

# Harmonious relations: quality transmission among composers in the very long run

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Most creative professionals develop and refine their talents by learning from others. In most empirical settings, estimating how this learning process fosters quality is challenging. This paper explores the transmission of quality among music composers over more than seven centuries. How does a composer's quality influence the quality of the composers they teach? Using a unique dataset of 17,433 composers, we show a strong relationship between student and teacher quality. Moreover, this quality transmission persists across multiple generations. Our results provide new insights on drivers of creativity, as well as the influence of teachers on students' achievements.

## 1. Introduction

What makes a great composer? One factor—not only relevant to the creative arts, but a broad range of areas—is education. There is long tradition of established music composers training new generations of composers, whether through one-on-one tutoring or formal education in music conservatories and other institutions. We explore the effect of this transmission of skills between composers: how does a composer's quality influence the quality of the composers they teach?

We define composer quality in terms of reputation and legacy. Specifically, our measure of quality is based on biographies of music composers: the longer a given biography, the higher a composer's quality. We combine two data sources for this purpose. First, we source composer biographies from [Grove Music Online \(2016–2021\)](#), an authoritative compendium which chronicles the artistic careers of musicians through history. From Grove, we extract key identifying data (such as names, and dates and places of birth) as well as our central outcome variable: the word count of each composer biography. Second, we draw on [Pfitzinger \(2017\)](#), a musical genealogy which comprehensively maps the teachers and students of individual composers.

Taken together, our source material provides us with a set of 17,433 composers, of which 7,545 are recorded with biographies in Grove. Our dataset spans the globe, and includes composers born as far back as the sixth century. We identify 36,927 teacher–student pairs, and can link these across multiple generations—the longest single chain spans 21 generations, and up to 11,744 individual composers can be linked in one chain. The richness of our data and the unique historical context of music composers allows us to shed new light on skill and quality transmission over the very long term, including over multiple generations.

The paper provides three interconnected explorations. First, we examine the correlation between composer quality and teaching activity. We show that higher quality composers (that is, with longer biographies) are more likely to have taught other composers, with quality also correlated with the number of students.

Second, we analyse how teachers' quality connects with students' quality. We control for factors that increase the likelihood of matching between any given teacher and student, such as geographical and cultural proximity. Taking into account the historical differences in musical education and potential creative clusters, we find a positive association between student and teacher quality.

Third, we demonstrate the persistence of quality transmission across multiple generations. Not only do teachers influence the quality of their students, they also indirectly influence the quality of subsequent generations of students. When controlling for the individual attributes of the teacher, we identify a diminishing—but statistically significant—effect up to the eighth generation of student.

Our analysis links with an extensive body of research relating to musicians and music (e.g., Baumol and Baumol 1994; Scherer 2004; Borowiecki 2017). From a cultural economics perspective, we contribute a novel and long-term view on the drivers of creative talent. Furthermore, our work offers broader lessons in the context of education and human capital acquisition, contributing to a broad field of literature examining the role of teachers in shaping the gains from education for students (e.g., Chetty *et al.* 2014a, b; Rivkin *et al.* 2005; Rockoff 2004). Our approach aligns with other analyses of human capital, which have used biographies and publication metadata to measure educational returns (e.g., Waldinger 2010; Simonton 1984, 2004). Particularly related is a recent study by Borowiecki (2022), which shows how a sample of 341 composers influenced the style of work of their students. Our focus here is instead on the *transmission of skill and quality* across teacher–student relationships. We are also able to build on a considerably larger and longer data series, even if less detailed.

The paper is structured as follows: in section 2, we provide an overview of the related literature, and follow with a brief historical context of music education in section 3. We describe our source material in section 4, and discuss key features and trends of the data in section 5. Thereafter, we present the results of our analysis. Section 6 explores what traits characterize a teacher, section 7 shows the relationships between teacher and student quality, and section 8 examines the long-term persistence of composer quality transmission across multiple generations. We conclude in section 9.

## 2. Literature review

The present study of music composers contributes to research on the determinants of creativity and, specifically, the transmission of culture. Baumol and Baumol (1994) consider the case of eighteenth-century Vienna, and find that demand for composers from competing noble courts served to cultivate a thriving market for composer talent. Scherer (2004) charts the shift in composer careers over the course of the eighteenth and nineteenth centuries—away from fixed patronage in the service of noble courts toward freelance arrangements and private contracts. Oates and Baumol (1972) find that the commercial viability of the theater in sixteenth- and seventeenth-century London relied on low real wages, and that the lower production costs opened the door to more playwrights being able to establish themselves. Simonton (1975) considers the creative productivity of writers, and the role of age

in influencing literary output. Similarly, Ginsburgh and Weyers (2006) examine the effect of age and experience on the creativity of painters across the life cycle. In the context of popular music, Askin and Mauskopf (2017) and Mueller (2021) show how new songs are inspired by old songs—that success depends on a combination of familiarity and differentiation.

Our research also relates to studies of human capital acquisition, and the contribution of teachers to students' outcomes (Angrist and Lavy 2001; Bold *et al.* 2019; Bosshardt and Watts 1990; Butters *et al.* 2011; Hanushek *et al.* 2019; Ost 2014; Schober 1984). A general finding is that student performance improves with teacher experience. Close analogues to our study consider the role of teaching and supervision in academic contexts, where the teacher–student relationship is relatively individualized. For example, Waldinger (2010) demonstrates the effect of faculty quality on the outcomes of PhD students, where quality is determined by publications and citations.

Methodologically, our use of biographical sources in measuring outcomes has a strong basis in other empirical applications. Borowiecki (2022) has previously demonstrated the applicability of biographical references in studying the stylistic influences of music composers. In contrast to that study, we consider the transmission of quality between composers and over the very long term. In different contexts, Borowiecki and Dahl (2021) and Kelly and O'Hagan (2007) use biographies to study artistic clusters. Rasterhoff (2017) uses biographies to chart the historical development of Dutch painters and publishers, while Galenson (2002) uses art history texts to quantify the career success of a sample of French painters. (For further discussion on biography-based analysis methods, see Borowiecki and O'Hagan 2012; O'Hagan and Kelly 2005.)

Outside of creative domains, biographical information has been used to document growth in the educated elite (Dittmar and Meisenzahl 2020), as well as to explore outcomes with respect to various professions, including academics (de la Croix *et al.* 2020), engineers (Hanlon 2022), and lawyers (Hansen and Strømme 2021). Similarly, metadata associated with published works has proven useful for several studies, including document file sizes as an indicator of the complexity of financial reports (Loughran and McDonald 2014), citation counts of judgments as a measure of judicial performance (Landes and Posner 1976; Murrell 2021) and book types from copyright title pages to proxy for historic educational attainment (Rapone 2022).

### 3. A brief history of music education

The tradition of music education in Medieval Europe was centered at monasteries, cathedrals, and parish schools. This was the case for Francesco Landini, born in 1325 in Florence, who is one of the earliest composers covered in our data, for whom we know at least one of his teachers. Landini became a teacher and organist at the Florentine monastery of Santa Trinità in 1361, and at the church of San Lorenzo from 1365 onward.

