lessons with their teachers at early ages—that is, when they were unlikely to have developed their own style of composing yet. Furthermore, it was very rare that students had actually composed before meeting the teacher.

Nonetheless, we pursue a natural experiment setting, exploiting teacher turnover at conservatories in order to identify more convincingly the effect a teacher may have had on his student. We estimate the student's similarity with his actual teacher at a given conservatory and compare it to the similarity with candidate teachers who had recently departed from or had not yet arrived at the given conservatory.[14] The pursued natural experimental design builds on the identification assumption that teacher turnover within a conservatory is uncorrelated with student characteristics. This assumption is plausible insofar as students (or their parents) did not time enrollment at a conservatory based on whether a single teacher left or arrived at that institution. Considering the historical periods covered, the concern seems rather negligible, as traveling and access to information were limited.

[13] A simple exploration of differences in mean similarity by connected status is shown in Appendix Table B.4.

[14] Our data cover 94 composer pairs connected at a conservatory out of 1064 pairs of composers who had a conservatory in common. The size of the risk set depends on the chosen time horizon for the analysis.

Table 3 reports the results in two panels for different time windows. For example, Panel (A) shows the 10-year window, which narrows down the risk set to candidate teachers who had departed from the conservatory during the preceding 10 years or would arrive at the conservatory in the following 10 years. The results show that a composer is by about 0.2 standard deviations more similar to his teacher at a conservatory (connected pair) than to candidate teachers who had recently departed from or were soon to arrive at the conservatory. There are no large differences between either of the observation windows.

These estimations are somewhat less precisely estimated than the baseline models, which is possibly due to the lower number of connected composers. Nevertheless, the magnitude of the coefficients is comparable. Furthermore, as can be seen in Appendix Table D.6, the extent of a teacher's influence does not seem to depend on where teaching took place (conservatory vs. private education), which in turn extends the validity of the approach pursued here.

6.3 Composition-level similarity

Composers evolve over their life cycle and change style and mood in music as they age and absorb more knowledge; they also evolve internally. Therefore, identifying a single style of a composer is not an easy undertaking. The fact that we detect the influence of a teacher in the lifetime style (that is, considering all compositions written) makes our result even stronger, since any eventual later-in-life deviations from the style imposed by the teacher would bias our coefficients downwards. An emerging question is thus when the student is influenced the most and how long the influence lasts? To answer this, we examine data at the composition level and explore how similar a student is over time to his actual teacher compared to candidate teachers. The analysis is conducted for teacher-student pairs for which we know the year they met as well as the year of composition of at least one work by teacher and the student.[15]

We focus on the student's compositions after the meeting with a teacher since composers had typically not composed anything before meeting their teacher.[16] When it comes to the teacher, we consider only his output before the meeting. This is done in order to eliminate any concern of reverse causality, since a teacher may be also influenced by his student. Essentially, we estimate

[15] An alternative approach to mitigate the concern of life cycle variations in compositional styles is provided in Appendix E.3. There we explore the teacher-student similarity across a range of variables that do not vary (much) over the lifetime (e.g., occupation, or choice of musical instruments or musical forms). For example, it is highly improbable that a composer who is a pianist will become a violinist due to external influences (at least not a violinist of a high enough quality to become mentioned in Grove).

[16] Appendix C.3 describes the difficulty in obtaining information about the year of composition, which limits a composition-level analysis.

the similarity between the student's style at different times after the first meeting and the teacher's style before the meeting, and compare it to the styles of candidate teachers.

We also include a time distance control to account for the number of years between the student's and the teacher's composition. This is done in order to account for changing fashions in style and to discount the importance of those of the teacher's compositions that had been written long before the meeting. We also introduce teacher-student pair fixed effects.

Table 4 shows the results. Interestingly, the teacher's influence is not constant over time. It is strong and statistically significant over a period of about 20 years after the meeting, after which the coefficients change signs. This implies that students eventually become more dissimilar to their actual teacher than to candidate teachers. The results may suggest that the style of a composer is evolving over his lifetime and that a teacher's influence—while being significant initially—is not permanent. In other words, given enough time, a composer develops a style that allows him to differentiate from his teacher. Based on his own observations and discussions, Pfitzinger (2017) arrives at a similar conclusion, remarking that "some composers [are] using their teachers as a steppingstone rather than putting them on a pedestal". However, these results have to be interpreted with some caution since the number of observations drops 20 and more years after a meeting.

6.4 Multigenerational similarity

To further investigate the nature of the influence that a teacher has on students, we explore multigenerational persistence. The approach may provide additional insights into the longevity of a teacher's influence when students go on to become composition teachers themselves. We have observed previously that a student's style may be changing over time and could eventually even diverge from teacher's style. This raises the question of how durable a teacher's style is likely to be over multiple generations of students. In other words, does a student bear an imprint of his teacher's teachers?[17]

Extending our data beyond the 211 first-degree connections, we arrive at 193 second-degree, 104 third-degree, and 44 fourth-degree connections. We then re-estimate our baseline model and present the results in Table 5. The teacher's influence is visible and significant in the first generation, as argued previously. We also observe that the influence persists through the next generation in a composer's musical lineage before it subsequently starts to fade. The coefficients remain positive

[17] In Section 2 we describe the relevance of this approach to the literature on cultural transmission. However, the concern of multigenerational influence is also on the mind of many composers, including Pfitzinger, whose research originates from the following personal question: "If I am a compositional descendant of Beethoven or Mahler or Widor or Chadwick, has their compositional style affected me?" (Pfitzinger, 2017, p. xi).

into the third generation but are estimated with less precision. This is an interesting finding, which points at the potentially multigenerational influence of a teacher.

6.5 Horizontal similarity

The focus so far has been on direct teacher-student similarity. We now extend the analysis to explore the existence of any indirect effects by looking at similarities across pairs of students who had a teacher in common. Given the individualistic nature of composition teaching, students would not often have interacted. Furthermore, since the studies of two students with the same teacher did not usually overlap, most students would not even have met.

Despite the implicit restrictions of this test, it is encouraging to observe in Table 6 that the similarity is significantly higher among students of the same teacher. The point estimates imply that students who had the same teacher are more similar to each other by about 0.1 standard deviations than they would be had they not had a teacher in common. This coefficient is about half the size of the effect observed directly between teachers and students, which supports the view that the teacher's influence is predominant.

7 The extent of influence

The observation that teachers influence the compositional style of their students raises questions of the conditions under which this effect emerges and becomes prevalent. In this section we restrict our sample to realized pairs only and exploit the heterogeneity of the observed influence by looking at factors that potentially matter for the extent of influence. In a methodological sense, this is equivalent to an exploration of the intensive margin. We build on our theoretical setup and quantify the extent of teacher influence as a function of his quality and investment of time in the student (Panel A of Table 7) and the student's subsequent career; that is, time to compose as well as exposure to other influences (Panel B of Table 7).

The first four specifications presented in Table 7 disclose that the quality of the teacher is positively related to the extent of his influence: higher quality teachers are more influential. For example, teachers with a one percent higher Murray quality index are up to almost a half standard deviation more influential. Positive associations are also observed for the other three teacher quality measures and are estimated with high precision across most specifications.

Next, we explore how the influence differs depending on the teacher's investment of time in the student, which is measured in two ways. First, we count the number of other students that the teacher has had, and observe a negative, albeit rarely statistically significant, relationship with similarity. This may suggest that composers who teach a higher number of students have less time to dedicate themselves to a single student, and hence their influence is potentially lower. Second, we approximate the teacher's effort invested in educating with the word count in the writings section of his biography. The writings section lists works that a composer has written and includes often pedagogical writings. The result suggests that the extent of influence increases as the teacher dedicates more time to pedagogical efforts.

In Panel (B) of Table 7 it is analyzed how the student's time to compose and exposure to other influences matter for the similarity with his teacher. First, we show results for students who have no other occupation listed in Grove than "composer". Those who do not also work as, for example, conductors or performers may have more time available to compose and, hence, better opportunities to potentially develop their own styles. The point estimates are negative but remain statistically insignificant. Second, for the subsample of students for whom we know the year they met the teacher, we calculate the remaining years of life. Once again, having more time to compose may create opportunities to redevelop one's style. The regressions deliver consistently negative coefficients, which are often statistically significant. The last estimation explores the existence of a systematic difference in similarity compared to one's teacher depending on the number of cities visited by the student throughout his career. It is conceivable that with more traveling and increased exposure to other influences, the teacher's imprint fades away. However, as can be observed, the departure from the teacher's influence is very limited.

All in all, this section has shown that the influence of teachers is also observable at the intensive margin. Interestingly, it is predominantly the teacher's background (his quality) and actions (the investment of time and effort) that matter for the breadth of influence. On the other hand, the student, once exposed to the teacher's influence, appears to have limited possibilities to depart from it in other ways than through the passage of time.

8 Implications for student quality

A number of different approaches have consistently disclosed that teachers have an influence on the style of their students. A question that emerges is whether the observed influence causes only good ideas to persist, or bad ones too? Or more generally: what are the implications for the quality of a student depending on how much and whom he is imitating?

We explore these questions by investigating the interaction terms between teacher quality and the extent of imitation by the student. More precisely, we estimate what the probability is that the student is placed within the top-quality quartile as a function of teacher quality and the extent of teacher-student similarity. This approach enables us to shed some light on the returns from imitation depending on teacher quality.

The results are shown in Table 8 using Spotify followers as the quality measure (see Appendix Tables B.5, B.6, and B.7 for comparable results using other quality measures). Students are more likely to be placed in the top-quality quartile if they imitate more high-quality teachers. The estimated effect implies that being one standard deviation more similar to a top-quartile quality teacher increases the probability of the student being placed in the top-quartile by about 15-20%. The positive effect remains significant and positive for composers influenced by teachers placed in the second quartile, albeit the point estimates tend to be smaller in size. Interestingly, the sign of the estimates changes for the bottom quartile: the negative coefficients imply that imitating low-quality teachers decreases the chance of the student being top quality himself.

These results suggest that imitation can be conducive to success, provided that the right role model is chosen, but otherwise it may become detrimental to one's chances of becoming successful.

9 Conclusion

The economics literature convincingly documents how teachers influence the quantity or quality of their students' output. A more subtle question is whether a teacher influences the style of work of a student—a concern of particular significance if one considers that it is a venture into a human's creative process and that creativity and ideas are transmitted across human relationships. The importance of a better understanding of the creation and transmission of ideas is also supported by the insight that ideas are getting more difficult to find (Bloom et al., 2020).

The flow of ideas is clearly the cornerstone of scientific or artistic innovations, and yet—since an idea is such an elusive concept—it is very difficult to study directly how ideas are transmitted across people. Therefore, empirical evidence supporting the conventional wisdom that teachers influence the style of creative work of their students is scarce. This paper presents the first systematic analysis of the teacher effect on creative output, by exploiting a novel database on music compositions, which provides a unique opportunity to capture and measure some key attributes of creative output. Baseline estimates compare differences in style between a connected pair (student and his actual teacher) and unconnected pair (student and candidate teachers—that is, contemporaneous composers who were alive during the student's formation age but were unconnected with him). Across a number of different approaches, it is consistently shown that a student's work is on average about 0.2 to 0.3 standard deviations more similar to works by his actual teacher compared to candidate teachers. The results also show that while the influence may not be permanent—it diminishes later in a composers life—it is sufficiently durable and significant to transmit into subsequent generations.

To shed light on the conditions under which the influence is enhanced, we have exploited a composer's detailed biographical data. This has provided insight into the factors stimulating the influence (e.g., the quality of the teacher) and also on details that appear largely irrelevant for increased influence (the student's subsequent career). The analysis also provides valuable information on the implications of increased imitation by a student for his career and overall quality. Imitating above average quality teachers can be conducive to the student's lifetime quality, while the opposite effect is observed for imitation of teachers in the bottom quality quartile.

Our analysis is constrained to a small, albeit prominent and influential, group of composers. However, although the context and background (music and history) of this study are distinctive, the mechanisms and explanations examined here are likely applicable to most settings where creative output is produced. For example, the phenomenon of direct and indirect influences is relevant for other areas of the arts, for science, and for the cultural and creative sectors more generally. However, it is not only the categorization of style or the ways in which style is transmitted across human relationships that is important, but also the very specific question of whether and how teachers, mentors, or leaders influence the style of work of others, be it the work of students or that of junior colleagues. For a composer, being influenced with bad ideas may deteriorate his future prospects and push cultural production away from its potential. In the creative sectors such bad influences may ultimately result in lower economic growth.

Some artists and scientists commit their lives to having lasting influence and becoming memorable. In doing so, they prioritize artistic output or academic publications that are visible to their peers, critics, and employers. However, it may often be via teaching that the greatest influence occurs, when the teacher lives on as a reverberation in the work of the student.

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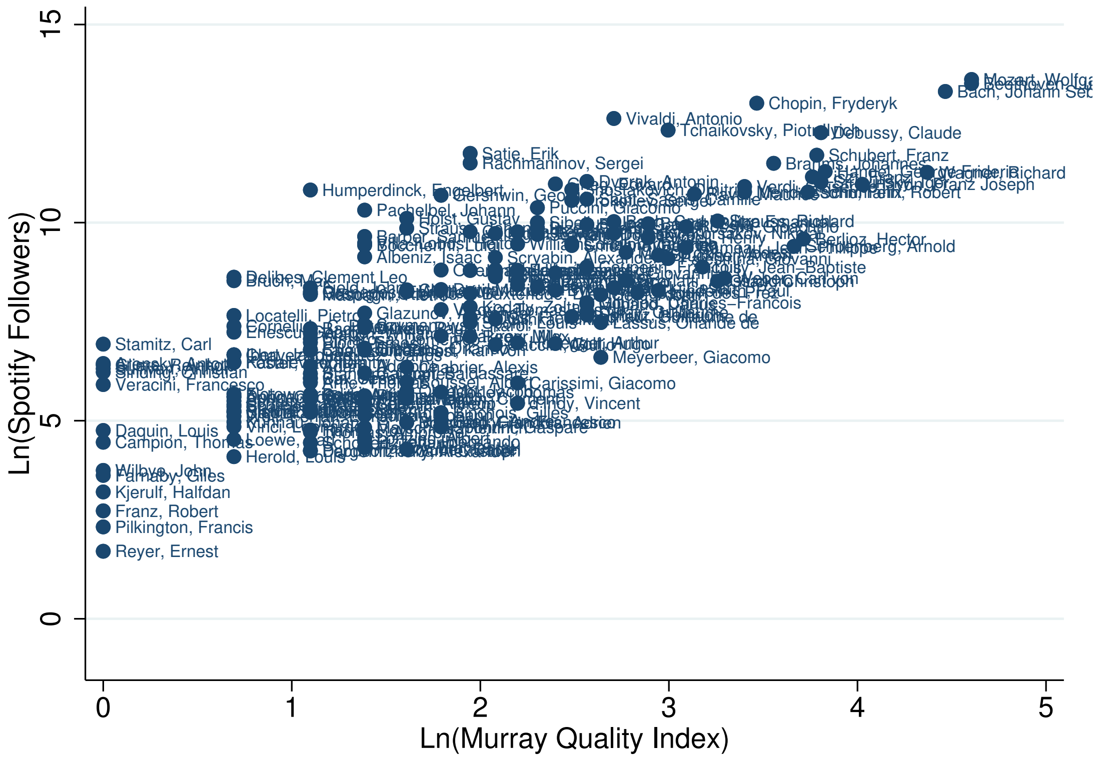
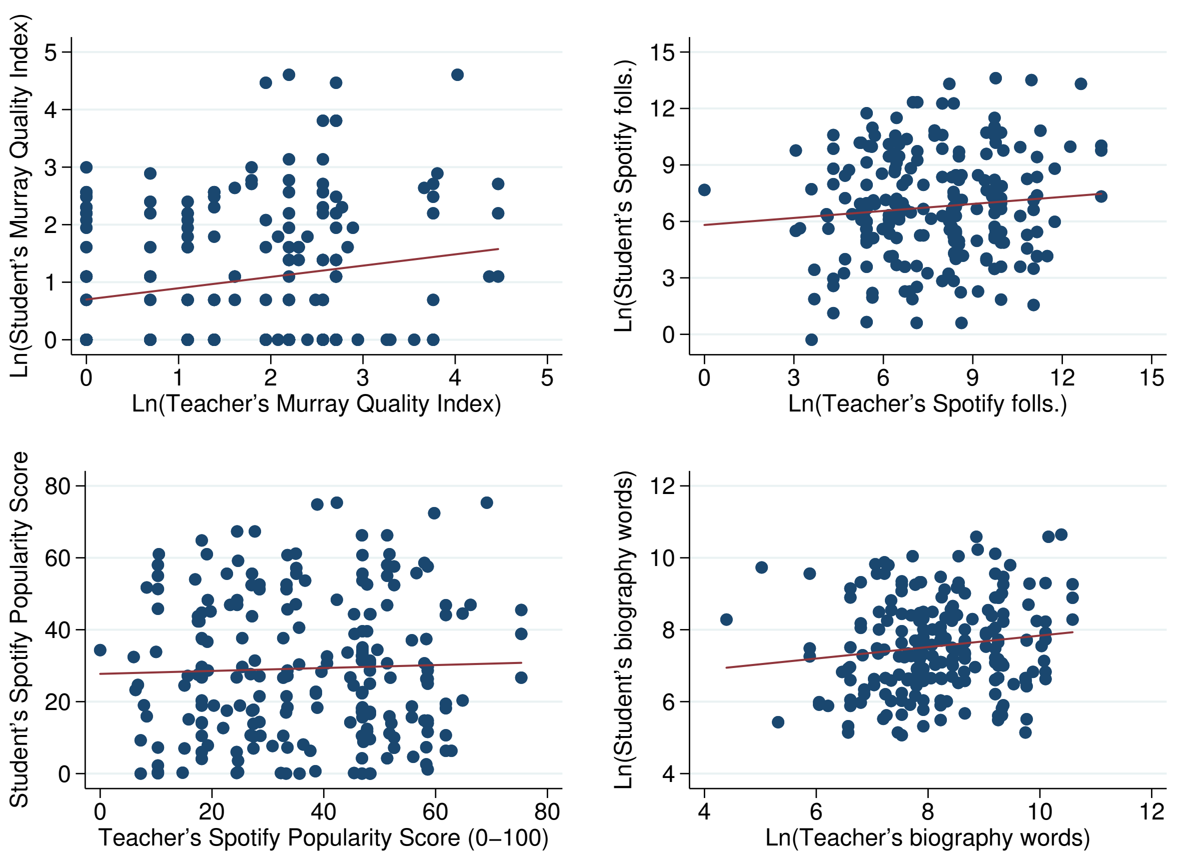
10 Figures

Figure 1: Spotify followers vs. Murray quality index



Notes: The scatterplot presents the relationship between the logged number of Spotify followers *(Ln(Spotify Followers))* and the logged Murray quality index *(Ln(Murray Quality Index)*. The data were collected by the authors (see Section 4 for details).

