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Numbers and Tempo: 1630-1800

Beverly Jerold

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Ever since antiquity, the human species has been drawn to numbers. In music, for example, numbers seem to be tangible when compared to the language in early musical texts, which may have a different meaning for us than it did for them. But numbers, too, may be misleading. For measuring time, we have electronic metronomes and scientific instruments of great precision, but in the time frame 1630-1800 a few scientists had pendulums, while the wealthy owned watches and clocks of varying accuracy. Their standards were not our standards, for they lacked the advantages of our technology. How could they have achieved the extremely rapid tempos that many today have attributed to them? Before discussing the numbers in sources thought to support these tempos, let us consider three factors related to technology:

- 1) The incalculable value of the unconscious training in every aspect of music that we gain from recordings. We cannot imagine a world in which the only music was live music. In his biography of Johann Sebastian Bach (1802), Johann Nikolaus Forkel marveled at Bach's practice of demonstrating to a pupil how a piece should sound, and concluded that many who scarcely know how to make sense of such a piece after years of practice would perhaps have learned it very well in a month if they had heard it played once properly.¹ The implications of Forkel's remarks are substantiated many times over in the eighteenth-century literature. Consider intonation, for instance. In 1752, Johann Joachim Quantz wrote that many professional ripienists could not tune pure fifths: "Although some experienced violinists or other instrumentalists observe their duties in this regard, most players, from ignorance or carelessness, do not. If each instrument in a large ensemble for accompaniment were tested separately, not only would almost every instrument be out of tune, but often not even two or three would be in tune with one another."²

¹ Johann Nikolaus Forkel, *Ueber Johann Sebastian Bachs Leben, Kunst und Kunstwerke* (Leipzig: Hoffmeister und Kühnel, 1802), 38f.

² Johann Joachim Quantz, *Versuch einer Anweisung die Flöte traversière zu spielen*, 3rd ed. (Berlin, 1789; repr. Kassel, 1953), XVII/vii/2, 239: ". . . wenn auch einige erfahrene Violinisten, oder andere Instrumentisten, sich in diesem Stücke ihrer Pflicht gemäss verhalten; dennoch der meiste Theil, entweder aus Unwissenheit, oder aus Nachlässigkeit, dawider handelt: so dass, wenn man bey einem zahlreichen Accompagnement, die Instrumente einzeln untersuchen sollte, man finden würde, dass nicht nur fast ein jedes Instrument in sich selbst unrein gestimmt seyn, sondern auch öfters nicht zwey oder drey mit einander übereinstimmen würden." Unless indicated otherwise, translations throughout are my own.

- 2) The greatly improved mechanism in today's period instruments, which allows very rapid tempos. The original instruments had mechanical defects and often required exceptional stamina, as described by Johann Joseph Klein (1801): "Many trumpeters, oboists, flutists, etc. have to strain their lungs to such a degree that often a resulting lung disease shortens their career."³ Keyboard instruments had much stiffer key action than today's reproductions, sometimes deforming the fingers.⁴
- 3) Our training with the metronome, which is essential for attaining rhythmic accuracy and velocity. By nudging the metronome gradually upward by small degrees, we obtain both accuracy and stratospheric tempos that would otherwise be impossible. Tempo and sound rhythm are intertwined, for without the latter, musicians cannot stay together or attain a rapid tempo. Until well into the nineteenth century, players needed some form of audible leadership, whether foot-stamping, stick-pounding, or extraordinarily loud playing from the first violinist. From legions of accounts, two offer typical examples. In the first, a footnote in the English translation (1709) of François Raguenet's comparison of French and Italian music describes the thunderous time beating at the Paris Opéra:

Some years since, the master of the music in the opera at Paris had an elbow chair and desk placed on the stage, where, with the score in one hand and a stick in the other, he beat time on a table put there for that purpose so loud that he made a greater noise than the whole band, on purpose to be heard by the performer. By degrees they removed this abuse from the stage to the music room [probably the orchestra pit], where the composer beats the time in the same manner and as loud as ever.⁵

Much later, Wolfgang Amadeus Mozart, too, had to resort to audible means to hold ensembles together, as reported by Vincent and Mary Novello after their visit to Mozart's widow Constanze, who described his energetic directing. He "would occasionally stamp with his feet, and once he was so loud in the Cathedral that Madame heard him at an immense distance."⁶

From this small sample of the available source material, we can begin to see the immense performance hurdles facing early musicians who lacked our advantages. A few composers, themselves outstanding performers, wrote music well beyond the capabilities of most practicing musicians, as contemporaries observed.

³ Johann Joseph Klein, *Lehrbuch der theoretischen Musick* (Offenbach, [1801]), 134: "Mancher Trompeter, Hoboist, Flötenspieler c. muss seine Lunge dergestalt angreifen, dass nicht selten ihm eine daher entstehende Lungenkrankheit das Lebensziel verkürzt." Further information about the limitations of wind and brass instruments is forthcoming from Brepols Publishers.

⁴ See Beverly Jerold, "Eighteenth-Century Stringed Keyboard Instruments from a Performance Perspective," *Ad Parnassum* 9 (April 2011): 75-100.

⁵ François Raguenet, *A Comparison between the French and Italian Musick and Operas* (London, 1709; repr. Farnborough: Gregg [1968]), 42f. Reprinted in *The Musical Quarterly* 32 (1946): 428.

⁶ Otto Erich Deutsch, *Mozart. A Documentary Biography*, trans. E. Blom, P. Branscombe and J. Noble (Stanford: Stanford University Press, 1965), 541.

