# Performance time productivity and versatility estimates for 102 classical composers

Aaron Kozbelt

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AARON KOZBELT
BROOKLYN COLLEGE OF THE CITY UNIVERSITY OF NEW YORK, USA

ABSTRACT Performance time productivity estimates for 102 classical composers are reported. For each composer, the grand total and totals within several musical genres (e.g., symphonies, concerti, operas) are provided, which are used to generate a measure of composer versatility, or the extent to which each composer's output spans multiple genres. Estimated durations of lost works for each composer are also summarized. Descriptive results identify the most prolific composers in the overall sample and within each genre. Illustrative correlational analyses revealed reliable overall associations between average annual productivity, eminence and composer birth year; versatility was related only to birth year. However, composers in different periods of musical history (Baroque/Classical, Romantic and 20th century) showed different patterns of correlations between the variables, with 20th-century composers showing no reliable correlations at all. Implications and suggestions for incorporating the reported productivity estimates into multi-level statistical analyses of composers' lifespan creative productivity are discussed.

KEYWORDS: *creative productivity, creativity, eminence, historiometry*

Across disciplines, a hallmark of eminent creators is extraordinarily high productivity (Simonton, 1994, 1997). Classical music is no exception (Simonton, 1977b). Many great composers are as renowned for the quantity of music they composed as for their music's quality: for example, Haydn composed over 100 symphonies, Vivaldi, over 400 concerti and Schubert, some 600 lieder. Such numerical totals are relatively common musical knowledge among aficionados, in part because classical composers are among the best-documented creators in any domain (Simonton, 1977a, 1991). Such detailed documentation means that in principle it should be possible to derive quite accurate estimates of composers' overall outputs from archival sources. Since productivity may be *the* most important variable for understanding the cognitive and social dynamics of creativity and eminence (Simonton, 1997), accurate measurement of the output of great composers is highly desirable for a comprehensive understanding of the nature of creativity in classical music. Such estimates could then be incorporated into correlational or multi-level statistical analyses to provide a firm

quantitative basis for any conclusions about links between productivity and musical creativity more generally.

Methodologically, what is the best way to arrive at estimates of productivity? Earlier tabulations of classical composers' outputs have operationalized this variable in various ways, all of which have substantial limitations. For instance, one previous measure is a count of the number of melodies listed in Barlow and Morgenstern's (1948, 1950) thematic anthologies per composer (Simonton, 1977b, 1991). However, these anthologies are arguably now outdated, especially for 20th-century music, and they fail to include any themes at all from a number of esteemed works (e.g., four of J. S. Bach's solo cello suites, Bruckner's Eighth Symphony and Te Deum, Debussy's *Pelléas et Mélisande* and piano études, all of Haydn's piano trios and all but one of his masses, Mahler's Third, Sixth, Seventh and Eighth Symphonies, Richard Strauss's *Elektra* and *Die Frau ohne Schatten*, and almost all of the music of Ives and the Second Viennese School). Instead of counting only cited themes, another possible measure is a count of all of the works written by each composer, or counts of works in various categories, such as vocal or operatic pieces (Simonton, 2000), or a count of works cited by Halsey (1976) as musical masterpieces (Simonton, 1991). However, this is also suboptimal, since individual works vary greatly in their duration, scoring and structural complexity (both between and within composers), and it is not always clear what should count as an individual work (e.g., whether a song cycle should count as one piece or many). A more sensitive option is to weight works in a systematic way. Along these lines, Simonton (1977a) used a genre-based system where each symphony received a score of 40, each concerto, 30, each art song, 5, etc. While much more refined than equally weighting all works, such a system still disregards any differences among works of the same genre. For instance, Mozart's last symphony is three times as long as his first (and is structurally far more complex), yet a genre-based system equally weights the two.

These prior operationalizations have yielded informative and largely convergent results that have greatly advanced our understanding of creative productivity in classical composers. However, these estimates all suffer from important limitations. They are often incomplete, essentially only index composers' outputs relative to one other (e.g., in terms of number of indexed melodies or listed compositions), and do not account for differences in composers' career durations, which necessarily impact overall output. A more ideal measure would provide a truly comprehensive estimate of each composer's productivity in more absolute terms and would also control for career duration.

One fine-grained, straightforward way of achieving this goal is to individually weight each work by its performance time. This measure also provides answers to descriptively interesting questions such as how many total hours of music various great composers actually wrote, or how much music they wrote on average per year of their career. Today, a vast amount of classical music has been recorded, with the surviving outputs of some composers (e.g., J. S. Bach, Beethoven, Mahler, Mozart and Stravinsky) available on CD essentially in their entirety; information about many of these recordings is also indexed on numerous online sources. Thus, accurate estimates of the total performance time output of many classical composers can be obtained much more readily than at any time in the past. Besides an overall total for

each composer, productivity within different categories of music (e.g., symphonies, concerti, operas) can also be estimated, and these figures can be refined by tabulating each composer's career span.

Such data can be used to yield a measure of compositional 'versatility', or the degree to which a composer's output spans multiple musical genres. Versatility can be compared with the construct of 'cross-training' among composers, described by Simonton (2000). Cross-training has been invoked as an explanation for trends in the differential aesthetic success of 911 operas by 59 composers, which showed a positive association with cumulative total compositions, a mostly negative association with cumulative operas, and no association with cumulative vocal works (Simonton, 2000). In this view, composers who fail to cross-train may 'overtrain', or focus too much on a particular type of creative product, such as operas, and become less flexible in how they approach new compositional projects (cf. Frensch & Sternberg, 1989). The relation between aesthetic success and the number of cumulative operas showed a backwards J-shape, suggesting that 'if a composer specializes enough just in opera creation, an advantage is gained that partly compensates for the overtraining effect' (Simonton, 2000, p. 311). In other words, the greatest operas tend to be by composers who either specialized in writing operas (e.g., Verdi, Wagner, Puccini, etc.) or, even better, by those who produced a great breadth of music (e.g., Mozart, Richard Strauss, Tchaikovsky, etc.). Thus, cross-training appears to be a promising construct for understanding some aspects of the nature of the relation between musical expertise and creativity.

Composer versatility, as operationalized presently, is rather similar to Simonton's (2000) notion of cross-training. However, cross-training involves cross-sectional analyses of composers' output (that is, their writing in different musical genres at approximately the same point in their careers). In contrast, the present measure of versatility indexes the total amount of music written in various musical genres, without regard to how output across genres was distributed throughout composers' careers. To illustrate this distinction consider the careers of Mozart versus Schumann. Mozart wrote in many musical genres throughout his life (Kozbelt, 2005); in contrast, Schumann tended to approach different types of composition sequentially, starting with piano works, and then progressing through lieder, chamber and symphonic music, and finally large-scale choral works. Thus, both Mozart and Schumann showed high versatility, but Mozart had much more extensive cross-training.

The primary purpose of this article is simply to consolidate available information on composers' outputs and to provide overall and genrewise performance time productivity estimates and an index of versatility for a reasonably large sample of classical composers. These estimates comprise a database that other researchers investigating creative productivity in classical composers may find useful.

A secondary purpose is to perform several statistical analyses to illustrate how the database can be used to examine relations between productivity, historical year, eminence and versatility. For instance, highly productive composers are generally more eminent than their less productive peers (Simonton, 1977b, 1991). Is that equally true throughout music history? Some of the most famed 20th-century composers, such as Stravinsky and Webern, were not nearly as prolific (in absolute terms) as earlier great composers; how do they rank among their contemporaries in terms of productivity?