Over time, composers have applied increasingly sophisticated methods of writing music, such as the five-line staff. Developments in methods of writing music were important, as they made it possible to compose more complex works, including polyphonic compositions that characterize Western music beginning from the Renaissance. These inventions also meant that the ability to read and write music became increasingly valued, which in turn increased the importance of music education. The focus of early music education was initially on notation, and continued toward the study of composition for selected students (Mark 2008).

A key role in the development of music education was played by Protestant Reformers who valued particularly the teaching of singing and instrumental music. As a result, the newly established schools included formal music education in their curricula from as early as the seventeenth century. At the elementary level, students learned music principles, and then progressed at the intermediate level to music theory and began composing music in class (Livingston 1971). It was not uncommon that the most talented students would receive additional individual tuition.

During that time, the first major theories emerged of what constitutes the act of composing. Particularly influential were the writings of French composer Jean-Benjamin de Laborde, born in 1734 and with two teacher connections in our data. In Laborde's writing from 1780, a composition constitutes "the ordering and disposing of several sounds in such a manner that their succession pleases the ear." This definition comes very close to the notion of melody and has been regarded as accurate throughout most of history (Forte 1974).

The golden age for classical music, at the turn of the nineteenth century, coincided with the emergence of conservatories across the world. The earliest conservatories were established in Naples already around the sixteenth century, but it was not before the 1800s when education in conservatories has become available in most European cities. This represented not only a move toward secular music education, but also the formalization and institutionalization of music education. Over the nineteenth century, the European models of music education spread to the United States (Mark 2008).

It was the individual teacher who played the predominant role throughout most of history in deciding upon the curriculum and instructional methods. However, since the second half of the twentieth century music education has become increasingly standardized. This coincides with a greater focus of scholarship on instructional methods and the development thereof (Costanza and Russell 2017). Often, instructional methods of music education have been advanced by music composers, including Zoltan Kodaly (who had 58 students, according to Pfitzinger 2017), Carl Orff (17 students), and Émile Jaques-Dalcroze (8 students).

Methods for the assessment of teaching have also developed, and became more widespread in the latter half of the twentieth century. This enabled performance of teachers and students to be tracked, and included criteria related to composing and arranging music within specified guidelines (Abril and Gault 2016).

## 4. Data

We collect data from two sources: a large compendium listing teachers of composers provided by Pfitzinger (2017) and Grove Music Online, a leading encyclopedia of music and musicians. The data collection process is conducted in a planned, structured, and systematic way, and parts of it have been outlined in more detail in Borowiecki (2022).

### 4.1. Teacher–student connections

Data on teacher–student connections is collected from Pfitzinger (2017), who provides a vast compendium listing teachers and students of 17,460 composers in "Composer Genealogies, A Compendium of Composers, Their Teachers, and Their Students".

The reliability of this source has been carefully evaluated. In particular, it is important to observe that each musician listed by Pfitzinger (2017) has been a composer, as opposed to, for example, a music performer like a pianist. The aim to consider only composers becomes

apparent from the title and also 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).

Borowiecki (2022) provides more extensive tests for a sample of composers listed by Pfitzinger (2017). It remains a possibility that Pfitzinger’s list is biased in some ways, for example, toward American or more recent composers. However, such biases are not relevant for the aims of our paper. Potentially problematic would be a bias toward pairs of composers who have been particularly influential on one another. However, we do not see any reasons why this could be the case, especially since Pfitzinger does not observe the degree of influence between composers. Therefore, any eventual subjective choices made by Pfitzinger will not matter much for the interpretation of our results.

#### 4.2. *Composers and their quality*

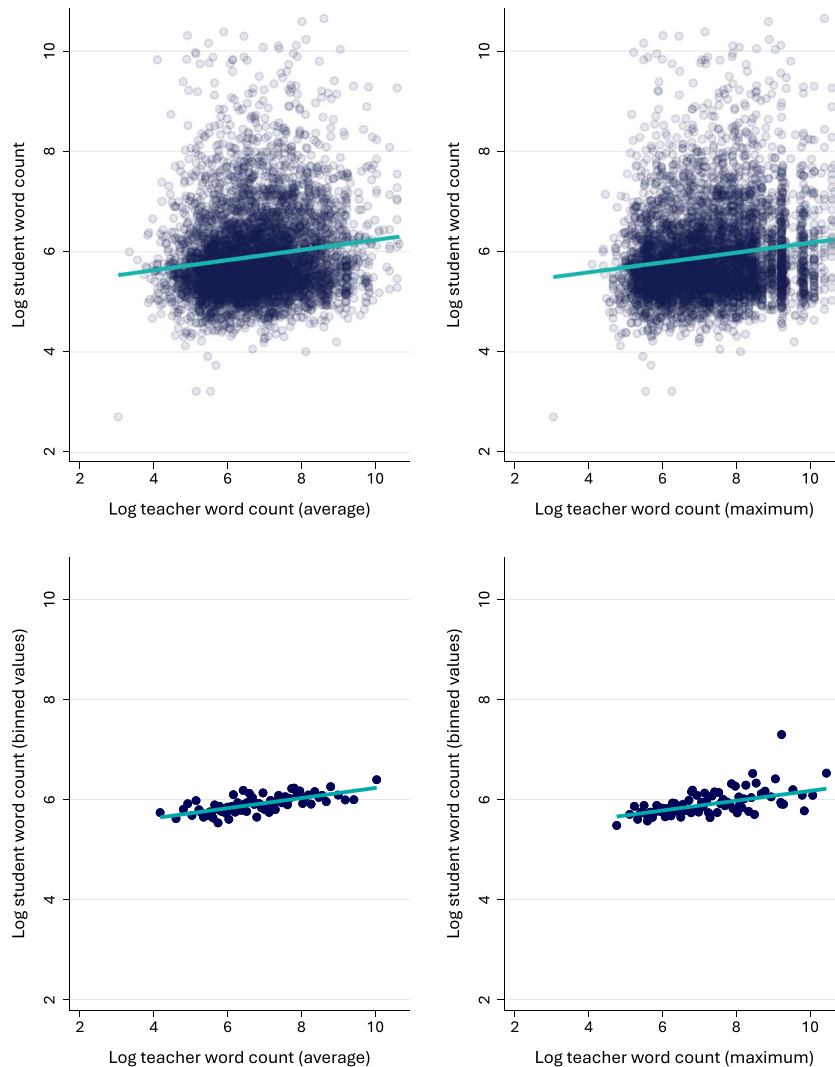
Additional data on music composers is scraped from *Grove Music Online* (Grove), a digital reference which builds on and continues the printed volumes of the *New Grove Dictionary of Music and Musicians*. Grove is regarded as a comprehensive encyclopedia providing extensive coverage of music and musicians. We have extracted information on the dates and places of composers’ births and deaths. More importantly, Grove provides our measure of a composer’s quality.

We define the quality of composers in terms of their reputation and cultural impact. The quality measures are expert-based metrics, approximated by the amount musicologists have written about a given composer. In contrast to more general biographical references, where biographies may focus on a range of personal and other aspects of individuals’ lives, the focus of Grove is on the musical careers of individuals. All else being equal, a longer biography implies that a composer has had a more noteworthy career and attained a higher cultural impact.

