

Johann Sebastian Bach’s Music is Speeding Up: Fake News?

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Abstract—This study in cultural informatics investigates the claim made in 2018 by several news media that performances of Johann Sebastian Bach’s *Double Concerto in D Minor*, his compositions in general, and of classical music as a whole are becoming ever faster. Data for a total number of 19,660 releases in five of Bach’s compositional categories from between 1950 and 2019 are retrieved from online database Discogs, of which 2,999 are analyzed historically for speed increase. For the *Double Concerto*, we do find a slight speedup, but surprisingly enough, West European recordings speed up much more than non-West European recordings. And whereas the *Brandenburg Concertos* and several cantatas do speed up significantly, the *Trio Sonatas for Organ and Suites for Cello Solo* actually tend to *slow down*. We review the original claims in light of this new evidence, and contextualize our findings by relating to studies on musical development, the pace of life in urbanized communities, and begin to construct a scientific hypothesis for explaining our findings.

Keywords—*Music; Tempo; Violin Concerto; BWV 1043; Bach; Data Analysis; Online Data Retrieval; Fake News.*

I. INTRODUCTION

Johann Sebastian Bach (1685-1750) is undoubtedly one of most revered classical composers in our time. Spanning nearly 1100 compositions ranging from huge oratoria such as the *Saint Matthew Passion, BWV 244* through *Brandenburg Concertos, BWV 1046 - 1051* to works as small as the *Sonatas and Partitas, BWV 1001 - 1006* written for a single violin only, many regard these works as the best that classical music has to offer. Today, all of Bach’s compositions have been conveniently indexed by a BWV (Bach-Werke-Verzeichnis, literally *Bach works catalogue*) numbering, categorizing the late master’s work in different genres like cantatas, concertos, or harpsichord works. But the details of everyday performance are not undisputed; many classical compositions have separate *movements*, which are often annotated with a ‘tempo’ or ‘style’ indication. Traditionally, in Italian (even for German composers), annotations, such as *presto* (‘rapidly’), *adagio* (‘slowly’), *vivace* (‘lively’) and *allegro* (‘cheerful’) leave plenty of room for interpretation on behalf of the musician (see Figure 1).

Late 2018, several news articles appeared claiming that the compositions of Bach, and classical music in general, are being performed ever faster. First published by the *Rolling Stone*, the article featured a record label’s study showing “performances of Bach are almost 30 percent faster than they were 50 years ago” [1]. From there, the news spread like wildfire. An article on *iNews - Britains Most Trusted Digital News Brand* claimed that “performances of classical music [...] are now one third

quicker than they were 50 years ago” [2]. They also cite a highly positioned music scholar when giving an explanation: “It’s a basic change in taste from the rather weighty concert style of previous years towards something that is more light, airy and flexible.” Or, as the international radio station *Classic FM* so aptly phrased it: “classical music performances are taken at a greater lick” [3]. Even more confident was broadcaster *WQXR*, stating that “Bach is undoubtedly getting faster” and like *Rolling Stone*, they also provide an explanation for the speedup: “Society speeds up? Music speeds up.” But even research institutions like the *Smithsonian Institution*, administered by the US Government, reported the news [4]. “Johann Sebastian Bach’s music may be timeless, but [...] even the compositions of [Bach] are not immune to today’s breakneck speed of life.” and “Clock the last 40 years and you’ll find the beat getting relentlessly faster.”

So Bach’s music, or classical music in general, is speeding up because life is speeding up. Interesting find, but the problem is that it isn’t true. Or partially, at best. Or for some recordings of some concertos released at some places only, to be precise. The news published by *Classic FM*, *WQXR* and *Smithsonian* all refer back to *Rolling Stone*, which appears to be the source of the news, but the lack of (academic) references, the apparently thin basis for the conclusions (three recordings of Bach’s *Double Violin Concerto in D Minor, BWV 1043*) and the seemingly reckless adoption of the news by other media raises questions about the scientific validity of the claims. Is Bach’s music really speeding up lately, or is this another prime example of *fake news*?