Such questions can be answered by examining correlations among productivity, eminence and versatility in different periods of music history. Different patterns of correlation across different periods might be taken as evidence for a shifting social dynamic for musical eminence, which has broader implications for understanding creativity in classical composers. Finally, suggestions on how the present database might be incorporated into more sophisticated multi-level statistical analyses are taken up in the discussion.

## *Method*

### SAMPLE OF COMPOSERS

Chwiałkowski (1996) provides complete lists of works for 132 classical composers, from which the present sample was selected. This reference was chosen as a starting point because it has the most comprehensive listing of the complete works of composers in the western classical tradition. Chwiałkowski also explicitly breaks down each composer's works into different compositional categories, which is useful for assessing composer versatility. The use of a single source is methodologically desirable because it ensures a uniform degree of thoroughness across composers, although naturally it necessarily limits the sample to composers included in that reference.

Living composers and those whose works have not been extensively recorded were excluded, leaving 102 composers for whom it was possible to establish reasonably accurate total performance time estimates. These 102 composers form the sample investigated presently. The individuals, 101 men and one woman (Amy Beach), encompass 15 nationalities, their lives span more than 400 years (1567 to 1994), and it has been estimated that their work accounts for at least 86 percent of all classical music performed, as measured in listener-hours (Moles, 1966/1958, pp. 28–29).

Each composer's year of birth and estimated career span (based on the difference between the dates of their earliest and latest known compositions) were tabulated. Also noted were eminence ratings provided for 91 of the 102 composers (Murray, 2003). Murray based his estimates on page number citations in a number of standard classical music references. Mozart and Beethoven tied for the most cited and were assigned scores of 100; other composers received lower scores based on the fraction of page number citations relative to Mozart or Beethoven.

### COMPOSITIONS

Every extant original work by each composer was included in the productivity estimates. Work lists taken from Chwiałkowski (1996) were cross-checked and supplemented by other references. All arrangements (of other composers' works, folksongs, or a composer's own works) were excluded, since these do not represent original composition. Each work was categorized into one of nine genres: chamber, choral, concerti, keyboard, opera, orchestral, symphonies, theater works and vocal. Eight of these are derived from Halsey (1976). The remaining genre, theater works, included ballets, incidental music and music for film, radio and television. It was added because the appropriate categorization of such works, based on requisite performance forces, is not always clear. When a work exists in multiple arrangements, the original version of the piece was used for categorization.

Compositions that are now lost, but which are known to have existed, were excluded from the basic productivity estimates. Often, lost works represent quite meager shares of composers' outputs. However, when lost works were more substantial, additions to the basic estimates were made and are reported in the appendix.

### PERFORMANCE DURATION ESTIMATES

Performance durations were obtained from a variety of sources. In descending order of preference, sources were: CD recordings, listed durations from published catalogs of composers' works, estimates based on sheet music or scores, averages of similar works by that composer, and Simonton's (1977a) genre-based weighting system, which a previous investigation (Kozbelt, 2004) revealed was highly correlated with performance time, $r = .86$, in a sample of 6,560 works by 18 eminent composers. In rare cases where no information that would permit a more specific estimate was available, an educated guess was made. Recordings, catalog listings and scores yield estimates that are specific to each work; the remaining sources yield estimates that are generic in nature and not tailored to individual works. In the data reported below, cases in which more than 25 percent of a given total or genre-specific estimate was not derived from work-specific estimates are flagged, as these are likely less accurate than other estimates and can in principle be refined when more information becomes available.

## *Results*

### PRODUCTIVITY ESTIMATES

Table 1 shows the sample of composers, their birth and death dates, estimated career spans, estimated total outputs, average annual outputs and eminence ratings. Average annual output equaled total output (in minutes) divided by career span.

The estimates in Table 1 yield some descriptively interesting findings. For instance, in terms of total extant music, the top 12 composers, in descending order, were: Handel, Haydn, Donizetti, Mozart, Vivaldi, J. S. Bach, C. P. E. Bach, Rossini, Schubert, Boccherini, J. C. Bach and Saint-Saëns, each with over 5000 minutes of music. (When lost works were accounted for, Vivaldi moved into second place and J. S. Bach moved above Mozart, but the order of the others was unchanged – see the appendix for details.) All but Rossini and Saint-Saëns also occupied the top 12 rankings based on average annual productivity. In descending order, these composers were: Schubert, Donizetti, Mozart, Vivaldi, Handel, Haydn, J. C. Bach, J. S. Bach, Mendelssohn, Boccherini, Purcell, and C. P. E. Bach, each of whom averaged at least 140 minutes of music per year of career. (When lost works were included, the order remained the same, except that J. S. Bach and J. C. Bach switched positions and Vivaldi moved into first place overall; however, Vivaldi's specific ranking depends on his estimated career span, which is not precisely known.)

Table 2 shows the genre-by-genre breakdown of output for each composer, as well as an estimate of composer versatility, that is, the extent to which each composer's output spanned multiple genres, which is shown in the rightmost column. This estimate was computed as a Gini coefficient (Gini, 1921, 1955/1912), a measure of the inequality of a distribution, using an online calculator, http://www.wessa.net/co.wasp. To control for individual differences in absolute output, the observed

TABLE 1 *Career data and overall performance time productivity estimates for 102 composers*