The biographical entries in Grove contain different sections. Each biography include an overview of the composer’s life. We refer to this section as “main description”, as it is the substantive body of the biography. As figure 1 illustrates there is a positive correlation between the length of the main description sections for teachers and their students. All else being equal, a ten per cent increase in teachers’ word count is associated with a one per cent increase in a student’s word count—a result that is statistically significant, and holds whether considering the average word count of each student’s teachers or the maximum word count of the highest quality teacher of each student.

Interestingly, this result is different from Borowiecki (2022, figure 2), who—based on a sample of top 341 composers—shows that there appears to be an insignificant relationship between quality of teachers and students. In this paper, by building on a much bigger sample of more than 7,500 composers, the result of a positive correlation between teacher and student quality comes closer to what would be expected in a wider population.

We also collect word count measures for additional sections in the biographies: the listing of composed works, the listing of written works (such as essays and books), and the biography’s own bibliography. We refer to these sections respectively as “works”, “writings” and “bibliography”. Not every biography includes all these additional sections.



**Figure 1.** *Correlation between teacher and student quality. Notes: Composer quality is approximated with the word count in the main description of the biographical entry. The plots in the top panels are based on all observations, while the plots in the lower panels are based on binned observations. The plots in the panels to the left are based on the average word count, while the plots in the panels to the right are based on the value of the highest quality teacher, if there was more than one teacher.*

## 5. Descriptives

Our source material provides us with a set of 17,433 composers, of which 7,545 are recorded with biographies in Grove. The dataset is weighted strongly toward Western composers: composers born in the United States, Germany, Italy, England, and France account for over half of all the composers in the dataset. Moreover, while the data include composers from as



Table 1. *Top 10 countries for composer births, percentage shares*

Country	Total (%)	(N)	Pre-1500	1500–99	1600–99	1700–99	1800–99	1900–49	1950
USA	31.9	5564		1		2.8	13	43.9	57.3
Germany	10.7	1871	16.8	18.8	26.8	28.9	17	4.9	3.1
Italy	7.5	1307	16	36.9	35.2	18.5	8.4	2.8	2.8
England	6.2	1088	14.3	13	7.3	8.4	8	4.7	5
France	5.9	1030	19.3	7.6	15.7	11.8	9.1	3.3	2.2
Austria	2.5	444	1.7		1.1	6.8	4.7	1.5	.7
Russia	2.5	432			.2	.9	4.3	2.8	1
Czechia	2.3	401	.8	.2	2.3	6.8	3.3	2	.3
Spain	2	346	5.9	7.3	3.2	2.4	3	1.1	1.2
Belgium	1.9	325	13.4	6.8	2.5	2.5	3.3	1	.3
Europe	57.1	9958	99.2	98.8	99.1	96.8	81.5	42.4	26.1
Rest of world	42	7315	.8	1.2	.7	3.2	18.4	57.5	73.8
Total (N)		17433	119	409	559	1327	4735	6503	3586

Notes: Percentage totals calculated relative to total number of births in each time period. For a small number of composers, birth countries are not identified. Hence, percentage shares do not sum to 100.

far back as the sixth century, our first teacher–student pairs arise with teachers born in the fourteenth century. The majority of composers in the dataset were born during the twentieth century.

As [table 1](#) summarizes, a noticeable trend is the rise of US composers. While “old world” Europe accounted for the lion’s share of our composers until the nineteenth century, the “new world” of the United States dominates the more recent period. Overall, US composers account for just under a third of all observations in the dataset—by far, the largest country represented in the data—and almost all were born after 1800.

### 5.1. *Biographies, word counts and quality*

Our principal measure of quality is the word count of the body of the biography (main description). As [table 2](#) outlines, the main description accounts for the substantive share of the total biographical content: on average, around 60 per cent for all biographies. By contrast, for those biographies which include a listing of composed works (around 80 per cent), the word count share for this section is on average less than 40 per cent.

A key trend to note in the biography data is how the average (main description) word count falls over time. The disaggregated results by time period for main description relate to the period in which composers were born. A further illustration of this is provided in [figure 2](#), which shows the distribution of (main description) word counts for both students and teachers over time. For comprehensibility, the box plot excludes outliers—as noted above, the highest composer word count we observe is over 42,000 words.

We do not suggest that the quality of composers has declined over time. Rather, one must account for the significant increase in the numbers of composers with biographies over time. Biographies for composers in the distant past are more likely to capture only a top tier for whom it was historically worthwhile writing about; as the costs of information recording and sharing have declined with time, the pool of composers for whom sufficient information exists for a biography has likely increased. One sign of this is the trend decline in the minimum word count.

Table 2. Summary statistics: biographical word count

Type/period born	N	Mean	Median	Min	Max	Share
Main description	7545	660.2	300	15	42011	58.6
Pre-1500	106	1998.2	957.5	211	22721	62.3
1500–99	386	1029.4	592.5	78	16847	65.9
1600–99	513	1087.8	532	67	39533	63.8
1700–99	1053	814.4	389	15	42011	61.9
1800–99	2428	711.6	280.5	16	29997	63.3
1900–49	2645	415.3	266	21	19447	51.8
1950	384	308.4	238	113	3281	51.4
List of composed works	6108	478.8	247	13	46397	36.7
List of written works	1462	98.1	58	5	1616	9.8
Bibliography	6185	180.8	70	3	16402	11.9
All sections	7545	1215	576	15	92595	

Notes: Share column reports each section's average percentage share of the total word count across the four biography sections. Calculations for each section are based only on those observations that include the relevant section. Hence, the word count shares for the four sections do not sum to 100.

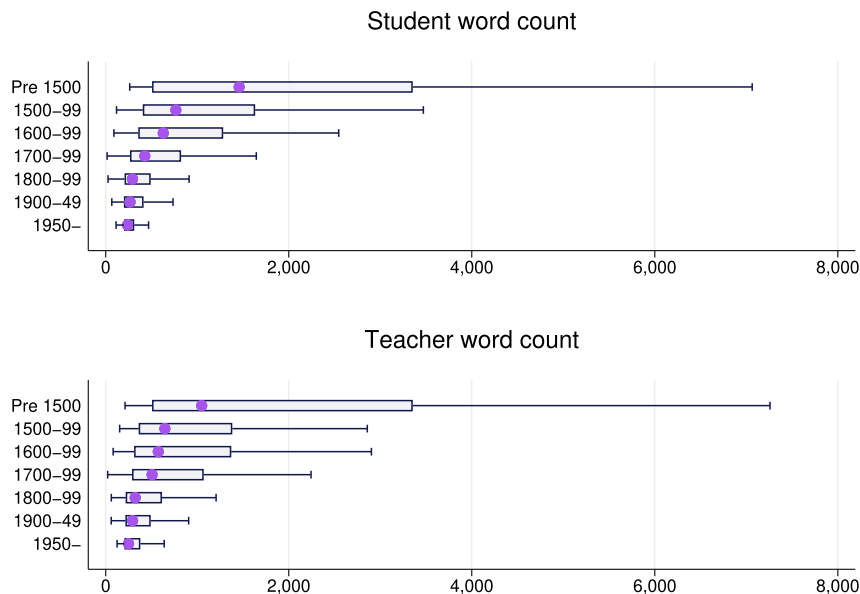
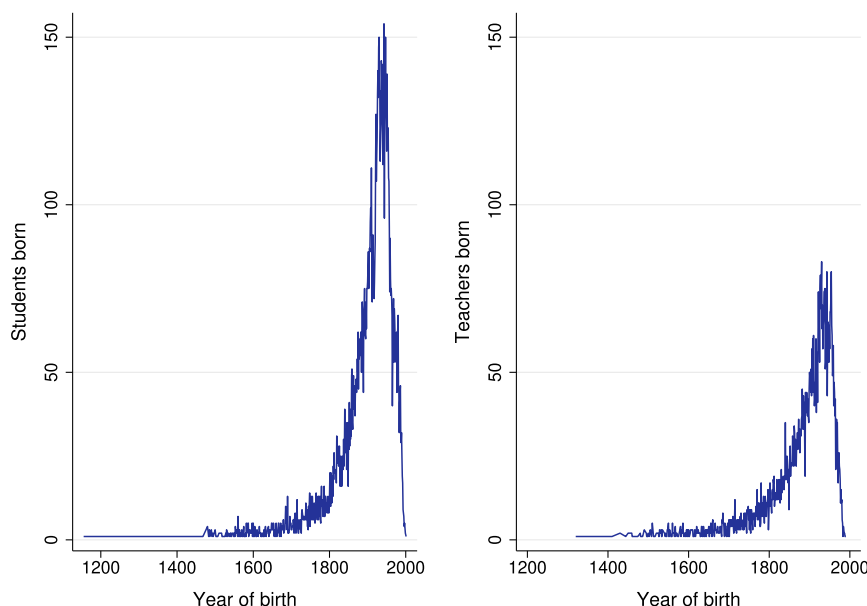