For nearly a century, the inconsistent tempo numbers associated with early eighteenth-century French time devices have attracted much attention and also controversy. Some of the tempos derived from the numbers in Michel L’Affilard’s *Principes très faciles pour bien apprendre la musique* (1705) for beginning vocal pupils are too rapid to enunciate the words, let alone sing them.⁷ As documented in a recent article (2010), the extreme tempos result from utilizing an incorrect measurement system – that is, interpreting the numbers as fractions of a second instead of pendulum lengths. A new source offers both the Paris dancing master Raoul Auger Feuillet’s tempo numbers for seventeen dance forms and a detailed drawing of the pendulum for which they were intended, thus providing the most authoritative source for this subject.⁸ Only a clockwork mechanism can measure fractions of seconds, so his numbers had to measure pendulum lengths. When comparing his numbers with those for the same dance forms from the two sources with consistently improbable tempos (L’Affilard and Louis-Léon Pajot, comte d’Onzembray), there is an almost exact correlation when all are measured according to pendulum length, instead of the presumed sixtieths of a second. Feuillet’s numbers produce realistic tempos that correspond to contemporaneous accounts of the dances and their steps. Since this article discusses also the pendulum numbers from Jacques-Alexandre de La Chapelle, Henri-Louis Choquel, and others, we can now examine the remaining principal sources that have been cited in support of extremely demanding tempos. In the following Dutch, French, and German passages, sometimes it is the early writer who uses numbers unscientifically, but in other instances, the modern literature has drawn conclusions not intended by the writer.

The mathematical possibilities of “half”

A major clue to the seventeenth century’s casual attitude about numbers comes from the Dutch musician Jan Albert Ban (1642/43), who reported that in music “one calls half everything that is less than whole.”⁹ This philosophy is evident in the numbers supplied in Marin Mersenne’s *Harmonie universelle* (1636) for the length of a pendulum cord. To produce the duration of one second, for example, he prescribed a length of 3½ *pieds*.¹⁰ In 1701, however,

⁷ Michel L’Affilard, *Principes très-faciles pour bien apprendre la musique*, fifth ed, (Paris: Christophe Ballard, 1705; repr. Geneva: Minkoff, 1971). Directions for interpreting the beat units are on folding plate II (inserted by p.55).

⁸ See Beverly Jerold, “The French Time Devices Revisited,” *Dutch Journal of Music Theory* 15/3 (Nov. 2010): 169-189.

⁹ Cited by Frits Noske in his introduction to Jan Albert Ban, *Zangh-Bloemzel & Kort Sangh-Bericht* (Amsterdam, 1642/43; repr. Amsterdam: Frits Knuf, 1969), unnumbered page 6 under “Performance Practice.” The statement is found in the *Onderrechtingh om deze Zanghen wel te zinghen*, which Ban added to his *Zangh-Bloemzel* (fol. * 3 v^o): “Welk de helft is van de voorgaende, die meer als een maet is in een Even Tydt ende werdt genaemt half-heele, vermits de zanghwustige in de zangh-wetenschap alle dingh half noemen als het minder is dan het geheel.”

¹⁰ Marin Mersenne, *Harmonie universelle, contenant la théorie et la pratique de la musique*, “Liure troisieme des Instrumens à cordes” (Paris, 1636; repr. Paris: Centre national de la recherche scientifique, 1965), 1:149: “. . . s’il

Joseph Sauveur offered a much more precise cord length of “3 pieds 8½ lignes de Paris” as the measurement for one second, adding that a length of just 3 *pieds* would not produce a perceptible error.¹¹ The French measurements are as follows:

Pied [foot = 331 mm.]

Pouce [inch], the 12th part of a *pied*

Ligne, the 12th part of a *pouce*

Because Sauveur’s essay was included in the *Mémoires de l’Académie des Sciences*, the most nearly official measurement for a foot in 1700 may have been the *pied universel* — 33.12 cm. with a *pouce* of 27.6 mm. Thus the pendulum length for one second of time is just slightly over 36½ *pouces*, equivalent to the English 39.1 inches. Most likely, Mersenne’s cord of 3½ feet to obtain a second was simply a rough rule of thumb. Since this is the basis for his other durations of time, they all are inaccurate. To obtain one-half second, he advised dividing this cord-length by four; for a measurement of two seconds, he prescribed a length of fourteen *pieds*, well over the actual length needed.¹² Clearly his numbers came from mathematical calculations instead of empirical observation.

Mersenne’s large treatise contains direct contradictions between passages in different locations. Here, for example, the reference is to playing a great many notes in the space of one second:

I use 32nd and 64th notes to indicate the great speed of the hand that often plays 32 or 64 notes or keys of the clavier in the time of one beat [“mesure”], as I have often experimented. This is why I give here the time of this beat as lasting a little less than one second; that is, the 3600th part of one hour. Thus the composer of this tablature often plays 32 notes and sometimes 64 in the time of one heartbeat or pulse, which is very remarkable.¹³

[the composer] veut que chaque mesure dure seulement vne seconde, il marquera 3½ qui signifie que la chorde penduë à vn clou, & qui tient vn poids attaché à l’autre bout, fait chacune de ses allées, ou chaque retour dans vne secóde minute.”

¹¹ Joseph Sauveur, *Principes d’acoustique et de musique: ou Système général des intervalles des sons* ([Paris: s.n., 1701]; repr. Geneva: Minkoff, 1973), 19: “prenez AC de 3 pieds 8½ lignes de Paris, qui est la longueur du Pendule simple à secondes (l’on pourroit prendre 3 pieds justes sans erreur sensible) . . .” Also reprinted in Joseph Sauveur, *Collected Writings on Musical Acoustics (Paris 1700-1713)*, ed. Rudolf Rasch (Utrecht: The Diapason Press, 1984).

¹² Mersenne, *Harmonie universelle*, “Liure troisieme des Instrumens à chordes,” 1:149: “Si l’on veut haster la mesure, & qu’elle ne dure qu’vne demie seconde, il faut accourcir la chorde en raison souz-doublée des temps ou des mesures, c’est à dire qu’il faut la faire 4 fois plus courte; & si l’on veut qu’elle dure 2 secondes, il la faut faire de quatorze pieds . . . car les longueurs des chordes sont en raison doublée des temps.”