| Composer | Lifespan | Estimated career span | Estimated total output | Average annual output | Eminence |
|---|---|---|---|---|---|
| Albéniz, I. | 1860–1909 | 27 | 1253 | 46 | 4 |
| Bach, C. P. E. | 1714–1788 | 57 | 7994* | 140 | 15 |
| Bach, J. C. | 1735–1782 | 25 | 5161* | 206 | 9 |
| Bach, J. S. | 1685–1750 | 49 | 8612 | 176 | 87 |
| Bach, W. F. | 1710–1784 | 52 | 1363* | 26 | 3 |
| Balakirev | 1837–1910 | 58 | 803* | 14 | 6 |
| Barber | 1910–1981 | 64 | 1249* | 20 | 4 |
| Bartók | 1881–1945 | 56 | 2184 | 39 | 18 |
| Beach | 1867–1944 | 63 | 1457* | 23 | – |
| Beethoven | 1770–1827 | 45 | 4902 | 109 | 100 |
| Bellini | 1801–1835 | 23 | 2062 | 90 | 9 |
| Berg | 1885–1935 | 36 | 677 | 19 | 14 |
| Berlioz | 1803–1869 | 47 | 1720 | 37 | 41 |
| Bernstein | 1918–1990 | 58 | 1413 | 24 | – |
| Bizet | 1838–1875 | 25 | 1308 | 52 | 10 |
| Bloch | 1880–1959 | 57 | 1349 | 24 | 3 |
| Boccherini | 1743–1805 | 45 | 6652* | 148 | 4 |
| Borodin | 1833–1887 | 45 | 891 | 20 | 8 |
| Brahms | 1833–1897 | 46 | 2801 | 61 | 35 |
| Britten | 1913–1976 | 54 | 4552 | 84 | – |
| Bruch | 1838–1920 | 71 | 2581* | 36 | 2 |
| Bruckner | 1824–1896 | 57 | 1666* | 29 | 19 |
| Busoni | 1866–1924 | 52 | 2493* | 48 | 8 |
| Buxtehude | 1637–1707 | 39 | 1935* | 50 | 7 |
| Chabrier | 1841–1894 | 37 | 816 | 22 | 5 |
| Chopin | 1810–1849 | 33 | 1118 | 34 | 32 |
| Copland | 1900–1990 | 58 | 1445 | 25 | 7 |
| Corelli | 1653–1713 | 33 | 591 | 18 | 12 |
| Couperin, F. | 1668–1733 | 39 | 1455 | 37 | 13 |
| Debussy | 1862–1918 | 39 | 1530 | 39 | 45 |
| Delius | 1862–1934 | 52 | 1818 | 35 | 7 |
| Dohnányi | 1877–1960 | 69 | 1796* | 26 | 2 |
| Donizetti | 1797–1848 | 33 | 11225* | 340 | 9 |
| Dupré | 1886–1971 | 75 | 1464* | 20 | – |
| Dvořák | 1841–1904 | 48 | 4559 | 95 | 13 |
| Elgar | 1857–1934 | 68 | 2899 | 43 | 8 |
| Falla | 1876–1946 | 46 | 629 | 14 | 9 |
| Fauré | 1845–1921 | 64 | 1407 | 22 | 13 |
| Franck | 1822–1890 | 57 | 2361* | 41 | 15 |
| Frescobaldi | 1583–1643 | 33 | 1061 | 32 | – |
| Glazunov | 1865–1936 | 56 | 2392 | 43 | 4 |
| Glinka | 1804–1857 | 36 | 1252 | 35 | 8 |
| Gluck | 1714–1787 | 44 | 3570* | 81 | 26 |
| Granados | 1867–1916 | 31 | 1311* | 42 | 3 |
| Grieg | 1843–1907 | 48 | 1572 | 33 | 11 |
| Handel | 1685–1759 | 56 | 14699 | 262 | 46 |
| Haydn | 1732–1809 | 55 | 11367 | 207 | 56 |

*(continued)*

TABLE 1 (Continued)

| Composer | Lifespan | Estimated career span | Estimated total output | Average annual output | Eminence |
|---|---|---|---|---|---|
| Hindemith | 1895–1963 | 55 | 4296 | 78 | 19 |
| Holst | 1874–1934 | 45 | 2093* | 47 | 5 |
| Ives | 1874–1954 | 40 | 1366 | 34 | 8 |
| Janáček | 1854–1928 | 59 | 1911 | 32 | 7 |
| Kodály | 1882–1967 | 69 | 1633* | 24 | 7 |
| Lalo | 1823–1892 | 45 | 1007* | 22 | 3 |
| Liszt | 1811–1886 | 65 | 4365 | 67 | 45 |
| Lutoslawski | 1913–1994 | 72 | 1035 | 14 | – |
| Mahler | 1860–1911 | 35 | 1057 | 30 | 23 |
| Mendelssohn | 1809–1847 | 28 | 4282 | 153 | 30 |
| Messiaen | 1908–1992 | 75 | 2079 | 28 | 13 |
| Monteverdi | 1567–1643 | 61 | 2198 | 36 | 31 |
| Mozart | 1756–1791 | 31 | 10136 | 327 | 100 |
| Mussorgsky | 1839–1881 | 25 | 855 | 34 | 16 |
| Nielsen | 1865–1931 | 58 | 1905 | 33 | 3 |
| Orff | 1895–1982 | 61 | 1524 | 25 | 5 |
| Paderewski | 1860–1941 | 42 | 677* | 16 | – |
| Paganini | 1782–1840 | 35 | 1836 | 52 | – |
| Poulenc | 1899–1963 | 46 | 1511 | 33 | 8 |
| Prokofiev | 1891–1953 | 58 | 4080 | 70 | 12 |
| Puccini | 1858–1924 | 50 | 1424 | 28 | 10 |
| Purcell | 1659–1695 | 23 | 3250 | 141 | 18 |
| Rachmaninov | 1873–1943 | 56 | 1728 | 31 | 7 |
| Rameau | 1683–1764 | 59 | 3204 | 54 | 22 |
| Ravel | 1875–1937 | 41 | 776 | 19 | 23 |
| Respighi | 1879–1936 | 43 | 3005* | 70 | 3 |
| Rimsky-Korsakov | 1844–1908 | 53 | 2959 | 56 | 15 |
| Rossini | 1792–1868 | 68 | 7597 | 112 | 22 |
| Roussel | 1869–1937 | 46 | 1205 | 26 | 5 |
| Saint-Saëns | 1835–1921 | 81 | 5136* | 63 | 13 |
| Sarasate | 1844–1908 | 35 | 414 | 12 | – |
| Satie | 1866–1925 | 41 | 654 | 16 | 7 |
| Scarlatti, D. | 1685–1757 | 55 | 3854* | 70 | 10 |
| Schoenberg | 1874–1951 | 59 | 1479 | 25 | 39 |
| Schubert | 1797–1828 | 20 | 7266 | 363 | 44 |
| Schumann | 1810–1856 | 33 | 3630 | 110 | 42 |
| Scriabin | 1872–1915 | 32 | 804 | 25 | 8 |
| Shostakovich | 1906–1975 | 57 | 4611 | 81 | 12 |
| Sibelius | 1865–1957 | 57 | 3059 | 54 | 10 |
| Smetana | 1824–1884 | 44 | 2219 | 50 | 12 |
| Strauss, J. Sr | 1804–1849 | 32 | 1599* | 50 | – |
| Strauss, J. Jr | 1825–1899 | 69 | 4252* | 62 | 5 |
| Strauss, R. | 1864–1949 | 79 | 4781 | 61 | 26 |
| Stravinsky | 1882–1971 | 69 | 1550 | 22 | 45 |
| Sullivan | 1842–1900 | 51 | 3853 | 76 | 5 |
| Szymanowski | 1882–1937 | 35 | 1214 | 35 | 4 |
| Tchaikovsky | 1840–1893 | 36 | 4217 | 117 | 20 |

*(continued)*

TABLE 1 (Continued)

| Composer | Lifespan | Estimated career span | Estimated total output | Average annual output | Eminence |
|---|---|---|---|---|---|
| Vaughan Williams | 1872–1958 | 81 | 3649 | 45 | 9 |
| Verdi | 1813–1883 | 68 | 3974 | 58 | 30 |
| Vivaldi | 1678–1741 | 36 | 9847 | 274 | 15 |
| Wagner | 1813–1883 | 50 | 3162 | 63 | 79 |
| Weber | 1786–1826 | 29 | 2265* | 78 | 27 |
| Webern | 1883–1945 | 44 | 682 | 16 | 19 |
| Wieniawski | 1835–1880 | 28 | 374* | 13 | – |
| Wolf | 1860–1903 | 23 | 1225 | 53 | 11 |
| *M* | 64.8 | 48.5 | 2874.0 | 65.2 | 18.7 |
| SD | 14.5 | 14.7 | 2625.9 | 70.2 | 20.1 |
| Range | 31–92 | 20–81 | 374–14699 | 12–363 | 2–100 |