Figure 2. Distribution of word counts over time: students and teachers. Notes: Dots mark median word count. Boxes indicate range from 25th to 75th percentiles. Bars connect adjacent values, 1.5 times the interquartile range respectively below the 25th percentile and above the 75th percentile. Outliers (beyond the adjacent values) are not shown.

## 5.2. Composer relationships

The bulk of composers are identified as students of other composers: 13,374 composers have known teachers (a further 373 are recorded as self-taught, with no other composer as teacher).



Figure 3. *Student and teacher births by year.*Table 3. *Share of composers who are teachers, by time period*

	Composers (N)	Teachers (N)	Teachers (%)
Pre-1500	122	28	23
1500–49	151	49	32.5
1550–99	265	80	30.2
1600–49	216	95	44
1650–99	349	155	44.4
1700–49	536	253	47.2
1750–99	796	415	52.1
1800–49	1527	792	51.9
1850–99	3219	1603	49.8
1900–49	6503	2930	45.1
1950–99	3616	1293	35.8
2000	16	2	12.5
Total	17433	7783	44.6

Notes: Total row includes composers for whom no birth year is available in our dataset.

Relatively fewer composers are identified as teachers of other composers—in total, 7,783. Figure 3 charts the distribution of students and teachers by birth year. As table 3 shows, the percentage share of composers who are teachers peaks at around 50 per cent for those born in the late eighteenth and nineteenth centuries.

Students can have multiple teachers, just as teachers can have multiple students. Our data provide a total of 36,927 student-teacher pairs. As table 4 shows, and consistent with the rising number of composers over time, both the average number of teachers per student and the average number of students per teacher exhibit a trend increase. The sharp rise in the average

Table 4. *Summary statistics: student–teacher pairs*

Period	Average number of teachers per student	Average number of students per teacher	Average difference in year born (S–T)	Average word count (main description)	Average word count difference (S–T)	Percent of ST pairs born in same country
Pre-1500	1.0	1.6	28.6	1998.2	–4948.3	39.1
1500–99	1.2	1.6	25.4	1029.4	–589.4	72.2
1600–99	1.4	2.0	25.8	1087.8	–1202.5	80.4
1700–99	1.6	3.0	28.1	814.4	–1863.0	60.9
1800–99	2.0	4.6	26.7	711.6	–1319.5	50.1
1900–49	2.5	5.4	24.9	415.3	–1275.7	51.3
1950–	2.8	3.5	25.8	308.4	–894.3	50.6
Full sample	2.2 (1.4)	4.3 (8.1)	25.8 (13.1)	660.2 (1731.0)	–1307.8 (4630.8)	52.8

Notes: Standard deviation for averages (full sample) denoted in parentheses.

number of students per teacher during the nineteenth century partly reflects the emergence of music conservatories and formal education settings for composers.

There is no material difference in the average age gap between teacher and student over time. However, the average here masks a broad distribution of age differences. Figure 4 considers all teachers–students pairs for which we have reliable composer birth years. Of these, 90 per cent have an age difference between six and 48 years.

As discussed above, the average word count for composers declines over time. However, there is no discernible trend in the average gap between a student’s word count and their teacher’s word count. That the average word count gap is consistently negative implies that, on average, students do not attain the same quality level as their teachers—here, one should recall that there are relatively fewer composers who become teachers. Finally, the share of student–teacher pairs where both student and teacher were born in the same country has declined since the seventeenth century. Overall, just over half of all pairs in our dataset were between composers born in the same country.

We can further link students and teachers across generations—that is, from teacher to student, to any student of that student, and so forth. Table 5 summarizes how many generations of students and teachers, and how many composers across generations, can be linked in our dataset. We define student generations as the downstream relationship from a teacher through first, second and all subsequent generations of students. In the other direction, teacher generations run upstream from a student through all generations of teachers. Panel A describes the average and range of generation “chains” (that is, the number of generations) for composers born in each time period. Panel B describes the average and range of the total number of composers that are linked across generations to composers born in each time period. Minimum values will always equal one, as the individual student or teacher is included as the first generation.

By way of example: on average, a composer born in the 1700’s will be linked to five (5.1) generations of students, covering 2,091 composers. But they might have up to 17 generations of students, with as many as 11,362 individual composers. On average, that same composer will be linked to at least six (6.7) generations of teachers, covering 26.6 teachers. But they might have up to 15 generations and potentially 182 teachers.

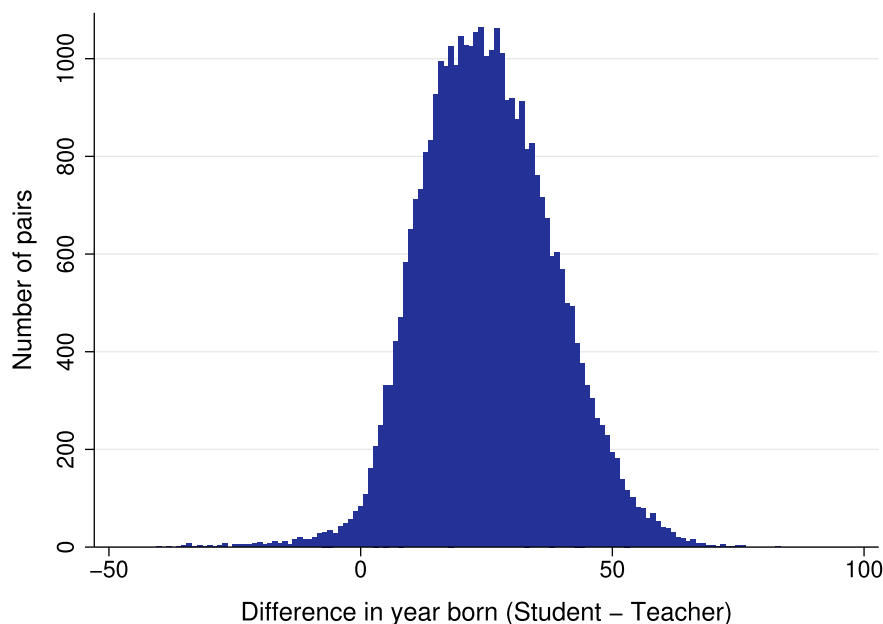


Figure 4. *Distribution of age difference between students and teachers. Notes: The figure illustrates the distribution of age differences between composers for every teacher–student pair in our dataset where exact years of birth are known. The mean age difference between teachers and their students is 25 years, with half of all pairs exhibiting age differences within the range 16–34 years.*