¹³ *Ibid.*, 1:163: “. . . i’vse de triples & quadruples crochuës pour marquer la grande vistesse de la main qui touche souuent 32, ou 64 notes ou touches du clavier dans le temps d’vne mesure, comme i’ay souuent experimenté, c’est pourquoy ie donne icy le temps de cette mesure qui dure vn peu moins qu’vne seconde minute, c’est à dire que la 3600. partie d’vne heure, de sorte que l’auteur de cette tablature touche souuent 32 notes, & quelquefois 64 dans le temps d’vn battement de coeur, ou de poux: ce qui est tres-remarquable.”

But in another location, he set the maximum number of notes performed in a second as sixteen:

It should be noted that they [musicians] make a beat's duration ["mesure"] more or less as they wish, but it is necessary to establish a certain and determined time for the beat if one wants to know how . . . to sing notes in the time of one beat. Because the astronomers have divided each minute of time into 60 parts . . . which they call a "second," equivalent to an ordinary pulsebeat . . ., I now suppose that a beat lasts one second, and say that there is certainly no hand so swift that it can play the same note or several notes more than 16 times, nor voice that can sing more than 16 notes or sixteenth notes in the time of a second. Consequently, those performing 32 notes to the *mesure* make it 2 seconds long, and those performing 64 make it 4 seconds long, or 4 pulsebeats. I have observed this with the best viol and spinet players . . . It follows that no one can play one or several notes more than 960 times in the space of one minute, or 17,600 times in one hour.¹⁴

While 16 notes to the second is seemingly more credible than 32 or 64, it still represents a guess more than scientific fact.¹⁵ According to Quantz in 1752 (below), no more than 8 notes can be performed in a pulsebeat. With the help of today's loud metronome, eight notes per second can be readily measured by ear. Beyond that number, one's perception may not be accurate. Instead of the number 16 representing solid scientific inquiry, it is probable that the writer said to himself: "32 or 64 notes to the second can't be right – it must be about half of 32 – that is, 16." More useful is Mersenne's following observation:

But because they change tempo several times . . . in singing the same piece of music, by hurrying or slowing the beats according to the text or the subject's different sentiments, it is difficult to establish any definite principle, if they do not use as many different cord lengths as needed for the different tempos.¹⁶

Not only were Mersenne's pendulum measurements inaccurate approximations, but he had no reliable equipment to test the validity of his conclusions. When dealing with actual performers, he found the tempo fluctuating constantly. The discrepancies among some of the above passages suggest that either Mersenne wrote them at different times and changed his views, or that another person was involved. His evaluation of musicianship is of some interest:

¹⁴ Ibid., 1:137f.: "If faut encore remarquer qu'ils font durer vne mesure plus ou moins comme ils veulent: mais il est necessaire d'establir vn temps certain & déterminé pour la mesure, si l'on veut sçauoir combien l'on peut faire de sons, c'est à dire combien l'on peut chanter de notes dans le temps d'vne mesure: & parce que les Astronomes ont diuisé chaque *minute* de temps en 60 parties, & que chaque 60 partie de minute, qu'ils nomment *seconde*, est esgale à vn battement ordinaire du poux, comme i'ay desia dit ailleurs, ie suppose maintenant qu'vne mesure dure vne seconde minute, & dis qu'il n'y a point de main si viste qui puisse toucher plus de 16 fois vne mesme corde, ou plusieurs, ny voix qui puisse chanter plus de 16 notes ou doubles crochuës dans le temps d'vne seconde minute, & consequemment que ceux qui font 32 notes à la mesure employent 2 secondes dans la mesure, & que ceux qui en font 64 font la mesure de 4 secondes ou de 4 battemens de poux: ce que i'ay obserué dans l'experience des meilleurs ioueurs de Violle & d'EpINETTE . . . D'où il s'ensuit que nul ne peut toucher plus de 960 fois vne, ou plusieurs chordes dans l'espace d'vne minute d'heure, ou 17600 dans vne heure."

¹⁵ In support of his belief in extraordinary tempos, Klaus Miehling, *Das Tempo in der Musik von Barock und Vorklassik*, 2nd edn. (Wilhelmshaven: F. Noetzel, 2003), 37f., accepts sixteen notes per second as credible.

¹⁶ Mersenne, *Harmonie universelle*, "Liure cinquiesme de la Composition," unnumbered page between 2:324 and 2:325: "Mais parce qu'ils changent plusieurs fois de mesure, soit binaire ou ternaire, en faisant chanter vne mesme piece de Musique, en hastant ou retardant le baisser & le leuer, suiuant la lettre & les paroles, ou les passions differentes du sujet dont ils traitent, il est difficile d'y apporter nulle regle certain, s'ils n'vsent d'autant de filets differents comme ils veulent faire de mesures differentes."

Some praise those who can make three or four hundred beats of good figured counterpoint against a pedal point; others laud those having great speed and lightness of hand, as in playing 32 notes in a binary *mesure* lasting only one second; and others, lastly, praise those who make a very large number of passages, diminutions, and variations on whatever subject given them. It can be added that those who play with good movement, fine grace, and in time are the most perfect of all, particularly if they have everything noted above, and if they know how to use the chromatic degrees as perfectly as the diatonic ones.¹⁷

What level of technique is implied by the last clause, which implies that some musicians were unable to handle accidentals with as much ease as other notes? How does this fit with his claims for extraordinary speed? What is more likely is that the speed of certain players *seemed* extraordinarily fast, so that he supposed them to be playing 32 notes to the second. When discussing musical instruments, Mersenne claimed that certain cornett players ration their wind so dexterously that they can play a chanson of 80 beats [“mesures”] without taking a breath. In an experiment, one player performed 100 *mesures* without taking a breath.¹⁸ While the duration of a *mesure* is not defined here, above it is in the vicinity of one second. Perhaps his subject knew the secret of circular breathing: inhaling through the nose at the same time as blowing air into the instrument with pressure from the cheeks. Mersenne's inaccurate pendulum measurements and his conflicting statements offer little guidance for tempo in the seventeenth century. His most informative observation may be that performers were constantly changing tempo within a piece, as would be expected when there was no metronome for instilling rhythmic accuracy.

