

Broca P. Remarques sur le siège de la faculté du langage articulé, suivies d'une observation d'aphémie (perte de la parole) (Remarks on the seat of the faculty of articulated language, followed by an observation on aphemia [loss of speech]). *Bull. Soc. Anat. Paris* 6(2^e Ser.):330-57, 1861. [Hôpital de Bicêtre, Paris, France]

Paul Broca's 1861 paper had a major impact on two fields: aphasia and cerebral localization. Broca divided language functions into receptive and expressive components and a general faculty of language, leading to scientific studies of aphasia. The loss of the expressive component is now called "Broca's aphasia." He identified the posterior third of the inferior frontal convolution as the cerebral localization of the motor component of speech, and it is now called "Broca's area." [The *SCI*[®] indicates that this paper has been cited in over 80 publications, 1945-1990, making it the most-cited paper from this journal.]

Paul Broca: Aphasia and Cerebral Localization

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One day after the autopsy on his now-famous patient "Tan" (so named because for the last 21 years of his life the only words he ever uttered were "tan-tan"), Broca presented a lecture to the *Société d'Anatomie de Paris*, which became his *Citation Classic* paper. Tan's brain presented widespread damage; Broca concluded, however, that the original damage (corresponding to the first 10 years when Broca's aphasia was the only functional loss)

was to the posterior part of the third convolution of the left frontal lobe.

A few months later, the autopsy of a case of Broca's aphasia of 18 months duration revealed a deep, well-circumscribed lesion of the posterior parts of the second and third convolutions of the left frontal lobe, with the principal damage to the third convolution.¹ In a later paper, he discussed six other cases, including three reported by Charcot and one by Gubler, all with lesions of the posterior third of the third convolution of the left frontal lobe.²

Broca's clear, scholarly evidence for precise cerebral functional localization opened an era (lasting more than 100 years) of virtually total domination of the neurosciences by localizationist concepts.³ The enormous complexity of the brain may have contributed to the conceptual rigidity that developed. To organize all that was known into a cohesive and understandable whole, anatomists had to compartmentalize. The descriptions and illustrations of those compartments (each clearly separated from the others), resulted in a concept of a rigid, sharply divided, unmaleable brain. Only a few scientists and clinicians projected an image of a dynamic adaptability (plasticity). This has had a negative effect on the clinical management of patients with brain damage; the brain's capacity to reorganize to produce recovery of functions has only recently begun to be recognized.^{3,4} The tone of Broca's reports, however, suggests that he would have avoided the pitfalls of strict localizationism.

Broca was a serious and generous scientist. Although the studies noted above were highly original, he did not claim originality, but rather stated that he was supporting the concepts of Bouillaud and Auburtin. His findings helped to overcome the disdain caused by the exaggerated and unfounded claims of phrenology and initiated a long and fruitful period of functional localization studies.

1. Broca P. Nouvelle observation d'aphémie produite par une lésion de la motié postérieure des deuxième et troisième circonvolutions frontales (A new observation of aphemia produced by a lesion of the posterior region of the second and third frontal convolutions). *Bull. Soc. Anat. Paris* 6(2^e Ser.):398-407, 1861. (Cited 30 times since 1945.)
2. ———. Localisation des fonctions cérébrales: siège du langage articulé (Localization of cerebral functions: seat of articulated language). *Bull. Soc. Anthropol.* 4:200-4, 1863. (Cited 20 times since 1945.)
3. Bach-y-Rita P. Brain plasticity. (Goodgold J, ed.) *Rehabilitation medicine*. St. Louis, MO: Mosby, 1988. p. 113-8.
4. Bach-y-Rita P & Wikah Bach-y-Rita E. Biological and psychosocial factors in recovery from brain damage in humans. *Can. J. Psychol.* 44:148-65, 1990.