Fake news is a denomination that has seen a rapid increase since the 2016 United States presidential election, even though it conceptually existed long before [5]. Historically, the term has been used to describe disinformation serving different goals than objective reporting, such as political gains or social unrest. In the ages of digitization, fake news seems to find its way to people much easier, with visits to fake news sites originating from social media at a much higher rate than visits to real news sites [6]. It is estimated that in the months prior to the 2016 U.S. elections, every American adult had been exposed to at least one fake news story [7].

Even though fake news only reaches a small part of the overall audience [6] [8], Facebook and other social media started tagging and removing fake news in order to combat the distribution of mis- and disinformation [9]. Despite these efforts, scientists Gordon Pennycook and David Rand found that tagging fake news stories creates an *implied truth effect*:



Figure 1. **Left:** the only known genuine portrait German composer of J.S. Bach, painted by E.G Haussmann. **Middle:** cutouts from the manuscript of Bach’s Double Violin Concerto show tempo indications “Vivace” (“lively”) and “Allegro” (“cheerful”) which leave plenty of room for interpretation. **Right:** the article from Rolling Stone claiming enormous speedups in performances of Bach’s work (image edited for size purposes).

once a story is *not* tagged as fake news, it is more likely to be deemed reliable [10]. An earlier study at McMaster University found that a statement, whether true or false, is more likely to be believed if it expresses information that ‘feels familiar’ [11]. But repetition also results in something like an implied truth effect: in an experiment by Frederick Bacon, people were given a number of statements and told that half of these were false. Even with this explicit beforehand instruction, people rated the repeated statements to be more reliable [12]. In Danielle Polage’s experiment “Making up History: False Memories of Fake News Stories”, half of the subjects were given a fake news story to read [13]. Five weeks later, the exposed subjects did not only find it to be more believable than the control group, but they were even more likely to believe that they actually heard the story from a source *outside* of the experiment. But most famous in this context might be the groundbreaking work by American psychologist Elizabeth Loftus. Her team has done extensive research on ‘false memories’, and found that people’s recollection of an episode might be corrupted even from hearing disinformation afterwards [14]. These studies collectively show that human memory is dynamic, susceptible to disinformation, and can easily integrate fake news as genuine facts – even to the extent of one’s personal history.

Regrettably though, efforts of verification seldomly find their way to the audience most susceptible to fake news [8]. Fact checking, dismissing false claims and disposing of mis- and disinformation are at the core of scientific practice. It is therefore hard to overstate the shock that went through the academic world when Dutch social psychologist Diederik Stapel was found to have engaged in large scale fact fraud, and as of 2019, almost 60 of his publications have been retracted [15] [16]. Since then, verification and the replicability of research is seriously gaining traction, as witnessed in the expansive work described in a publication by 24 authors reproducing 21 social science studies from *Nature* and *Science* [17]. But also economic disciplines do not escape scrutiny and

more recently, even famous computer science experiments are being rigorously replicated, and even extended [18] [19]. An interesting related development is the observation by Sacha Epskamp from University of Amsterdam, that shows fast-paced development of methodological developments and software implementations might both facilitate and undermine replicability [20]. Though Epskamp does not explicitly quantify the term ‘fast-paced’, it is an interesting observation that the pace of development appears to be speeding up in scientific replicability too.

With a much more light-hearted objective, we aim to contribute to the practice of fact finding by checking whether Bach’s Double Violin Concerto is indeed being performed at an ever faster pace, such as reported by Rolling Stone and others. We will also investigate the more general claim that Bach’s other compositions (or indeed all classical music) are speeding up by analyzing his other two Violin Concertos, the six Brandenburg Concertos, six well-known cantatas, the six Trio Sonatas for Organ and the six Suites for Cello Solo. Together, these categories cover a broad variety of compositions with variations in ensemble sizes, instrumentations and ‘compositional details’, such as polyphony, the number of movements, and whether dedicated to liturgical service or attaining a more secular occasion. We retrieve data for a total of 19,660 Bach recordings released between 1950 and 2019 and analyze the historical development of their duration.

The rest of this paper is organized as follows: in Section II, the methods for retrieving and analyzing the releases of Bach’s works are detailed. The results of this analysis are presented in Section III, where we also discuss possible explanations for the found results. Finally, the conclusions of our research are laid out in Section IV.

