

ESSAY

Paul Broca: from fame to shame?

ABSTRACT

In 2016, the University of Bordeaux ran a competition within the local neuroscience community to find a name for its new neuroscience building. The name of Paul Broca, who was born nearby in 1824, was chosen in honour of his origins and his contributions to neuroscience. Recently, however, a debate has been ignited about the appropriateness of this choice, given Broca's endorsement of physiological anthropology. At a time when academic institutions worldwide are revising their curricula to better reflect the contributions of previously overlooked groups, how should we respond when the views of the 'founding fathers' of neurology clash with those of society today?

Here are eight instances in which the lesion was in the posterior third of the third frontal convolution. This number seems to me to be sufficient to give strong presumptions. And the most remarkable thing is that in all the patients the lesion was on the left side. I do not dare draw conclusions from this. (Broca, 1863)

Paul Broca was initially hesitant in 1863, but two years later, he was confident that ‘*nous parlons avec l’hémisphère gauche*’ (we speak with the left hemisphere) and narrowed it down to the *troisième circonvolution frontale* (today known as the inferior frontal gyrus). This work revolutionised neuroscience in the 1860s and led not only to Broca’s name becoming an eponym for this brain area, but also laid the foundations for new theories (e.g. localizationism, cerebral dominance and asymmetry), methods (lesion-symptom mapping), and disciplines (neurobiology of language, aphasiology).

During Broca’s time, members of the *Société Anthropologique de Paris* were engaged in a spirited debate about the localisation of function in the brain. While Broca was not the first to present evidence for speech in the left hemisphere,¹ he recognised the potential significance of his aphasia patient Louis Victor Leborgne (also known as ‘Tan’), publishing a detailed clinical-anatomical description.² This work on Leborgne enabled Broca to identify the cortical area for speech articulation. Unanimously across languages, the opercular and triangular part of the inferior frontal gyrus is still referred to as ‘Broca’s area’, and he joins the many scientists (e.g. Luigi Rolando, Carl Wernicke, Alexander Monro, Jan Purkinje, Richard Heschl, Franciscus Sylvius, Heinrich Sachs, Johann Christian Reil, Adolf Meyer, Moriz Probst) whose names were adopted for neuroanatomical structures. Broca went on to preserve Leborgne’s brain, offering future generations the possibility to revisit the anatomy of this famous case using CT, MRI,

and diffusion-weighted imaging tractography methods.³⁻⁵ His work still resonates to this day and its impact has been solidified with the invention of cognitive neuroimaging methods and techniques (see Supplementary Figure 1).

In 2016, the University of Bordeaux and the Nouvelle-Aquitaine region launched a competition within the Bordeaux neuroscientific community to name the new building that was to house the *Institut interdisciplinaire de neurosciences* (IINS) and the *Institut des maladies neurodégénératives* (IMN). The name of Paul Broca

garnered ardent support, and the building subsequently became known as the ‘Centre Broca’.

Born in Sainte-Foy-la-Grande (77 km east of Bordeaux), Broca practised medicine and science in Paris, eventually advancing to become Chair of surgical pathology at the Faculty of Medicine.

Beyond his scientific reputation, his strong republican views made Paul Broca, who died in 1880 at the age of 56 (Fig. 1), one of the exemplary



Figure 1 Paul Broca, born 1824 in Sainte-Foy-la-Grande (Nouvelle Aquitaine) and died in 1880 in Paris. Portrait from the personal collection of Broca's great-grandson Philippe Monod-Broca, courtesy of Michel Thiebaut de Schotten.

symbols of the Third Republic (the French government from 1870 to 1940). Shortly after his death, statues of him were erected in several places, and his name was given to streets, administrative buildings, and medical lecture halls.

Broca's impact on clinical neuroanatomy has never been questioned, although the neuroanatomical, neuropsychological, and functional specificity of his eponymous cortical area have been repeatedly challenged.^{6,7} Mounting evidence shows that ‘Broca's area’ is structurally and functionally heterogeneous. Structurally, the primary sources of variability are the differences in the definition of the cortical area (e.g. the debate on the inclusion of areas BA47 and BA6) and the inter-individual variability of the anatomical landmarks. Functionally, the

area was shown not to be exclusive to articulation, but to activate also during comprehension and domain-general tasks. A meta-analysis of functional activation studies reveals the extended bilateral network associated with ‘Broca’ (Fig. 2).