Figure 2: Connected: Teacher quality vs. student quality



Notes: The scatterplots show that there has not been a clear relationship between the quality of a teacher (horizontal axis) and a student (vertical axis) when using four different quality measures, as follows: the logged Murray quality index (top left), the logged number of Spotify followers (top right), the Spotify popularity score (0-100, bottom left), and biography word count (bottom right). The data were collected by the authors (see Section 4 for details).

11 Tables

Table 1: Distribution of BM composers by number of teachers and students

	No. Teachers		No. Students	
	Freq.	Pct.	Freq.	Pct.
0	200	57.3	251	71.9
1	94	26.9	57	16.3
2	41	11.7	16	4.6
3	13	3.7	11	3.2
4	1	0.3	4	1.1
5+	0	0	11	3.2
N	349	100.0	349	100.0

Notes: The table reports the number of teachers of a student and the number of students of a teacher. Connections are counted only if both student and teacher were listed in Barlow and Morgenstern (1975, 1976). The data were collected by the authors (see Section 4 for details).

Table 2: Effects of connection on similarity

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Connected	0.118**	0.283***	0.305***	0.095**	0.178***	0.241***	0.169***	0.137***
	(0.054)	(0.092)	(0.111)	(0.039)	(0.064)	(0.091)	(0.057)	(0.045)
Ln(Geog. distance)	-0.015***	-0.033***	-0.040***	-0.030***	-0.022***	-0.005	-0.027***	-0.011***
	(0.004)	(0.006)	(0.008)	(0.004)	(0.006)	(0.009)	(0.004)	(0.004)
Ln(Time distance)	-0.034***	-0.046***	-0.045***	-0.031***	-0.039***	-0.039***	-0.029***	-0.036***
	(0.006)	(0.008)	(0.010)	(0.006)	(0.008)	(0.011)	(0.009)	(0.006)
N	23489	23489	23489	23489	23489	23489	23489	23489
R^2	0.29	0.32	0.28	0.37	0.38	0.33	0.29	0.21
Commonality Controls	X	X	X	X	X	X	X	X
Composer FE	X	X	X	X	X	X	X	X
Quarter-century FE	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The point estimates presented are based on Equation (2). The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key, and time signature (columns 4-8, respectively) for a given pair of composers, i and j. *Connected (Grove)* indicates realized teacher-student pairs as identified in Grove. The reference group is conditioned to pairs where the candidate teacher was alive for at least one year when the candidate student was between the ages of five and 30. Controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Section 4 for details).

Table 3: Within-conservatory natural experiments

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Panel A: 10-year window								
Connected at conservatory	0.083	0.115	0.265*	0.117*	0.163	0.438***	0.214**	-0.021
	(0.076)	(0.122)	(0.144)	(0.062)	(0.119)	(0.169)	(0.108)	(0.071)
N	179	178	160	179	178	160	157	175
R^2	0.11	0.22	0.18	0.14	0.26	0.24	0.23	0.40
Panel B: 15-year window								
Connected at conservatory	0.082	0.103	0.233*	0.099*	0.141	0.400***	0.194**	0.016
	(0.071)	(0.118)	(0.139)	(0.057)	(0.115)	(0.161)	(0.097)	(0.070)
N	224	223	201	224	223	201	198	219
R^2	0.10	0.19	0.15	0.13	0.23	0.20	0.20	0.32
Commonality Controls	X	X	X	X	X	X	X	X
Conservatory FE	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key signature, and time signature (columns 4-8, respectively) for a given pair of composers, i and j. *Connected at conservatory* indicates realized teacher-student pairs at a given conservatory. The reference group includes candidate teachers who recently departed from or did not yet arrive at the given conservatory. Controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Section 4 for details).

Table 4: Effects of connection on similarity over time. Estimated at the composition level

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Post-meeting (up to 10 years)	0.374***	0.268***	0.110	0.503***	0.264***	0.093	0.050	-0.134
	(0.069)	(0.072)	(0.071)	(0.091)	(0.077)	(0.064)	(0.127)	(0.120)
Post-meeting (up to 20 years)	0.624***	0.391***	0.155**	0.603***	0.323***	0.168**	0.379**	0.344
	(0.095)	(0.096)	(0.072)	(0.116)	(0.098)	(0.073)	(0.170)	(0.233)
Post-meeting (up to 30 years)	-0.188	-0.003	-0.097	-0.573***	-0.381*	-0.296	-0.316	0.344
	(0.174)	(0.179)	(0.170)	(0.203)	(0.200)	(0.184)	(0.208)	(0.233)
Post-meeting ($\geq$ 30 years)	-1.053***	-0.859***	-0.400*	-0.662**	-0.437*	-0.328	-0.256	0.400
	(0.227)	(0.232)	(0.230)	(0.261)	(0.254)	(0.232)	(0.325)	(0.327)
N	958	958	958	958	958	958	741	944
R^2	0.15	0.05	0.02	0.10	0.04	0.03	0.02	0.06
Controls	X	X	X	X	X	X	X	X
Teacher-Student Pair FE	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key signature, and time signature (columns 4-8, respectively) between the teacher's compositions before meeting the student and the student's compositions after the meeting. *Post-meeting* indicates four different time intervals at which composition-level similarity is measured: at 0-10, 11-20, 21-30 and more than 30 years after the teacher-student meeting. The reference category is composition-level similarity between a given student and a candidate teacher. Controls not shown include time difference between the years when the two compared works were composed. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Section 4 for details).

Table 5: Multigenerational transmission

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Connected (1st degree)	0.108**	0.275***	0.298***	0.102***	0.178***	0.237***	0.190***	0.174***
	(0.054)	(0.091)	(0.112)	(0.039)	(0.062)	(0.090)	(0.058)	(0.048)
Connected (2nd degree)	0.087*	0.147*	0.138	0.124**	0.167**	0.192*	0.026	0.120*
	(0.050)	(0.079)	(0.094)	(0.055)	(0.076)	(0.105)	(0.090)	(0.064)
Connected (3rd degree)	0.040	0.043	0.138	0.032*	0.004	0.023	0.079	0.107
	(0.022)	(0.165)	(0.162)	(0.019)	(0.097)	(0.121)	(0.114)	(0.098)
Connected (4th degree)	-0.092	-0.030	-0.038	-0.063	-0.072	-0.040	0.025	0.059
	(0.101)	(0.162)	(0.146)	(0.103)	(0.142)	(0.149)	(0.067)	(0.062)
N	45736	45736	45736	45736	45736	45736	45736	45736
R^2	0.28	0.30	0.25	0.33	0.34	0.31	0.24	0.22
Commonality Controls	X	X	X	X	X	X	X	X
Distance Controls	X	X	X	X	X	X	X	X
Composer FE	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key signature, and time signature (columns 4-8, respectively) for a given pair of composers, i and j. *Connected* indicates realized teacher-student connections of the 1st degree (teacher-student), 2nd degree (teacher-student's student), etc. The reference group is conditioned for each generation to pairs where the candidate teacher was alive for at least one year when the candidate student was between the ages of five and 30. Commonality controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent. Distance controls not shown include logged geographic distance (in kilometers) and logged temporal distance (in years) between the birthplaces of two composers. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Section 4 for details).

Table 6: Horizontal similarity

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Connected (horizontal)	0.110**	0.152**	0.111	0.099**	0.121*	0.045	0.011	0.094**
	(0.048)	(0.072)	(0.078)	(0.039)	(0.063)	(0.079)	(0.052)	(0.040)
N	29884	29884	29884	29884	29884	29884	29884	29884
R^2	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01
Commonality Controls	X	X	X	X	X	X	X	X
Distance Controls	X	X	X	X	X	X	X	X
Composer FE	X	X	X	X	X	X	X	X
Quarter-century FE	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key signature, and time signature (columns 4-8, respectively) for a given pair of composers, i and j. Explanatory variables are defined as follows. *Connected (horizontal)* indicates pairs of students who had a teacher in common. The reference group is conditioned to pairs where the candidate teacher was alive for at least one year when the candidate student was between the ages of five and 30. Commonality controls not shown include dummies for common birth country, time period, and their interaction, common nationality and common descent. Distance controls not shown include logged geographic distance (in kilometers) and logged temporal distance (in years) between the birthplaces of two composers. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Section 4 for details).

Table 7: The extent of influence

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
	A. Teacher's quality and investment of time in the student							
Ln(Teacher's Murray index)	0.108	0.360***	0.467***	0.170***	0.358***	0.388***	0.206***	0.159***
	(0.066)	(0.100)	(0.127)	(0.044)	(0.075)	(0.108)	(0.055)	(0.041)
N	211	211	211	211	211	211	211	211
R^2	0.04	0.11	0.12	0.13	0.18	0.15	0.12	0.09
Ln(Teacher's Spotify followers)	0.022	0.153***	0.213***	0.079***	0.191***	0.242***	0.080**	0.020
	(0.033)	(0.050)	(0.058)	(0.022)	(0.039)	(0.052)	(0.032)	(0.024)
N	211	211	211	211	211	211	211	211
R^2	0.02	0.08	0.10	0.11	0.19	0.18	0.09	0.03
Spotify popularity score	0.005	0.025***	0.032***	0.012***	0.029***	0.035***	0.011***	0.004
	(0.004)	(0.007)	(0.008)	(0.003)	(0.005)	(0.006)	(0.004)	(0.003)
N	211	211	211	211	211	211	211	211
R^2	0.03	0.10	0.12	0.13	0.22	0.20	0.09	0.03
Ln(Teacher's bio. word count)	0.110	0.397***	0.538***	0.182***	0.433***	0.522***	0.222***	0.144***
	(0.068)	(0.106)	(0.136)	(0.042)	(0.076)	(0.110)	(0.062)	(0.047)
N	211	211	211	211	211	211	211	211
R^2	0.03	0.11	0.14	0.13	0.22	0.19	0.12	0.07
Ln(Teacher's # of students)	-0.034	-0.049	-0.072	-0.007	-0.058	-0.184**	0.004	-0.057
	(0.053)	(0.077)	(0.081)	(0.040)	(0.068)	(0.092)	(0.050)	(0.036)
N	211	211	211	211	211	211	211	211
R^2	0.02	0.03	0.03	0.05	0.07	0.09	0.05	0.03
Ln(Teacher's writings	0.017	0.085**	0.095**	0.025	0.061*	0.042	0.050**	0.027
word count)	(0.027)	(0.043)	(0.048)	(0.018)	(0.033)	(0.043)	(0.024)	(0.018)
N	211	211	211	211	211	211	211	211
R^2	0.02	0.05	0.05	0.06	0.09	0.08	0.07	0.04
	B. Student's time to compose and exposure to other influences							
Student composer has	-0.016	-0.088	-0.173	-0.045	-0.145	-0.289	-0.073	-0.048
no other occupation	(0.130)	(0.210)	(0.265)	(0.090)	(0.163)	(0.229)	(0.128)	(0.095)
N	211	211	211	211	211	211	211	211
R^2	0.02	0.03	0.03	0.05	0.07	0.08	0.05	0.03
Student's time to compose	-0.010**	-0.007	-0.003	-0.007**	-0.007	-0.007	-0.010**	-0.010**
	(0.005)	(0.007)	(0.008)	(0.003)	(0.006)	(0.008)	(0.005)	(0.004)
N	95	95	95	95	95	95	95	95
R^2	0.10	0.08	0.06	0.15	0.12	0.13	0.09	0.10
Student's # cities visited	-0.026**	-0.018	0.002	-0.013	-0.021	0.003	-0.016	-0.019
	(0.012)	(0.022)	(0.027)	(0.010)	(0.018)	(0.024)	(0.012)	(0.013)
N	211	211	211	211	211	211	211	211
R^2	0.03	0.03	0.03	0.06	0.07	0.07	0.06	0.04
Commonality Controls	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key signature, and time signature (columns 4-8, respectively) for a realized teacher-student pair. Each panel reports a separate set of regressions using explanatory variables defined as follows. *Ln(Teacher's Murray Index)*, *Ln(Teacher's Spotify Followers)*, *Teacher's Spotify Popularity* and *Ln(Teacher's bio. word count)* are the teacher's logged Murray quality index, logged number of Spotify followers, Spotify popularity score (0-100), and logged biography word count, respectively. *Ln(Teacher's # of students)* are the logged number of a composer's students. *Ln(Teacher's writings word count)* are the teacher's logged word count in the writings section of his biography. *Student composer has no other occupation* indicates students whose only listed occupation is that of a composer. *Student's time to compose* measures the number of years between the student's year of death and the year when he met with the teacher. *Student's # cities visited* is the number of cities that the student visited during his career. Controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Section 4 for details).

Table 8: Student's quality and imitation

	Student is in top quartile of BM composer quality (Spotify followers)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Teacher >75th pctile. * Std(Sim.)	0.200***	0.154***	0.110***	0.271***	0.178***	0.123***	0.210***	0.172**
	(0.044)	(0.023)	(0.021)	(0.075)	(0.039)	(0.026)	(0.057)	(0.080)
Teacher in 50-75th pctile. * Std(Sim.)	0.157***	0.101***	0.096***	0.172***	0.083*	0.049	0.173**	0.208***
	(0.054)	(0.034)	(0.031)	(0.066)	(0.046)	(0.036)	(0.073)	(0.070)
Teacher in 25-50th pctile. * Std(Sim.)	0.032	0.049	0.047	0.230*	0.107	0.013	0.155	0.167*
	(0.105)	(0.063)	(0.073)	(0.131)	(0.091)	(0.071)	(0.100)	(0.088)
Teacher <25th pctile. * Std(Sim.)	-0.240**	-0.157**	-0.177**	0.038	-0.116	-0.136	-0.060	-0.052
	(0.111)	(0.064)	(0.074)	(0.130)	(0.081)	(0.090)	(0.074)	(0.072)
N	183	183	183	183	183	183	183	183
R^2	0.20	0.23	0.21	0.17	0.17	0.16	0.18	0.14
Commonality Controls	X	X	X	X	X	X	X	X
Teacher Quality Controls	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable indicates whether the student is in the top quartile of BM composer quality measured by Spotify followers. Each column reports a separate set of regressions using similarity measures defined as follows. Standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared are shown in columns 1-3. Cosine similarity of 2-/3-/4-grams, key signature, and time signature are shown in columns 4-8. Commonality controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent. Teacher quality controls not shown include dummies for teacher being in a given quality quartile. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Section 4 for details).

Appendix

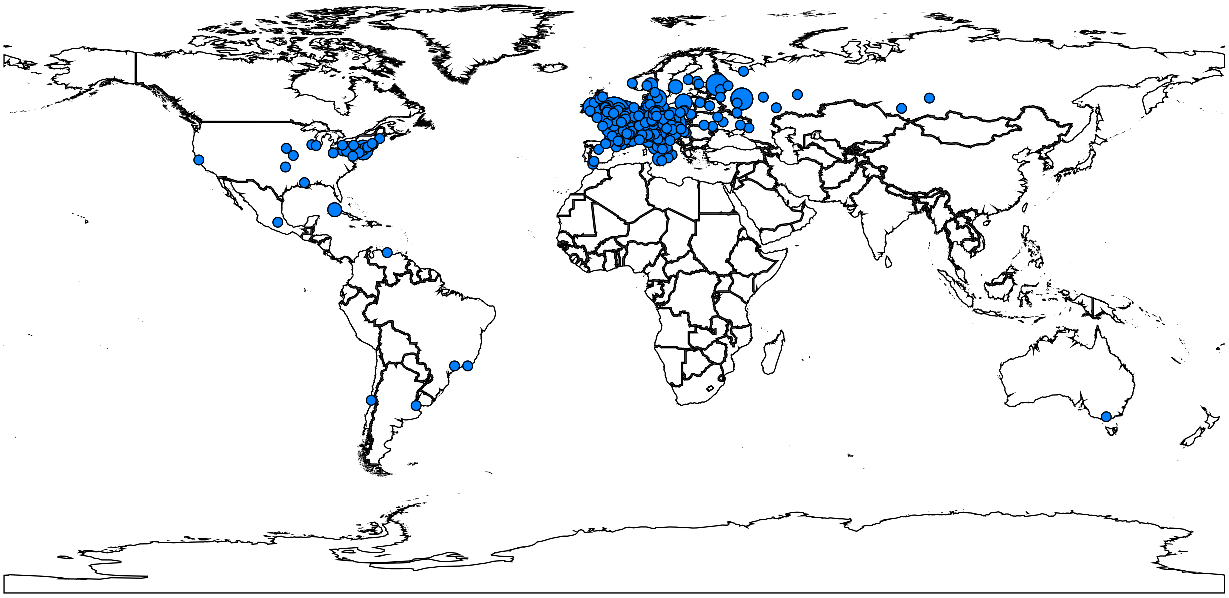
A Appendix figures

A.1

Figure A.1: Example of a theme: ”Für Elise” by Ludwig van Beethoven

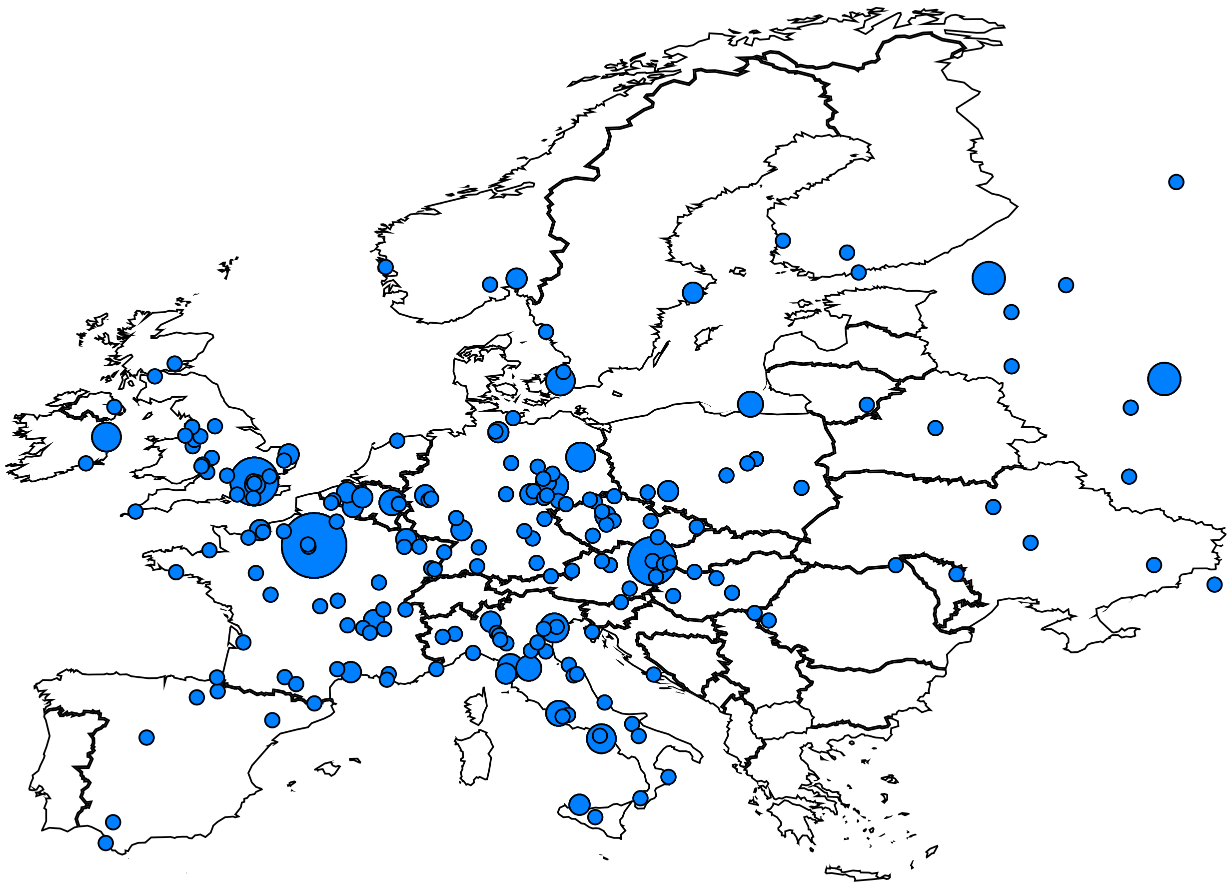
Notes: Cropped screenshot from Barlow and Morgenstern (1975, p. 50). Theme: E — D# — E — D# — E — B — D — C — A. Transposed: G — F# — G — F# — G — D. Key signature: A Minor (See C.2 for identifying major vs. minor keys). Time signature: 3/8. Year of Composition: 1810 (IMPSL, 2018).