II. METHODS

The growth of the Internet and public availability of data is both a blessing and a curse for scientists. *Discogs* is a community-driven online database owned by Zink Media

TABLE I. THE NUMBER OF RELEASES IN THE DATA SET RETRIEVED FROM DISCOGS ('TOTAL') AND AFTER FILTERING ('USED') FOR EACH COMPOSITION IN THIS STUDY.

	Composition	Total	Used	Percentage
Violin	BWV1041	893	149	16.685%
	BWV1042	901	149	16.537%
	BWV1043	1120	169	15.089%
Brandenburg	BWV1046	1008	227	22.520%
	BWV1047	1279	284	22.205%
	BWV1048	1257	275	21.877%
	BWV1049	1019	223	21.884%
	BWV1050	1116	263	23.566%
	BWV1051	911	205	22.503%
Cantatas	BWV106	918	34	3.703%
	BWV131	414	28	6.763%
	BWV140	756	45	5.952%
	BWV170	309	24	7.767%
	BWV173	549	10	1.821%
	BWV208	525	6	1.143%
Organ Trio S.	BWV525	713	61	8.555%
	BWV526	410	47	11.463%
	BWV527	346	47	13.584%
	BWV528	684	53	7.749%
	BWV529	368	54	14.674%
	BWV530	462	53	11.472%
Cello Suites	BWV1007	748	110	14.706%
	BWV1008	514	99	19.261%
	BWV1009	635	102	16.063%
	BWV1010	520	89	17.115%
	BWV1011	635	100	15.748%
	BWV1012	650	93	14.308%

containing more than 11 million Digital Data Locations (DDL) for audio recordings such as CD's, vinyl, digital bootlegs and promotional releases [21]. It is publicly accessible and offers an open Application Programming Interface (API), which can be used to query the database, making it suitable for quantitative analysis of historical releases [22]. Since Discogs offers a large quantity of different types of recordings, this source forms a valid representation of recordings from this era.

In order to retrieve the DDLs from Discogs, a search query is first sent to the API containing a search term (e.g., "BWV 1043") which then returns a list of DDLs. Each DDL contains a pointer to the information from exactly one release, which can then be downloaded separately to obtain details about the recording.

Since Discogs is widely accessible without central moderation, the retrieved data might be invalid, incorrect or incomplete. One can therefore hardly escape the laborious task of manually sifting through the data returned by the API after issuing a query. To be suitable for analysis, the DDL has to meet three requirements:

- The DDL's data must include a **year** of release;
- The DDL's data must contain the **entire work**, and not just a single movement;
- Every used track in the DDL's data must contain a valid value in their **duration** field.

In order to (in)validate the results research reported by the various news media from Section I, we retrieved a total of 1120 releases from between 1958 and 2018 of Bach's Double Violin Concerto. After manually filtering the DDLs, 169 valid, complete and correct data records were used for linear regression, plotting duration against year of release

(see Table I). The applied method is as follows: for dataset D , containing the DDLs with their years of release x and associated durations y , a straight line

$$f(x) = a \cdot x + b \quad (1)$$

is fitted, where x denotes the year for which the fit is calculated. Values for a and b are calculated by

$$a = \frac{\sum_{i \in D} ((x_i - \text{mean}(\mathbf{x})) \cdot (y_i - \text{mean}(\mathbf{y})))}{\sum_{i \in D} ((x_i - \text{mean}(\mathbf{x}))^2)} \quad (2)$$

$$b = \text{mean}(\mathbf{y}) - a \cdot \text{mean}(\mathbf{x}). \quad (3)$$

For the Double Violin Concerto, the three movements (*Vivace*, *Largo ma non tanto* and *Allegro*) were also analyzed separately. To compare results to Bach's other two violin concertos, 893 and 901 releases for *BWV 1041* and *BWV 1042* from between 1955 and 2018 were retrieved, from which 149 and 149 suitable data records were analyzed in similar fashion (see Table III).

Widening the scope, we extended the investigation to four more compositional categories, some of which are very different from the violin concertos. The second category, the six *Brandenburg Concertos*, *BWV 1046 - 1051* are compositions of ensemble sizes comparable to the violin concertos, but with very different instrumentations including oboes, fagottos, trumpets, horns and "echo flutes". For this category, we retrieved 6590 DDLs of which 1477 (equalling 22.41%) were usable after manually filtering the data.

