

## FEATURE

## CHRISTMAS 2011: DIAGNOSIS

**Beethoven's deafness and his three styles**

**Edoardo Saccenti and colleagues** chart the relation between the composer's deafness and his compositions

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**Beethoven's deafness**

Beethoven (1770-1827) first mentioned his hearing loss in a letter to the physician Franz Wegeler dated 29 June 1801:

“For the last three years my hearing has grown steadily weaker . . . I can give you some idea of this peculiar deafness when I must tell you that in the theatre I have to get very close to the orchestra to understand the performers, and that from a distance I do not hear the high notes of the instruments and the singers' voices. . . Sometimes too I hardly hear people who speak softly. The sound I can hear it is true, but not the words. And yet if anyone shouts I can't bear it.”

Some details of Beethoven's hearing loss can be derived from accounts found in his correspondence (table).<sup>1</sup> His left ear was affected first, and he reported (bilateral) tinnitus, high tone hearing loss associated with poor speech discrimination, and recruitment with loud noises. Czerny reports that after 1812 people had to shout to make themselves understood.<sup>1</sup> In 1818 Beethoven started to communicate through notebooks. There are no reports that he could still understand spoken conversation after 1825, so we assume that his deafness was almost complete by then.<sup>2</sup> Although still debated, these symptoms suggest a sensorineural hearing loss with its origin in the organ of Corti.<sup>3</sup> Wagner and Rokitansky (the father of modern morbid anatomy) performed a postmortem examination on 27 March 1827, the day after the composer's death,<sup>4</sup> and wrote:

“The Eustachian tube [and] the facial nerves were very much thickened. The acoustic nerves on the other hand were wrinkled and were without a medulla. The auditory arteries running near them were dilated beyond the size of the lumen of a raven's quill and were cartilaginous. The left acoustic nerve was much

the thinner . . . the right had a much thicker white root, the brain substance in the region of the fourth ventricle was much denser in consistency and more vascular than those nerves which arose from it.”

Medical discussions about Beethoven's health date back to the start of 20th century.<sup>5</sup> Beethoven's medical history has been pieced together with various differential diagnoses to account for his deafness, systemic diseases, and death. Donnemberg et al suggested syphilitic otitis as the probable cause of hearing loss,<sup>6</sup> while Karmody and Bachor suggested inflammatory bowel disease associated with sclerosing cholangitis.<sup>3</sup>

**Clinical manifestations of hearing loss and Beethoven's styles**

The periods of Beethoven's composition—the so called three styles<sup>7</sup>—correspond to stages in the progression of his deafness, although correlation does not imply causality.<sup>8</sup> In the 1960s Cawthorne discussed the impact of deafness on the art of Beethoven, Swift, and Goya<sup>9</sup> but seemingly only on a psychological level, as Harrison did in concluding that “it is impossible to know in any detail how deafness affects the potential to compose music.”<sup>10</sup> Nonetheless, these modern attempts to establish a link between the composer's deafness and his music were not the first.

Beethoven's contemporaries immediately drew direct connections between his hearing impairment and the perceived unintelligibility of his late works, especially the late piano sonatas and string quartets.<sup>11</sup> For Richard Wagner, Beethoven's late works were supreme (“a revelation from another world”<sup>12</sup>), not despite, but because of, his deafness, which shielded the composer from the disturbance of the outer world and forced him to live in his inner world<sup>11</sup>—a schopenhauerian idea that

could be difficult to reconcile with the irritation and interference caused by tinnitus.<sup>10</sup>

Beginning with the observation that Beethoven's hearing loss started off in the high tones, Liston and colleagues investigated whether his use of high tones correlated with the progression of hearing loss.<sup>13</sup> They analysed the power spectrum of a CD recording of Beethoven's nine symphonies, focusing on the region between 2500 Hz and 5000 Hz. They speculated that it should represent the overtones that the composer would have heard assuming that he would have been aware of those overtones either by hearing them when music was performed (that is, through an auditory feedback loop) or by perceiving them in his mind. They did not find a progressive decrease in the use of high tones and concluded that Beethoven was not relying on auditory feedback.