Figure A.2: Map of composers by birth location: World



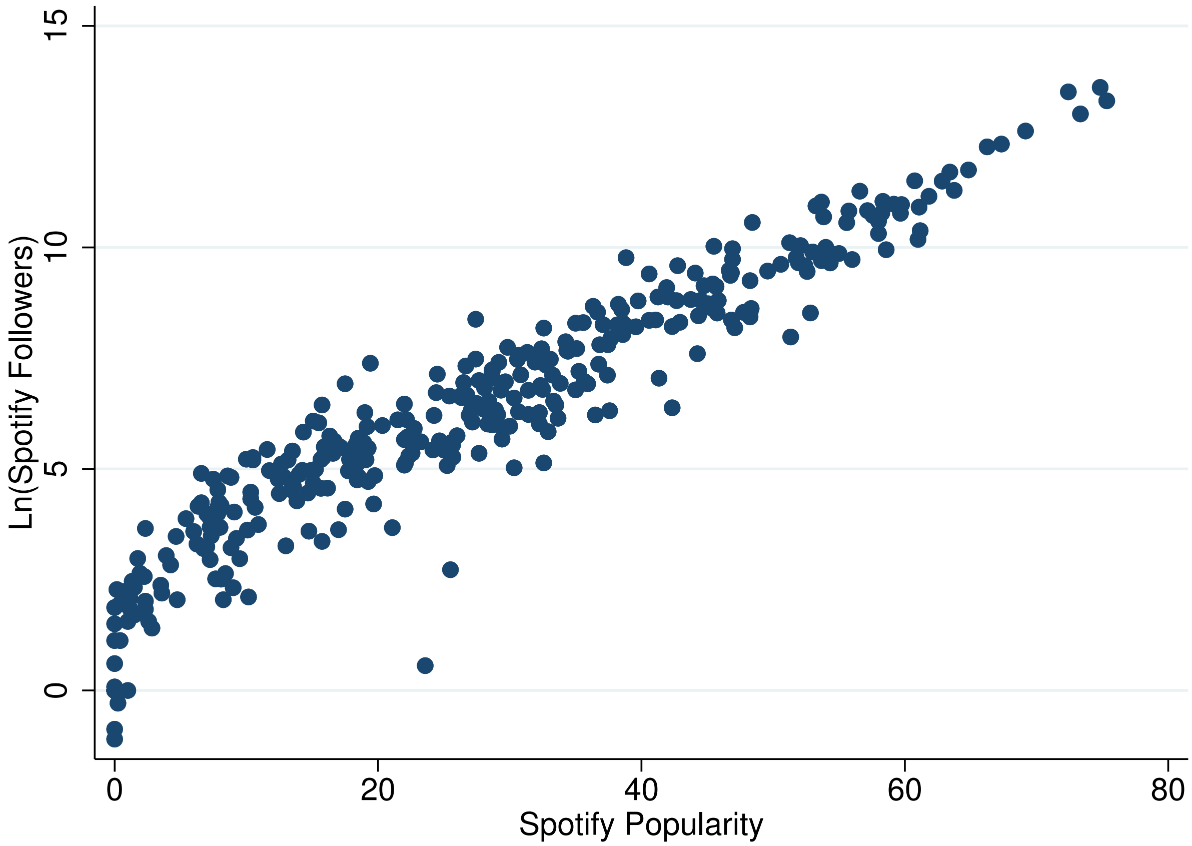
Notes: The map shows birth location for composers listed in Barlow and Morgenstern (1975, 1976). The data were collected by the authors (see Section 4 for details).

Figure A.3: Map of composers by birth location: Europe



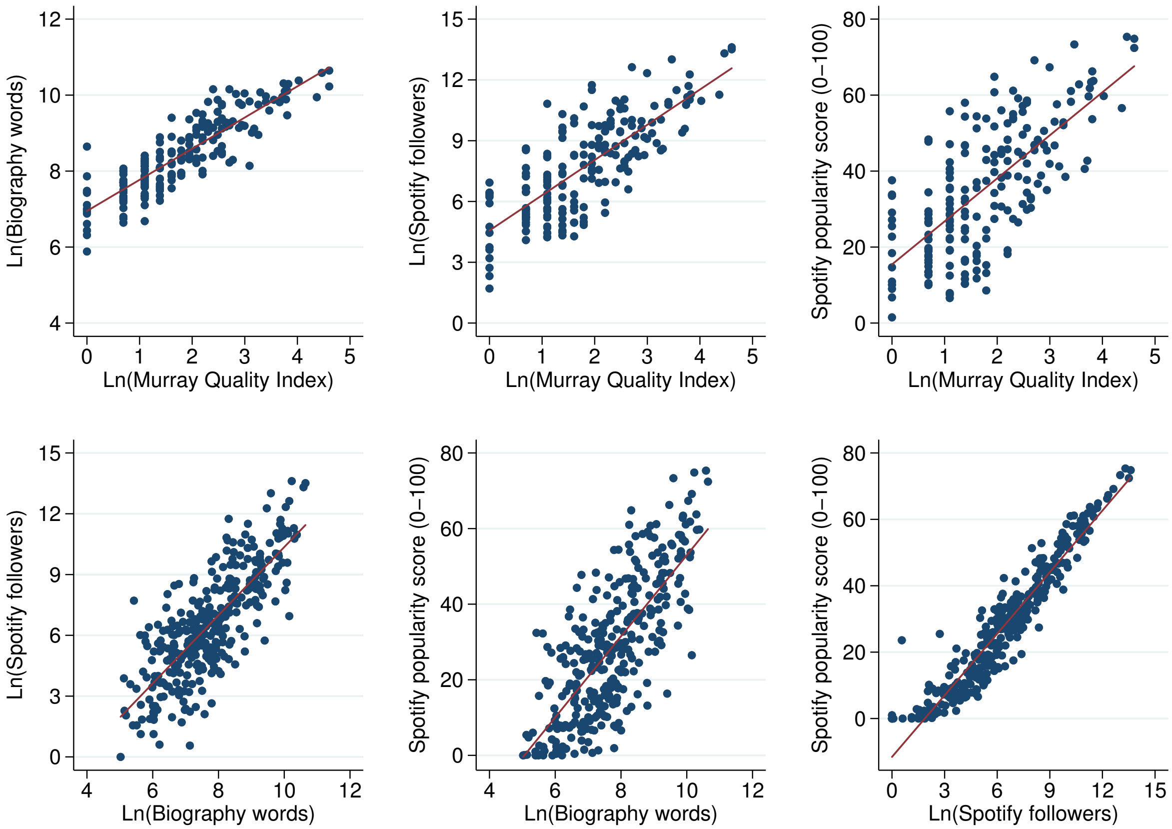
Notes: The map shows birth location for composers born in Europe and listed in Barlow and Morgenstern (1975, 1976). The data were collected by the authors (see Section 4 for details).

Figure A.4: Spotify followers vs. Spotify popularity



Notes: The scatterplot presents the relationship between the logged number of Spotify followers *(Ln(Spotify Followers))* and Spotify popularity score *(Spotify Popularity)* measured on a scale from 0 to 100. The data are retrieved for each composer and month over a 12-month period from October 2016 to September 2017 and averaged out. See Section 4 for details.

Figure A.5: Scatterplots for composer quality



Notes: The scatterplots present the relationships between each of our four composer quality measures: the logged Murray quality index *(Ln(Murray Quality Index)*, the logged biography word count in the life section of an entry in Grove *(Ln(Biography words))*, the logged number of Spotify followers *(Ln(Spotify Followers))*, and *Spotify popularity score (0-100)*. The data were collected by the authors (see Section 4 for details).

B Appendix tables

Table B.1: Similarity measures for BM composer pairs

	N	Mean	s.d.	p10	p50	p90
Pct. 1-grams shared	29,474	0.70	0.13	0.53	0.70	0.88
Pct. 2-grams shared	29,474	0.36	0.13	0.20	0.35	0.53
Pct. 3-grams shared	29,474	0.13	0.08	0.04	0.11	0.24
Pct. 4-grams shared	29,474	0.04	0.04	0.00	0.03	0.09
Cosine Similarity, 1-grams	29,474	0.89	0.08	0.78	0.91	0.97
Cosine Similarity, 2-grams	29,474	0.60	0.17	0.36	0.61	0.81
Cosine Similarity, 3-grams	29,474	0.29	0.17	0.08	0.27	0.54
Cosine Similarity, 4-grams	29,474	0.12	0.12	0.00	0.08	0.28
Cosine Similarity, key	29,244	0.34	0.24	0.00	0.34	0.67
Cosine Similarity, time	29,474	0.54	0.25	0.18	0.57	0.86

Notes: Similarity coefficients measure the pct. of collective 1-/2-/3-/4-grams shared (rows 1-4, respectively) or cosine similarity of 1-/2-/3-/4-grams, key, and time signature (rows 5-10, respectively) for a given pair of composers i and j. The summary is restricted to pairs where the older of the pair was alive when the younger was between age five and 30. The data were collected by the authors (see Section 4 for details).

Table B.2: Distribution of BM composers, by century of birth

Century	**Freq.**	**Pct.**
14th	1	0.3
15th	4	1.1
16th	20	5.7
17th	26	7.4
18th	44	12.6
19th	240	68.8
20th	14	4.0
Total	349	100.0

Notes: The table shows the absolute and relative frequencies of composers listed in Barlow and Morgenstern (1975, 1976) by century of birth. The data were collected by the authors (see Section 4 for details).

Table B.3: Composer lifespans and age at meeting

	N	Mean	p5	p25	p50	p75	p95
Composer Lifespan *(obs. = composer)*	349	67.13	39	56	70	79	89
Age at meeting teacher *(obs. = relationship)*	476	15.80	0	12	17	20	26

Notes: The table shows the mean and percentiles of composers lifespan (first row) and age at meeting teacher (second row). The data were collected by the authors (see Section 4 for details).

Table B.4: Difference in mean similarity, by connected status

	Not Connected	Connected	Level Difference	Percent Difference
	(1)	(2)	(3)	(4)
Pct. 1-grams shared	0.703	0.737	0.033***	5%
Pct. 2-grams shared	0.359	0.402	0.043***	12%
Pct. 3-grams shared	0.125	0.159	0.034***	27%
Pct. 4-grams shared	0.038	0.052	0.014***	35%
Cosine Similarity, 1-grams	0.888	0.916	0.028***	3%
Cosine Similarity, 2-grams	0.597	0.670	0.073***	12%
Cosine Similarity, 3-grams	0.294	0.356	0.062***	21%
Cosine Similarity, 4-grams	0.117	0.151	0.034***	29%
Cosine Similarity, key	0.344	0.426	0.082***	24%
Cosine Similarity, time	0.539	0.626	0.088***	16%

Notes: Similarity coefficients measure the pct. of collective 1-/2-/3-/4-grams shared (rows 1-4, respectively) or cosine similarity of 1-/2-/3-/4-grams, key, and time signature (rows 5-10, respectively) for a given pair of composers i and j. The sample is restricted to pairs where the older of the pair was alive when the younger was between age five and 30. Column (3) shows the t-test difference between teacher-student pairs (Connected) and all other pairs (Not Connected). Column (4) indicates the magnitude of the difference. Significance levels: ***p $<$ .01.

Table B.5: Student's quality and imitation (Quality measure: Spotify popularity)

	Student is in top quartile of BM composer quality (Spotify popularity)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Teacher >75th pctile. * Std(Sim.)	0.217***	0.171***	0.153***	0.351***	0.213***	0.144***	0.312***	0.292**
	(0.055)	(0.032)	(0.030)	(0.099)	(0.057)	(0.044)	(0.105)	(0.112)
Teacher in 50-75th pctile. * Std(Sim.)	0.243	0.104	0.038	0.271	0.191	0.082	-0.036	0.394***
	(0.258)	(0.131)	(0.118)	(0.198)	(0.138)	(0.104)	(0.157)	(0.147)
Teacher in 25-50th pctile. * Std(Sim.)	0.144	0.152*	0.071	0.305	0.188	0.058	0.297***	0.373*
	(0.114)	(0.081)	(0.126)	(0.205)	(0.131)	(0.068)	(0.108)	(0.196)
Teacher <25th pctile. * Std(Sim.)	-0.927*	-0.040	0.048	0.807	0.007	0.190	-0.074	-0.131
	(0.491)	(0.542)	(0.410)	(1.300)	(0.403)	(0.552)	(0.316)	(0.294)
N	183	183	183	183	183	183	183	183
R^2	0.60	0.62	0.59	0.59	0.59	0.56	0.60	0.60
Commonality Controls	X	X	X	X	X	X	X	X
Teacher Quality Controls	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable is the probability of a student being in the top quartile of BM composer quality measured by the Spotify popularity score. See notes in Table 8 for further details.

Table B.6: Student's quality and imitation (Quality measure: Murray quality index)

	Student is in top quartile of BM composer quality (Murray quality index)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Teacher >75th pctile. * Std(Sim.)	0.248***	0.172***	0.147***	0.433***	0.225***	0.131***	0.106	0.150
	(0.053)	(0.032)	(0.030)	(0.102)	(0.056)	(0.043)	(0.084)	(0.109)
Teacher in 50-75th pctile. * Std(Sim.)	0.191	0.159*	0.130	0.376**	0.279***	0.280***	0.450***	0.221
	(0.128)	(0.090)	(0.094)	(0.150)	(0.098)	(0.102)	(0.108)	(0.142)
Teacher in 25-50th pctile. * Std(Sim.)	0.066	0.244	0.224	0.276	0.153	0.062	0.067	0.353*
	(0.252)	(0.239)	(0.229)	(0.241)	(0.146)	(0.064)	(0.217)	(0.203)
Teacher <25th pctile. * Std(Sim.)	-0.133	-0.095	-0.209	-0.222	0.134	0.015	0.148	0.009
	(0.111)	(0.145)	(0.221)	(0.354)	(0.122)	(0.051)	(0.155)	(0.208)
N	183	183	183	183	183	183	183	183
R^2	0.62	0.64	0.61	0.63	0.62	0.59	0.58	0.55
Commonality Controls	X	X	X	X	X	X	X	X
Teacher Quality Controls	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable indicates whether the student is in the top quartile of BM composer quality measured by Murray quality index. See notes in Table 8 for further details.

Table B.7: Student's quality and imitation (Quality measure: Biography words)

	Student is in top quartile of BM composer quality (biography words)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Teacher >75th pctile. * Std(Sim.)	0.118*	0.089*	0.082*	0.234*	0.142**	0.104*	0.096	0.165
	(0.068)	(0.046)	(0.043)	(0.121)	(0.068)	(0.055)	(0.080)	(0.122)
Teacher in 50-75th pctile. * Std(Sim.)	0.154*	0.109*	0.103*	0.072	0.092	0.086	0.259**	0.086
	(0.082)	(0.059)	(0.059)	(0.130)	(0.084)	(0.072)	(0.114)	(0.093)
Teacher in 25-50th pctile. * Std(Sim.)	-0.046	0.160	0.106	0.597**	0.300***	0.180*	0.213	0.261
	(0.147)	(0.141)	(0.148)	(0.243)	(0.107)	(0.098)	(0.153)	(0.183)
Teacher <25th pctile. * Std(Sim.)	0.225	0.194	0.309	0.216	0.109	0.060	-0.025	0.269
	(0.238)	(0.204)	(0.210)	(0.213)	(0.115)	(0.065)	(0.184)	(0.193)
N	183	183	183	183	183	183	183	183
R^2	0.57	0.58	0.58	0.59	0.60	0.57	0.58	0.56
Commonality Controls	X	X	X	X	X	X	X	X
Teacher Quality Controls	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable indicates whether the student is in the top quartile of BM composer quality measured by biography word count. See notes in Table 8 for further details.

C Further details on data

C.1 Data collection process

This section complements the data Section 4 by describing the data collection process, which has been conducted in a planned, structured and systematic way. As outlined below, the process relied on a large number of motivated research assistants, mostly with training and interest in music, involved continuous and independent checks, often supported by computer-based algorithms, and regular consultation and dialogue with experts, especially musicologists and musicians, including composers.

Most of the biographical records from Grove have been collected manually. This was necessary due to the complex and irregular structure of the information provided (e.g., lists of teachers or conservatories attended). Collecting data for 349 composers lasted in total 445.8 hours. This gives an average time per entry of 1.27h (76.4 min), with a maximum of 315 minutes (spent on a 24370 word long biography of Franz Liszt, excluding works, bibliography, and writings sections).[1]

Parallel to this, we have used a self-developed computer software in order to scrap all systematically available data from Grove (birth/death dates, lists of occupations, etc.). The automatically collected data were also used to deliver useful word count indicators. Furthermore, as described in Section 4.3, we have scrapped Spotify data over a 12-month period from October 2016 to September 2017.