Third was a collection of six popular cantatas (BWV 106, 131, 140, 170, 173 and 208), compositions that involve vocal soloists, duets and choirs. Though ensemble sizes can vary considerably from one recording to the next, cantatas are usually performed by significantly more musicians than both the violin and Brandenburg concertos. This specific selection of cantatas was partially enforced by the Discogs API which does not facilitate prefix free queries, and by the number of DDLs available for each cantata, which might reflect its popularity (see Table I). Although very many of the retrieved cantata DDLs contained a value for 'year', very few of those also had a value for 'duration', thereby still resulting in high dismissal; of 3471 retrieved DDLs, only 147 yielded suitable data, a mere 4.24%.

The fourth category was made up by the six *Trio Sonatas for Organ*, *BWV 525 - 530*. Although performed by only one musician, Bach's organ compositions can be considered to be of 'near-equal complexity' to his concertos; in fact, organ-solo arrangements exist for several of Bach's concertos, including BWV 1043. For this category, we retrieved 2983 DDLs of which 315 were usable after filtering, corresponding to a post-filter usability of 10.56%.

The fifth and final category is made up by data records for the six *Cello Suites*, *BWV 1007 - 1012*. These works, written for a single cellist only, largely consist of isolated melody lines accompanied by the accidental harmonization. Though Bach somehow managed to weave a sophisticated polyphonic style even in these sparse compositions, they are undoubtedly belong to the 'smallest' of Bach's works. This category holds

TABLE II. THE NUMBER OF RELEASES PER CONTINENT FOR EACH OF THE VIOLIN CONCERTOS BWV 1041 & 1042, AND THE DOUBLE CONCERTO BWV 1043.

Composition	Continent	Number of releases
BWV1041	West-Europe	119
	East-Europe	9
	North America	12
	Australia	3
	Asia	1
	South America	1
	Unknown	4
BWV1042	West-Europe	114
	East-Europe	8
	North America	17
	Australia	4
	Asia	1
	South America	1
	Unknown	4
BWV1043	West-Europe	126
	East-Europe	5
	North America	25
	Australia	3
	Asia	3
	South America	2
	Unknown	5

593 data points after filtering, which corresponds to 16.02% of 3702 retrieved DDLs.

A subset of the retrieved entries from the filtered data set contained a value in the “country” field, indicating where the release was originally issued. Even though many individual countries are too thinly represented for significant analysis, collectively the values might provide some additional insight into our data (see Table II). We separately analyzed the West European releases, and categorized all others as either non-West European or ‘unknown’. Finally, all data used for the calculations in this section has been made publicly available for reproduction, replication and further investigation of our results [23].

III. RESULTS AND DISCUSSION

From the analysis as reported in Section II, it appears out that the reported speedup of the Double Violin Concerto contains a grain of truth, be it a tiny one. With a 5.31% decrease in duration over 169 recordings from between 1958 and 2018, performances of the work have indeed sped up slightly in the past 60 years (see Table III). This effect is not confined to any single one of its movements, with the duration of the *Vivace* decreasing by 5.09%, the *Largo* decreasing by 3.63% and the final *Allegro* movement decreasing by 8.45%. The speedup of this concerto however, is much more prominent in West European releases (10.74%) than in non-West European releases (4.85%) (see Figure 2). But the pattern is not entirely uniform across the violin concertos as a category. Although like the Double Concerto, recordings of the *Violin Concerto in E Major, BWV 1042* sped up, by an average of 7.40% between 1955 and 2018, recordings the *Violin Concerto in A Minor, BWV 1041* are actually *slowing down* on average, with a duration increase of 0.40% over the same period.

The Brandenburg Concertos are the only category in this investigation which have consistently been speeding up in recent history. But whereas the recordings of all concertos show a decrease in duration between 1953 and 2018, there are significant differences between the individual concertos,

with BWV 1048 showing a double-digit decrease in duration and BWV 1047 a mere 3.19%. But in this category too, the speedup appears to be mainly a West European phenomenon, with two of the concertos slowing down in non-West European releases. The six cantatas of this study show a rather eccentric pattern; although BWV 106, 131, 140 and especially BWV 173 show significant speedups, the other two (BWV 170 and 208) show a moderate slowdown in the period from 1957 to 2018.