*Note*: * = More than 25% of the total performance time estimate derived from 'generic' sources (e.g., averages, genre-based weighting) rather than work-specific sources (e.g., recordings, scores). All outputs are listed in minutes, rounded to the nearest integer. Lost works are not included in these estimates.

proportion of a composer's music in each genre was compared to the expected proportion if a composer had written an equal amount of music in each of the nine genres. For the present dataset, the computation of the Gini coefficient involved plotting the cumulative percentage of a composer's total output by genre, starting with the genre(s) with the lowest output. The Gini coefficient equals the ratio of the area between this cumulative output function and a perfectly even distribution (given by a cumulative percentage function with a slope of 1), divided by the total area under the perfectly even distribution. A Gini coefficient of 0 represents a completely even distribution of output across genres. Theoretically, a Gini coefficient of 1 represents a completely uneven distribution of output across genres; in the present study, because only nine genres were analyzed, a perfectly uneven distribution would correspond to a Gini coefficient of .889. The general pattern can easily be gauged by noting the high values for Verdi, Gluck, Puccini, and Wagner, who mainly composed operas. Overall, the *M*(SD) Gini coefficient was 0.556(0.167) and ranged from 0.238 (for Nielsen) to 0.889 (for Johann Strauss Sr).

Since some early composers predated the invention of certain musical forms, their expected proportions were adjusted by removing such categories and redistributing the expected proportions accordingly. Monteverdi and Frescobaldi were born substantially earlier than the rest of the sample; the chamber, concerto, orchestral and symphony genres were eliminated for these composers. For the nine other composers born before 1700, only the symphony category was dropped. (These cases are represented by dashes in Table 2.) Scores for all remaining composers were computed using all nine genres.

Totals within each genre reveal which composers topped each distribution. For instance, Boccherini and Haydn each wrote more than twice as much chamber music as their nearest rivals, Mozart and Beethoven. Likewise, for choral music, J. S. Bach and Handel each composed over twice as much as the next most prolific choral

TABLE 2 *Performance time productivity estimates for 102 composers, by genre*

| Composer | Chamber | Choral | Concerto | Keyboard | Opera | Orchestral | Symphony | Theater | Vocal | Gini coeff. |
|---|---|---|---|---|---|---|---|---|---|---|
| Albéniz | **33** | 0 | 27 | 593 | **503** | **22** | 0 | 0 | 75 | .717 |
| Bach, C. P. E. | **1205** | **1732** | 1180 | **2693** | 0 | 0 | 212 | 0 | **972** | .538 |
| Bach, J. C. | **1072** | **964** | 717 | **240** | **1473** | **87** | 354 | 0 | **254** | .463 |
| Bach, J. S. | 659 | 5336 | 286 | 2007 | 0 | 171 | – | 0 | 153 | .712 |
| Bach, W. F. | 168 | **631** | 83 | 355 | 0 | 0 | **95** | 0 | **31** | .650 |
| Balakirev | 0 | **68** | 66 | **328** | 0 | 110 | 80 | **38** | **113** | .501 |
| Barber | **110** | **123** | 102 | **233** | 260 | 91 | 50 | **48** | **232** | .302 |
| Bartók | 470 | 128 | 252 | 727 | 60 | 259 | 0 | 98 | **190** | .466 |
| Beach | 133 | **580** | 37 | **280** | 46 | 0 | 41 | 0 | **340** | .598 |
| Beethoven | 1816 | 338 | 320 | 1186 | 118 | 169 | 354 | 228 | 373 | .460 |
| Bellini | **226** | 0 | 8 | **25** | 1516 | **63** | 0 | 0 | **224** | .781 |
| Berg | 58 | 0 | 63 | 62 | 261 | 21 | 0 | 0 | 212 | .606 |
| Berlioz | **12** | 756 | 39 | 12 | **525** | 61 | 90 | 0 | 225 | .651 |
| Bernstein | **64** | 190 | 53 | **111** | 543 | 87 | 102 | 191 | 72 | .409 |
| Bizet | **5** | **113** | 0 | 141 | 766 | 33 | 64 | 56 | 130 | .633 |
| Bloch | 439 | 109 | 248 | 99 | 140 | 112 | 139 | 0 | 63 | .399 |
| Boccherini | **5188** | 389 | 216 | 0 | 73 | 14 | 519 | **50** | **203** | .771 |
| Borodin | 239 | 0 | 0 | 88 | 424 | 7 | 78 | 0 | 55 | .663 |
| Brahms | 759 | 449 | 167 | 459 | 0 | 171 | 175 | 0 | 621 | .457 |
| Britten | 420 | 594 | 116 | 88 | 1773 | 128 | 115 | **884** | 434 | .503 |
| Bruch | **281** | **1095** | 375 | **50** | **350** | 51 | 104 | **25** | **250** | .519 |
| Bruckner | 75 | **800** | 0 | 79 | 0 | 50 | 633 | 0 | **29** | .707 |
| Busoni | **380** | **200** | 180 | **936** | 486 | 157 | 0 | 41 | **113** | .504 |
| Buxtehude | 181 | **308** | 0 | 629 | 0 | 0 | – | 0 | 817 | .644 |
| Chabrier | 0 | 26 | 10 | 162 | 494 | 25 | 0 | 0 | 99 | .729 |
| Chopin | 81 | 118 | 0 | 872 | 0 | 0 | 0 | 0 | 47 | .805 |
| Copland | 143 | 65 | 46 | 158 | 197 | 215 | 99 | 442 | 80 | .358 |
| Corelli | 455 | 0 | 0 | 0 | 0 | 136 | – | 0 | 0 | .817 |
| Couperin, F. | 423 | 0 | 0 | 726 | 0 | 0 | – | 0 | 306 | .697 |

*(continued)*

TABLE 2 (Continued)