The notation index from BM has been professionally scanned in and then transcribed. In some cases themes had to be entered manually from the thematic index if they were not listed in the notation index. We have also transcribed composer names and the number of works from the thematic index, and harmonized name spelling across all sources.

The BM data were then extended manually in a number of ways. First, the missing key and time signature were collected. Second, we obtained the true major or minor key for ca. 850 works from the titles in order to validate our prediction of minor vs. major key signature (see Appendix C.2). Third, we collected the composition year for all works that we were able to match with the corpus found in the International Music Score Library Project (see Appendix C.3). Fourth, we identified for which instrument or instruments each work has been composed, and finally, we obtained information on the musical form of each composition, as long as this information was provided in the BM source (see Appendix E.3).

The quality of the manual data collection efforts has been ensured in a number of ways. First, regular contact with individual research assistants and/or meetings in groups ensured correctness, consistency, and a high intrinsic motivation across the team. Second, the author of this study

[1] In exploratory data quality tests we have studied and monitored the time used by the research assistant per entry in relation to the word count length of the biographical entry. The data are so detailed that they would allow us to re-run models with research assistant fixed effects, but we do not see the need for this.

and Daniel P. Gross have extensively and randomly checked entries throughout the whole process. Third, we conducted double-checks by asking another research assistant to independently collect the same part of data, and then we studied any discrepancies. Third, whenever possible we triple-checked entries using automatically scrapped data from Grove Music Online covering standardized variables (e.g., date and country of birth). All these efforts have substantially diminished the risks of any systematic errors in the data collection process and ensure that data entry errors such as typos have been largely eliminated.

Wherever possible and appropriate, we collected control data from additional and independent sources. For example, we obtained our four composer quality metrics from three different, independent sources. It is encouraging that each of these metrics delivers very similar results and, as one would expect, they are also highly correlated (e.g., Figure A.5). Furthermore, we have coded data in different ways to ensure that results are not driven by any of our potentially subjective choices. For instance, our baseline results are for eight different (albeit correlated) measures of similarity between pairs of composers or compositions. Finally, we conducted a range of robustness tests (see Appendix D.2) and validity tests (see Appendix D.3).

During the planning phase of this project and as it progressed, input from experts on music, music history and education has continuously and consistently been sought after and incorporated whenever possible, including from musicologists (e.g., at the Harvard University Department of Music or the Department of Music at UCSB), music librarians (e.g., at Trinity College Dublin), composers (e.g., Jean-Luc Fafchamps or Scott Pfitzgerald, who is also an expert on teacher-student relationships), practitioners (e.g., the director of Oviedo Opera House), and a number of amateur and professional musicians, mostly from personal networks.

The data collection process was planned during the summer and fall of 2014, it began in October 2014, and lasted until early 2018. The databases have been extended in various ways over the period December 2020 to April 2021 during the revisions conducted. The collection of data has been supported by a total of 13 research assistants, who are listed in the acknowledgments. Those who were supporting the collection and processing of musical content were required to have musical training. In total, eight of the research assistants had degrees or were studying for degrees in music (sometimes dual degrees in music and economics). Some of our assistants were affiliated with the Harvard University Department of Music, others worked as freelance musicians. Each one had a keen interest in music and/or music history, and is acknowledged as a crucial contributor to the outcome of this project.

C.2 Identifying key signature

Every key signature represents both a major key and a minor key (e.g., an empty key signature is either C Major or A Minor). To identify major vs. minor keys, we perform several tests. First, we look for early note in theme matching the major vs. minor key (often, first note is the tonic note of key). Second, we count tonic notes of major vs. minor key in the theme. Third, we count tonic chord notes of major vs. minor key. We then validate the predictive power of these tests against a sample of ca. 850 themes for which the true major or minor key is known from title of the work (e.g., "Prelude in C# Minor"). Using combinations of tests with high predictive power enables us to estimate the true key signature with a relatively high precision (accuracy rates of >90%).

C.3 Year of composition

We use the International Music Score Library Project (IMSLP) in order to collect the year of composition for each of the works covered by Barlow and Morgenstern (BM). IMSLP is recognized by the scientific community as one of the most comprehensive resources on music scores. Nonetheless, we encounter several challenges. First, IMSLP does not include all our composers and omits in particular individuals whose works are still under copyright. Second, it is often not possible to uniquely match a work from BM with IMSLP. Third, for many works the year of composition is unknown or missing.[2]

All in all, we collect data on the composition years for 66.9% of our themes. For about two thirds of these themes the composition year is a single year, whereas for the remaining ca. 4,000 themes it is provided in a relatively wide range (avg. 5.49 years, st. dev. 7.81), during which the work has been—or is thought to have been—written. In the baseline models we consider the minimum of this range in order to capture when the creative process of composing has begun, but the results would not change qualitatively, if instead we used the average. In addition, 5% of themes with known composition years are provided with uncertainty (e.g., indicated with the word *circa*, a question mark, or similar). For these reasons, the analysis at the composition-level has to be interpreted with some caution.

[2] In a pilot study, we collected years of first performance and first publication of a work, with the aim to predict the year of composition. However, the years of first performance and publication are mostly missing, unknown or unavailable. Furthermore, there exists a very significant variation between these years and the year of composition (e.g., not rarely have works been first performed or published many years after the composer deceased).

D Further tests

D.1 Alternative conditions

The choice of the control group is important, but as can be seen in this section, the results are not particularly sensitive to variations in the risk set. The overall aim of the conditions imposed is to narrow down the sample to pairs where there was a reasonable probability for the formation of a teacher-student relationship. This is why our baseline condition restricts our analysis to pairs of composers where the older of the two composers in a pair was alive for at least one year while the younger was in his "formation age", which we define as being between the ages five and 30. This condition holds for all realized pairs (i.e., none of the actual pairs is dropped) and restricts all pairs to the same time period. In the remainder of this section, we discuss alterations to the conditioning by considering other time and geographic cut-off values.

Conditioning to same time period

We explore a number of other ways of how to condition to the same time period. The tests are reported in Table D.1 as follows: Panel (A) shows the baseline, where we condition to pairs where the candidate teacher was alive when the candidate student was aged five to 30; Panel (B) is the least restrictive estimation, where no conditions are imposed; in Panel (C) we condition to teachers and students whose lives overlapped by at least one year; in Panel (D) we condition to teacher and students whose lives overlapped by at least ten years; in Panel (E) we condition to pairs where the student was born during the teacher's lifetime; in Panel (F) we condition to pairs where the teacher was alive when the student was between the ages 10 to 25; in Panel (G) we condition to pairs where the teacher was alive when student was between the ages 15 to 20. Throughout these tests, the main change is observed in the size of the benchmark, which matters for the number of observations. It can be concluded that the results remain robust in each of these specifications.

Conditioning to geographic proximity

In addition to restricting in the baseline to pairs where both composers lived in the same period, one may want to condition further to pairs of composers who lived in geographic proximity. We begin this analysis by additionally restricting the analysis to pairs where both composers have the same country of birth (Panel A of Table D.2), since being born in the same country may facilitate the formation of connections within the borders of the same country. Alternatively, one may argue that the cost of connecting is lower for composers of the same nationality, who share a similar culture, usually speak the same language, and so on. Therefore, Panel (B) shows a regression that restricts to pairs where both composers have the same nationality. The conducted tests are demanding. For example, restricting pairs to those who have the country of birth or nationality in common leads to an exclusion of about half of realized pairs. It is thus encouraging to observe that the results remain robust throughout the specifications.

Finally, we pursue the most restrictive condition in which we require composer pairs to be located in the same city and time. These estimations are presented in the Appendix E.4 and once again reconfirm the baseline findings.

Table D.1: Effects of connection on similarity: Conditioning to same time period

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
A. Baseline condition: Teacher was alive when student was age 5 to 30								
Connected	0.118**	0.283***	0.305***	0.095**	0.178***	0.241***	0.169***	0.137***
	(0.054)	(0.092)	(0.111)	(0.039)	(0.064)	(0.091)	(0.057)	(0.045)
N	23489	23489	23489	23489	23489	23489	23489	23489
R^2	0.29	0.32	0.28	0.37	0.38	0.33	0.29	0.21
B. Alternative condition: No conditions								
Connected	0.106**	0.272***	0.297***	0.100**	0.175***	0.234**	0.190***	0.171***
	(0.054)	(0.091)	(0.112)	(0.039)	(0.062)	(0.090)	(0.057)	(0.048)
N	45736	45736	45736	45736	45736	45736	45736	45736
R^2	0.28	0.30	0.25	0.33	0.34	0.31	0.24	0.22
C. Alternative condition: Lives of teacher and student overlapped								
Connected	0.109**	0.267***	0.284**	0.091**	0.164**	0.217**	0.153***	0.137***
	(0.055)	(0.092)	(0.113)	(0.039)	(0.064)	(0.090)	(0.058)	(0.044)
N	24542	24542	24542	24542	24542	24542	24542	24542
R^2	0.29	0.32	0.28	0.37	0.37	0.33	0.29	0.20
D. Alternative condition: Lives of teacher and student overlapped by at least 10 years								
Connected	0.115**	0.279***	0.298***	0.090**	0.172***	0.234**	0.171***	0.129***
	(0.054)	(0.093)	(0.111)	(0.039)	(0.064)	(0.091)	(0.057)	(0.044)
N	22303	22303	22303	22303	22303	22303	22303	22303
R^2	0.30	0.32	0.29	0.38	0.38	0.33	0.29	0.21
E. Alternative condition: Student born during teacher's lifetime								
Connected	0.109**	0.267***	0.284**	0.091**	0.164**	0.217**	0.153***	0.137***
	(0.055)	(0.092)	(0.113)	(0.039)	(0.064)	(0.090)	(0.058)	(0.044)
N	24542	24542	24542	24542	24542	24542	24542	24542
R^2	0.29	0.32	0.28	0.37	0.37	0.33	0.29	0.20
F. Alternative condition: Teacher was alive when student was age 10 to 25								
Connected	0.115**	0.279***	0.298***	0.090**	0.172***	0.234**	0.171***	0.129***
	(0.054)	(0.093)	(0.111)	(0.039)	(0.064)	(0.091)	(0.057)	(0.044)
N	22303	22303	22303	22303	22303	22303	22303	22303
R^2	0.30	0.32	0.29	0.38	0.38	0.33	0.29	0.21
G. Alternative condition: Teacher was alive when student was age 15 to 20								
Connected	0.111**	0.275***	0.293**	0.083**	0.162**	0.224**	0.160***	0.119***
	(0.055)	(0.093)	(0.114)	(0.039)	(0.065)	(0.092)	(0.057)	(0.043)
N	20970	20970	20970	20970	20970	20970	20970	20970
R^2	0.30	0.33	0.29	0.38	0.38	0.33	0.29	0.21
Commonality Controls	X	X	X	X	X	X	X	X
Distance Controls	X	X	X	X	X	X	X	X
Composer FE	X	X	X	X	X	X	X	X
Quarter-century FE	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key, and time signature (columns 4-8, respectively) for a given pair of composers. *Connected* indicates realized teacher-student pairs. The reference group is conditioned in ways as summarized in each panel title. Controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1.

Table D.2: Effects of connection on similarity: Conditioning to geographic or cultural proximity

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
	A. Alternative condition: Teacher and student born in same country							
Connected	0.222***	0.498***	0.517***	0.205***	0.362***	0.365**	0.239**	0.111
	(0.079)	(0.133)	(0.168)	(0.062)	(0.105)	(0.141)	(0.095)	(0.079)
N	2192	2192	2192	2192	2192	2192	2192	2192
R^2	0.40	0.42	0.39	0.46	0.49	0.47	0.39	0.33
	B. Alternative condition: Teacher and student share nationality							
Connected	0.190**	0.399***	0.394**	0.172***	0.257**	0.292**	0.196**	0.141*
	(0.074)	(0.143)	(0.182)	(0.059)	(0.105)	(0.135)	(0.083)	(0.076)
N	2627	2627	2627	2627	2627	2627	2627	2627
R^2	0.38	0.40	0.37	0.43	0.45	0.43	0.36	0.33
Commonality Controls	X	X	X	X	X	X	X	X
Distance Controls	X	X	X	X	X	X	X	X
Composer FE	X	X	X	X	X	X	X	X
Quarter-century FE	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key, and time signature (columns 4-8, respectively) for a given pair of composers. *Connected* indicates realized teacher-student pairs. The reference group is conditioned to pairs where the candidate teacher was alive for at least one year when the candidate student has been between the ages of five and 30, and additionally it is conditioned in ways as summarized in each panel title. Controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1.

D.2 Robustness tests

Alternative specifications

The baseline results showing the effects of connection on similarity (see Table 2) are robust to a number of alternative specifications. We summarize the robustness tests in Table D.3. Panel (B) presents the results for truncated themes at six notes (Panel A repeats the baseline coefficients from Table 2). Panel (C) restricts the sample to pairs of composers born in Europe. Panel (D) shows the estimates for a subsample of composers born after 1750; we drop the early years when originality has not been valued very highly, nor has there been potentially much freedom for creativity.[3] Panel (E) restricts the sample to pairs of composers, where the actual or candidate teacher has died after 1920. By doing this, we drop the most recent period, which is characterised by the onset of modern broadcasting technologies, such as the radio and later television. Panel (F) shows models, where each of the dependent variables has been logged, instead of standardized.

Including bins of distance terms

All baseline specifications include controls for the geographic distance (logged, in km) and time distance (logged, in years). The logged variables take account of the potentially non-linear relationship of large geographic or temporal distances. Alternatively, one may want to take more explicit account of potential nonlinearity by including bins of distance terms. We generate a set of geographic dummies to indicate pairs of composers who are born apart by 100-250 km, 250-500 km, 500-1000 km, or >1000 km. We also generate a set of time dummies to indicate pairs of composers who are born apart by 0-10 years, 10-25 years, 25-50 years, or 50-100 years. The results are shown in Table D.4. First, it can be observed that most of the geographic distance bins do not differ significantly from the baseline of pairs of composers born less than 100 km apart, albeit the point estimates are typically negative and increase with distance, so that pairs of composers born over 1000 km apart are found to be more dissimilar. This may reflect a greater divergence in compositional style between composers born on different continents. Second, coefficients on each of the time bins are estimated with considerably greater precision and suggest the existence of larger decreases in similarity relative to the baseline (pairs born less than 10 years apart) and also across each of the bins (the point estimates increase significantly in absolute terms for each greater time interval). These results suggest that compositional style varies potentially more widely across generations of composers than across space. Third and most importantly, it is reassuring that throughout all these alterations and sub-sampling approaches the results on teacher influence remain very stable.

[3] See Section 3 for historical context on music originality.

Table D.3: Robustness tests: Different specifications and sub-sampling

	Pct. Shared				Cosine Sim.			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Panel A: Baseline (Table 2)								
Connected	0.118**	0.283***	0.305***	0.095**	0.178***	0.241***	0.169***	0.137***
	(0.054)	(0.092)	(0.111)	(0.039)	(0.064)	(0.091)	(0.057)	(0.045)
N	23489	23489	23489	23489	23489	23489	23489	23489
R^2	0.29	0.32	0.28	0.37	0.38	0.33	0.29	0.21
Sample	World	World	World	World	World	World	World	World
Panel B: Themes truncated at six notes								
Connected	0.099*	0.195**	0.150*	0.102**	0.149**	0.156**	0.169***	0.137***
	(0.056)	(0.086)	(0.079)	(0.039)	(0.058)	(0.063)	(0.057)	(0.045)
N	23489	23489	23489	23489	23489	23489	23489	23489
R^2	0.30	0.29	0.20	0.39	0.42	0.44	0.29	0.21
Sample	World	World	World	World	World	World	World	World
Panel C: Composers born in Europe only								
Connected	0.184***	0.351***	0.372***	0.131***	0.212***	0.240**	0.211***	0.134***
	(0.057)	(0.098)	(0.118)	(0.044)	(0.073)	(0.099)	(0.058)	(0.047)
N	17370	17370	17370	17370	17370	17370	17370	17370
R^2	0.28	0.31	0.29	0.37	0.38	0.34	0.30	0.22
Sample	Europe	Europe	Europe	Europe	Europe	Europe	Europe	Europe
Panel D: Composers born after 1750 only								
Connected	0.118**	0.292***	0.309***	0.095**	0.173***	0.234**	0.168***	0.137***
	(0.055)	(0.094)	(0.112)	(0.039)	(0.065)	(0.092)	(0.058)	(0.046)
N	22947	22947	22947	22947	22947	22947	22947	22947
R^2	0.29	0.32	0.28	0.37	0.38	0.33	0.29	0.20
Sample	Drop pre-1750	Drop pre-1750	Drop pre-1750	Drop pre-1750	Drop pre-1750	Drop pre-1750	Drop pre-1750	Drop pre-1750
Panel E: Period of commercial broadcasting dropped								
Connected	0.139*	0.357**	0.374**	0.141***	0.246***	0.263*	0.154**	0.174***
	(0.078)	(0.144)	(0.176)	(0.054)	(0.091)	(0.137)	(0.064)	(0.053)
N	12610	12610	12610	12610	12610	12610	12610	12610
R^2	0.24	0.29	0.27	0.35	0.37	0.33	0.26	0.22
Sample	Drop post-1920	Drop post-1920	Drop post-1920	Drop post-1920	Drop post-1920	Drop post-1920	Drop post-1920	Drop post-1920
Panel F: Logged dependent variable								
Connected	0.040**	0.115***	0.145***	0.036**	0.094***	0.151***	0.118***	0.100***
	(0.019)	(0.037)	(0.054)	(0.016)	(0.036)	(0.054)	(0.041)	(0.034)
N	23489	23288	20305	23489	23288	20305	20223	23012
R^2	0.31	0.31	0.21	0.35	0.33	0.27	0.18	0.18
Sample	World	World	World	World	World	World	World	World
Commonality Controls	X	X	X	X	X	X	X	X
Distance Controls	X	X	X	X	X	X	X	X
Composer FE	X	X	X	X	X	X	X	X
Quarter-century FE	X	X	X	X	X	X	X	X

Notes: The dependent variable is a standardized (Panels A-D) or logged (Panel E) similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key, and time signature (columns 4-8, respectively) for a given pair of composers i and j. Panel A shows the baseline coefficients from Table 2. Panel (B) presents the results for truncated themes at six notes. Panel (C) restricts the sample to pairs of composers born in Europe. Panel (D) restricts the sample to pairs of composers born after 1750. Panel (E) shows models with logged dependent variables. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1.