All else being equal, the earlier a composer is born, the longer is their chain of student generations and the shorter is their chain of teacher generations. Moreover, counts of students will be greater than counts of teachers as there are more students than teachers in the dataset—and in turn, on average, more students per teacher than teachers per student.

A more illustrative example is to consider the longest chain in our dataset, starting with the fifteenth-century composer Jean Mouton (figure 5). This chain spans composers from the mid-fifteenth century through to the modern day, and includes many of the leading composers indicated by word counts in our dataset (for example, Bach, Beethoven, Haydn, Mozart, and Schumann) as well as prolific teachers (such as Nadia Boulanger, with 413 students). This chain highlights part of the quality persistence story—but also the limits of this persistence. Beyond the fifteenth generation, composer word counts are relatively low.

## 6. Teacher attributes

As a first step to understanding how relationships between teachers and students emerge, it is useful to consider what attributes are characteristic of teachers. In the context of this study, our principal variable of interest is composers' biographical word counts. We hypothesize that the longer the biography—that is, the greater a composer's "quality"—the more likely it is that a composer will have acted as teacher to another composer. We consider the lengths of different sections of the biographies. Most relevant is the section listing composers' written

Table 5. Summary statistics: generations of composers over time

	Student generations				Teacher generations			
	Mean	Median	Min	Max	Mean	Median	Min	Max
Panel A: Number of generations of composers								
Pre-1500	2.9	2	1	21	2.2	2	1	4
1500–99	3.4	2	1	19	2.9	2	1	6
1600–99	5.3	2	1	19	4	3	1	11
1700–99	5.1	2	1	17	6.7	7	1	15
1800–99	3.5	2	1	14	12	14	1	20
1900–49	2.1	1	1	10	14.5	15	1	21
1950–	1.5	1	1	8	15.2	16	1	19
Full sample	2.7	2	1	21	13.2	15	1	21
Panel B: Number of composers across linked generations								
Pre-1500	515.3	2	1	11025	2.3	2	1	4
1500–99	1032.8	2	1	11471	3.5	3	1	11
1600–99	2534.1	2	1	11744	6.9	5	1	33
1700–99	2091	2	1	11362	26.6	18	1	182
1800–99	403.4	2	1	8679	175.4	188	1	583
1900–49	21.2	1	1	2553	456.2	449	1	1118
1950–	2.7	1	1	122	828.7	856	1	1557
Full sample	343.7	2	1	11744	471.1	410	1	1557

Notes: This table summarizes how many generations of students and teachers, and how many composers across generations, can be linked in our dataset. Panel A describes the average and range of generation “chains”, while Panel B describes the average and range of total number of composers that are linked across generations.

works: among other things, these writings include essays and texts on music theory and history, which would be relevant in an educational context.

To assess the likelihood of a composer in our dataset being a teacher, we construct a probit model where the dependent variable is a binary response depending on whether a composer is a teacher or not. In addition to word count measures, we include variables for composers’ lifespan and the number of contemporaneous composer births and deaths in the same city as the composer at their birth or death. We expect these factors to be positively correlated with the likelihood of being a teacher. We also include a full suite of controls for country of birth and half-century of birth.

The average marginal effects are presented in [table 6](#), and align with our expectations. Column one includes all word count measures (with effects measured per 100 words); the remaining columns test each biography section separately. The strongest effect is associated with the writings section (column 5), which is perhaps not very surprising, considering the fact that the writings section often includes teaching material written by a given composer. But this effect is also offset by the percentage share of the writings section relative to the total biography’s word count. The interpretation of this result is that a composer is more likely to be a teacher in our dataset, the more written works the composer has produced—but only to the extent he or she still has a noteworthy musical career beyond those written works. A long list of written works matters less if the overall biography is short.

We can similarly examine how the factors considered above influence how many students a composer has, given that he or she is a teacher. [Table 7](#) reports Poisson regression estimates (average marginal effects), where the number of students is the dependent variable and the

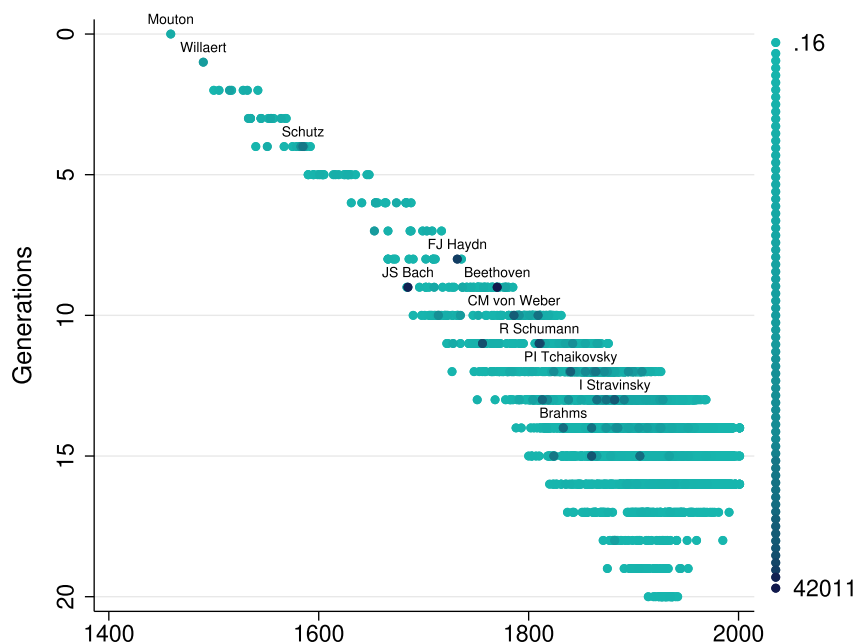


Figure 5. *Descendants of Jean Mouton.* Notes: The figure illustrates the distribution of composers by birth year across the longest generational chain in our dataset. This chain, which starts with Jean Mouton, includes 10,321 individual composers across 21 generations. The darker colored points indicate composers with higher word counts. Notable composers in this chain include (in descending word count order): Ludwig van Beethoven, Johann Sebastian Bach, Franz Joseph Haydn, Robert Schumann, Wolfgang Amadeus Mozart, Hugo Wolf, Igor Stravinsky, Franz Liszt, Carl Maria von Weber, and Pyotr Ilyich Tchaikovsky. (To maintain legibility, not all names are included in the figure.) In addition, Nadia Boulanger, who enters in the fourteenth generation, is the teacher in our dataset with the highest number of students (413)—one reason that the highest number of overall composers in the chain is found in the fifteenth generation.

sample is restricted to only those composers who are teachers. Once again, we observe a significant effect associated with word counts, particularly when we focus on the writings section (column 5). On average and holding the percentage share constant, a 100-word increase in the writings section is correlated with a teacher having around 4.7 times as many students. (One should recall here that the writings section is typically the shortest of the four biography sections, and relatively fewer biographies include composers' written works.)