This seems to contrast with the evidence that Beethoven sought mechanical aids to compensate for his vanishing hearing. Around 1814 he started using ear trumpets made for him by Mälzel<sup>2</sup> (fig 1). In 1817 he asked the piano maker Andreas to prepare a piano with increased volume<sup>14</sup> and requested that Graf build him a resonance plate—"a sound conductor which, being placed on the pianoforte, helped to convey the tone more distinctly to his ear."<sup>15</sup>

It is difficult to reconcile the assumptions of Liston and colleagues with our limited understanding of the mechanism of musical perception<sup>16</sup> and the cortical organisation that leads to the formation of musical ideas.<sup>17-18</sup> Assuming that Beethoven could have heard overtones in his mind somehow conflicts with the composer's description of his own compositional process in spatial terms of "narrowness," "height," and "breadth" rather than in terms of sounds.<sup>10</sup> Last but not least, the use of a CD recording of Beethoven symphonies performed by a modern symphony orchestra is unlikely to reproduce what Beethoven and his contemporaries would have heard in concert because of the use of substantially different instruments.<sup>19</sup> It would be interesting to repeat the analysis of Liston and colleagues on a recording played on period instruments.

## Symptoms of deafness through analysis of manuscripts: use of high notes

We adopted a different approach to investigate the presence of an auditory feedback loop over the three periods and styles. We turned our attention to what Beethoven actually wrote rather than what he could have heard, analysing the scores of his string quartets for the use of high notes. The string quartets are usually grouped into early, middle, and late works and are considered the utmost representation of Beethoven's three styles.<sup>20-21</sup> The periods during which they were composed coincide with the onset of the condition (early quartets: opus 18, 1798-1800), worsening of hearing impairment (middle quartets: opus 59, 1805-6, and opus 74 and 95, 1810-11), or the supposed total deafness (late quartets: opus 127, 130, 131, 132, and 135, 1824-6). Whereas opus 18, 59, and 127-135 are stylistically homogeneous, opus 74 and 95 are isolated works showing marked transitional stylistic features. Defining their exact sequence of composition is complicated as Beethoven customarily worked on several pieces at the same time. Each of these clusters of works was composed within short time spans of about two years; as we do not have accounts of the progression of his hearing loss with such a time resolution we treated it as steady over each time span. This led us to consider for analysis these four groups (1798-1800, 1805-6, 1810-11, 1824-6) rather than the individual quartets.

We considered the first violin part of the exposition of the first movement of each quartet, counting the number of notes above G<sup>6</sup> (1568 Hz); it seems a reasonable threshold for defining the high notes given the typical violin writing in Beethoven's chamber music. We recorded the number of high notes in each of the four groups and normalised it to the total number of notes used in the corresponding group, giving the percentage of high notes and accounting for the different length of the musical excerpts. This pilot exercise indicated the existence of a possible relation between the progression of Beethoven's deafness and the use of high notes in his music. Figure 2 shows how the use of high notes decreased over the period 1798-1801 and increased around 1824-6, the years of the late string quartets and of complete deafness.

These results only partially agree with those of Liston and colleagues and suggest that, as deafness progressed, Beethoven tended to use middle and low frequency notes, which he could hear better when music was performed, seemingly seeking for an auditory feedback loop. When he came to rely completely on his inner ear he was no longer compelled to produce music he could actually hear when performed and slowly returned to his inner musical world and earlier composing experiences. According to a *BMJ* reviewer, Beethoven reportedly did not compose with a piano in the room to prevent him from playing the music until it was written, a fact that could support the argument raised by Wagner.<sup>12</sup>

As they encompass only a limited subset of Beethoven's compositions, our results, as well as those of Liston and colleagues, are far from being conclusive: proving or disproving whether Beethoven's hearing loss had a substantial impact on shaping his musical style would require complete and exhaustive statistical and spectral analyses of the composer's complete catalogue.

This article is dedicated to the memory of Arrigo Quattrocchi.

Competing interests: All authors have completed the ICMJE uniform disclosure form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