Table D.4: Robustness test: Effects of connection on similarity with nonlinear distance controls

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Connected	0.103*	0.261***	0.282**	0.088**	0.162**	0.218**	0.157***	0.125***
	(0.054)	(0.093)	(0.112)	(0.040)	(0.065)	(0.092)	(0.058)	(0.045)
Geog. distance 100-250 km	0.005	-0.063	-0.023	0.003	0.021	0.070	0.025	-0.027
	(0.046)	(0.066)	(0.074)	(0.035)	(0.056)	(0.076)	(0.043)	(0.042)
Geog. distance 250-500 km	-0.045	-0.065	-0.013	-0.027	0.043	0.109	-0.004	-0.028
	(0.040)	(0.062)	(0.071)	(0.032)	(0.051)	(0.068)	(0.043)	(0.039)
Geog. distance 500-1000 km	-0.027	-0.048	-0.017	-0.002	0.044	0.091	-0.041	-0.025
	(0.044)	(0.065)	(0.075)	(0.033)	(0.056)	(0.078)	(0.043)	(0.037)
Geog. distance >1000 km	-0.061	-0.149**	-0.124	-0.072**	-0.040	0.030	-0.095**	-0.030
	(0.044)	(0.065)	(0.076)	(0.033)	(0.055)	(0.077)	(0.044)	(0.037)
Time distance 10-25 yrs	-0.032***	-0.041**	-0.031	-0.031***	-0.040**	-0.029	-0.046***	-0.042***
	(0.012)	(0.016)	(0.019)	(0.011)	(0.017)	(0.022)	(0.017)	(0.013)
Time distance 25-50 yrs	-0.110***	-0.174***	-0.166***	-0.102***	-0.157***	-0.147***	-0.161***	-0.135***
	(0.014)	(0.025)	(0.028)	(0.013)	(0.022)	(0.026)	(0.024)	(0.015)
Time distance 50-100 yrs	-0.256***	-0.388***	-0.389***	-0.208***	-0.326***	-0.342***	-0.292***	-0.283***
	(0.021)	(0.041)	(0.047)	(0.020)	(0.032)	(0.040)	(0.033)	(0.022)
N	23489	23489	23489	23489	23489	23489	23489	23489
R^2	0.30	0.32	0.29	0.37	0.38	0.33	0.29	0.21
Commonality Controls	X	X	X	X	X	X	X	X
Composer FE	X	X	X	X	X	X	X	X
Quarter-century FE	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key, and time signature (columns 4-8, respectively) for a given pair of composers, i and j. *Connected* indicates realized teacher-student pairs. The reference group is conditioned to pairs where the candidate teacher was alive for at least one year when the candidate student was between the ages of five and 30. Controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent. The baseline are pairs of composers born apart by less than 100 km and less than 10 years. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Section 4 for details).

D.3 Validity tests

Here we pursue several attempts to provide further support towards the validity of our methodology. First, we demonstrate that a composer's style relates to other works from the same location and period. Second, we show that our results resonate theories propagated within musicology.

In the arts, style is a "...distinctive manner which permits the grouping of works into related categories" (Fernie, 1995) and it is often divided into the general style of a country, period, and also the interaction of the two. Using an unrestricted set of composer pairs, we regress each of our eight similarity measures on either an indicator for common birth country, common birth country interacted with common time period, common birth city, geographic distance or temporal distance between birthplaces. Table D.5 presents the results. As one would expect, common location and/or time period implies a more similar style of the pair in question, whereas the opposite is true for greater geographic or temporal distance between birthplaces of two composers. Bringing these results into perspective: to be born in the same country increases similarity by about one-fourth of what a teacher's influence is on style similarity. The location and period are thus significant factors in determining a person's style, albeit they are markedly less dominant than a teacher's influence.

Next, we explore whether there exists a systematic difference in the influence depending on whether the education takes place in the formal, institutional setting of a conservatory or if it has an informal character (e.g., private tuition). The expectation in musicology is the absence of any difference: "Whether the [teacher-student] relationship involves years of personal mentoring or simply attending a master class, the respect we have for these composers urges us to make their teachings part of ourselves, part of who we are as composers" (Pfitzinger, 2017, p. xi). The regressions are shown in Table D.6 and deliver insignificant estimates, which does not support the notion that influence depends on the educational setting or type of teaching relationship. This result is encouraging as it is in line with musicologists' understanding of a composer's teaching influence.

Finally, we study the differences in similarity of realized teacher-student pairs across musical periods and show that the only detectable difference in similarity over time relative to the Renaissance is observable for the key signature. Since the key signature saw the largest developments in the 16th and 17th centuries, this is another finding that resonates music history scholarship (see Appendix E.5).

Table D.5: Validity tests: Similarity across works from same time and place

	Pct. Shared				Cosine Sim.			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Panel A: Common birth country								
Common birth country	0.0526***	0.113***	0.150***	0.0522***	0.0832***	0.0991***	0.0142	0.0802***
	(0.0109)	(0.0152)	(0.0168)	(0.00855)	(0.0132)	(0.0169)	(0.0121)	(0.0103)
N	57,970	57,970	57,970	57,970	57,970	57,970	57,970	57,970
R^2	0.262	0.281	0.241	0.356	0.351	0.299	0.215	0.208
Panel B: Common birth country and 50-year period								
Common birth country *	0.0433***	0.0945***	0.121***	0.0603***	0.0830***	0.0985***	0.0726***	0.175***
* period (50-year)	(0.0151)	(0.0212)	(0.0235)	(0.0119)	(0.0184)	(0.0235)	(0.0168)	(0.0144)
N	57,970	57,970	57,970	57,970	57,970	57,970	57,970	57,970
R^2	0.261	0.281	0.240	0.356	0.351	0.299	0.215	0.210
Panel C: Common birth city								
Common birth city	0.0833**	0.123**	0.0994*	0.0194	-0.0194	-0.0639	0.0109	0.253***
	(0.0382)	(0.0534)	(0.0592)	(0.0301)	(0.0463)	(0.0594)	(0.0424)	(0.0363)
N	57,970	57,970	57,970	57,970	57,970	57,970	57,970	57,970
R^2	0.261	0.281	0.240	0.356	0.351	0.299	0.215	0.208
Panel D: Geographic distance apart								
Ln(Geog. distance)	-0.0370***	-0.0736***	-0.0903***	-0.0420***	-0.0684***	-0.0810***	-0.0318***	-0.0343***
	(0.00284)	(0.00397)	(0.00439)	(0.00223)	(0.00343)	(0.00441)	(0.00315)	(0.00270)
N	57,970	57,970	57,970	57,970	57,970	57,970	57,970	57,970
R^2	0.264	0.285	0.245	0.360	0.355	0.303	0.216	0.210
Panel E: Temporal distance apart								
Ln(Time distance)	-0.00861***	-0.0219***	-0.0256***	-0.0173***	-0.0235***	-0.0315***	-0.0367***	-0.0653***
	(0.00251)	(0.00351)	(0.00389)	(0.00198)	(0.00304)	(0.00390)	(0.00279)	(0.00237)
N	57,970	57,970	57,970	57,970	57,970	57,970	57,970	57,970
R^2	0.261	0.281	0.240	0.357	0.351	0.300	0.217	0.218
Composer FE	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key, and time signature (columns 4-8, respectively) for a given pair of composers i and j. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1 The data were collected by the authors (see Section 4 for details).

Table D.6: Validity test: No difference between formal and informal setting of education

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Conservatory education	0.016	-0.077	-0.230	0.009	-0.066	-0.208	0.048	-0.113
	(0.168)	(0.278)	(0.351)	(0.112)	(0.201)	(0.285)	(0.144)	(0.113)
N	154	154	154	154	154	154	154	154
R^2	0.04	0.07	0.06	0.10	0.13	0.11	0.13	0.06
Commonality Controls	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key signature, and time signature (columns 4-8, respectively) for realized teacher-student pair. *Conservatory education* indicates realized pairs, whose teaching took place at a conservatory. Controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Section 4 for details).

D.4 Implications of religion for teaching, connecting, and composing

The historical context has implicitly shown that throughout history the institution of the church has played a role in music education and composition. This is neither a surprising fact, nor is it specific to music, but it may give rise to questions on whether the religious denomination of a composer matters for the teaching or composing. We will approach this in three parts, by looking at how the composer's religious background matters for his involvement in teaching, for the probability of two composers connecting, and for composition outcomes; But first, we need the data.

Initially, we have collected data on the religious background of composers from biographical entries in Grove. However, the religious denomination was provided for only 27 composers. This is an interesting finding in itself: Building on the assumption that Grove provides only the most relevant information for a composer, the very limited records on the religious background may suggest that it is rarely regarded as a determining factor in a composer's career.

We have then used additional sources. We began searching for publications listed in JSTOR that cover composers and their religious background, then we proceeded to other online and offline biographies on composers, and in last instance, we searched additional online resources (e.g,. articles in classical music magazines). These efforts enabled us to obtain the religious background for 151 composers. The main denominations are Catholic 38%, Jewish 22%, and Protestant 20%. There are also 12% composers who have no religion (5 atheists, 2 agnostics, and 10 described as non-religious).[4]

We begin with an exploration of how a composer's background matters for his involvement in teaching or studying, and summarize the findings in columns (1)-(5) of Panel A in Table D.7. Here we consider one of the following five dependent variables: a dummy variable for whether the composer has an occupation listed in Grove as a teacher (column 1; see Appendix E.3 for more details), a dummy for whether the composer taught another BM composer (column 2), and the number of BM students (column 3), a dummy for whether the composer studied with another BM composer (column 4), and a given composer's number of BM teachers (column 5). Among the three main religions, the only significant coefficient is found for Protestants, who are about 21% more likely to have a teacher occupation listed in Grove compared with non-religious composers. This may be due to the Protestant emphasis laid on education, but it has to be observed that the difference relative to Catholic or Jewish composers is much smaller and insignificant.

Second, we analyze whether there are any differences in the probability of forming a teacher-student connection based on having the religion in common. It can be seen in column 6 of Panel A in Table D.7 that the estimate on the common religion indicator is very small and statistically

[4]Three side remarks are in order. First, comparing the full data on religious background (151 observations) with the small sample from Grove (27 observations), we observe a very similar share across the different denominations. This indicates that there is unlikely to be a bias in Grove with regard to religion. Second, all estimations that follow would also hold for the 27 observations from Grove, but their volatility would naturally increase. Third, Felix Mendelssohn is an interesting individual, who converted from Judaism to Protestantism at the age of seven; we record him as a Protestant, which is the religious denomination of his time as a composer.

insignificant. This suggests that the religious background of the teacher and student has not determined the probability of connecting, but instead matching may have been taking place across religious boundaries.

Indeed, we observe different religious beliefs for 30 out of 70 realized teacher-student pairs, where we know the religious background of both composers. In particular, teacher-student connections have been formed between Catholics and Jews (7 realized pairs), Catholics and Protestants (4), and Protestants and Jews (2), but mostly where one of the composers is non-religious (13).

The absence of any clear pattern when it comes to the formation of educational connections is encouraging. Nonetheless, to reconfirm our baseline results on stylistic similarity between the student and teacher, we add in a robustness test the control for common religion. The results are shown in Panel C of Table D.7. Alternatively one may want to estimate the baseline with additional variables that indicate whether either the candidate/realized teacher or the candidate/realized student had a particular religious denomination. This is shown in Panel D of Table D.7. Both estimations support the robustness of the teacher's influence.

Table D.7: Effects of religion on teaching, connecting, and composing

A. Effects of religion on educational involvement and connection

	(1) Teacher occupation	(2) Realized teacher	(3) # of students	(4) Realized student	(5) # of teachers	(6) Connected
Catholic	0.137	0.00734	0.281	-0.0284	-0.0576	
	(0.105)	(0.130)	(0.578)	(0.135)	(0.248)	
Protestant	0.210*	-0.0153	0.161	0.0527	0.0994	
	(0.116)	(0.145)	(0.642)	(0.150)	(0.275)	
Jewish	0.136	-0.193	-0.443	0.0143	-0.0372	
	(0.107)	(0.133)	(0.588)	(0.137)	(0.252)	
Other	0.258*	-0.160	1.459*	0.499**	0.678*	
	(0.154)	(0.192)	(0.852)	(0.199)	(0.366)	
Common religion						0.00536
						(0.00353)
N	151	151	151	151	151	4,015
R^2	0.028	0.057	0.057	0.036	0.059	0.097
Century FE	X	X	X	X	X	
Continent FE	X	X	X	X	X	
Commonality Controls						X
Distance Controls						X
Composer FE						X
Quarter-century FE						X
Sample	World	World	World	World	World	World

B. Effects of connection on similarity: Adding a control for common religion

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Connected	0.243**	0.493**	0.544**	0.179***	0.265**	0.261	0.307***	0.140
	(0.120)	(0.215)	(0.274)	(0.064)	(0.127)	(0.202)	(0.086)	(0.093)
Common Religion	0.058	0.148**	0.281***	0.045	0.161**	0.288***	0.083**	-0.019
	(0.043)	(0.067)	(0.075)	(0.033)	(0.062)	(0.075)	(0.039)	(0.020)
N	4015	4015	4015	4015	4015	4015	4015	4015
R^2	0.27	0.35	0.35	0.42	0.45	0.42	0.36	0.26
Commonality Controls	X	X	X	X	X	X	X	X
Distance Controls	X	X	X	X	X	X	X	X
Composer FE	X	X	X	X	X	X	X	X
Quarter-century FE	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

C. Effects of connection on similarity: Controlling for religion of either composer

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Connected	0.136**	0.317***	0.338***	0.117***	0.211***	0.277***	0.190***	0.145***
	(0.053)	(0.091)	(0.109)	(0.039)	(0.062)	(0.089)	(0.057)	(0.045)
Catholic	0.255***	0.512***	0.525***	0.240***	0.484***	0.569***	0.345***	0.058***
	(0.025)	(0.038)	(0.040)	(0.010)	(0.020)	(0.033)	(0.016)	(0.012)
Protestant	0.332***	0.564***	0.564***	0.441***	0.606***	0.624***	0.321***	0.171***
	(0.025)	(0.037)	(0.039)	(0.012)	(0.022)	(0.033)	(0.020)	(0.016)
Jewish	-0.049***	-0.074***	-0.124***	-0.041***	-0.136***	-0.131***	-0.004	-0.033***
	(0.009)	(0.016)	(0.020)	(0.008)	(0.016)	(0.019)	(0.019)	(0.012)
N	23489	23489	23489	23489	23489	23489	23489	23489
R^2	0.31	0.34	0.31	0.40	0.41	0.35	0.31	0.21
Commonality Controls	X	X	X	X	X	X	X	X
Distance Controls	X	X	X	X	X	X	X	X
Composer FE	X	X	X	X	X	X	X	X
Quarter-century FE	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: Panel A: The dependent variable is a dummy for whether the composer has an occupation listed in Grove as teacher (column 1), a dummy for whether the composer taught another BM composer (column 2), the number of BM students (column 3), a dummy for whether the composer studied with another BM composer (column 4), the number of BM teachers (column 5), and a dummy for whether the pair of composers is connected (column 6). Controls not shown in columns (1)-(5) include dummies for century and continent of birth of the composer. Controls not shown in column (6) include dummies for common birth country, time period, and their interaction, common nationality, and common descent. *Catholic*, *Protestant*, and *Jewish* are dummy variables that indicate the religious denomination of a composer; the benchmark are non-religious composers. *Common religion* indicates pairs of composers that have the religious denomination in common.

Panels B and C: The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key, and time signature (columns 4-8, respectively). *Connected* indicates realized teacher-student pairs. Controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent.

Panels A-C: Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Section 4 and Appendix D.4 for details.).

D.5 Studying music vs. studying composition

For musicians "to study with" someone is a complex matter. All composers after all were musicians, and indeed many of them made their living performing music (and teaching music to amateurs), and so one could wonder whether studying with a great composer actually transmitted the skills (and styles) of composition or was it just how to play an instrument. In other words, studying piano with a great composer who was also a great pianist may have little to do with compositions and everything with playing the instrument. In this case, our coefficients on stylistic influence of the teacher would be biased towards zero. The true teacher influence on the compositional style of the student would be greater. Furthermore, it needs to be pointed out that this concern would be irrelevant if our data captured only those who studied composition. Therefore, in this section, we discuss, assess and test the reliability of the realized teacher-student connections.

First of all, it has to be highlighted that each of the individuals covered in our research has been a composer, be it alone for the fact that they composed meaningful enough works to be included in the BM dictionary of musical themes. It is also conceivable that even if the teacher taught piano to the student, but they were both composers, that they talked about composing during their piano lessons. It is thus likely that influence of composition style has been transmitted even if the teaching was primarily focused on something else.

Second, it is evident that Pfitzinger has aimed to list connections between *composition* teachers and students, as opposed to, for example, connections between two music performers. The aim becomes becomes apparent from the title ("Composer Genealogies, A Compendium of Composers, Their Teachers, and Their Students") and the preface:

"*It is my hope that this book may serve as a resource for music historians, composers, and theorists who want to analyze the pedagogical influences of particular composers on their students. (...) there is a noticeable dearth of information about composers teaching composers and the importance of examining compositional lineage. (...) As writers and researchers examine the relationships of composers, they will be able to more readily access the composition teachers that a particular composer had, [and] who taught those teachers (...)*" (Pfitzinger, 2017, preface)

We proceed next to test the Pfitzinger data using our own data from Grove on connections between composition teachers and students.[5] For this reason we re-estimate the baseline regressions using only our own data from Grove on realized pairs of composition teachers and students. The results remain in general consistent with the baseline, but the coefficients are estimated with higher precision and have a marginally greater magnitude, compared with the baseline (not reported).

[5] We have collected our data independently from Pfitzinger and before he published his volume. In our data collection, we have identified 32 realized pairs that Pfitzinger has not found (after checking on these, we are confident that our matches are correct). On the other hand, Pfitzinger has identified 45 realized pairs that we have not found in Grove. We have also checked on these pairs and concluded that Grove does not provide any mention of these connections. When reading other, more specialized reference works, we have been able to confirm some of these 45 realized connections. Since we have no reason to believe that there are mistakes in Pfitzinger, we use in the baseline specification the union of realized pairs that are found in either set (our Grove data or Pfitzinger).

This could suggest that Pfitzinger may have overidentified some teacher-student relationships or included connections that have not been very meaningful.

Finally, we conduct tests using occupation information from Grove in order to provide a better understanding of the difference between the influence of a composition teacher vs. instrumental music teacher. The composers covered in this research had up to six occupations listed in Grove, but >90% of composers had at most three occupations (see further details in Appendix E.3). The most common instrumental occupation of the teacher is that of a pianist (14%), followed by violinist (9%), and organist (5%).