The time signatures and Saint-Lambert

From some point in the seventeenth century and through the eighteenth century, time signatures in much of Europe connoted valuable information about tempo, as Jean Rousseau's vocal method (1683) explains:¹⁹

C	Four beats <i>graves</i> (very slow)
C-barré	Two beats <i>lents</i> (slow)
2	Two beats <i>vîtes</i> (quick)

¹⁷ Ibid., “Liure sixiesme des Orgues,” 1:392: “Quelques-vns font grand estat de ceux qui peuuent faire trois ou quatre cent mesures de bon contrepoint figuré contre vn point d’Orgue; les autres de ceux qui ont vne grande vitesse & legereté de main, comme il arriue lors qu’ils font trente-deux notes dans la mesure binaire, qui dure seulement vne seconde minute; & les autres enfin de ceux qui font vn tres-grand nombre de passages, de diminutions, & de varietez contre tel suiet qu’on leur puisse donner: à quoy l’on peut adiouster que ceux qui iouent d’vn beau mouuement & d’vne bonne grace, & quie sont iustes à la mesure, sont les plus parfaits de tous, particulièrement s’ils ont tout ce qui a esté remarqué cy-dessus, & s’ils sçauent vser des degrez Chromatiques aussi parfaitement que des Diatoniques.”

¹⁸ Mersenne, *Harmonie universelle*, “Liure cinquiesme des Instrumens à vent,” 1:276: “. . . l’autre consiste en la dispensation du vent, qu’ils poussent si doucement, & qu’ils mesnagent si dextrement qu’ils sonnent vne chanson de 80 mesures sans reprendre leur vent ou leur haleine . . . l’on a encore expérimenté que le sieur Sourin d’Auignon faisoit cent mesures sans respirer, ou reprendre vent.”

¹⁹ Jean Rousseau, *Méthode claire, certaine et facile pour apprendre à chanter la musique* (Paris, 1683), 34-36. His 1678 edition is lost.

3/2	Three beats <i>lents</i>
3	Three beats <i>légers</i> (moderate)
3/4	Three beats <i>plus vîtes</i> (more quickly) than 3
3/8	Three beats <i>beaucoup plus vîtes</i> (much more quickly) than 3/4
6/4	Six beats <i>légers</i>
6/8	Six beats <i>plus vîtes</i> than 6/4

In 1719, Jacques Hotteterre supplied tempo designations for the following time signatures:²⁰

C	Four beats ordinarily <i>très lentement</i>
C-barré	Four beats <i>légers</i> or two beats <i>lents</i>
2	Two beats ordinarily <i>vives</i> (animated)
2/4	Two beats <i>légers</i>
3/2	Three beats <i>lents</i>
3	Three beats sometimes very <i>lente</i> and sometimes very <i>vive</i>
3/8	One beat in its true movement, which is <i>vif</i> , but sometimes three beats very <i>lents</i> , as in 3 or even 3/2
6/4	Sometimes six beats <i>graves</i> , but more often two beats <i>vif</i> or <i>léger</i>
6/8	Two beats; examples include two giges and a vocal air marked ‘ <i>Gracieusement</i> ’

Each signature can be qualified by an accompanying term of tempo or expression. While Hotteterre found varied usage for some of the signatures, the basic concept remains the same as in Rousseau’s listing. The slowest tempos are represented by **C** in duple meter and **3/2** in triple meter, with each successive signature usually conveying a somewhat faster tempo. According to Saint-Lambert’s harpsichord method (1702):

The signature of **3/2** contains three half-notes; one or its value is placed on each beat, which must be *grave*, that is, *lent*, and just like those [quarter-notes] in the signature of four beats [**C**].²¹

In pieces having internal changes of meter between binary and ternary, the quarter-note of **C** is often equivalent to the half-note of **3/2**, as in Dieterich Buxtehude's *Präludium* in G minor (WV 149, ex. 1), in which the subject matter continues unbroken into the new signature. This equivalence, however, should not be considered a rule, for composers did not always apply the signatures consistently. The main point is that the quarter note of **C** and the half note of **3/2** generally represent the slowest beat unit for duple and triple time signatures, respectively.

²⁰ Jacques Hotteterre, *L'Art de préluder sur la flûte traversière* (Paris, 1719; repr. Geneva: Minkoff, 1978), 57-60.

²¹ Saint-Lambert, *Les Principes du clavecin* (Paris, 1702; repr. Geneva: Minkoff, 1972), 19: "La Mesure de trois pour deux contient trois Blanches, & l'on en met une, ou sa valeur, sur chaque temps lesquels doivent être graves, c'est-à-dire lents, & tout pareils à ceux de la Mesure à quatre temps."

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Ex. 1. Buxtehude, *Präludium* in G minor, mm.153-155.

In this system of time signatures, note durations are relative. Consider the language in Rousseau’s vocal method: “Every barred signature should be beat half again as fast as usual, as seen in the minor sign [*C-barré*], which is none other than the major sign [*C*] in diminished form.”²² Without metronomes for accurate measurement, “half again as fast” has to be interpreted in the sense given above by Ban — an undefined increment that is something less than a whole.