To test the robustness of these results, we also run the models on a large subset of our data, focusing on US composers born in the first half of the twentieth century. These results, along with the coefficient estimates for the tables presented here, are available in appendix A (tables A2 and A4). While the magnitude of effects differs—which we would expect given the known differences in word counts over time, and which are necessarily limited when considering only one half century—the direction and significance of the word count effects is largely consistent.

Table 6. *Observable characteristics influencing the likelihood of a composer being a teacher (average marginal effects)*

	(1)	(2)	(3)	(4)	(5)
Word count (main description)	0.005 (0.003)	0.009*** (0.002)			
Word count (works)	0.008*** (0.003)		0.016*** (0.002)		
Word count (bibliography)	0.001 (0.009)			0.040*** (0.007)	
Word count (writings)	0.103*** (0.022)				0.172*** (0.024)
Main pct of total		-0.001** (0.000)			
Works pct of total	-0.000 (0.001)		-0.002*** (0.001)		
Bibliography pct of total	0.000 (0.001)			-0.002** (0.001)	
Writings pct of total	-0.004** (0.002)				-0.009*** (0.002)
Lifespan	0.003*** (0.000)	0.003*** (0.000)	0.003*** (0.000)	0.003*** (0.000)	0.003*** (0.000)
Births (per 100)	0.011*** (0.001)	0.011*** (0.001)	0.011*** (0.001)	0.011*** (0.001)	0.012*** (0.001)
Deaths (per 100)	0.010 (0.007)	0.011 (0.007)	0.009 (0.007)	0.009 (0.007)	0.013** (0.007)
Birth Country FE	X	X	X	X	X
Birth Cohort FE	X	X	X	X	X
Observations	7468	7468	7468	7468	7468

Notes: The dependent variable is the probability of a composer being a teacher, and it is regressed in a Probit model on word count measures of different parts of a composer's biography and various background characteristics. The results reported here are average marginal effects. Births/deaths (per 100): the number of composer births/deaths in the composer's country of birth/death in the half-century (00–49 or 50–99) of their birth/death. Word count (all types): Effect per 100 words. In column 1, “main pct of total” is omitted due to multicollinearity: the percentage shares of all four sections sum to 100. Standard errors are clustered by country and half century, and are reported in parentheses. Coefficient estimates are reported in table A1.

\* $p < 0.1$ .

\*\* $p < 0.05$ .

\*\*\* $p < 0.01$ .

The results presented here should be interpreted as correlation indicators rather than causal effects. For our purposes, the exercise here is not to identify factors that influence whether a composer becomes a teacher. Rather, it is to identify composer traits observable in our dataset that are consistent with an increased likelihood of being a teacher. Thus, a longer biography—our proxy for composer quality—does not necessarily “cause” a composer to become a teacher. It is also plausible that a composer's biography may be longer precisely because they have taught other composers.

As a further exploratory exercise, we consider the extent to which a teacher's composer quality influences the likelihood of his or her student having a biography. As students can have multiple teachers, we test the effect of both the average biographical word count across



Table 7. *Number of students of composer teachers and teacher quality (Poisson, average marginal effects)*

	(1)	(2)	(3)	(4)	(5)
Word count (main description)	0.119*** (0.018)	0.057*** (0.008)			
Word count (works)	0.032** (0.015)		0.057*** (0.009)		
Word count (bibliography)	-0.290*** (0.061)			0.083*** (0.017)	
Word count (writings)	0.994*** (0.261)				1.548*** (0.239)
Main pct of total		-0.050*** (0.015)			
Works pct of total	0.050*** (0.014)		0.015 (0.013)		
Bibliography pct of total	0.168*** (0.034)			0.064** (0.027)	
Writings pct of total	-0.044 (0.039)				-0.140*** (0.037)
Lifespan	0.144*** (0.031)	0.144*** (0.035)	0.146*** (0.035)	0.145*** (0.035)	0.141*** (0.033)
Births (per 100)	0.098*** (0.032)	0.089*** (0.030)	0.107*** (0.029)	0.102*** (0.031)	0.109*** (0.032)
Deaths (per 100)	1.282*** (0.200)	1.246*** (0.227)	1.327*** (0.232)	1.300*** (0.231)	1.272*** (0.216)
Birth Country FE	X	X	X	X	X
Birth Cohort FE	X	X	X	X	X
Observations	3780	3780	3780	3780	3780

Notes: This table summarizes Poisson regression estimates for factors correlated with the number of students per teacher, reported as average marginal effects. The dependent variable is the number of students of a teacher and the sample is restricted to composers who are teachers. Births/deaths (per 100): the number of births/deaths in the composer's country of birth/death in the half-century (00–49 or 50–99) of their birth/death. Word count: Effect per 100 words. In column 1, “main pct of total” is omitted due to multicollinearity: the percentage shares of all four sections sum to 100. Standard errors clustered by country and half century, and are reported in parentheses. Coefficient estimates are reported in [table A3](#).

\* $p < 0.1$ .

\*\* $p < 0.05$ .

\*\*\* $p < 0.01$ .

a given student's teachers and the maximum word count value for a given student's teachers (that is, each student's highest quality teacher). [Table 8](#) presents average marginal effects from probit models comparing both average and maximum teacher effects on the likelihood of a student having a biography. We report the effects here for every 100 words in teachers' biographies, and control for effects from students' country of birth and time period.

In general, students are more likely to be recorded in Grove, the higher is the measured quality of their teachers. That said, biographical word counts are only part of the story. In supplementary analysis provided in appendix [table A6](#), we consider two subsets of students: those *only* with teachers born in the same country as the student, and those with *no* teachers born in the same country as the student. In addition, we control for age differences between

Table 8. *Average marginal effect of teacher word count on likelihood of student having a biography*

	All teachers		Only teachers with biographies	
	Average	Maximum	Average	Maximum
Teacher word count	0.000639* (0.00038)	0.000844*** (0.00025)	0.000419 (0.00030)	0.000712*** (0.00024)
Birth Country FE	X	X	X	X
Birth Cohort FE	X	X	X	X
Observations	13291	13291	11682	11682

Notes: This Probit model includes standard errors clustered by student's birth country and half century of birth. Average or maximum teacher word count (see column heading), per 100 words in main description. Reported estimates are average marginal effects. Coefficient estimates are reported in Table A5.

\* $p < 0.1$ .

\*\* $p < 0.05$ .

\*\*\* $p < 0.01$ .

teachers and students (either the average age difference to all teachers, or the age difference to the teacher with the highest word count). All else being equal, students who share a common country of birth with all of their teachers are more likely to be recorded in Grove than those who have no teachers with whom they share a country of birth. And for students in this latter group, the greater is the age difference to their teachers, the less likely it is that those students are recorded in Grove.