| Composer | Chamber | Choral | Concerto | Keyboard | Opera | Orchestral | Symphony | Theater | Vocal | Gini coeff. |
|---|---|---|---|---|---|---|---|---|---|---|
| Debussy | 109 | 88 | 49 | 408 | 328 | 133 | 0 | 132 | **283** | .419 |
| Delius | 142 | 313 | 101 | 32 | 577 | 337 | 0 | 75 | 241 | .469 |
| Dohnányi | 308 | **240** | 211 | 340 | **315** | 124 | **134** | 20 | **104** | .295 |
| Donizetti | 622 | **485** | 52 | 322 | 7585 | 40 | **112** | 0 | **2007** | .747 |
| Dupré | **103** | **316** | **56** | 880 | 0 | **5** | 27 | **25** | **52** | .704 |
| Dvořák | 1060 | 565 | 118 | 391 | 1260 | 480 | 386 | 26 | 273 | .411 |
| Elgar | **418** | **1226** | 90 | 140 | 69 | 471 | 158 | 124 | **203** | .492 |
| Falla | **41** | **15** | 39 | 77 | **243** | 73 | 0 | 86 | 55 | .457 |
| Fauré | 323 | 158 | 31 | 309 | **274** | 15 | 0 | **134** | 263 | .411 |
| Franck | 247 | 562 | 73 | **667** | **410** | 102 | **77** | 0 | **223** | .466 |
| Frescobaldi | – | 37 | – | 770 | 0 | – | – | 0 | 254 | .676 |
| Glazunov | 475 | **120** | 122 | 342 | 0 | 642 | 318 | 320 | 53 | .416 |
| Glinka | 167 | **48** | 0 | 310 | 402 | **62** | 13 | **31** | 219 | .531 |
| Gluck | 57 | **5** | 0 | 0 | **3182** | 138 | 0 | 63 | **125** | .837 |
| Granados | **143** | **16** | **10** | 551 | **398** | **89** | 0 | **25** | **79** | .625 |
| Grieg | 161 | **145** | 33 | 545 | 32 | 50 | 37 | 133 | 436 | .509 |
| Handel | 465 | 4512 | 215 | 495 | 6527 | 410 | – | 96 | 1979 | .606 |
| Haydn | 4261 | 1232 | 470 | 701 | 1666 | 161 | 2345 | 41 | 490 | .519 |
| Hindemith | 1136 | 391 | 407 | 423 | 696 | 202 | 175 | 427 | 439 | .282 |
| Holst | **167** | 606 | 53 | 58 | **472** | 290 | **109** | **145** | 193 | .410 |
| Ives | 221 | 173 | 0 | 227 | 0 | 244 | 133 | 0 | 368 | .447 |
| Janáček | 134 | 447 | 44 | 128 | 907 | 192 | 0 | 54 | **5** | .620 |
| Kodály | 227 | **602** | 0 | 122 | **269** | 101 | 29 | **42** | **241** | .497 |
| Lalo | 250 | **10** | 130 | **11** | **374** | 15 | 61 | 56 | 100 | .540 |
| Liszt | 65 | 1257 | 184 | 1869 | 90 | 360 | 119 | 0 | 421 | .609 |
| Lutoslawski | 267 | **50** | 82 | 56 | 0 | 237 | 108 | 20 | **215** | .451 |
| Mahler | 9 | 71 | 0 | 0 | 0 | 8 | 744 | 0 | 225 | .799 |
| Mendelssohn | 763 | 1011 | 263 | **855** | 380 | 90 | 415 | 244 | 269 | .345 |
| Messiaen | 96 | **208** | 207 | 890 | 239 | 221 | 79 | 0 | 139 | .466 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Monteverdi | – | 1533 | – | 0 | 534 | – | – | 52 | 79 | .646 |
| Mozart | 1980 | 1118 | 1176 | 814 | 2575 | 1074 | 727 | 95 | 577 | .336 |
| Mussorgsky | 0 | **31** | 0 | 106 | **506** | 19 | 0 | 4 | 189 | .736 |
| Nielsen | 338 | **174** | 80 | 187 | 219 | 79 | 206 | 303 | **319** | .238 |
| Orff | **20** | **226** | 13 | 0 | **60** | 24 | 0 | 976 | **205** | .730 |
| Paderewski | **46** | **5** | 55 | **297** | 110 | 30 | 74 | 0 | **60** | .527 |
| Paganini | 1394 | **25** | 407 | 0 | 0 | 0 | 0 | 0 | **10** | .830 |
| Poulenc | 147 | 241 | 89 | 216 | 264 | 51 | 0 | 212 | 291 | .320 |
| Prokofiev | 202 | 275 | 260 | **513** | 1271 | 202 | 281 | 926 | 150 | .398 |
| Puccini | 42 | 80 | 0 | 10 | 1221 | 29 | 0 | 0 | 42 | .818 |
| Purcell | 326 | 1309 | 0 | 107 | 493 | 0 | – | 404 | **611** | .517 |
| Rachmaninov | 149 | 258 | 158 | 462 | 216 | 109 | 152 | **15** | 209 | .312 |
| Rameau | 67 | 73 | 0 | 144 | 1917 | 0 | – | **859** | 144 | .703 |
| Ravel | 141 | 7 | 39 | 142 | 89 | 29 | 0 | 114 | 215 | .448 |
| Respighi | **436** | **197** | 305 | **177** | **1111** | 355 | 61 | 95 | 268 | .421 |
| Rimsky-Korsakov | 219 | 155 | 57 | **156** | 1904 | 161 | 92 | 22 | 193 | .617 |
| Rossini | 227 | **603** | **13** | 438 | 5444 | **44** | 0 | 41 | **787** | .749 |
| Roussel | 190 | 86 | 28 | 99 | 230 | 94 | 125 | 246 | 107 | .281 |
| Saint-Saëns | 583 | **733** | 373 | 590 | **1739** | 151 | 155 | 258 | **554** | .388 |
| Sarasate | 277 | 0 | 137 | 0 | 0 | 0 | 0 | 0 | 0 | .815 |
| Satie | 6 | 17 | 0 | 279 | 87 | **24** | 0 | 177 | 64 | .631 |
| Scarlatti, D. | 52 | **413** | 0 | 2083 | **565** | **46** | – | 0 | **695** | .648 |
| Schoenberg | 353 | 261 | 91 | 100 | 169 | 147 | 41 | 0 | 317 | .398 |
| Schubert | 935 | 945 | 27 | 1565 | **892** | 55 | 354 | 165 | 2328 | .486 |
| Schumann | 459 | 754 | 153 | 1177 | 130 | 44 | 150 | 53 | 710 | .496 |
| Scriabin | **3** | 0 | 27 | 571 | 0 | 21 | 177 | 0 | **5** | .798 |
| Shostakovich | 564 | **333** | 170 | 295 | 724 | 137 | 701 | **1421** | 266 | .383 |
| Sibelius | 798 | 433 | 78 | 479 | 40 | 339 | 212 | 393 | 287 | .347 |
| Smetana | 91 | **94** | 0 | **716** | 1068 | 175 | 45 | 0 | **30** | .677 |
| Strauss, J. Sr | 0 | 0 | 0 | 0 | 0 | **1599** | 0 | 0 | 0 | .889 |
| Strauss, J. Jr | 4 | **10** | 9 | 0 | **1682** | 2542 | 0 | 0 | **5** | .796 |
| Strauss, R. | 337 | 235 | 257 | 257 | 2055 | 480 | 168 | 290 | 702 | .440 |

*(continued)*

TABLE 2 (Continued)

| Composer | Chamber | Choral | Concerto | Keyboard | Opera | Orchestral | Symphony | Theater | Vocal | Gini coeff. |
|---|---|---|---|---|---|---|---|---|---|---|
| Stravinsky | 165 | 223 | 75 | 127 | 335 | 128 | 88 | 319 | 90 | .292 |
| Sullivan | 27 | 723 | 19 | **48** | 2157 | 315 | 36 | 267 | 261 | .658 |
| Szymanowski | 120 | 69 | 48 | 264 | **219** | **20** | 101 | 62 | 311 | .398 |
| Tchaikovsky | 232 | **249** | 232 | 451 | 1457 | 475 | 247 | 527 | 347 | .340 |
| Vaughan Williams | 301 | 917 | 172 | **200** | 537 | **285** | 359 | **604** | 274 | .292 |
| Verdi | 24 | 195 | 0 | **8** | 3629 | 0 | 0 | 0 | 118 | .859 |
| Vivaldi | 1059 | 874 | 4090 | **5** | **3184** | 305 | – | 0 | 330 | .645 |
| Wagner | 0 | 63 | 0 | 120 | 2683 | 124 | 57 | 17 | 98 | .798 |
| Weber | 182 | **329** | 209 | 374 | 671 | 10 | 44 | **211** | **235** | .388 |
| Webern | **242** | 34 | 0 | **125** | 0 | **110** | 9 | 0 | **162** | .588 |
| Wieniawski | **279** | 0 | 90 | 0 | 0 | 0 | 0 | 0 | **5** | .829 |
| Wolf | 65 | 69 | **20** | **93** | 109 | 25 | 0 | 30 | 814 | .671 |