When discussing the tempo relationship between these same two signatures (as well as others), Saint-Lambert used an idiomatic “once again as fast” (“*une fois plus vite*”): “In pieces with a minor sign [*C-barré*], the notes are *une fois plus vite* than those marked with a major sign [*C*], since in the same duration of a beat one puts two quarter notes instead of one.”²³ While the modern mind might be inclined to interpret the latter clause as “twice as fast,” the beat had a wide latitude, as Saint-Lambert notes below. His phraseology is simply another means of expressing the same concept as Rousseau’s “half again as fast.” In other publications of this period, writers will state clearly “*deux fois*” to mean “twice as,” just as in modern usage. When *une fois plus vite* is translated as “twice as fast,” it produces implausible and impossible metronome marks such as 252 for Saint-Lambert’s dotted quarter note in *6/8*.²⁴ Tempo is subject to so much variation (as Saint-Lambert observed) that pat formulas will rarely work in practice. *Une fois plus vite* means only a general increase that will vary according to conditions. Thus the beats of the *3* signature will be somewhat faster than if the piece had been written in *3/2*, while

²² Jean Rousseau, *Méthode claire, certaine et facile pour apprendre à chanter la musique*, 5th edn. (Amsterdam, c.1710; repr. Geneva: Minkoff, 1976), 40: “. . . tout signe qui est barré se doit battre la moitié plus légèrement qu’à l’ordinaire, comme on le voit au signe mineur qui n’est autre chose que le majeur diminué.”

²³ Saint-Lambert, *Principes*, 18: “. . . dans les Pièces marquées du Signe mineur, les Notes vont une fois plus vite que dans celles qui sont marquées du Signe majeur; puisque dans la même durée d’un temps, on met deux Noires au lieu d’une.”

²⁴ Miehlung, *Das Tempo*, 51f. Cited as **M** 240 by Rebecca Harris-Warrick in her translation: *Principles of the Harpsichord by Monsieur de Saint Lambert* (Cambridge: Cambridge University Press, 1984), 43n.

the beats of **3/8** will be somewhat faster than those of **3**, unless marked otherwise. This is the only solution that is both musical and practical under conditions at the time.

In teaching concepts of tempo and rhythm to rank beginners in music, Saint-Lambert used another number (from which the metronome number 252 cited above derived) quoted today. He compared quarter notes in the signatures of **C-barré**, **3**, and one form of **6/4** to the steps of a man walking five quarters of a league in an hour (about three miles), but cautioned:²⁵

This is not a rule that should be applied to all sorts of pieces, for if it were, they would have too uniform a tempo because the notes would all be played at the same speed. But there are several kinds of tempo; thus quarter notes (and the other notes in proportion) have to be played in certain pieces with one tempo and in other pieces with another tempo.²⁶

As he observed, the pace of a walking man is only an estimate, for the steps of a tall man will be slower than those of a short man to cover the same distance in an hour. Nevertheless, his analogy, which probably derived from a topical allusion for a moderately brisk pace, has today been calculated to indicate that a quarter note = **M** 125 in the time signature of **C-barré**.²⁷ Saint-Lambert, however, cited the necessity for a steady pulse as the chief reason for this figure of speech:

I have not so much claimed by this comparison to give the true measure of the quarter note's duration as I have hoped to give an idea of the equality they must have. This is the most essential aspect of movement.²⁸

The pursuit of sound rhythm is why Saint-Lambert kept returning to the subject of beat equality, for this is what gives music its "soul" and "what it can least do without."²⁹ In contrast to quarter notes in the above signatures, Saint-Lambert had his man walk quite slowly for quarter notes in

²⁵ For the conversion of leagues to miles, see Harris-Warrick, *Principles*, xv.

²⁶ Saint-Lambert, *Principles*, 17: "Mais ce . . . n'est pas une regle qui doit s'appliquer à toutes sortes de Pièces: car si cela étoit, elles auroient une trop grande uniformité de mouvement entre elles, puisque les Notes se conduiroient en toutes d'une même vitesse. Or il y a plusieurs sortes de mouvemens; ainsi il faut par nécessité que les Noires & les autres Notes à proportion, se conduisent en certaines Pièces, d'une certaine vitesse, & en d'autres Pièces d'une autre vitesse."

²⁷ Miehlung, *Das Tempo*, 50f. Harris-Warrick, *Principles*, 43n., places the quarter note at **M** 120. In real life, it is unlikely that a beginning pupil would walk five quarters of a league many times to find the right speed. And the unpaved terrain would have required a varying pace.

²⁸ Saint-Lambert, *Principles*, 24: ". . . n'ay-je pas tant prétendu par cette comparaison, donner la vraie mesure de la durée des Noires, que j'ay songé à donner l'idée de l'égalité qu'elles doivent avoir; ce qui est le plus essentiel du mouvement."

²⁹ *Ibid.*, 25: ". . . Ce qui consiste à passer les Notes d'une même valeur avec une grande égalité de mouvement . . . on doit toujours luy donner la cadence qui en est l'ame, & la chose dont elle peut le moins se passer."

the *fort grave* signature of C: “I always compare the beats of music to the steps of a man because [these], being equal among themselves, are very appropriate for giving a correct idea of the beats and their equality.”³⁰ Saint-Lambert specifically disclaimed any intention of indicating the quarter note’s exact duration. When summing up his lengthy discussion of tempo and the time signatures, he advised that one “can use the privilege of musicians, and give pieces whatever tempo is pleasing . . . provided that it is not directly opposite to that required by the signature.”³¹

Whereas modern time-beating rarely subdivides beats, so that the notes in beats comprised of small note values have to be performed very quickly, subdivision was recommended by eighteenth century writers. Observing that the “celebrated Tartini” used beat subdivision with his pupils, the French critic Pascal Boyer (1767) added that the signatures were never intended to tell the musician what to do with his body: “When beating the measure of two beats, several music masters make four hand movements, while others make eight motions for the measure of four beats, etc., without anyone ever accusing them of not knowing how to beat time.” He also explained that the varied time signatures served as much to indicate the form of periods and construction of musical phrases, as to designate the degree of lightness given the notes.³²

Figurative vs. literal interpretation

Sometimes an early writer uses a number in a figurative or pedagogical sense; for example, Quantz’s pulsebeat of 80, discussed in his book about practical music (1752).³³ According to his full text on this subject, which notes the pulse’s variability, 80 was simply a round figure convenient for teaching tempo relationships (recall that Mersenne placed the pulsebeat at 60). Quantz complained that the same piece is played moderately on one occasion, faster at another, and still faster at yet another; a *Presto* is frequently made into an *Allegretto* and an *Adagio* into an *Andante*, doing the composer the greatest injustice. Because the metronome was still far in the future, Quantz had to devise an analogy for teaching tempo relationships.