Quite contrarily to the Violin and Brandenburg Concertos, recordings of the Trio Sonatas for Organ have slowed down considerably around the world. Showing an average increase in duration of 7.15% between 1950 and 2018, the only outlier in this category is BWV 529, which shows a slight decrease of 3.98% in duration. Similarly, the Cello Suites have also slowed down up in recent history. On average, the duration recordings of these works have increased by 3.30%. Here, only BWV 1008 shows a decrease in duration of 8.29%, whereas BWV 1012 slowed down 10.87%. Moreover, the only speedups of these works are found in West European recordings; the rest of the world is actually slowing down.

The geographical origin of the releases appears to be an important indicator for its tempo development. Of the 27 compositions we analyzed, 18 compositions (66.6%) have increased in speed of performance in West European releases. However, the non-West European releases of the same 27 compositions, less than half (13 performances, 48.1%) could be confirmed speeding up. Three cantatas have insufficient non-European data though; excluding these brings the total to 13 out of 24 (54.2%). These numbers give rise to the interesting question if (or why) the speedups and slowdowns are related to the specific location, demographic or culture in which a release is being issued. But still, even for the works with the largest speedup across all categories in this investigation, cantata “*Erhöhtes Fleisch und Blut*”, BWV 173, the decline in duration (18.39%) is nowhere near the 30% figure reported by the Rolling Stone and others.

The root of the difference might be the sparsity of the source data. The findings as presented by Rolling Stone were based on just three releases of BWV 1043: the version by David & Igor Oistrakh (1961, 17:15), one by Arthur Grumiaux & Herman Krebbers (1978, 15:42) and most recently Nemanja Radulovic & Tijana Milosevic (2016, 12:34), indeed showing a 27.06% decrease in duration. However, if we cherry pick three different releases from Discogs roughly covering the same era (Milstein & Morini (1965, 15:40), Suske & Kröhner (1980, 16:42), Menuhin & Oistrakh (2016, 18:41)), the duration actually shows an *increase* of 19.19%. So, it seems that a set of three data points is simply too small for any definitive conclusions.

Music is changing though. A paper by Serra et al. [24] studied contemporary popular music between 1955 and 2010 using the Million Song Dataset [25]. By analyzing pitch, loudness and timbre, the researchers conclude that contemporary popular music develops towards less variety in pitch transitions and a more uniform timbre. Especially the loudness of pop songs has increased between 1965 and 2005, a trend which is sometimes dubbed the “loudness war, a terminology that is used to describe the apparent competition to release recordings with increasing loudness, perhaps with the aim of catching potential customers attention” [24].