*Note*: Estimates are in minutes and are based only on extant works. Entries in which more than 25% of the total is derived from generic sources (e.g., averages, genre-based weighting) rather than work-specific sources (e.g., recordings, scores) are in boldface. The Gini coefficient is a measure of 'versatility', with lower scores representing a more even distribution of output across genres (see text for details on the computation). A dash indicates cases in which a composer could not have written in a genre because the genre had not yet been invented; these were excluded from the Gini coefficient computation.

composers, C. P. E. Bach, Monteverdi and Purcell; when J. S. Bach's lost choral works were included, he outdistanced Handel by nearly 3000 minutes. Not surprisingly, Vivaldi dominated the concerto distribution, writing nearly four times as much as C. P. E. Bach and Mozart, who themselves considerably outdistanced the remaining composers. The distribution of keyboard music had a tighter upper tail, topped by C. P. E. Bach, D. Scarlatti, J. S. Bach, Liszt, and Schubert. Donizetti, Handel, and Rossini wrote the most operatic music, substantially more even than Vivaldi, Verdi, and Gluck (though Vivaldi took third place when lost operas were included). For orchestral music, Johann Strauss Jr dominated by a wide margin, followed by Johann Strauss Sr and Mozart. Haydn wrote over three times as much symphonic music as any other sampled composer; Mahler, Mozart and Shostakovich topped the remainder of the distribution. Shostakovich, Orff, Prokofiev, Britten and Rameau wrote the most theater music, with Rameau taking second place when lost works were included; however, time estimates for this category were less certain than for other genres. Finally, for vocal music, Schubert, Donizetti and Handel topped the list and were separated from all other composers by a wide margin.

## ILLUSTRATIVE ANALYSES

As noted above, beyond basic descriptive results, the database can also be used to test statistical hypotheses about the relations between productivity and other variables, such as historical year, eminence and extent of composer versatility. Several illustrative correlational analyses were performed.

Prior to analysis, the distributions for eminence and average annual output were checked for normality, because these variables typically show highly positively skewed distributions (Murray, 2003). The distribution of eminence scores departed substantially from normality (skewness = 2.38, standard error of skewness = 0.25, kurtosis = 6.26, standard error of kurtosis = 0.50), so scores were subjected to a natural logarithmic transformation, which normalized the distribution (skewness = 0.26, kurtosis = − 0.41). The distribution of average annual output was also non-normal (skewness = 2.63, standard error of skewness = 0.24, kurtosis = 7.11, standard error of kurtosis = 0.47) and was likewise natural logarithm-transformed, which corrected the problem (skewness = 0.73, kurtosis = 0.18). The distribution of versatility scores was also examined. Versatility was much closer to a normal distribution (skewness = 0.12, standard error of skewness = 0.24, kurtosis = − 1.06, standard error of kurtosis = 0.47) than the other variables. To examine the possibility of curvilinear relations between versatility and other variables (cf. Simonton, 2000), versatility scores were converted to standard scores and squared, yielding a quadratic versatility variable. To increase the sensitivity of the quadratic scores, the linear component of the quadratic scores was removed in the following way: standardized versatility scores were first used to predict the quadratic scores, and standardized residuals from this regression analysis were used in the analyses. A positive relation between quadratic versatility scores and another variable indicates a U-shaped function, in which composers who are extreme specialists and extreme generalists score highest on the second variable. A negative relation indicates an inverted U-shaped function, in which composers who are extreme specialists and extreme generalists score lowest on the second variable.

Across the entire sample, average annual output (*ln*-transformed) was reliably correlated with *ln*-transformed eminence, $r(89) = .42$, $p < .001$, and birth year, $r(100) = -.42$, $p < .001$, but not with versatility, $r(100) = -.02$, NS. Thus, overall, greater productivity was associated with higher eminence and an earlier birth year (consistent with Simonton, 1977b, 1991). Additionally, birth year was reliably correlated with *ln*-transformed eminence, $r(89) = -.32$, $p < .01$, and versatility, $r(100) = -.39$, $p < .001$, indicating that historically later composers are less eminent as well as more balanced in their output. The correlation between *ln*-transformed eminence and versatility was not reliable, $r(89) = .08$, NS. Quadratic versatility was not reliably associated with any of the other variables. When lost works were included in the computations, the analyses yielded very comparable results.

Does historical year affect the relation between eminence, productivity, and versatility? For instance, are productivity and versatility equally good predictors of eminence throughout the history of western music? To investigate this question in a rudimentary way, composers were divided into groups based on birth year, so that composers within each group belonged to the same basic period(s) of western music history (e.g., Baroque, Classical, Romantic, and 20th century). The sample included comparatively few Baroque and Classical period composers. To bolster statistical power, composers from those two periods were consolidated into the one group ($N = 19$); Beethoven, born in 1770, was the latest composer included in the group. As a transitional figure, Beethoven could also have justifiably been placed with the Romantic-era composers; however, his placement does not materially impact the results of either group. He was placed in the first group mainly to boost its sample size.

The second group ($N = 43$) consisted mainly of mainstream Romantic-era composers born between 1782 and 1860, inclusive. The third group ($N = 40$) consisted of composers born after 1860, who mainly created their most significant works in the 20th century. The year 1860 was set as a cut-point because composers born after 1860 would have reached age 40 after the year 1900; 40 is an important milestone in lifespan creativity, since on average creators are most productive and most likely to make important contributions around that age (Murray, 2003; Simonton, 1997). Thus, besides keeping the sample sizes of the last two groups similar, the 1860 cut-point is also theoretically motivated to identify 20th-century composers.

The three groups were compared on each variable. The results reinforce the correlations involving birth year described above. For *ln*-transformed average annual output, $F\ (2,\ 99) = 15.29$, $p < .001$, $\eta^2 = .24$, a large effect size; $M(\mathrm{SD}) = 0.42\ (0.89), -0.23(0.76)$, and $-0.63\ (0.49)$ for the three groups, in historical order; Tukey-Kramer post hoc comparisons showed significant differences between the Baroque/Classical and each of the other two groups, which themselves showed a marginally reliable difference ($p = .076$). For *ln*-transformed eminence, $F(2, 88) = 5.78$, $p < .01$, $\eta^2 = .12$, a medium to large effect size; $M(SD) = 2.98(1.04), 2.60(0.83)$, and $2.16(0.80)$ for the three groups, in historical order; Tukey-Kramer post hoc comparisons revealed a reliable difference only between Baroque/Classical and 20th-century composers. For versatility, $F(2, 99) = 18.28$, $p < .001$, $\eta^2 = .27$, a large effect size; $M(SD) = 0.42(0.77),\ 0.42(0.95)$, and $-0.63\ (0.71)$ for the three groups, in

historical order; Tukey-Kramer post hoc comparisons revealed reliable differences between 20th-century composers and each of the other groups. For quadratic versatility, $F(2, 99) = 0.82$, NS, $\eta^2 = .02$, a small effect size.