Another aspect of Broca’s academic life, however, casts a shadow on this idealised portrait. Broca was one of the driving forces behind physical anthropology, which sought to characterise human races based on measurements of various parameters such as forehead height and cranial volume. He and others concluded that there exists a hierarchy of the human species with superior (white

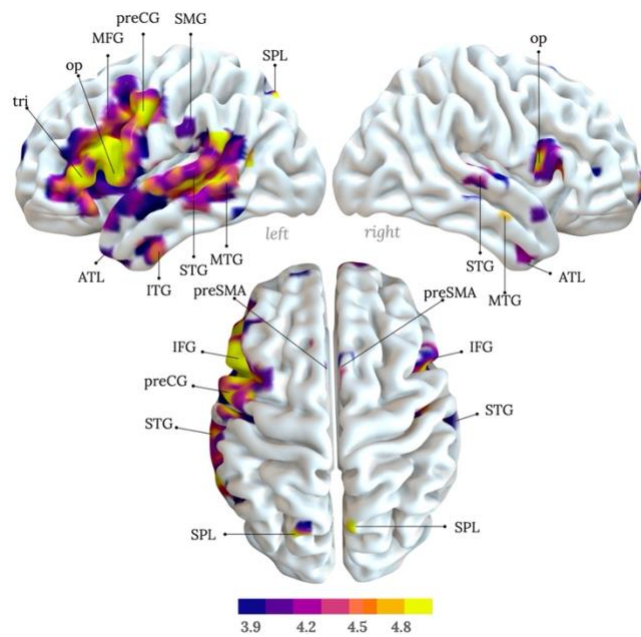


Figure 2 Neurosynth metaanalysis of the 223 studies mentioning ‘Broca’. ATL, anterior temporal lobe; ITG, inferior temporal gyrus; MFG, middle frontal gyrus; MTG, middle temporal gyrus; op, pars opercularis; preCG, precentral gyrus; preSMA, presupplementary moto

men) and inferior standing (the rest of humanity, including women). Despite his defence of a racial ideology, Broca spoke out against slavery on the basis that the inequality of the races did not justify the enslavement of a part of humanity. He was also known for his rejection of anti-Semitic and nationalistic ideologies, popular in Europe at the end of the 19th century. It is therefore difficult to hold Broca responsible for the later use of physical anthropology by the theorists of Nazism. Progress in sociological anthropology and the emergence of genetics have since demonstrated that the notion of the human race is a baseless social construct.¹ Indeed,

¹ It should be noted that some works of population genetics have in turn been hijacked to justify the inequality of races, especially in the USA in circles close to Donald Trump, but that is another debate.

Broca's racist theories had sunk into oblivion until historians unearthed them at the beginning of the 21st century.⁸

Given these considerations, was it wise to name a university building after him? This question was raised publicly and vehemently in 2020 by the *Association Mémoires et Partages*, which is seeking recognition of Bordeaux's slave-owning past. Between 1672 and 1837, the most significant triangular trade was the transatlantic slave trade which operated between Europe, Africa and the Americas. Bordeaux was an essential harbour at the time and facilitated the deportation of an estimated 150,000 Africans to the Americas. There is a certain amalgam between racialism and slavery (even though, as discussed, Broca himself was anti-slavery).

At the time Broca's name was adopted for the building in 2016, the neuroscience community was largely unaware of the extent of his involvement in the development of racist theories (the first academic publications by historians on the subject go back only ten years). However, in September 2021, the University initiated a process of reflection that aims to place the debate about Broca and his legacy in Bordeaux in its proper scientific and social context.

To foster this debate, the University organised a conference on September 13th 2021. Following this initial debate, the process of reflection will continue, fed by other interventions, and our community will ultimately be consulted through the county council and encouraged to provide an opinion on what should be done with this heritage (A change of name? The addition of an explanatory plaque?). Arguments can be made both for keeping the name (e.g. to foster an educational debate) or for changing it (e.g. to avoid giving credit to controversial personalities), and these should be carefully considered by the University committees and the broader neuroscience community.

It is not within our purview to make a decision on the use of eponyms. Nevertheless, we hope that the debate in Bordeaux will prove to be an opportunity for community building and will

help in forging a greater focus on the history of neuroscience. The debate is complex and requires a rethinking of the societal context of the time as well as a consideration of current issues. If, as the quote popularised by Newton suggests,² we are dwarfs standing on the shoulders of giants, then it turns out that these giants were also human beings with their own imperfections. While these might have appeared trivial in their time, they clash with the convictions of a modern society in perpetual evolution.