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## Table

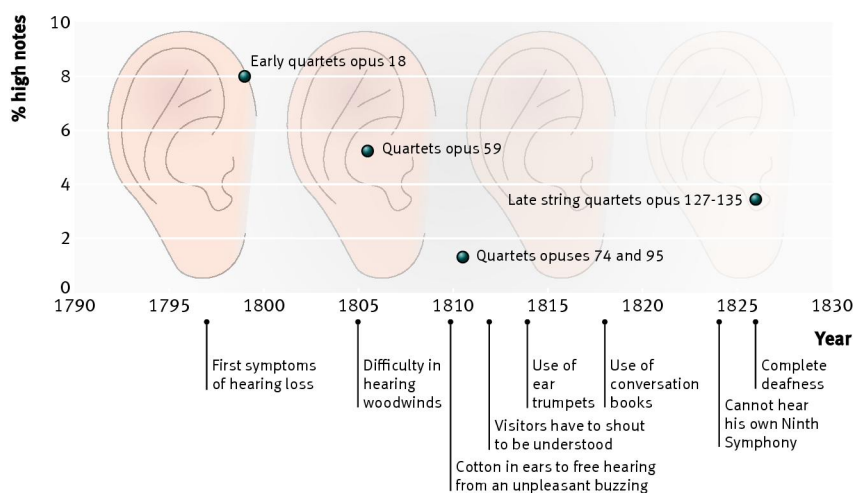
Table 1 | Landmarks in Beethoven's life, deafness, and music

Date	Accounts of deafness progression	Relevant works
1770	Born in Bonn on 16 December	—
1796-8	First symptoms of hearing impairment	Piano sonatas opus 2 and 7; cello sonatas opus 5
1798-1800	—	String quartets opus 18; first symphony opus 21
1801	First mention of hearing loss in letter to Franz Wegeler (29 June) and Karl Amenda (July)	First symphony opus 21; violin sonata opus 24; piano sonata opus 28
1803	—	Third symphony (Eroica) opus 55
1802	<i>Heiligenstadt testament</i> : an open, unsent, letter to his brothers and friends disclosing his inner feeling about his progressing impairment	Eroica variations opus 35; piano sonatas opus 26 and 27; second symphony opus 36
1804	He is still able to hear conversation. He conducts first performance of Eroica	Piano sonatas opus 53 (Waldstein) and opus 57 (Appassionata) symphony opus 55
1805-6	He reports difficulties in hearing woodwinds in instrumental concerts	String quartets opus 59; fourth piano concerto opus 58; Overtures Leonore I and II; fourth symphony opus 60; violin concerto opus 61
1810-1	He reports "Cotton in my ears at the pianoforte frees my hearing from the unpleasant buzzing" and describes hearing loss as "a fiend ... settled in my ears"	String quartets opus 74 and 95
1812	According to his pupil Carl Czerny and to composer Luis Spohr, conversation with the composer required shouting	Seventh and eighth symphonies opus 92 and 93
1814	Last public appearance as performer (May) with the Archduke trio in B flat opus 97. Beethoven starts using ear trumpets, many provided by Mälzel	Triple concerto opus 56; piano sonata opus 90
1815	Necessity of having different ear trumpets for speech, music, and different ambient sizes	Cello sonatas opus 102
1816	Viennese journal <i>Nachrichten Wien</i> informs readers about his hearing impairment	Piano sonata opus 101; <i>An die ferne Geliebte</i> opus 98
1818	Beginning of written communication through conversation books	Piano sonata opus 106 (Hammerklavier)
1822	In letter to cellist Bernhard Romberg, he reports pain on listening to instrumental playing	Piano sonatas opus 110 and 111; finishes <i>Missa solemnis</i> opus 123; overture <i>Die Weihe des Hauses</i> opus 124
1824	At first performance of Ninth Symphony (8 May), composer does not realise that music had ended. One of the soloists had physically to turn him to acknowledge the public	Late string quartets
1825	Last references to possibility of mechanical aided speech hearing	Late string quartets
1826	Complete deafness (?)	Late string quartets

## Figures



**Fig 1** Hearing trumpets used by Beethoven and conserved in the Beethoven Haus in Bonn. Several of them were built by Johann Nepomuk Mälzel, the inventor of the metronome: the inventor and its invention were celebrated by the composer in the *allegretto scherzando* of the Eighth Symphony in F, opus 93 (1812) (reproduced with permission from Beethoven Haus)



**Fig 2** Trend in use of high notes in Beethoven's string quartets with time progression of hearing loss. For each group of quartets composed in 1798-1800 (opus 18), 1805-6 (opus 59), 1810-11 (opus 74 and 95), and 1824-6 (opus 127-135) we calculated the percentage of notes above high G<sup>6</sup> in the exposition section of first violin part of the first movement

# QUATUOR 13.

Adagio ma non troppo.

L. van Beethoven, Op. 130.

COLLECTION LITOLFF No. 6c

By opus 130 the high notes had returned (relatively speaking)