Correlations among the variables for each group of composers were also examined. Within each group of composers, versatility *z* scores and quadratic versatility scores were recomputed using only data from the composers in that group. Correlations among the variables for the first two groups (Baroque/Classical and Romantic) are shown in Table 3, and they refine the general results reported above. For the Baroque- and Classical-era composers, greater average annual output was reliably associated with a later birth date and greater versatility; greater average annual output was also marginally significantly associated with greater eminence ($p = .06$). Versatility was marginally negatively correlated with both eminence and birth year, indicating that more versatile composers were somewhat less eminent and earlier born. Quadratic versatility was marginally positively correlated with birth year, indicating that later composers in this group showed a greater tendency to be either more specialized (e.g., Gluck and Boccherini) or more versatile (e.g., Mozart and J. C. Bach) than earlier composers. No other correlations were reliable.

The pattern of correlations among Romantic-era composers was somewhat different. Average annual output was again positively correlated with eminence; however, in contrast to the earlier composers, output was negatively associated with birth year. Birth year was also negatively correlated with eminence among Romantic-era composers, in contrast to a non-significant positive correlation in the first group. Finally, quadratic versatility was marginally positively associated with eminence. No other correlations were reliable.

Interestingly, the pattern of correlations among 20th-century composers differed substantially from either of the other groups: in this sub-sample *none* of the correlations between any of the variables were statistically reliable ($p < .05$). The correlations between *ln*-transformed average annual output and *ln*-transformed eminence, birth year, versatility, and quadratic versatility, respectively, were .000, −.035, −.280, and −.108; the correlations between *ln*-transformed eminence and birth year, versatility, and quadratic versatility, respectively, were .020, .021, and −.200; the correlations between birth year and versatility and quadratic versatility, respectively, were −.069 and −.055 (d.f. = 33 for correlations involving eminence; d.f. = 38 for all other correlations for this group). The only correlation that was even marginally reliable was between *ln*-transformed average annual output and versatility ($r = -.280$, $p = .08$). This result suggests a slight trend for more productive 20th-century composers to be more balanced in their output (since a high Gini coefficient indicates an unbalanced output across genres). In general, however, 20th-century composers showed a markedly weaker pattern of associations among the variables than did composers in earlier epochs.

These patterns of correlations were robust when lost works were included and/or when composers with no eminence ratings were excluded from the samples, except that the negative relation between birth year and quadratic versatility was not consistently reliable across analyses of Romantic-era composers.

TABLE 3 *Correlations between average annual output, eminence, birth year and versatility, for Baroque/Classical- and Romantic-era composers*

| | *ln* avg. annual output | *ln* eminence | Birth year | Versatility | Quadratic versatility |
|---|---|---|---|---|---|
| *ln* Avg. Annual Output | – | .457(*) | .569* | −.558* | .096 |
| *ln* Eminence | .388* | – | .174 | −.403(*) | .246 |
| Birth year | −.501** | −.460** | – | −.400(*) | .401(*) |
| Versatility | −.214 | −.034 | −.092 | – | .000 |
| Quadratic Versatility | .175 | .332* | −.227 | .000 | – |

*Note.* *$p < .05$, **$p < .01$, (*) $p < .10$. Correlations above the diagonal are for the 19 Baroque- or Classical-era composers born in 1770 or earlier (d.f. = 16 for correlations involving eminence; d.f. = 17 for all other correlations). Correlations below the diagonal are for the 43 Romantic-era composers (d.f. = 36 for correlations involving eminence; d.f. = 41 for all other correlations). Lost works are not included in these computations.

## *Discussion*

The main purpose of this report was simply to provide accurate estimates of the total and genre-by-genre performance time outputs of a sample of classical composers. The data consolidated here may be used as a reference by other researchers investigating creative productivity in composers. Comparable published databases include estimates of the 'listener-hour' frequency with which the music of 100 composers can be heard (Moles, 1966/1958, pp. 28–29), eminence ratings of 522 composers based on citations in music references (Murray, 2003), rankings of the perceived greatness of 99 composers based on surveys of members of the American Musicological Society (Farnsworth, 1969, p. 228), aesthetic significance and listener accessibility ratings for several thousand classical pieces (Halsey, 1976), tabulations of average note-transition probabilities in a sample of over 15,000 classical melodies (Simonton, 1984) and measures of the degree to which 57 composers showed typical left- versus right-hemisphere traits, as rated by a sample of musicologists (Petrov & Danilova, 2004).

The descriptive results yielded estimates of the most prolific composers overall and within nine musical genres. Interestingly, some of the totals deviated considerably from another list of the estimated performance time output of the 11 'most prolific classical composers', based on a survey conducted by *Classical Music* magazine (reported in Ash, 2003, p. 148). Those estimates were generally higher than the ones reported here, even when lost works are included in the present totals. The largest discrepancies were for Haydn, Purcell, Handel, Beethoven, Mozart and Verdi, with differences of 130, 62, 50, 38, 29, and 20 hours, respectively. Reasons for the discrepancies are unclear and will remain so without more information on the method of estimating output in the earlier survey.

While this investigation attempted to refine earlier methods of estimating composers' outputs by using performance time rather than counts of melodies in thematic dictionaries, counts of individual works, or estimates based on different uniform weights for different musical genres, a performance time measure also has arguable limitations. First, sources such as CD recordings will naturally show variation in performance time, depending on which performance is chosen; however, variability exists in other measures as well, and there is no reason to expect a unique systematic bias in the present measure. Second, it might be objected that performance time trivializes composers' efforts in scoring and orchestration, and that a piano piece and an orchestral piece of the same duration should not be equally weighted. However, to some extent, this problem could be overcome by separating works by genre (as in Table 2) and differentially weighting genres to reflect differences in performance forces. Similarly, one might object that some music is structurally denser and more complex than other music, and that performance time by itself ignores this distinction. This is certainly true to some extent. However, this seems largely a between-composers issue. Relatively few cases spring to mind of a composer routinely and systematically writing in a far more concentrated way in shorter pieces compared to longer ones, though this is probably true for Anton Webern, whose mature serial works are more focused and laconic than his late Romantic juvenilia, and it might arguably be the case for composers such as Beethoven or Wagner, whose musical language evolved considerably over the course of their careers (see also Simonton,

1980). However, such critiques are again not unique to a performance time measure but can also be applied to other prior operationalizations of productivity.

Results from the correlational analyses are largely consistent with previous work (e.g., Simonton, 1977b, 1991, 2000) and with intuitions about the relation between some of these variables. For instance, the overall negative correlation between birth year and productivity was not very surprising (since historically later composers writing in more complex idioms will likely compose less music on average) and, indeed, helps to validate the present database. However, some additional trans-historical trends were evident, especially for the versatility variables, which qualify the basic findings. For instance, greater productivity was associated with greater versatility, but only among Baroque- and Classical-era composers (and, to a marginal extent, 20th-century composers).

Moreover, average annual productivity and quadratic versatility both increased during the Baroque and Classical eras; average annual productivity then decreased, along with eminence, throughout the Romantic era. The U-shaped relation between eminence and versatility observed among Romantic composers is partly consistent with the J-shaped relations between these variables found in Simonton's (2000) analysis of the aesthetic success of operas and Sulloway's (1996) finding that the most eminent scientists tend to be either the most versatile or specialized, in terms of the number of domains to which they contributed, with the advantage favoring the most versatile.