We present the results in Table D.8 as follows: we exclude teachers who are pianists (Panel A), exclude teachers who have one of the three most common instrumental occupations (i.e., pianists, violinists or organists; Panel B), exclude teachers who have any instrumental occupation that appears more than once (in total there have been 11 unique instrumental occupations, and after this restriction our sample decreased by 99 teachers; Panel C), keep teachers whose first (the main) occupation is that of a composer (Panel D), and keep teachers whose only occupation is composers (Panel E).

Throughout this increasingly restrictive sampling procedure, it becomes apparent that the "purer" the background of a composer teacher, the more influential he is on the compositional style of the student. In particular, the coefficients remain very stable in statistical significance, but they tend to increase in size throughout the sub-sampling.

It is not clear what determines this pattern, which could be due to several different factors. One possibility is that certain teacher-student pairs have been discussing during training also non-composition related topics (e.g., how to play an instrument). Another one is that a teacher who is also an instrumentalist, and hence a performer, is more time constrained and can dedicate fewer resources to a single student.

Table D.8: Effects of connection on similarity: Excluding instrumental music teachers

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
A. Exclude teachers who are pianists								
Connected	0.126*	0.281**	0.304**	0.126***	0.204**	0.269**	0.224***	0.150***
	(0.065)	(0.116)	(0.140)	(0.046)	(0.079)	(0.111)	(0.059)	(0.051)
N	19603	19603	19603	19603	19603	19603	19603	19603
R^2	0.31	0.33	0.29	0.36	0.37	0.33	0.29	0.22
Sample	World	World	World	World	World	World	World	World
B. Exclude teachers who are pianists, violinists or organists								
Connected	0.153**	0.360***	0.403***	0.137***	0.221**	0.305**	0.262***	0.165***
	(0.073)	(0.126)	(0.151)	(0.049)	(0.086)	(0.123)	(0.061)	(0.057)
N	17832	17832	17832	17832	17832	17832	17832	17832
R^2	0.30	0.32	0.28	0.36	0.37	0.34	0.29	0.22
C. Exclude teachers who have any instrumental occupation								
Connected	0.159**	0.372***	0.415***	0.150***	0.245***	0.335***	0.253***	0.171***
	(0.074)	(0.127)	(0.153)	(0.048)	(0.084)	(0.123)	(0.062)	(0.058)
N	17524	17524	17524	17524	17524	17524	17524	17524
R^2	0.30	0.32	0.28	0.36	0.37	0.33	0.30	0.22
D. Keep teachers who are mainly composers (first occupation)								
Connected	0.117**	0.283***	0.298**	0.080**	0.140**	0.177*	0.173***	0.102**
	(0.057)	(0.097)	(0.119)	(0.040)	(0.066)	(0.091)	(0.058)	(0.042)
N	18848	18848	18848	18848	18848	18848	18848	18848
R^2	0.29	0.32	0.29	0.38	0.39	0.34	0.30	0.22
E. Keep teachers who are only composers								
Connected	0.285**	0.638***	0.704***	0.178**	0.330***	0.415**	0.218***	0.191**
	(0.110)	(0.199)	(0.251)	(0.072)	(0.118)	(0.182)	(0.083)	(0.080)
N	9779	9779	9779	9779	9779	9779	9779	9779
R^2	0.32	0.34	0.30	0.40	0.40	0.35	0.32	0.23
Commonality Controls	X	X	X	X	X	X	X	X
Distance Controls	X	X	X	X	X	X	X	X
Composer FE	X	X	X	X	X	X	X	X
Quarter-century FE	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The point estimates presented are based on Equation (2). The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key, and time signature (columns 4-8, respectively) for a given pair of composers. *Connected* indicates realized teacher-student pairs. The reference group is conditioned to pairs where the candidate teacher was alive for at least one year when the candidate student was between the ages of five and 30, and as outlined in each panel title. Controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Section 4 for details).

E Additional Results

E.1 Other direct influences

Another form of direct influence is that of peers. Many composers formed peer connections with other contemporaneous composers and were exposed to their ideas and compositional style, which in turn may have influenced their own style. In this case the similarity of the benchmark pairs of composers, if it included peer connections, would increase. This in turn would bias the coefficients on similarity of realized teacher-student pairs downwards. In other words, our coefficients on teacher influence would be biased towards zero, whereas the true teacher effect would be greater than observed.[6]

To better understand and account for the bias arising from peer influence, we have collected extensive data from Grove on peer connections (i.e., connections between two music composers who made acquaintance during their lives). For our sample of composers, we have identified in total 3050 connections between one of our 349 BM composers and any other composer (that is, also composers not included in BM). Among those 3050 connections, there are 359 peer connections between two composers that are both included in our BM sample. Since Grove provides information only on significant events in a composer's life, the identified connections can be assumed to be meaningful or formative in some way.

The data on realized peer connections are then used in regressions summarized in Table E.1, as follows: First, we show the baseline model that excludes peer connections from the benchmark group (Panel A, or also Table 2). Second, we keep peer connections and show that this marginally decreases the coefficients on teacher influence, as hypothesized previously (Panel B). Despite the downward bias, however, it is encouraging to observe that teacher influence is strong enough to deliver statistically significant and comparable (in size) coefficients for the whole sample. Third, we introduce a dummy variable to indicate realized peer connections (Panel C). The introduction of *Connected peers* takes the downward bias out again, so that the coefficients on teacher influence are about identical with the baseline coefficients presented in Panel (A).

These explorations disclose that a teacher's influence is independent and largely unaffected by a composer's exposure to peers. The tests show also that the results based on the baseline model and presented in Table 2 are not sensitive to the exclusion of peer connections from the benchmark group. The interpretation of coefficients on peer influence is more difficult due to the high probability of self-selection into peer relationships. Composers were likely matching with peers based on similarities in their compositional styles. Nonetheless, the extent of peer similarity is striking.

[6] In theory, some composers may have become influenced by contemporaneous *unconnected* composers. We regard this is as a low probability concern, especially for the earlier years when access to information was restricted and costly. However, if this was the case, the influence of unconnected contemporaneous composers would lead to the same downward bias of the coefficients on teacher influence, as discussed above.

Table E.1: Effects of peer connection on similarity

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
A. Baseline (peer connections excluded)								
Connected	0.118**	0.283***	0.305***	0.095**	0.178***	0.241***	0.169***	0.137***
	(0.054)	(0.092)	(0.111)	(0.039)	(0.064)	(0.091)	(0.057)	(0.045)
N	23489	23489	23489	23489	23489	23489	23489	23489
R^2	0.29	0.32	0.28	0.37	0.38	0.33	0.29	0.21
B. Alternative estimation (peer connections not excluded)								
Connected	0.101*	0.255***	0.274**	0.086**	0.156**	0.211**	0.160***	0.131***
	(0.054)	(0.094)	(0.113)	(0.039)	(0.065)	(0.092)	(0.058)	(0.045)
N	23807	23807	23807	23807	23807	23807	23807	23807
R^2	0.29	0.32	0.29	0.38	0.38	0.33	0.29	0.21
C. Teacher-student similarity vs. peer similarity (peer connections not excluded)								
Connected	0.116**	0.282***	0.309***	0.096**	0.180***	0.244***	0.168***	0.138***
	(0.054)	(0.093)	(0.112)	(0.039)	(0.064)	(0.091)	(0.058)	(0.045)
Connected peers	0.329***	0.629***	0.781***	0.237***	0.545***	0.753***	0.200***	0.157***
	(0.084)	(0.121)	(0.130)	(0.035)	(0.064)	(0.095)	(0.047)	(0.042)
N	23807	23807	23807	23807	23807	23807	23807	23807
R^2	0.29	0.32	0.29	0.38	0.38	0.34	0.29	0.21
Commonality Controls	X	X	X	X	X	X	X	X
Distance Controls	X	X	X	X	X	X	X	X
Composer FE	X	X	X	X	X	X	X	X
Quarter-century FE	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The point estimates presented are based on Equation (2). The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key, and time signature (columns 4-8, respectively) for a given pair of composers. *Connected* indicates realized teacher-student pairs. *Connected peers* indicates realized peer pairs. The reference group is conditioned to pairs where the candidate teacher was alive for at least one year when the candidate student was between the ages of five and 30. Controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Section 4 for details).

E.2 Influence of past masters

The influence of some great masters is likely to persist beyond their lifetime. For example, the looming shadow of Ludwig van Beethoven's genius has intimidated numerous composers who followed him. Besides Johannes Brahms, composers like Felix Mendelssohn and Gustav Mahler felt Beethoven's presence. Mendelssohn has also played a pivotal role in popularizing and reigniting interest in the work of Johann Sebastian Bach. It is important to note that none of the influences by past composers matter directly for the results of the paper, since the baseline estimations restrict the comparison group to contemporaneous composers (see Section 5.1 and Appendix D.1). In other words, the influence of a deceased composer on a composer alive, such as that of Beethoven on Brahms, or Bach on Mendelssohn, will not be directly observed in our specifications. However, there exist channels by which a past master may matter for our results—we discuss and address these concerns more rigorously in what follows.

The influence of past masters on current composers can hypothetically take one of the following three forms. First, masters do not influence the next generation(s). Second, masters influence every single composer in the next generation(s). Third, masters influence some, but not all composers. The first two types of influence (influencing nobody or everybody) would not matter for our estimations, which look at differences between connected and unconnected contemporaneous composers.

The third type of influence would be a problem, but only if masters influenced *both* the teacher and the student independently, but nobody else. In other words, if masters influenced connected composers, but not unconnected ones, then we would observe higher similarity between the teacher-student pairs relative to unconnected contemporaneous composers. As a result, the hypothetical past-master bias would increase the coefficients in our favor. For this bias to emerge, it is necessary that the past-master influence affects both teacher and student *independently*. Otherwise, for example, if the student was influenced by the past master *via* his teacher, then we would have an example of "teacher influence".

It is difficult to think of any plausible reason why past masters would systematically and independently influence the teacher and student, but nobody else; hence, this matter should largely be regarded as theoretical. Nonetheless, we approach the problem more rigorously by estimating the past-master effect on all composers and separate out the past-master effect on those composers who—in our data set—have been in a realized teachers-student pair. In other words, what is estimated is the differential effect that past masters have on realized teachers or students. It is not clear ex ante how to determine a past master, but we have pursued a number of approaches based on top scores of the Murray quality index, the number of Spotify followers, the Spotify popularity score, or the length of biographical entry in various sections. The results that follow are not sensitive to the choice of any particular quality measure or the cut-off value.

Table E.2 highlights that composers tend to be more similar to important past composers – this does not come as a surprise. More importantly, the past-master effect is not larger for realized teacher-student pairs, but—if anything—it appears to be lower. It is encouraging to observe that there is no support for the past-master influence being greater for realized teacher-student pairs, than for unconnected composers.

Table E.2: Past-master effect on all composers vs. on teachers or students

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Past-master influence	0.227**	0.740***	0.902***	0.557***	1.072***	1.407***	0.668***	0.175*
	(0.095)	(0.094)	(0.084)	(0.039)	(0.087)	(0.173)	(0.058)	(0.103)
Past-master influence on teachers or students	-0.094	-0.190**	-0.242**	-0.072	-0.137	-0.277*	-0.104	0.015
	(0.062)	(0.079)	(0.103)	(0.047)	(0.084)	(0.166)	(0.067)	(0.111)
N	45736	45736	45736	45736	45736	45736	45736	45736
R^2	0.34	0.39	0.35	0.48	0.49	0.42	0.30	0.28
Commonality Controls	X	X	X	X	X	X	X	X
Distance Controls	X	X	X	X	X	X	X	X
Composer FE	X	X	X	X	X	X	X	X
Quarter-century FE	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key, and time signature (columns 4-8, respectively) for a given pair of composers. *Connected* indicates realized teacher-student pairs. Past master identified as a composer with a Murray Index > 15. Controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Section 4 for details).

E.3 Effects of connection on similarity in occupation, musical instrument, and musical form

This paper provides efforts to illuminating the phenomenon of diffusion and influence by teachers in music composition. The focus is on how the teacher shapes the student's style of work, since this comes closest to the concept of an idea and its transmission. Another way in which the teacher potentially influences the student is by providing them with the right tools and methods; for example, by explaining how to compose for the organ, as opposed to for an orchestra. This appendix provides an exploration of these other influences by looking at non-thematic material, in particular composers' lists of occupations, and choice of musical instruments and musical forms.

There is another advantage of this approach, especially if one is concerned that the compositional style of a musician changes over the life cycle. The approach pursued here diminishes this concern, since it is based on measures that vary considerably less over a composer's lifetime. For example, it is most unlikely that a composer who is a pianist will become a violinist due to external influences (at least not of a high enough quality to be mentioned in Grove). It would also be a big undertaking for a composer who, for example, writes predominantly for the piano to begin composing for the flute, or for an opera composer to begin writing chamber music. In short: The entrance barriers across occupations or musical instruments and forms are considerably greater than tweaks in the compositional style.

Before we present the results, a few words are needed on the additional collection of data and its summary.

Additional data collection on non-thematic output

First, we collect for each composer lists of occupations from Grove, which are systematically provided at the beginning of each biography. For example, Fryderyk Chopin was a "Polish composer and pianist". Most common for composers covered in our sample was to have one occupation only (45%), followed by two occupations (28%, as in the example above), three occupations (18%), etc.; only one composer had six occupations. The most common occupation is obviously that of a composer, which sees no variation, and is followed by conductor (18%), pianist (14%), teacher (13%), violinist (9%), and organist (5%). The list of occupations is typically provided in the order of significance and, hence, not surprisingly, the most common first occupation is that of a composer (89%) followed by violinist and pianist (about 2% each).

Second, we collect data on the musical instrument and musical form of each composition. We are able to extract this information from BM's dictionaries of musical themes. For example, one of Beethoven's works is described as follows: "Concerto No. 1, in C, Op. 15, Pft.", which enables us to identify the musical form (concerto) and musical instrument (fortepiano). We are able to identify the instrument(s) for 79% of the works covered, which is a high proportion. The most common musical instrument is the fortepiano (32% works per composer), followed by orchestra

(21%), violin (14%), string (7%), harpsichord (6%), organ (1.6%), cello (1.5%), and flute (1.4%).[7] Using the available information, we construct a dummy variable that indicates a composer's *main instrument*, which we simply define as the mode of all instruments provided for a composer. The main instrument is fortepiano (39% of composers), followed by orchestra (31%), violin (13%), harpsichord (7.5%), and organ and flute (1.5% each).

Third, we obtain data on musical forms, which is available for 61% of works. These records are noisy and contain as many as about 200 unique entries (after corrections for spelling and translations), but only 19 musical forms appear more often than 0.5% of times (symphony, suite, overture, concert, etc.). The results that follow remain consistent whether one focuses on the 19 most common musical forms or aggregates all observations into categories, such as concert, chamber, theatrical, dance, church, improvisations).[8] The main aggregated musical forms (the mode of all musical forms of a composer) are concert music (34%), theatrical (25%), and chamber (20%).

The newly collected data can then be used to illuminate how often pairs of composers have a particular attribute in common. A simple inspection of averages of common attributes delivers insightful pattern:

- Any instrumental occupation (pianist, violinist, etc.) has only 3% of all pairs of composers in common, but as many as 9.9% of realized pairs (i.e., where teacher and student were actually connected).
- Any musical instrument (piano, violin, etc.) has 26% of all pairs of composers in common and 51% of realized pairs.
- Any musical form (grouped into concert, chamber, etc.) has 72% of all pairs of composers in common and 86% of realized pairs (looking at musical forms in a disaggregated way, we would have, respectively, 66% and 80%).

Results on non-thematic similarity

There are different ways to identify the problem at hand (in fact there is probably enough material here for a separate study). In an attempt to keep the paper as methodologically coherent and consistent as possible, we simply regress the newly constructed commonality terms on the dummy variable "Connected" that identifies realized pairs and include the same controls as in the baseline

[7]Two side remarks are in order. First, the missing instruments in the unclassified themes is not a problem of data quality in the source dictionary, but rather a reflection of the fact that composers have not always indicated the target (or preferred) instrument. Second, orchestra is an aggregate, which combines instruments from different families of musical instrument, typically including some of the separately listed instruments (e.g., violin), but not all (e.g., organ). In the results that follow orchestra is treated on a par with the individually listed instruments, since it captures some of the choices or preference of the composer. However, the results would remain consistent, if the orchestra category was instead excluded. Analogous observations apply also for the string family of instruments.

[8]Another word of caution: Categorization of works is difficult to conduct in a systematic way since certain works could belong to one or more of the suggested aggregated musical forms.

regressions, namely the sets of distance variables and commonality controls, and condition to pairs of composers where the older of the two composers in a pair was alive for at least one year while the younger was between the ages five and 30.

The results are presented in Table E.3. We show how connection matters for similarity in the occupation of teacher and student (Panel A), similarity in choice of musical instruments (Panel B) or musical forms (Panel C), and how a student's choice of musical instruments depends on the teacher's main instrument or the teacher's instrumental occupation (Panel D). Throughout these results we observe consistently that connection matters for any of the measures. For example, realized pairs are 5% more likely to have an instrumental occupation in common (e.g., both the teacher and the student are a pianist; column 1, Panel A). We also show that this effect persists for any of the instrumental occupations that involve an instrument from the keyboard instrument family (column 2), or the piano (column 3), and even for non-instrumental occupations (e.g., occupations like teacher, theorist, writer, etc.; column 4). Throughout the results summarized in Panels A-C, it becomes apparent, that common attributes, whether a common occupation, musical instrument, or musical form, are about 5-17% more likely to be observed for realized pairs.

Finally, we also disclose that a student composes about half a work more (or six percentage points more works) for an instrument that is his actual teacher's main instrument (columns 1 and 2, Panel D). The student also composes significantly more for an instrument that is his teacher's occupational instrument (e.g., student writes more for the piano if the teacher is a pianist; columns 3-4, Panel D). There are also many other interesting indications of the teacher's influence (not reported). For example, students have significantly more own students if their teacher has an occupation as teacher.

It is important to note that the baseline results on the effects of connection on similarity are robust to the inclusion for any of the commonality controls obtained and analysed in this section (not reported). See also, for example, Table D.8 on estimations that exclude instrumental music teachers.