It is the mark of a progressive society to be able to reflect upon the work of others in context. Many universities are currently undergoing this exercise as they redesign their curricula to feature more inclusive content from the history of neuroscience. At the societal level, there is increasing awareness of the selective nature of our perspective on pivotal contributors to science. As a consequence, efforts are underway to ensure that works by key thinkers who were not always included in the history of science, including works by women and by people of colour, are added to public repositories.^{9,10}

As scientists, we gather evidence to advance knowledge and combine our efforts to have a positive impact on society. Following the scientific method, we formulate hypotheses, scrutinise them in light of the evidence, draw our conclusions, and, where necessary, repeat the process. But for all our rigorous methods and trained minds, there are few absolute truths in science; rather there are weighted opinions based on the evidence available at the time. As a consequence, we must repeatedly and critically question the world around us and adapt our conclusions to account for new evidence. The current debate is both timely and necessary as we seek to recalibrate our values and positions in the face of new knowledge. Time will tell if

² Newton borrowed the metaphor from the French philosopher Bernard of Chartres: *We are like dwarfs on the shoulders of giants, so that we can see more than they, and things at a greater distance, not by virtue of any sharpness of sight on our part, or any physical distinction, but because we are carried high and raised up by their giant size.* John of Salisbury *The Metalogicon* (1159) bk. 3, ch. 4, quoted in R. K. Merton *On the Shoulders of Giants* (1965).

we get it right. For now, it is crucial that we engage in discussions and join together to find the best solutions. This effort will leave a footnote for history that our community became aware of these issues and addressed them in the context of the times in which we were living.

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Figure legends

Figure 1 Paul Broca, born 1824 in Sainte-Foy-la-Grande (Nouvelle Aquitaine) and died in 1880 in Paris. Portrait from the personal collection of Broca's great-grandson Philippe Monod-Broca, courtesy of Michel Thiebaut de Schotten.

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Supplementary figure 1. A search on PubMed (14/10/2021) revealed 6,873 peer-reviewed publications mentioning 'Broca'.

Data availability

Data and supplementary figure are available from <https://github.com/StephForkel/Broca>.

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References

1. Roe D, Finger S. Gustave Dax and his fight for recognition: an overlooked chapter in the early history of cerebral dominance. *J Hist Neurosci.* 1996;5(3):228-240.

doi:10.1080/09647049609525672

2. Sondhaus E, Finger S. Aphasia and the CNS from Imhotep to Broca. *Neuropsychology*. 1988;2(2):87-110. doi:10.1037/h0091739
3. Signoret JL, Castaigne P, Lhermitte F, Abelanet R, Lavorel P. Rediscovery of Leborgne's brain: anatomical description with CT scan. *Brain Lang*. 1984;22(2):303-319. doi:10.1016/0093-934x(84)90096-8
4. Dronkers NF, Plaisant O, Iba-Zizen MT, Cabanis EA. Paul Broca's historic cases: high resolution MR imaging of the brains of Leborgne and Lelong. *Brain*. 2007;130(Pt 5):1432-1441. doi:10.1093/brain/awm042
5. Thiebaut de Schotten M, Dell'Acqua F, Ratiu P, et al. From Phineas Gage and Monsieur Leborgne to H.M.: Revisiting Disconnection Syndromes. *Cereb Cortex*. 2015;25(12):4812-4827. doi:10.1093/cercor/bhv173
6. Uylings HBM, Malofeeva LI, Bogolepova IN, Amunts K, Zilles K. Broca's language area from a neuroanatomical and developmental perspective. In: Hagoort HCMB&., ed. *The Neurocognition of Language*. Oxford University Press; 1999:319-336. doi:10.1093/acprof:oso/9780198507932.003.0010
7. Tremblay P, Dick AS. Broca and Wernicke are dead, or moving past the classic model of language neurobiology. *Brain Lang*. 2016;162:60-71. doi:10.1016/j.bandl.2016.08.004
8. Reynaud-Paligot C. *La République Raciale. Paradigma Racial and Ideology Republican (1860-1930)*. Presses Universitaires de France; 2006. doi:10.3917/puf.reyna.2006.01
9. Wade J, Zaringhalam M. Why we're editing women scientists onto Wikipedia. *Nature*. Published online 2018. doi:10.1038/d41586-018-05947-8

10. O'Reilly N. Why we're creating Wikipedia profiles for BAME scientists. *Nature*.

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