³⁰ Ibid., 18: “La Mesure à quatre temps est fort grave; les temps s’en doivent mesurer sur les pas d’un Homme qui se promene, & même assez lentement. Je compare toujours les temps de la Musique aux pas d’un Homme, parce que les pas d’un Homme étant égaux entre eux, sont fort propres à donner une juste idée des temps & de leur égalité.”

³¹ Ibid., 25: “il peut user du privilege des Musiciens, & donner aux Pièces tel mouvement qu’il luy plaira . . . pourvû qu’il ne choisisse pas pour une Pièce un mouvement directement opposé à celui que demande le Signe.”

³² Pascal Boyer, *Lettre à Monsieur Diderot, sur le projet de l’unité de clef dans la musique . . .* (Amsterdam, 1767), 52-54, 49.

³³ Quantz, *Versuch*, XVII/vii/47-55, 261-68.

Observing that there are so many tempo categories that it would be impossible to define them all, he selected four Italian terms to serve as the basis for determining the others, and applied a pulsebeat as follows (in the signature of C):

Allegro assai, a pulsebeat per half note;
Allegretto, a pulsebeat per quarter note;
Adagio cantabile, a pulsebeat per eighth note;
Adagio assai, two pulsebeats per eighth note.³⁴

He modified these categories in certain respects; for example, by inserting a moderate *Allegro* (usually indicated by terms such as *Poco Allegro*, *Vivace*, or simply *Allegro*) between *Allegro assai* and *Allegretto*. As he observed, the number 80 was just an expedient to teach gradations of tempo:

I do not claim that a whole piece should be measured off according to the pulsebeat; this would be pointless and impossible. I simply want to show how any tempo desired can be established in at least two, four, six, or eight pulse beats, and how you can become acquainted with the various tempo categories by yourself, which will lead to further inquiry.³⁵

Today, Quantz's rough formula has been granted an aura of scientific authority that he never intended. Some have translated his pulsebeat into metronome numbers, promoting the astonishingly rapid tempos produced by his first category without observing that the last category is implausibly slow, for it produces sixteen beats per measure. None of these tempos can be taken literally. For example, the pulse rate is not a stable indicator. According to *Black's Medical Dictionary* (Lanham, MD, 1992): "The pulse rate is usually about 70 per minute, but it may vary in health from 50 to 100, and is quicker in childhood and slower in old age than in middle life; it increases in all feverish states." A pulse measurement which can be neither seen nor heard cannot be verified accurately without a modern scientific instrument. Pendulums were known by a few individuals in Europe, but not by Quantz, for he had not seen Étienne Loulié's pendulum (1696) and doubted its efficacy because it had fallen into oblivion.³⁶ Thus Quantz's pulsebeat theory was unworkable in the sense in which we have applied it, for musicians had no means with which to check their own pulse rate, unless it coincided with a second of time. His

³⁴ Quantz, *Versuch*, XVII/vii/51, 264.

³⁵ Quantz, *Versuch*, XVII/vii/48, 261f.: "Ich verlange nicht, dass man ein ganzes Stück nach dem Pulsschlage abmessen solle; denn dieses wäre ungereimt und unmöglich: sondern meine Absicht geht nur dahin, zu zeigen, wie man zum wenigsten durch zween oder vier, sechs oder acht Pulsschläge, ein jedes Zeitmaass, so man verlangt, fassen, und vor sich, eine Erkenntniss der verschiedenen Arten desselben, erlangen, und daher zu weiterm Nachforschen Anlass nehmen."

³⁶ *Ibid.*, § 46. Étienne Loulié, *Éléments ou principes de la musique* (Paris: Ballard, 1696; repr. Geneva: Minkoff, 1971), 86ff.

goal was not to set a defined tempo, but to establish the relationship among the various tempo categories.

From Quantz's pulsebeat formula, a tempo of **M** 160 has been deduced for various dance forms (including the dotted quarter note of a Gigue).³⁷ Quantz himself, however, stated that one must consider both the tempo word at the beginning of the piece and its fastest notes, because a pulsebeat allows executing no more than eight very fast notes, whether double-tongued or bowed.³⁸ Since nearly all pieces have subdivided beats, this automatically excludes the tempos deduced for the *Allegro assai* category.

In his influential keyboard treatise (1789), Daniel Gottlob Türk interpreted Quantz's tempo categories figuratively. While some musicians divide tempo into four main classifications, he said, others divide it into three, six, or even only two categories: "Quantz's principles define tempo only in general; particular cases belong to the exceptions which, even in the most detailed treatise, a music teacher would have great difficulty specifying. Moreover, composers themselves are not without exception agreed about tempo definitions and the customary descriptive words. By 'Allegro', one individual understands a much greater degree of speed than does another." Noting that there can be many objections to using a human pulse for measurement and that the distance between Quantz's fastest and slowest categories is too great, Türk nevertheless would recommend his formula to beginners for gaining at least some concept of differing tempos.³⁹ Experienced musicians, too, were not exempt from faulty tempos: "Many dilettantes [members of the upper classes who retained their amateur status for social reasons], and to some extent even professional musicians, play most pieces in a moderately fast tempo — thus the Presto is much too slow, the Adagio, however, too fast." According to Türk, many variables affect tempo:

³⁷ Based on Quantz, *Versuch*, XVII/vii/58, 270f., many writers, including Miehling, *Das Tempo*, 199; Curt Sachs, *Rhythm and Tempo* (New York: Norton, 1953), 318; and Ralph Kirkpatrick, "Eighteenth-Century Metronomic Indications," *Papers Read by Members of the American Musicological Society* (1938): 30-50 at 45f., propose **M** = 160 for the following dance forms: Gavotte, Bourrée, Rigaudon (two beats/bar); Passacaille, Chaconne, Menuet (three beats/bar); Gigue, Canarie (two beats/bar of **6/8**). For a table of metronome speeds for five tempo categories deduced from Quantz's pulsebeat, see *The New Grove Dictionary of Music and Musicians* ("Performing practice"), 2nd edn., ed. Stanley Sadie and John Tyrrell (London: Macmillan, 2001), 19:369.

³⁸ Quantz, *Versuch*, XVII/vii/51, 263f.: "... so ist zu merken: dass man vor allen Dingen, sowohl das zu Anfange des Stücks geschriebene, das Zeitmaass andeutende, Wort; als auch die geschwindesten Noten, woraus die Passagen bestehen, betrachten müsse. Weil man nun mehr als acht ganz geschwinde Noten, nicht wohl, es sey mit der Doppelpzunge, oder mit dem Bogenstriche, in der Zeit eines Pulsschlages aus üben kann . . ."

³⁹ Daniel Gottlob Türk, *Klavierschule* (Leipzig, 1789; repr. Kassel: Bärenreiter, 1962), 110-112: "Wenn sich auch gegen diesen Massstab, wie Quanz selbst anmerkt, manches einwenden lässt; wenn überdies vielleicht der Abstand vom *Allegro assai* bis zum *Adagio molto* doch etwas zu gross angenommen seyn sollte . . ."

How fast is the tempo in an Allegro assai . . .? This question cannot be answered because of varying factors. For example, an Allegro with intermixed thirty-second notes must not be played as quickly as one whose fastest passages consist only of eighth notes. An Allegro for the church or in sacred cantatas, a complex trio or quartet, etc. should have a much more moderate tempo than an Allegro for the theater or in chamber style; for example, symphonies, divertimentos, etc. An Allegro filled with lofty, solemn, grand thoughts requires a slower, more emphatic pace than one in which leaping joy is the dominant character.”⁴⁰

To these we can add such factors as the number of voices in the composition, the complexity of the texture and rhythms, and the acoustics of the performing space.

When observing the variability to which the human pulse is subject, the flutist Johann George Tromlitz (1791) doubted its adequacy for determining tempo, and posed some questions. If a young, passionate musician whose blood impels him to ever faster tempos were to choose a tempo based on his pulse, what would happen to his rapid passages? How would this tempo fit with the accompaniment? And where does this leave the main point — the true substance of the piece and the composer’s wishes? The same issue arises with the Adagio, particularly an intricate one: “Because from time immemorial it has been difficult, if not completely impossible, for such a fiery and excitable temperament to perform a melody that is touching, I believe that today’s fashionable composers have completely abandoned it, for this type of Adagio is nearly extinct. Whether that is right and good, I will not say, but it seems to me a very great shame. To be sure, the Adagio is not only difficult to play, but also difficult to compose.” There must be a way, continued Tromlitz, to find the tempo of the words at the beginning of a piece: “I know of none other than the musical feeling. But if we are to find the right tempo this way, we must know the piece’s substance beforehand. To be guided solely by the tempo words is in my view an error, or at least a very weak means.” For example, “when the performer is guided [in an Allegro] only by the meaning of ‘quickly,’ as very often happens, he will certainly, or at least for the most part, miss the composer’s intention, for he does not grasp the substance, the essence to which his attention should be completely directed and on which everything depends.”⁴¹

To solve the problem of setting tempo, inventors tried to perfect a time-measuring device, but their efforts, aside from accuracy, proved too large and expensive for practical use. In 1800, one of these inventors, G. E. Stockel, referred to the “many difficulties” of Quantz’s pulsebeat system, for it cannot compare with devices utilizing the senses of sight and hearing. Stockel also mentioned that Allegros were now about a third faster than fifty years ago.⁴² In 1752, Quantz

⁴⁰ Ibid., 111, 112.

⁴¹ Johann George Tromlitz, *Unterricht die Flöte zu spielen* (Leipzig, 1791; repr. Amsterdam: Frits Knuf, 1973), 92f.

⁴² G. E. Stockel, “Ueber die Wichtigkeit der richtigen Zeitbewegung eines Tonstücks, nebst einer Beschreibung

considered their rapid tempos to be almost twice as fast as those of former times, and that pieces formerly designated as *Allegro assai*, *Presto*, *Furioso*, etc. were performed nearly no faster than their present *Allegretto*.⁴³ As instruments and performance standards improved, tempo increased. According to Ignaz Ferdinand Kajetan Arnold's book (1806) about orchestras and their leaders:

I am saying nothing new in bringing up the assorted Allegro tempos used by different orchestras and at various times. In some court orchestras, it borders on Andante, in others, on Presto or Prestissimo. All pieces of older composers must usually be taken at a slower tempo, for they would become completely unintelligible if the tempo were pushed in the same way as with modern works that count on more skill from the player. The music director of an orchestra practiced in new pieces can with good reason prescribe to his players an Andante where the older composer wrote Allegro or Allegretto. Whoever wants a vivid confirmation of this can take the first piece from J. A. Hiller's *Jagd* [a "Sinfonie," which begins Allegro con Spirito] and perform its tempo mark at the same speed with which we take this tempo at present. He will be amazed to feel all the charm, which is so abundant in every part of Hiller's masterwork, vanish.⁴⁴

Because Hiller's *Jagd* was written in 1770, tempo in general had increased in just thirty-six years, a period short enough to have many eyewitnesses still present. The word Arnold used to describe what is lost by a tempo too fast — *Anmuth* [charm, grace] — is apt. A notable exception to tempo inflation occurred in mid-eighteenth century French opera. More song-like than Italian simple recitative, French recitative became the location for singers to display crowd-pleasing devices, as the *philosophe* Jean Le Rond d'Alembert described (1759):

meines musikalischen Chronometers . . . ,” *Allgemeine musikalische Zeitung* 2 (Leipzig, 1800): 657-678 at 661f.