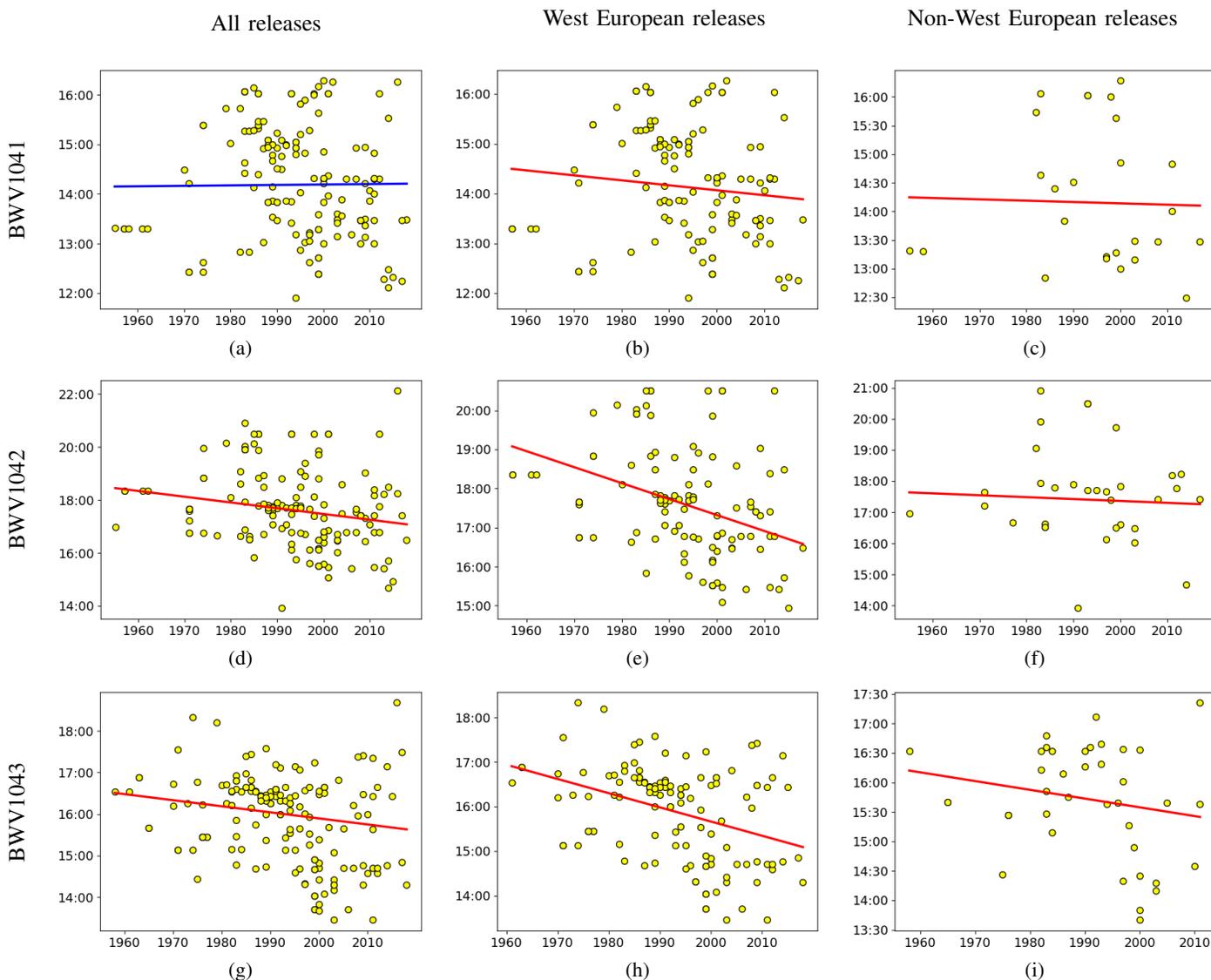


Figure 2. Speed development in Bach’s (Double) Violin Concertos over the period 1955 - 2018. Generally speaking, both for the Double Concerto (Figures 2g, 2h and 2i) and the Violin Concerto in E Major (Figures 2d, 2e and 2f), newer releases tend to be faster, but the effect is much stronger in Western Europe than elsewhere. The Violin Concerto in A Minor (Figures 2a, 2b and 2c) actually slows down a bit, even though both regional subsets speed up slightly.

In a report by Hubert Léveillé Gauvin, 303 U.S. top-10 singles from the period between 1986 and 2015 have been compared on various temporal properties like overall tempo (measured in BPM), time before the first lyrics, and time before the title is first mentioned. The study found that “attention-grabbing [tempo] principles” such as overall speed increased significantly, possibly driven by the “attention economy” [26]. But the speedup here is different, because classical music involves new recordings of the same old ‘songs’, whereas for most U.S. pop songs are first releases. Furthermore, their data set covers *American* pop songs, which are technically speaking from a different culture than West European classical music, so a definite relation is hard to forge. Still, the speedup in pop songs for the hypothesized purpose of attention-grabbing is too alluring to be left unnoticed in light of our findings.

And how could demographics play a role in the speedup of some of Bach’s works? Is the “pace of life” or the “speedup

of society” to blame, as mentioned by the (experts in) various news media? There is some relevant scientific research. In a study by Levine and Norenzayan, the average pace of life, measured in walking speed, working speed, and the accuracy of clocks, has been investigated for 31 countries [27]. The researchers found significantly higher values in both Japan and the countries of Western Europe. The famous study “Growth, Innovation, Scaling, and the Pace of Life in Cities” by Bettencourt et al. shows that the population size of a city is positively related to its pace of social life [28]. With ever increasing numbers living in urban areas over the last century, especially in Western Europe, this would imply that the regional pace of social life is increasing accordingly [29]. The recent explosive growth of urbanization now has 80% of the European population living in urban areas, especially in Northern and Western parts [30]. A particularly interesting detail about this study, by Marc Antrop from University of Ghent, is that it covers an era

TABLE III. THE INCREASE IN DURATION FOR RELEASES IN ALL FIVE COMPOSITIONAL CATEGORIES. I_{TOTAL} IS THE INCREASE IN DURATION FOR ALL RELEASES, WHEREAS I_{WEST} DENOTES THE SAME VALUES FOR WEST EUROPEAN RELEASES ONLY, AND $I_{NONWEST}$ FOR NON-WEST EUROPEAN RELEASES ONLY.