Table E.3: Effects of connection on similarity in occupation, musical instrument, and musical form

	(1)	(2)	(3)	(4)
	A. Common occupation			
	Common any instrumental occupation	Common keyboard occupation	Common pianist occupation	Common non-instrumental occupation
Connected	0.0506***	0.0523***	0.0481***	0.0926***
	(0.0179)	(0.0177)	(0.0169)	(0.0223)
N	23,489	23,489	23,489	23,489
R^2	0.149	0.167	0.158	0.193
	B. Common musical instrument			
	Common any instrument	Common main instrument	Common keyboard	Common piano
Connected	0.175***	0.0458**	0.148***	0.147***
	(0.0307)	(0.0214)	(0.0295)	(0.0299)
N	23,489	23,489	23,489	23,489
R^2	0.298	0.456	0.292	0.274
	C. Common musical form			
	Common any form	Common main form	Common concert form	Common chamber form
Connected	0.0846***	0.0848***	0.152***	0.0674***
	(0.0224)	(0.0309)	(0.0290)	(0.0227)
N	23,489	23,489	23,489	23,489
R^2	0.416	0.218	0.251	0.209
	D. Student's instrument choice based on teacher's main or occupational instrument			
	Student's choice of teacher's main instrument (count)	Student's choice of teacher's main instrument (share)	Student's choice of teacher's instrumental occupation (count)	Student's choice of teacher's instrumental occupation (share)
Connected	0.548**	0.0662***	0.308***	0.0385***
	(0.225)	(0.0224)	(0.116)	(0.0144)
N	20,816	19,064	22,320	21,546
R^2	0.248	0.142	0.147	0.137
Commonality Controls	X	X	X	X
Distance Controls	X	X	X	X
Composer FE	X	X	X	X
Quarter-century FE	X	X	X	X
Sample	World	World	World	World

Notes: The point estimates presented are based on an adaptation of Equation (2). The dependent variable indicates pairs of composers that have a common occupation (Panel A), common musical instrument (Panel B), common musical form (Panel C), and pairs where the student composes for an instrument that is his teacher's main instrument or occupational instrument (Panel D). *Connected* indicates realized teacher-student pairs. The reference group is conditioned to pairs where the candidate teacher was alive for at least one year when the candidate student was between the ages of five and 30. Controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent. Standard errors are clustered by candidate student. Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Appendix E.3 for details).

E.4 Within-city similarity

Composers have been located almost exclusively in cities (as opposed to rural areas), since they needed to access large, expensive cultural infrastructure such as concert halls and opera houses in order to test and perform their works, and these are available only in cities. Therefore, one may want to restrict the sample to pairs of composers where both teacher and candidate were located in the same city and time. This approach, which effectively decreases the actual geographic distance between two composers to about zero, is pursued in this section.

To conduct this analysis, we extract from Grove the lifetime migration records for each composer, including the dates when a stay in a city began and ended. Migration histories have been fairly well-documented, since they form an important part of a person's biography. It is true that a few observations may be imprecise when it comes to the exact beginning/ending date, but there are no indications for the existence of any systematic biases.

The data collection effort resulted in 2117 composer-city-level observations. Out of these, we dropped 108 observations, where the exact location is not provided but only the country (for example, "Germany (city unknown)"), or when multiple places have been visited (mostly during touring in another country or continent, for example, "Various, mult. countries (Europe; Russia)"). The remaining observations indicate that composers have been located on average in 6.05 cities during their lifetime, including the city of birth and returns to the same city. The most mobile composers visited up to 20 cities during their lifetime, with a maximum of 23 cities. There are 149 unique cities in our data, with Paris being the most prominent one (10153 pairs, unconditioned, realized or unrealized), followed by London (2700), Vienna (2346), Berlin (1539), Rome (1275), and New York City (990).

We condition to pairs of composers who have overlapped in a city (i.e., realized/candidate teacher and realized/candidate student have been located in the same city at the same time). We also keep the baseline condition requiring that the teacher has been alive when the student was in his formation age (between five and 30); this restriction is not required to obtain qualitatively the same results, but it serves the purpose of our estimations. Both conditions ultimately mean that we compare the similarity of connected composers with the similarity of unconnected composers, contemporaneously and within the borders of the same city. As such, this estimation mitigates also the concern of location specific indirect influences (see Section 5).

Table E.4 shows the results for the regression that is conditional on city overlap during student's formation age and includes city fixed effects in addition to all previous controls. Some of the point estimates are found to be slightly smaller in comparison with the baseline, as expected, but more importantly: The effect of connection on similarity is positive and statistically significant, which provides an important support for the findings.

Table E.4: Effects of connection on within-city similarity

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Connected	0.126	0.285***	0.337***	0.114***	0.151**	0.176*	0.155**	0.115***
	(0.114)	(0.096)	(0.093)	(0.042)	(0.067)	(0.101)	(0.064)	(0.033)
N	6619	6619	6619	6619	6619	6619	6619	6619
R^2	0.36	0.39	0.36	0.43	0.43	0.39	0.34	0.30
Commonality Controls	X	X	X	X	X	X	X	X
Distance Controls	X	X	X	X	X	X	X	X
Composer FE	X	X	X	X	X	X	X	X
Quarter-century FE	X	X	X	X	X	X	X	X
City FE	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key, and time signature (columns 4-8, respectively) for a given pair of composers. *Connected* indicates realized teacher-student pairs. The reference group is conditioned to pairs of composers who have overlapped in a city (i.e., realized/candidate teacher and realized/ candidate student have been located in the same city at the same time) and where the candidate teacher was alive for at least one year when the candidate student was between the ages of five and 30. Controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Section 4 and Appendix E.4 for details).

E.5 Stable influence across musical periods

This research covers about five centuries of data, and the inclusion of time fixed effects, various sub-sampling approaches or imposed restrictions will largely mitigate concerns arising from any potential time variation. However, one may wonder what are the differences, if any, in the extent of teacher influence over time. We approach this issue by looking at whether the degree of similarity differs over musical periods. The analysis is presented in Table E.5, where similarity is regressed on musical periods chosen based on the student's year of birth, as follows: Renaissance (before 1600), which is the baseline, Baroque (1600-1750), Classical (1750-1830), Early Romantic (1830-1860), and Late Romantic (after 1860).

The coefficients are mostly insignificant, which indicates that teacher-student similarity has remained fairly stable across musical periods. There is one exception though: the key signature metric delivers smaller coefficients on similarity for all periods following the Renaissance, and this result is statistically significant from the Classical period (column 7). Interestingly, this finding is in line with music historical developments. The key signature originates from the Medieval period, but it was initially very simple using only a one-flat signature. According to the Harvard Dictionary of Music, the key signatures with more than one flat did not appear until the Baroque, and signatures with sharps not until the Classical period. These historical developments increased composers' potential for differentiation with regard to key signature; our result resonates this by disclosing the decreasing similarity.

Table E.5: Stable influence across musical period

	Pct. Shared			Cosine Sim.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Baroque	0.013	0.660	1.542	0.436	0.691	1.398	-0.644	0.207
	(0.317)	(0.655)	(1.162)	(0.298)	(0.671)	(0.960)	(0.583)	(0.436)
Classical	-0.388	0.130	0.274	0.244	0.110	-0.214	-0.830*	-0.252
	(0.258)	(0.369)	(0.586)	(0.236)	(0.497)	(0.532)	(0.443)	(0.426)
Eearly Romantic	-0.393	0.081	0.222	0.151	0.223	0.117	-0.736*	-0.418
	(0.245)	(0.312)	(0.539)	(0.233)	(0.484)	(0.520)	(0.437)	(0.423)
Late Romantic	-0.775***	-0.453	-0.268	-0.242	-0.415	-0.529	-0.942**	-0.536
	(0.258)	(0.328)	(0.555)	(0.246)	(0.496)	(0.540)	(0.449)	(0.429)
N	211	211	211	211	211	211	211	211
R^2	0.06	0.06	0.07	0.13	0.12	0.14	0.07	0.09
Commonality Controls	X	X	X	X	X	X	X	X
Sample	World	World	World	World	World	World	World	World

Notes: The dependent variable is a standardized similarity coefficient that measures the pct. of collective 2-/3-/4-grams shared (columns 1-3, respectively) or cosine similarity of 2-/3-/4-grams, key signature, and time signature (columns 4-8, respectively) for realized teacher-student pairs. The musical periods are classified based on the birth year of the student as follows: Renaissance (before 1600), which is the baseline, Baroque (1600-1750), Classical (1750-1830), Early Romantic (1830-1860), and Late Romantic (after 1860). Controls not shown include dummies for common birth country, time period, and their interaction, common nationality, and common descent. Standard errors are clustered by candidate teacher. Significance levels: ***p < .01, **p < .05, and *p < .1. The data were collected by the authors (see Section 4 for details).

F List of teacher-student pairs

Table G.1: Teacher-student list

Teacher	Student	Year met	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Adam, Adolphe	Delibes, Clement Leo	1847	0.44	0.22	0.07	0.85	0.38	0.14	0.54	0.84
Albeniz, Isaac	Severac, Deodat de		0.30	0.08	0.00	0.39	0.12	0.00	0.28	0.59
Albeniz, Isaac	Turina, Joaquin		0.46	0.19	0.07	0.74	0.43	0.17	0.33	0.86
Arensky, Anton	Gliere, Reinhold	1884	0.28	0.07	0.00	0.51	0.13	0.00	0.22	0.42
Arensky, Anton	Gretchaninov, Alexander	1882	0.25	0.08	0.04	0.58	0.30	0.07	0.27	0.21
Arensky, Anton	Juon, Paul		0.31	0.08	0.03	0.54	0.14	0.05	0.43	0.43
Arensky, Anton	Medtner, Nicolas		0.26	0.10	0.00	0.43	0.19	0.00	0.43	0.63
Arensky, Anton	Rachmaninov, Sergei	1885	0.40	0.13	0.03	0.66	0.30	0.08	0.55	0.81
Arensky, Anton	Scryabin, Alexander		0.41	0.12	0.04	0.64	0.28	0.10	0.25	0.87
Bach, Carl Philipp Eman.	Bach, Johann Christian		0.45	0.19	0.09	0.78	0.47	0.25	0.54	0.93
Bach, Johann Christian	Mozart, Wolfgang Amadeus	1764	0.35	0.19	0.08	0.85	0.65	0.45	0.85	0.89
Bach, Johann Sebastian	Bach, Carl Philipp Eman.	1714	0.51	0.21	0.07	0.81	0.59	0.33	0.74	0.87
Bach, Johann Sebastian	Bach, Johann Christian	1735	0.36	0.17	0.06	0.83	0.57	0.36	0.76	0.71
Bach, Johann Sebastian	Bach, Wilhelm	1710	0.36	0.10	0.03	0.87	0.57	0.35	0.47	0.94
Balakirev, Mily	Borodin, Alexander	1862	0.37	0.10	0.03	0.59	0.25	0.07	0.54	0.57
Balakirev, Mily	Cui, Cesar	1856	0.27	0.11	0.03	0.48	0.21	0.06	0.00	0.46
Balakirev, Mily	Mussorgsky, Modest	1858	0.33	0.09	0.02	0.51	0.24	0.08	0.31	0.60
Balakirev, Mily	Rimsky-Korsakov, Nikolai	1861	0.43	0.10	0.02	0.64	0.30	0.05	0.38	0.65
Balakirev, Mily	Tchaikovsky, Piotr Il.	1869	0.36	0.09	0.03	0.71	0.33	0.12	0.58	0.78
Bloch, Ernest	Jacobi, Frederick		0.22	0.06	0.01	0.52	0.14	0.03	0.16	0.63
Boieldieu, Francois-Adr.	Adam, Adolphe	1821	0.47	0.24	0.08	0.85	0.38	0.15	0.24	0.63
Boito, Arrigo	Wolf-Ferrari, Ermanno	1895	0.55	0.24	0.07	0.86	0.69	0.53	0.56	0.60
Brahms, Johannes	d'Albert, Eugen		0.14	0.04	0.02	0.43	0.30	0.22	0.46	0.78
Bruch, Max	Malipiero, Gian Francesco	1906	0.52	0.16	0.02	0.64	0.24	0.05	0.32	0.35
Bruch, Max	Respighi, Ottorino	1902	0.56	0.21	0.07	0.75	0.45	0.23	0.41	0.21

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Table G.1 – continued from previous page

Teacher	Student	Year met	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Bruch, Max	Straus, Oskar		0.41	0.15	0.05	0.59	0.29	0.15	0.41	0.14
Bruch, Max	Williams, Ralph Vaughan	1897	0.54	0.21	0.07	0.82	0.61	0.32	0.64	0.27
Bruckner, Anton	Kreisler, Fritz	1882	0.41	0.26	0.12	0.85	0.64	0.32	0.41	0.60
Bruckner, Anton	Schelling, Ernest		0.26	0.08	0.03	0.54	0.26	0.14	0.00	0.58
Buxtehude, Dietrich	Bach, Johann Sebastian	1705	0.55	0.17	0.06	0.83	0.61	0.36	0.67	0.84
Byrd, William	Morley, Thomas		0.42	0.14	0.01	0.62	0.24	0.07	0.88	0.53
Byrd, William	Weelkes, Thomas		0.40	0.12	0.03	0.52	0.19	0.05	0.45	0.43
Cannabich, Christian	Stamitz, Carl		0.43	0.13	0.06	0.58	0.16	0.11	0.32	0.63
Carissimi, Giacomo	Scarlatti, Alessandro		0.50	0.10	0.01	0.67	0.19	0.02	0.13	0.78
Chadwick, George	Still, William Grant		0.24	0.05	0.00	0.25	0.04	0.00	0.00	0.06
Cherubini, Luigi	Auber, Daniel	1805	0.42	0.18	0.07	0.69	0.40	0.18	0.60	0.56
Cherubini, Luigi	Boieldieu, Francois-Adr.		0.52	0.26	0.10	0.87	0.46	0.16	0.78	0.86
Cherubini, Luigi	Halevy, Fromental	1811	0.38	0.06	0.00	0.71	0.17	0.00	0.18	0.47
Clementi, Muzio	Field, John		0.33	0.14	0.05	0.54	0.24	0.09	0.32	0.46
Clementi, Muzio	Meyerbeer, Giacomo		0.41	0.15	0.05	0.65	0.30	0.14	0.55	0.82
Copland, Aaron	Bernstein, Leonard		0.38	0.13	0.01	0.65	0.19	0.01	0.66	0.92
Copland, Aaron	Harris, Roy	1926	0.38	0.14	0.05	0.80	0.50	0.18	0.78	0.36
Copland, Aaron	Schuman, William		0.45	0.12	0.01	0.76	0.25	0.01	0.46	0.41
Corelli, Arcangelo	Locatelli, Pietro		0.41	0.16	0.08	0.69	0.39	0.22	0.00	0.85
Debussy, Claude	Bartok, Bela		0.57	0.24	0.06	0.73	0.46	0.25	0.65	0.81
Delibes, Clement Leo	Koven, Reginald De		0.28	0.11	0.03	0.58	0.24	0.06	0.64	0.33
Delibes, Clement Leo	Kreisler, Fritz		0.57	0.34	0.10	0.86	0.49	0.15	0.55	0.88
Delius, Frederick	Warlock, Peter	1911	0.47	0.15	0.02	0.74	0.33	0.06	0.35	0.75
Dohnanyi, Erno	Bartok, Bela		0.41	0.17	0.06	0.73	0.29	0.10	0.68	0.79
Dukas, Paul	Chavez y Ramirez, Carlos		0.13	0.03	0.02	0.12	0.04	0.03	0.32	0.32
Dukas, Paul	Milhaud, Darius		0.15	0.04	0.01	0.45	0.27	0.10	0.34	0.23

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Table G.1 – continued from previous page

Teacher	Student	Year met	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Dukas, Paul	Piston, Walter		0.20	0.05	0.01	0.39	0.17	0.05	0.37	0.45
Dvorak, Antonin	Burleigh, Harry Thacker		0.36	0.14	0.06	0.79	0.53	0.20	0.59	0.58
Dvorak, Antonin	Friml, Rudolf	1895	0.22	0.05	0.01	0.61	0.30	0.06	0.21	0.59
Dvorak, Antonin	Lehar, Franz		0.43	0.20	0.10	0.76	0.57	0.31	0.79	0.75
Dvorak, Antonin	Suk, Josef	1891	0.25	0.09	0.02	0.65	0.33	0.11	0.46	0.58
Elgar, Edward	Carpenter, John Alden	1906	0.43	0.17	0.06	0.69	0.40	0.18	0.47	0.53
Enescu, George	Piston, Walter		0.44	0.18	0.05	0.69	0.32	0.07	0.22	0.58
Faure, Gabriel	Aubert, Louis	1887	0.31	0.07	0.02	0.52	0.16	0.05	0.07	0.79
Faure, Gabriel	Casella, Alfredo		0.45	0.18	0.06	0.84	0.49	0.15	0.27	0.52
Faure, Gabriel	Enescu, George	1896	0.45	0.23	0.10	0.83	0.58	0.26	0.28	0.48
Faure, Gabriel	Honegger, Arthur		0.61	0.30	0.13	0.89	0.60	0.28	0.27	0.76
Faure, Gabriel	Ibert, Jacques		0.49	0.20	0.06	0.87	0.47	0.17	0.27	0.55
Faure, Gabriel	Jongen, Joseph		0.23	0.05	0.01	0.53	0.25	0.10	0.48	0.68
Faure, Gabriel	Messager, Andre	1871	0.19	0.06	0.01	0.57	0.21	0.03	0.48	0.33
Faure, Gabriel	Ravel, Maurice	1897	0.62	0.33	0.12	0.91	0.56	0.20	0.64	0.83
Faure, Gabriel	Schmitt, Florent	1889	0.25	0.10	0.04	0.59	0.40	0.21	0.28	0.81
Field, John	Glinka, Mikhail	1817	0.33	0.11	0.03	0.52	0.17	0.05	0.20	0.44
Franck, Cesar	Bemberg, Henri		0.23	0.07	0.02	0.64	0.28	0.08	0.30	0.59
Franck, Cesar	Chausson, Ernest		0.61	0.26	0.05	0.82	0.46	0.13	0.52	0.40
Franck, Cesar	Debussy, Claude		0.62	0.31	0.09	0.80	0.53	0.19	0.67	0.75
Franck, Cesar	Dukas, Paul		0.22	0.05	0.01	0.58	0.25	0.03	0.32	0.22
Franck, Cesar	Duparc, Henri		0.38	0.14	0.04	0.72	0.41	0.14	0.26	0.84
Franck, Cesar	Hue, Georges		0.27	0.11	0.02	0.68	0.37	0.07	0.35	0.75
Franck, Cesar	Lekeu, Guillaume	1889	0.34	0.11	0.03	0.63	0.31	0.07	0.15	0.92
Franck, Cesar	Pierne, Gabriel		0.43	0.16	0.05	0.76	0.40	0.15	0.35	0.57
Franck, Cesar	d'Indy, Vincent	1872	0.56	0.25	0.06	0.82	0.43	0.12	0.36	0.54