⁴³ Quantz, *Versuch*, XVII/vii/50, 263n.: “Was in vorigen Zeiten recht geschwind gehen sollte, wurde fast noch einmal so langsam gespielt, als heutiges Tages. Wo Allegro assai, Presto, Furioso, u. d. m. dabey stund, das war eben so geschrieben, und wurde fast nicht geschwinder gespielt, als man heutiges Tages das Allegretto schreibt und ausführet.”

⁴⁴ Ignaz Ferdinand Kajetan Arnold, *Der angehende Musikdirektor oder Die Kunst ein Orchester zu bilden, in Ordnung zu erhalten, und überhaupt allen Forderungen eines guten Musikdirector Genüge zu leisten* (Erfurt, 1806), 58ff.: “Ich sage nichts neues, wenn ich die verschiedene Masuren des Allegro bey verschiedenen Orchestern, und zu verschiedenen Zeiten anführe. In mancher Kapelle grenzt es ans Andante, in mancher ans Presto, Prestissimo. Alle Tonstücke älterer Komponisten müssen gewöhnlich in langsamern Zeitmaase genommen, und würden ganz und gar unverständlich werden, wenn man sie gleich Werken neuerer Tonkünstler, welche mehr auf die Fertigkeit der Spieler rechnen, abjagen wollte, und der Musikdirektor eines auf neue Sachen eingespielten Orchesters, kann mit gutem Fug seinen Leuten da Andante vorschreiben, wo der ältere Tonsetzer Allegro, Allegretto hingeschrieben hatte. Wer sich davon recht lebhaft überzeugen will, der nehme das erste beste Stück aus Vater Hillers *Jagd*, und trage es sich mit dem darüber stehenden Zeitmaase so vor, wie man dieses Zeitmaas gegenwärtig nimmt, und er wird mit Erstaunen alle Anmuth, an der jedes Stück dieses Hillerschen Meisterwerks so reichhaltig ist, gänzlich aus demselben verschwunden fühlen.”

This recitative to which we cling so strongly in our operas . . . is today more deadly than ever. To make their voices stand out, singers think only of screaming and dragging their notes. They absolutely ignore the vitality of the declamation, so necessary to the recitative . . . We are certain that in the time of Lulli the recitative was sung much more quickly, and was less tedious. Lulli, who was a man of taste and even of genius, felt . . . that the recitative was not made to be executed with effort and slowness . . . Since then, our recitative, without gaining anything in other respects, has even lost the declamation that this artist had given it . . . The trills and *ports de voix* which we use in such abundance will always be an insurmountable stumbling block to the declamation.⁴⁵

On the other hand, some French instrumentalists were heading in the other direction, for the violinist Jean-Marie Leclair had to caution those who played his compositions:

By the term Allegro I certainly do not mean a tempo too fast; it is a cheerful tempo. Those who rush too much, especially in character pieces (like most fugues in four beats) make the music trivial, instead of conserving its nobility.⁴⁶

In early texts, some numbers will be inaccurate, partly from a lack of scientific expertise and equipment, and partly from standards of the times. On the other hand, the pace of Saint-Lambert's walking man was not intended to be taken literally, but to teach the concept of beat equality to beginners. Likewise, Quantz's pulsebeat formula, with its unintended extremes of fast and slow, was a figurative substitute for the lack of an accurate time-measuring device to distinguish the various degrees of tempo. (We sometimes fail to make the tempo distinctions that Quantz wanted, for artists have been known to perform an Allegretto at the highest speed the fingers and instrument can muster.) Upon examination, none of the sources cited in support of overly rapid tempos can withstand scrutiny.

In selecting a tempo, clarity is a major consideration. When the notes rush by so quickly that the listener cannot focus on anything and the music never breathes, the composer's intention is lost. While the lack of technology in earlier centuries would have produced tempos considerably slower than those today, the goal is not necessarily to replicate them, but to engage the listener meaningfully. Recently, Lorin Maazel led the Vienna Philharmonic orchestra in a performance of Mozart's Symphony no. 40, using more moderate tempos for the faster movements than often heard. The result was captivating, because it conveyed warmth and enabled details from the composer's genius to be perceived and savoured.

⁴⁵ Jean Le Rond d'Alembert, "De la liberté de la musique," *Mélanges de littérature, d'histoire, et de philosophie* (Amsterdam, 1766), 4:425f.

⁴⁶ Jean-Marie Leclair, *Ouvertures et Sonates en Trio*, Op. 13 (Paris, [1753]; repr. New York: Broude, 1991), Avertissement: ". . . je n'entend point par le terme d'Allegro, un mouvement trop vite; c'est un mouvement Guay. ceux qui le pressent trop, sur tout dans les morceaux de caractère comme dans la plus part des Fugues a quatre Temps, rendent le chant Trivial, au lieu d'en conserver la Noblesse."

Few rules or principles can be established for tempo. Although Feuillet's reasonable pendulum numbers are a valuable guide to tempo and the most accurate information we have, they apply to music of simple texture that is to be danced. With a dance form set for keyboard by a composer like François Couperin or Johann Sebastian Bach, the more complex texture may require a slower tempo. Because of its many variables, tempo cannot be quantified, but should be adapted, as Türk and Tromlitz said, to the composition's musical substance.