	Work	Years	I_{total}	I_{west}	$I_{nonwest}$
Violin	BWV1041	1955 - 2018	0.404%	-4.212%	-1.017%
	BWV1042	1955 - 2018	-7.400%	-13.097%	-2.141%
	BWV1043	1958 - 2018	-5.314%	-10.743%	-4.853%
Brandenburg	BWV1046	1954 - 2018	-8.434%	-11.552%	7.467%
	BWV1047	1953 - 2018	-3.194%	-4.691%	4.683%
	BWV1048	1953 - 2018	-10.451%	-11.412%	-6.626%
	BWV1049	1954 - 2018	-6.178%	-7.854%	-2.408%
	BWV1050	1954 - 2018	-4.124%	-3.584%	-3.472%
	BWV1051	1954 - 2018	-9.266%	-10.372%	-11.145%
Cantatas	BWV106	1967 - 2017	-13.517%	-13.352%	-8.199%
	BWV131	1973 - 2016	-13.962%	-4.527%	-
	BWV140	1967 - 2014	-11.902%	-15.950%	-3.136%
	BWV170	1957 - 2018	3.620%	4.748%	-15.208%
	BWV173	1979 - 2009	-18.387%	-16.504%	-
	BWV208	1995 - 2012	3.573%	4.313%	-
Organ Trio S.	BWV525	1954 - 2016	19.631%	18.323%	7.484%
	BWV526	1950 - 2014	4.153%	2.503%	10.498%
	BWV527	1959 - 2018	7.638%	7.975%	-3.468%
	BWV528	1950 - 2013	4.617%	5.891%	1.366%
	BWV529	1950 - 2013	-3.981%	-2.180%	-2.283%
	BWV530	1960 - 2014	10.864%	10.219%	-2.719%
Cello Suites	BWV1007	1960 - 2018	0.957%	-2.903%	5.522%
	BWV1008	1960 - 2019	-8.285%	-12.835%	1.907%
	BWV1009	1960 - 2018	6.349%	7.626%	8.703%
	BWV1010	1960 - 2018	5.481%	-5.618%	20.339%
	BWV1011	1960 - 2018	4.412%	-6.836%	9.299%
	BWV1012	1960 - 2018	10.865%	3.649%	5.802%

from 1950, which largely coincides with ours. These findings therefore provide an interesting hypothesis, worthy of further exploration in future work.

IV. CONCLUSION

In this paper, we explored the historical tempo development in performances of Bach’s Double Violin Concerto, and of his compositions in general, following several online news reports which claimed significant speedups. We found these claims to be questionable on several points. Even though the Double Concerto has sped up slightly during the last decades, several other compositions slowed down, so there is no general trend for Bach’s work, let alone for classical music as a whole. Interesting discovery is that the speedup of this concerto is most prominent in West European releases, but the pervasiveness of this pattern across musical genres is yet to be confirmed. Future work could therefore entail similar investigations for other composers, such as Palestrina, Haydn, Mozart, Beethoven, Chopin, Brahms, Tchaikovsky and Rachmaninoff, covering a broader range of styles, historical periods and topographical provenance. If sufficient amounts of data are available, such an investigation could shed more light on the ubiquity of the findings from this investigation.

Summarizing, some categories of Bach’s music tend to speed up somewhat, but predominantly, sometimes even exclusively, in West European releases. Could this phenomenon be related to the high pace of life in cities, and therefore simply ride along the increasing urbanization since the fifties? Or is it the intensifying race for attention that increases the meter of the metronome? Our lives are moving faster, our attention spans shorter, and our music tries to keep the pace. It seems

like a plausible theory, but more evidence is needed to not dismiss this hypothesis as *fake news*.

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