In contrast to earlier periods, 20th-century composers showed no reliable correlations on any of the measured variables, suggesting that the dynamic between productivity, eminence and versatility has evolved over time. A key aspect of this dynamic may be the kind of demands made on composers and how they have responded to them. Since the Renaissance, music has clearly become more complex on virtually every criterion: melodic originality, harmony, rhythm, meter, structural intricacy, freedom of form and orchestration (Grout, 2001; Machlis, 1979; Martindale, 1990; Simonton, 1980), which is surely related to the observed trans-historical decline in productivity. Earlier composers were often required to write a great quantity of music simply to make their living or reputation; since many worked for patrons, a premium was not necessarily set on bold innovation, and they could gradually develop a style by composing numerous rather similar works.

In contrast, later composers, especially in the 20th century, have on average written less music overall but have simultaneously composed in a wider variety of genres; they have also had to respond to greater pressure for novelty than did earlier generations (Machlis, 1979). This appears to have favored composers who are rather rapidly able to find new means of expression. Because of lower productivity and greater versatility compared to earlier eras, these new means of expression are typically not evolved over long series of similar compositions; instead breakthroughs are often encapsulated in individual flagship works.

This kind of approach to creativity resembles that of a particular type of creator, namely, 'conceptual innovators' or 'finders', described in detail by Galenson (2001, 2005) in several domains. Galenson discovered that these individuals frequently create their most renowned works at relatively young ages. Interestingly, Simonton (1991) found that historically more recent composers showed a tendency to have written their most renowned work at younger ages, at least for a composite citation measure, though not for a measure based on Halsey's (1976) aesthetic significance

ratings. A decline in age at most renowned hit would be consistent with an increasing prevalence of 'conceptual' composers in the 20th century and with a change in the dynamic of eminence that de-emphasizes raw productivity in a more limited range of genres, as suggested by the present results. Several prominent 20th century composers are probably good candidates for Galenson's category of conceptual innovators, perhaps especially Stravinsky and Schoenberg, both of whom made some of their most important contributions (*L'oiseau de feu*, *Petrouchka* and *Le sacre du printemps*, and *Verklärte Nacht*, *String Quartet #1* and *Chamber Symphony #1*, respectively) by their early 30s. However, more detailed analyses are needed to support these claims confidently.

The analyses reported here inform these issues in a fairly rudimentary way, but the data in Tables 1 and 2, supplemented by the appendix, could also be incorporated into more sophisticated multi-level statistical analyses, which are beyond the scope of this investigation. For instance, one important and somewhat controversial issue in the study of creative productivity is why the abilities of some creators appear to improve with age, while others decline (Galenson, 2001, 2005; Zickar & Slaughter, 1999). Composers' career trajectories were not addressed in the present study; however, such questions can be quantitatively addressed through the statistical method of hierarchical linear modeling (Raudenbusch & Bryk, 2002). In this technique, composer-level variables such as birth year, eminence, productivity and versatility are used to predict individual composers' career trajectories, which can be operationalized by how aesthetic success measures (Kozbelt, 2005; Simonton, 1986) or the ratio of masterpiece-level music to total music composed in a given time interval (Kozbelt, 2004, 2005; Simonton, 1977a) vary as a function of age or musical experience. Such analyses would yield direct, quantitative answers to questions about which factors are associated with improvements or declines in creativity. Obviously, such composer-level variables will yield the most valid results when they are measured with the greatest precision, as has been attempted here.

In the future, estimates for individual composers can be refined as more obscure pieces are recorded (or otherwise documented) and as some works previously thought lost are rediscovered, as happened with Vivaldi's opera *Montezuma* in 2002. As additional information becomes available, the sample could also be extended to include other productive, eminent composers such as Marc-Antoine Charpentier, Cherubini, Gounod, Honegger, Hummel, Lully, Meyerbeer, Milhaud, Palestrina, Alessandro Scarlatti and Telemann, reputedly the most prolific composer of all. In the meantime, the present dataset may serve as a provisional summary of some composers' creative productivity.

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## *Appendix: Approximate performance time estimates for lost works of each composer*

Albéniz: choral (40 min), keyboard (100 min), opera (140 min)
Bach, J. S.: choral: approximately 100 cantatas (2000 min), *St. Mark Passion* (100 min)
Bach, W. F.: choral (100 min)
Balakirev: chamber (30 min)
Bartók: chamber (80 min), symphony (40 min)
Beethoven: concerto (20 min)
Berlioz: chamber (40 min), choral (60 min), opera (60 min), vocal (50 min)
Bernstein: opera (100 min), theater (30 min)
Bizet: choral (70 min), opera (100 min), orchestral (10 min)
Boccherini: theater (20 min)
Bruch: chamber (120 min), choral (50 min), orchestral (110 min); others, genres unspecified
Busoni: keyboard (120 min)
Dvořák: chamber (100 min), choral (40 min)
Falla: opera (240 min), theater (40 min)
Glinka: orchestral (30 min)
Gluck: theater (20 min)
Handel: opera (500 min)
Haydn: chamber (400 min), choral (100 min), concerti (150 min), keyboard (100 min), opera (500 min)
Hindemith: chamber (40 min), keyboard (40 min), theater (60 min)
Janáček: chamber (60 min), choral (40 min), keyboard (100 min), opera (30 min), vocal (30 min)
Kodály: orchestral (10 min), theater (20 min)
Lalo: symphony (60 min)
Monteverdi: choral (30 min), opera (460 min), theater (40 min)
Mozart: concerto (20 min), keyboard (50 min), orchestral (100 min), symphony (50 min)
Mussorgsky: keyboard (40 min)
Orff: numerous early songs (no further information available)
Paganini: chamber (120 min), concerto (30 min)
Rameau: opera (500 min), theater (200 min)
Ravel: vocal (25 min)
Roussel: chamber (40 min), keyboard (10 min)

Scarlatti, D.: choral (300 min), opera (600 min)
Schubert: chamber (70 min), keyboard (110 min)
Sibelius: symphony (20 min)
Smetana: chamber (30 min), keyboard (40 min)
Strauss, R.: chamber (30 min), keyboard (40 min)
Szymanowski: chamber (20 min)
Tchaikovsky: theater (50 min)
Vaughan Williams: orchestral (30 min)
Verdi: orchestral (10 min), vocal (40 min)
Vivaldi: choral (280 min), concerto (130 min), opera (3600 min)
Wagner: chamber (20 min), keyboard (40 min), orchestral (50 min), vocal (50 min)
Weber: chamber (80 min), keyboard (130 min), opera (140 min), theater (30 min)
Wolf: choral (10min), keyboard (20min), symphony (40min)

*Note*: Time estimates for lost works are necessarily quite speculative and are mainly derived from averages of similar works or Simonton's (1977a) genre-based system. Fragments and cases where lost works amounted to a negligible proportion of a composer-genre combination are not included.

AARON KOZBELT (PhD, University of Chicago, 2002) is Associate Professor of Psychology and the Bernard H. Stern Professor in Humor at Brooklyn College of the City University of New York. His general research foci are creativity, expertise, and cognition in the arts. His research on the psychology of music mainly involves archival analyses of classical composers' outputs, their career trajectories, and self-evaluations.
*Address*: Psychology Department, Brooklyn College – CUNY, 2900 Bedford Avenue, Brooklyn, NY 11210-2889, USA. [email: AaronK@brooklyn.cuny.edu]