As with our exploratory analysis of both who is a teacher and the number of students per teacher, we also test the robustness of our results by looking at US composer teachers born from 1900 to 1949. We find that the relative magnitudes of the average and maximum effects flip: that the effect of the average word counts for all teachers of a given student is greater than the effect of the teacher with the highest word count. We explore this further by considering German teachers born in the same time period—which yields a similar pattern to the US cohort, though with different magnitudes. We then examine all teachers born in three different half centuries, which shows that the relative magnitudes of average and maximum effects vary over time. These results are included in appendix A (tables A7 and A8).

## 7. Teacher influence on student quality

The large set of teacher–student pairs available in our data inevitably invites consideration of how teacher quality influences student quality. But as is typical of wider examinations of teachers and education on student outcomes, there is a large degree of endogeneity to address in such analysis. In the specific context of composers, there is a high risk of selection bias: the best teacher composers may be better at identifying the most promising students.

The OLS framework we apply here only allows us to identify correlations. While we control for several factors that likely influence the probability of teachers and students connecting, the results in this section are primarily restricted to correlations.

We estimate the following OLS model:

$$Q_s = \alpha + \beta Q_t + \gamma X_{st} + \delta_1 \text{Birth Cohort}_s + \delta_2 \text{Birth Country}_s + \delta_3 \text{Birth Cohort}_s * \text{Birth Country}_s + \epsilon_s \quad (1)$$

where  $Q_s$  and  $Q_t$  are the quality measures of each student  $s$  and teacher  $t$  correspondingly.  $X_{st}$  represents the set of controls, such as shared country of origin (discussed below), as well as the total number of teachers of student  $t$ .

*Birth Cohort<sub>s</sub>* denotes the set of half-century dummies based on the date of birth of student  $s$ ; *Birth Country<sub>s</sub>* the set of country dummies based on the country of birth of student  $s$ , while *Birth Cohort<sub>s</sub>\*Birth Country<sub>s</sub>* denotes the interaction between both sets of dummies to control for potential composer clusters.

Connecting to teachers from different cultural background might lead to a less efficient quality transmission than connecting to a teacher of the same background in terms of nationality or country of origin. For example, the Polish student might grasp more information and skills from the Polish teacher even if they meet outside Poland than from the foreign teacher due to language barriers or cultural differences. All else being equal, two teachers of the same quality will transfer different quality to a student dependent on their geographic and cultural proximity. Therefore,  $X_{st}$  includes a set of dummies to denote whether the student and teacher are born in the same country and in the same city, whether they are of the same nationality, and whether the student was born in the same city as the city of death of the teacher.

We consider three sets of fixed effects: birth cohort fixed effects, birth country fixed effects, and the interaction of these two. Birth cohort fixed effects employ half-century dummies based on each student's year of birth. This allows us to account for differences in music education in different periods. With more individual education, as in early music history, the quality transmission might be more pronounced than in the more institutionalized setting common in later periods. Note that there are very few composers born before 1500 (only 119, see table 1). We include this group with a dummy for "Pre-1500".

Birth country fixed effects, as well as interaction between birth cohort and birth country, allow us to take into account the differences in the density of composers in different regions. If a student is born, for example, in eighteenth-century Vienna with a high concentration of composers and musicians, the student's quality will be influenced not only by his or her teachers, but also by the overall cultural and societal environment. Hence, ignoring the effect of being born in a creative cluster might overestimate the effect of teacher quality on student quality. However, inclusion of the country-birth cohort interaction term adds over 400 additional individual controls, which may lead to decrease of statistical power.

Table 9 presents the estimation results of equation (1) with different combinations of fixed effects.

The results with different sets of fixed effects show a significant and positive effect of teacher quality, as measured in the logged word count of the main description from Grove. Student quality is significantly and positively associated with teacher quality, and the magnitude of the effect is meaningful as well.

On average, a teacher with 10 per cent more words in the main Grove entry has students whose biographies are 0.29 to 0.5 per cent longer. While this is an average effect, when we look across the distribution of students by their word counts, we find a significant positive effect of teacher word count at all levels of student word count. Put another way, the results we present here cannot simply be dismissed as a manifestation of selection bias: good teachers picking good students.

We also re-estimate the model using word counts for the three additional biography sections: works, bibliography, and writings. Teachers' writings and bibliography word counts exhibit a significant and positive association with students' biography entry length, though the magnitude of this effect is smaller than we observe for the main description. Note, however, that the additional sections are not always present, so the lower magnitude of the estimated

Table 9. *Effect of teacher's quality on the student's quality*

	(1)	(2)	(3)	(4)
	Student quality (logged word count)			
Teacher quality (logged word count)	0.0523***	0.0483***	0.0501***	0.0292***
	(0.00662)	(0.00655)	(0.00697)	(0.00752)
Number of teachers		0.0628***	0.0561***	0.0667***
		(0.00400)	(0.00402)	(0.00446)
Same country of origin			0.0362*	0.0824***
			(0.0220)	(0.0234)
Same nationality			0.00956	0.0378
			(0.0226)	(0.0238)
Same city of birth			0.0204	0.00687
			(0.0360)	(0.0374)
Student is born in the teacher's city of death			-0.0147	-0.0271
			(0.0271)	(0.0281)
Birth Country FE				X
Birth Cohort FE	X	X	X	X
Birth Country * Birth Cohort FE				X
Observations	12032	12032	10998	10998
R <sup>2</sup>	0.105	0.125	0.113	0.158

Notes: This table reports estimates of equation (1). The dependent variable is student quality and is measured in the log number of words in the main part of Grove encyclopedia. Robust standard errors are reported in the parentheses.

\* $p < 0.1$ .

\*\* $p < 0.05$ .

\*\*\* $p < 0.01$ .

coefficient could be partially explained by a higher number of null observations. The results are presented in appendix A, [tables A9, A10, and A11](#).

## 8. Multigenerational analysis

We have observed previously that a teacher's quality may determine the quality of her student. Therefore, it is pertinent to ask whether the teacher's influence on the quality of a student persists into the next generation, when the student becomes a teacher herself? To put it differently, does there exist a relationship between a teacher's quality and the quality of her student's student? The unique long-term feature of our dataset allows us to investigate the persistence of quality across generations of students.