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Table G.1 – continued from previous page

Teacher	Student	Year met	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Gade, Niels	Grieg, Edvard	1863	0.36	0.11	0.03	0.75	0.39	0.13	0.55	0.75
Gade, Niels	Heise, Peter		0.30	0.03	0.00	0.44	0.07	0.00	0.52	0.36
Gade, Niels	Jensen, Adolf		0.36	0.07	0.01	0.62	0.11	0.04	0.31	0.76
Gade, Niels	Kjerulf, Halfdan		0.42	0.06	0.02	0.59	0.10	0.03	0.34	0.69
Glazunov, Alexander	Prokofiev, Sergei		0.46	0.26	0.12	0.85	0.58	0.33	0.68	0.90
Glazunov, Alexander	Shostakovich, Dmitri		0.48	0.23	0.10	0.66	0.35	0.20	0.36	0.44
Gliere, Reinhold	Khachaturian, Aram	1925	0.27	0.03	0.00	0.52	0.07	0.00	0.00	0.73
Gliere, Reinhold	Miaskovsky, Nicolas		0.33	0.03	0.00	0.56	0.07	0.00	0.37	0.36
Gliere, Reinhold	Prokofiev, Sergei	1902	0.21	0.04	0.01	0.59	0.14	0.03	0.04	0.38
Godard, Benjamin	Chaminade, Cecile		0.39	0.15	0.05	0.62	0.21	0.09	0.14	0.77
Goldmark, Karl	Sibelius, Jean	1890	0.35	0.14	0.05	0.80	0.42	0.16	0.55	0.83
Gounod, Charles-Francois	Bizet, Georges		0.59	0.40	0.20	0.90	0.69	0.40	0.80	0.81
Gounod, Charles-Francois	Debussy, Claude		0.57	0.38	0.14	0.81	0.57	0.25	0.60	0.77
Gounod, Charles-Francois	Franck, Cesar		0.58	0.33	0.12	0.80	0.51	0.20	0.52	0.95
Gounod, Charles-Francois	Hahn, Reynaldo	1885	0.55	0.34	0.15	0.85	0.65	0.33	0.63	0.92
Gounod, Charles-Francois	Hue, Georges		0.35	0.13	0.03	0.68	0.38	0.16	0.46	0.74
Gounod, Charles-Francois	Saint-Saens, Camille		0.64	0.43	0.19	0.84	0.60	0.33	0.79	0.83
Halevy, Fromental	Bizet, Georges	1853	0.28	0.08	0.00	0.68	0.20	0.02	0.25	0.80
Halevy, Fromental	Gounod, Charles-Francois		0.38	0.11	0.03	0.66	0.26	0.06	0.27	0.76
Halevy, Fromental	Maillart, Louis		0.37	0.11	0.00	0.65	0.28	0.00	0.19	0.96
Halevy, Fromental	Masse, Victor		0.34	0.05	0.00	0.63	0.13	0.00	0.36	0.55
Halevy, Fromental	Offenbach, Jacques		0.32	0.07	0.01	0.60	0.13	0.02	0.13	0.64
Halevy, Fromental	Paladilhe, Emile		0.38	0.06	0.00	0.63	0.11	0.00	0.46	0.72
Halevy, Fromental	Saint-Saens, Camille	1851	0.27	0.07	0.02	0.71	0.30	0.06	0.47	0.58
Halevy, Fromental	Weckerlin, Jean Baptiste		0.34	0.09	0.04	0.59	0.22	0.08	0.06	0.60
Harris, Roy	Schuman, William		0.29	0.10	0.00	0.57	0.17	0.00	0.71	0.56

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Table G.1 – continued from previous page

Teacher	Student	Year met	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Haydn, Franz Joseph	Beethoven, Ludwig van		0.69	0.55	0.36	0.98	0.92	0.80	0.91	0.97
Herold, Louis	Adam, Adolphe		0.55	0.27	0.09	0.88	0.58	0.21	0.63	0.75
Humperdinck, Engelbert	Griffes, Charles Toml.		0.45	0.25	0.07	0.80	0.45	0.23	0.26	0.56
Humperdinck, Engelbert	Scott, Cyril	1892	0.33	0.13	0.02	0.63	0.22	0.06	0.28	0.03
Humperdinck, Engelbert	Weill, Kurt		0.26	0.08	0.01	0.51	0.14	0.02	0.21	0.19
Ippolitov-Ivanov, Mikh.	Gliere, Reinhold		0.31	0.04	0.00	0.61	0.13	0.00	0.27	0.91
Ireland, John	Britten, Benjamin	1930	0.51	0.29	0.15	0.84	0.62	0.36	0.68	0.79
Josquin des Prez	Janequin, Clement		0.52	0.22	0.10	0.79	0.57	0.26	0.29	1.00
Juon, Paul	Jacobi, Frederick		0.23	0.05	0.02	0.42	0.10	0.03	0.00	0.21
Juon, Paul	Kilpinen, Yrjo		0.27	0.08	0.02	0.43	0.15	0.04	0.22	0.46
Kodaly, Zoltan	Bartok, Bela	1905	0.50	0.29	0.12	0.80	0.61	0.30	0.81	0.97
Liadoff, Anatol	Miaskovsky, Nicolas		0.49	0.09	0.02	0.55	0.16	0.04	0.39	0.70
Liadoff, Anatol	Prokofiev, Sergei		0.34	0.10	0.02	0.69	0.29	0.05	0.63	0.68
Liszt, Franz	Cornelius, C. Peter	1852	0.35	0.10	0.01	0.62	0.39	0.13	0.24	0.75
Liszt, Franz	Franck, Cesar		0.66	0.32	0.11	0.83	0.58	0.21	0.65	0.91
Liszt, Franz	Hubay, Jeno		0.19	0.05	0.02	0.61	0.22	0.08	0.56	0.76
Liszt, Franz	Smetana, Bedrich	1848	0.57	0.35	0.17	0.91	0.77	0.49	0.47	0.83
Liszt, Franz	d'Albert, Eugen	1881	0.16	0.06	0.03	0.58	0.45	0.22	0.35	0.49
Liszt, Franz	d'Indy, Vincent	1873	0.52	0.22	0.06	0.87	0.57	0.22	0.36	0.68
Mascagni, Pietro	Zandonai, Riccardo		0.33	0.07	0.04	0.63	0.33	0.14	0.00	0.23
Massenet, Jules	Bemberg, Henri		0.29	0.09	0.02	0.78	0.37	0.13	0.10	0.66
Massenet, Jules	Charpentier, Gustave		0.43	0.14	0.05	0.70	0.45	0.21	0.65	0.85
Massenet, Jules	Chausson, Ernest	1879	0.60	0.24	0.06	0.77	0.45	0.22	0.75	0.42
Massenet, Jules	Enescu, George	1895	0.57	0.27	0.10	0.75	0.49	0.24	0.35	0.72
Massenet, Jules	Hahn, Reynaldo	1885	0.55	0.33	0.11	0.76	0.56	0.38	0.55	0.92
Massenet, Jules	Kreisler, Fritz		0.51	0.28	0.10	0.80	0.50	0.22	0.72	0.60

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Table G.1 – continued from previous page

Teacher	Student	Year met	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Massenet, Jules	Pierne, Gabriel		0.49	0.19	0.05	0.81	0.50	0.24	0.54	0.56
Massenet, Jules	Schmitt, Florent	1889	0.32	0.13	0.04	0.59	0.36	0.17	0.17	0.36
Messager, Andre	Beydts, Louis		0.31	0.00	0.00	0.37	0.00	0.00	0.58	0.85
Miaskovsky, Nicolas	Kabalevsky, Dmitry		0.40	0.06	0.01	0.51	0.05	0.01	0.00	0.15
Miaskovsky, Nicolas	Khachaturian, Aram	1929	0.52	0.15	0.04	0.67	0.28	0.05	0.57	0.45
Moniuszko, Stanislaw	Cui, Cesar	1856	0.26	0.09	0.05	0.41	0.24	0.13	0.00	0.00
Monteverde, Claudio	Schutz, Heinrich	1628	0.53	0.16	0.04	0.68	0.37	0.21	0.79	0.99
Moszkowski, Moritz	Nin, Joaquin		0.52	0.21	0.06	0.83	0.65	0.50	0.33	0.80
Moszkowski, Moritz	Schelling, Ernest	1882	0.29	0.07	0.02	0.32	0.09	0.03	0.00	0.48
Moszkowski, Moritz	Turina, Joaquin		0.52	0.18	0.04	0.79	0.47	0.19	0.51	0.78
Nin, Joaquin	Lecuona, Ernesto		0.30	0.12	0.03	0.54	0.27	0.05	0.43	0.87
Paderewski, Ignacy Jan	Schelling, Ernest		0.21	0.04	0.03	0.33	0.13	0.08	0.00	0.82
Parry, Hubert	Butterworth, George		0.38	0.15	0.08	0.63	0.26	0.15	0.18	0.25
Parry, Hubert	Holst, Gustav	1893	0.39	0.16	0.02	0.61	0.32	0.05	0.15	0.61
Parry, Hubert	Ireland, John		0.35	0.18	0.05	0.73	0.45	0.12	0.72	0.64
Parry, Hubert	Williams, Ralph Vaughan	1890	0.36	0.14	0.03	0.62	0.39	0.08	0.64	0.57
Piston, Walter	Bernstein, Leonard	1935	0.36	0.10	0.02	0.59	0.25	0.06	0.59	0.59
Ponchielli, Amilcare	Mascagni, Pietro	1883	0.62	0.24	0.07	0.81	0.48	0.21	0.32	0.88
Ponchielli, Amilcare	Puccini, Giacomo		0.62	0.26	0.04	0.79	0.52	0.23	0.45	0.83
Ravel, Maurice	Williams, Ralph Vaughan	1908	0.55	0.34	0.12	0.90	0.76	0.53	0.83	0.91
Reger, Max	Weinberger, Jaromir		0.36	0.12	0.02	0.77	0.31	0.04	0.33	0.86
Respighi, Ottorino	Hanson, Howard	1921	0.41	0.23	0.09	0.85	0.57	0.36	0.34	0.26
Rimsky-Korsakov, Nikolai	Arensky, Anton	1879	0.43	0.12	0.04	0.66	0.28	0.10	0.73	0.40
Rimsky-Korsakov, Nikolai	Glazunov, Alexander	1879	0.52	0.28	0.09	0.80	0.51	0.19	0.69	0.82
Rimsky-Korsakov, Nikolai	Gretchaninov, Alexander	1890	0.29	0.09	0.02	0.57	0.22	0.04	0.45	0.73
Rimsky-Korsakov, Nikolai	Ippolitov-Ivanov, Mikh.		0.48	0.23	0.10	0.79	0.48	0.23	0.35	0.70

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Table G.1 – continued from previous page

Teacher	Student	Year met	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Rimsky-Korsakov, Nikolai	Liadoff, Anatol	1876	0.42	0.15	0.05	0.68	0.30	0.11	0.76	0.78
Rimsky-Korsakov, Nikolai	Miaskovsky, Nicolas		0.40	0.12	0.02	0.62	0.23	0.04	0.26	0.70
Rimsky-Korsakov, Nikolai	Prokofiev, Sergei	1904	0.56	0.29	0.13	0.84	0.65	0.32	0.61	0.76
Rimsky-Korsakov, Nikolai	Rachmaninov, Sergei		0.54	0.31	0.11	0.88	0.61	0.28	0.68	0.31
Rimsky-Korsakov, Nikolai	Respighi, Ottorino	1900	0.61	0.35	0.17	0.88	0.69	0.40	0.76	0.91
Rimsky-Korsakov, Nikolai	Stravinsky, Igor	1902	0.57	0.31	0.13	0.81	0.59	0.29	0.70	0.90
Roussel, Albert	Auric, Georges	1914	0.33	0.11	0.04	0.43	0.19	0.05	0.20	0.42
Roussel, Albert	Satie, Erik		0.38	0.09	0.02	0.44	0.13	0.03	0.63	0.70
Rubinstein, Anton	Tchaikovsky, Piotr Il.		0.59	0.30	0.12	0.87	0.58	0.32	0.62	0.83
Saint-Saens, Camille	Faure, Gabriel	1861	0.65	0.40	0.18	0.94	0.68	0.37	0.74	0.89
Saint-Saens, Camille	Hahn, Reynaldo	1885	0.43	0.28	0.12	0.83	0.69	0.52	0.71	0.95
Saint-Saens, Camille	Messager, Andre		0.17	0.05	0.01	0.50	0.18	0.04	0.33	0.50
Satie, Erik	Poulenc, Francis	1914	0.38	0.13	0.02	0.47	0.18	0.03	0.52	0.41
Scarlatti, Alessandro	Scarlatti, Domenico	1685	0.49	0.20	0.08	0.86	0.60	0.31	0.56	0.70
Schmitt, Florent	Auric, Georges	1913	0.49	0.21	0.04	0.64	0.29	0.09	0.12	0.23
Schoenberg, Arnold	Berg, Alban		0.15	0.02	0.00	0.28	0.05	0.00	0.22	0.61
Spohr, Louis	Hartmann, Johann Peter		0.45	0.14	0.08	0.61	0.28	0.15	0.21	0.95
Stanford, Charles	Butterworth, George		0.38	0.09	0.00	0.47	0.12	0.00	0.38	0.74
Stanford, Charles	Coleridge-Taylor, Samuel		0.40	0.14	0.02	0.52	0.22	0.03	0.38	0.28
Stanford, Charles	Holst, Gustav	1893	0.39	0.14	0.05	0.79	0.35	0.10	0.34	0.44
Stanford, Charles	Ireland, John		0.35	0.14	0.06	0.74	0.39	0.17	0.39	0.29
Stanford, Charles	Williams, Ralph Vaughan	1890	0.36	0.13	0.04	0.65	0.32	0.13	0.41	0.61
Strauss, Richard	Jongen, Joseph		0.18	0.04	0.01	0.45	0.12	0.05	0.53	0.67
Sullivan, Arthur	d'Albert, Eugen		0.22	0.09	0.03	0.74	0.62	0.56	0.40	0.52
Suppe, Franz von	Koven, Reginald De		0.31	0.13	0.04	0.81	0.60	0.38	0.49	0.61
Suppe, Franz von	Millocker, Carl		0.48	0.22	0.05	0.73	0.37	0.10	0.60	0.50

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Table G.1 – continued from previous page

Teacher	Student	Year met	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
Tartini, Giuseppe	Nardini, Pietro	1734	0.36	0.12	0.02	0.49	0.23	0.07	0.68	0.70
Telemann, Georg Philipp	Bach, Wilhelm		0.53	0.19	0.04	0.84	0.33	0.05	0.05	0.83
Thomas, Ambroise	Enescu, George	1895	0.58	0.26	0.07	0.77	0.43	0.11	0.51	0.78
Thomas, Ambroise	Inghelbrecht, Desire-Em.	1887	0.40	0.15	0.05	0.74	0.40	0.08	0.54	0.92
Thomas, Ambroise	Massenet, Jules	1861	0.72	0.36	0.09	0.73	0.38	0.13	0.60	0.57
Thomson, Virgil	Bernstein, Leonard	1932	0.52	0.16	0.03	0.64	0.23	0.06	0.17	0.59
Vieuxtemps, Henri	Godard, Benjamin		0.37	0.17	0.04	0.65	0.29	0.06	0.63	0.53
Vieuxtemps, Henri	Hubay, Jeno	1878	0.40	0.09	0.03	0.55	0.14	0.07	0.22	0.05
Vinci, Leonardo	Pergolesi, Giovanni		0.36	0.16	0.08	0.71	0.43	0.23	0.27	0.65
Vivaldi, Antonio	Bach, Johann Sebastian		0.54	0.29	0.13	0.86	0.65	0.46	0.71	0.96
Wagner, Richard	Humperdinck, Engelbert	1880	0.36	0.24	0.10	0.91	0.61	0.31	0.68	0.70
Weber, Carl von	Benedict, Julius	1821	0.23	0.07	0.02	0.57	0.35	0.17	0.24	0.41
Weyse, Christoph E.F.	Hartmann, Johann Peter		0.53	0.15	0.04	0.59	0.24	0.09	0.29	0.62
Widor, Charles-Marie	Honegger, Arthur	1911	0.15	0.04	0.01	0.58	0.41	0.16	0.19	0.34
Widor, Charles-Marie	Milhaud, Darius		0.27	0.08	0.02	0.58	0.50	0.38	0.03	0.36
Williams, Ralph Vaughan	Britten, Benjamin	1930	0.63	0.30	0.13	0.88	0.73	0.47	0.70	0.71
Williams, Ralph Vaughan	Gibbs, Cecil Armstrong		0.23	0.07	0.03	0.66	0.32	0.12	0.61	0.76
d'Albert, Eugen	Dohnanyi, Erno	1897	0.31	0.10	0.01	0.37	0.06	0.01	0.00	0.50
d'Indy, Vincent	Albeniz, Isaac	1895	0.53	0.25	0.07	0.66	0.36	0.12	0.49	0.87
d'Indy, Vincent	Auric, Georges	1914	0.38	0.14	0.04	0.68	0.34	0.08	0.53	0.61
d'Indy, Vincent	Canteloube, Joseph	1902	0.38	0.21	0.09	0.67	0.41	0.18	0.58	0.36
d'Indy, Vincent	Honegger, Arthur	1911	0.56	0.30	0.11	0.77	0.51	0.19	0.47	0.51
d'Indy, Vincent	Jongen, Joseph		0.29	0.06	0.01	0.55	0.18	0.06	0.77	0.74
d'Indy, Vincent	Lekeu, Guillaume	1890	0.48	0.17	0.06	0.76	0.42	0.17	0.37	0.52
d'Indy, Vincent	Milhaud, Darius		0.61	0.28	0.08	0.79	0.47	0.16	0.30	0.53
d'Indy, Vincent	Nin, Joaquin		0.54	0.28	0.06	0.60	0.36	0.14	0.65	0.90

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Table G.1 – continued from previous page

Teacher	Student	Year met	2-grams	3-grams	4-grams	2-grams	3-grams	4-grams	Key	Time
d'Indy, Vincent	Roussel, Albert		0.48	0.13	0.02	0.61	0.28	0.02	0.59	0.75
d'Indy, Vincent	Satie, Erik	1905	0.39	0.15	0.02	0.71	0.33	0.04	0.55	0.84
d'Indy, Vincent	Severac, Deodat de		0.32	0.09	0.04	0.65	0.27	0.12	0.25	0.56
d'Indy, Vincent	Turina, Joaquin		0.56	0.23	0.07	0.77	0.44	0.14	0.67	0.90