Extending our data beyond the 36,927 first-degree connections, we arrive at 36,364 second-degree, 34,852 third-degree, and later 9,609 tenth-degree connections. The data is then used to estimate a linear regression with or without teacher fixed effects, as presented in [table 10](#). The findings confirm that teacher's quality plays a large and significant role for the first generation of students, as shown previously. For example, the model with teacher fixed effects in column 2 implies that teachers with biographies longer by 10 per cent have students whose biographies are longer by about 0.9 per cent. The amplifying effect with coefficients significantly greater than one are observed throughout six generations of

Table 10. *Multigenerational transmission*

	(1)	(2)
	Student quality (logged word count)	
Teacher quality (logged word count):		
1st degree	0.0169*** (0.00143)	0.0886*** (0.00311)
2nd degree	0.0109*** (0.00147)	0.0682*** (0.00302)
3rd degree	0.00929*** (0.00153)	0.0541*** (0.00299)
4th degree	0.00565*** (0.00158)	0.0420*** (0.00297)
5th degree	0.00262 (0.00167)	0.0311*** (0.00296)
6th degree	0.00109 (0.00179)	0.0219*** (0.00297)
7th degree	0.0000125 (0.00183)	0.0144*** (0.00296)
8th degree	−0.00114 (0.00197)	0.00868*** (0.00298)
9th degree	−0.00261 (0.00214)	0.00325 (0.00306)
10th degree	−0.00358 (0.00254)	
Teacher FE		X
R <sup>2</sup>	0.003	0.020
Observations	81,612	81,612

Notes: The dependent variable is student quality calculated as the logged word count length of the biographical entry, and it is linearly regressed on teacher quality, which is measured as the logged word count length of the biographical entry of the 1st degree teacher, 2nd degree teacher, etc. Standard errors are reported in the parentheses.

\* $p < 0.1$ .

\*\* $p < 0.05$ .

\*\*\* $p < 0.01$ .

students. Moreover, the persistence in quality remains significant and large through several subsequent generations in a composer's musical lineage before it starts to fade. In particular, in the estimation with teacher fixed effects, the coefficients remain positive and statistically significant into the eight generation, but the point estimates decrease gradually.

The results shown here support the notion that quality is persistent across multiple generations. This finding is of relevance to the literature on the intergenerational transmission of traits and is in line with recent scholarship on social immobility by highlighting (in a different context) how persistent quality traits can be across many generations.

Additionally, our intergenerational results offer an alternative way to address concerns about endogeneity. While the pairing of teachers and students likely reflects active choices on the part of one or both parties (a student choosing an acclaimed teacher, or a teacher choosing a promising student), the probability that the same applies to the link between a

teacher and, say, a fifth-generation student is much lower. That is, for later generations, the observed effect of a teacher's quality can be expected to come closer to the causal effect. However, the possibility of persistence in self-selection across several generations should not be ignored either.

## 9. Conclusion

The central insight that this paper builds on is that teacher quality matters for student performance. The purpose has been to quantify the extent of quality transmission between music composers, where quality is defined in terms of reputation and cultural impact. By focusing on composers, we are able to illustrate the effect of professional creatives communicating their field-specific skills and talents to new generations.

Our analysis is directly relevant to understanding the long-term development of music composers and other fields in the cultural and creative sectors with similar patterns of within-field training. The results also have broader applicability with respect to the acquisition of human capital. In particular, our findings highlight two complementary factors relevant for students' educational attainment: first, how accomplished a student's teachers are; second, how compatible student and teacher are in terms of their backgrounds. Students that share common cultural factors with their teachers—perhaps most obviously, the same language—experience the higher quality. Put simply, our results hint that it is easier for students to develop their talents if they have similar backgrounds with their teachers.

One of the most striking findings is the persistence of quality transmission. While the effect of a teacher's quality is most pronounced on the quality of that teacher's direct students, our results reveal cascading effects that persist through several generations. For example, when controlling for individual teacher effects, we find that a significant positive correlation between teacher quality and the observed quality of up to the eighth generation of students.

That said, we would caution against over-generalizing our results. The pattern of education among composers is distinct from schooling. Our study focuses on teachers' quality with respect to their own careers as composers. This is distinct from teachers' pedagogical quality: that is, their mastery of teaching rather than their mastery of the content. Our data do not allow us to directly observe differences in composers' pedagogical attributes. Nevertheless, while the rise of music conservatories during the nineteenth century represents a change in the dynamics of the teacher–student relationship—reflected, for example, in the increase in the average number of students per teacher—we note that the effect of quality transmission holds over the long term.

At least two concerns may be raised with respect to our data: (1) the extent to which word count is a true proxy for quality; and (2) the risk of bias with respect to which composers are included in our biographical source material. On the first point, any assessment of quality is necessarily subjective: beauty is in the eye of the beholder. We have nevertheless sought an objective basis to define quality. Given our focus on reputation and cultural impact, we consider biographical word count to be a fair indicator of quality. But were one to consider quality through a different lens—for example, by attempting assessment of the technical competence of composers or the complexity of their compositions—then different measures (and source material) would be required.

On the second point, while we accept that bias can be found, one must ask if and how such bias would affect our results. One bias relates to the geographic distribution of the composers in our dataset. We acknowledge there is a heavy weighting of European and US composers, which is likely disproportionate in the context of global music history. In the most restrictive



sense, one can conclude that we find quality transmission among *Western* composers. But while the magnitude of effects might conceivably differ, we would not expect that the nature of creative quality transmission is so fundamentally different for composers in other parts of world that are less represented in our dataset.

While our results confirm the presence of quality transmission, we do not draw any definitive conclusions about the mechanisms of quality transmission or why quality effects evidently persist. An obvious story is that if teacher quality influences student quality, then when a student becomes a teacher, some element of the quality they pass on to their students is an echo of their own teachers. But how and why this occurs is less clear.

One factor may be the effect of the small number of highly accomplished composers whose contributions to the world of music are so profound, that there are reputational gains for the successive generations of students who follow in their footsteps. While imitation may be the sincerest form of flattery, it may also yield considerable career benefits to more effective imitators—and the best placed to imitate are likely to be student descendants of the original article. This proposition is in line with Borowiecki (2022), who shows that imitating high quality teachers may be conducive to career success.

Similarly, high quality composers may be better at gently guiding—or forcefully directing—their prodigies to professional success by harnessing the lessons of their own achievements. A further possible explanation relates to nepotism and access to influential networks: that is, part of the effect we observe is less about *what* students know and more about *who* they know. It is not unlikely that there exists some degree of nepotism in music education as it is known to occur in parent–child relationships (de la Croix and Goñi 2021). Disentangling the relative strength of these—and potentially other—channels is beyond the scope of this paper. There is undoubtedly a wealth of opportunities for deeper explorations on these points.

There is also little doubt that the historical music setting of this paper is highly distinct. However, the results presented and mechanisms outlined above would likely apply to other creative domains in the past and even nowadays. Therefore, we can perhaps conclude by venturing into the question: What can musicians, other artists or even creative workers in the cultural and creative sectors take away from our findings? For the aspiring creative person, the obvious lesson is that it helps to find an accomplished teacher. Better still, find an accomplished teacher with a similar cultural background. While there are no guarantees of success in life, the chances of being recognized as a high-quality creative person are stronger with a high-quality teacher.

### Acknowledgements

The authors would like to thank Greg Clark and participants at the International Conference on Cultural Economics (ACEI 2021), Frontier Research in Economics and Social History (FRESH) meeting, Lund (November 2021) and the Swedish Economic History Meeting/Annual Conference of the Scandinavian Society for Economic and Social History, Gothenburg (October 2021). Excellent research assistance was provided by Martin Hørlyk Kristensen. The empirical analysis was partially carried out with wu.cloud, a cloud computing facility of the Vienna University of Economics and Business.

### Data availability

The data and methods underlying this article are available in the Data Archive of the Journal of Political Economy at <https://www.journals.uchicago.edu/doi/suppl/10.1086/718370>.

## Supplementary material

Supplementary material is available at *European Review of Economic History* online.

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