

Brief Communication: How Much Larger Is the Relative Volume of Area 10 of the Prefrontal Cortex in Humans?

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KEY WORDS brain; frontal lobe; prefrontal cortex; area 10; residuals; allometry

ABSTRACT It has long been thought that the prefrontal cerebral cortex has been greatly expanded in the human brain. Semendeferi et al. ([2001] *Am. J. Phys. Anthropol.* 114:224–241) showed that Brodmann's area 10 is relatively larger in the human compared to pongid brains. The question is: how much larger *relatively* is it? Using their data, it can be shown that the relative increase for human prefrontal area 10 is only 6% larger. Looking at the data base of neural structures provided by Stephan et al. ([1981] *Folia Primatol.* (Basel) 35:1–29), it is apparent that 6% is a relatively low residual value from a predicted value based on allometric considerations between total brain weight and any given neural structure. When this small increase is combined with their earlier findings on area 13 of prefrontal cortex (Semendeferi et al. [1997] *J.*

Hum. Evol. 32:375–388), it appears that the prefrontal cortex in humans is not some 200% larger as claimed by some researchers (Deacon [1997] *Symbolic Species*, New York: W.W. Norton; cf. Holloway [1998] *Am Sci* 86:184–186), and that the findings of Semendeferi et al. ([2001] *Am. J. Phys. Anthropol.* 114:224–241) are in agreement with the earlier work (Semendeferi and Damasio [2000] *J. Hum. Evol.* 38:317–332; Semendeferi et al. [1997] *J. Hum. Evol.* 32:375–388), showing that the human frontal lobe volume is what would be expected for a primate of its brain size. While the prefrontal cortex may have increased relatively in *Homo sapiens*, the increase is likely to have been far less than currently believed. *Am J Phys Anthropol* 118:399–401, 2002. © 2002 Wiley-Liss, Inc.

In their recent research paper on a comparative study of Brodmann's area 10 of the prefrontal cortex, Semendeferi et al. (2001, p. 224) showed that the human value for area 10 is "... larger relative to the rest of the brain than it is in apes." This observation, if true when replicated with larger sample sizes, is an important empirical finding, particularly since Semendeferi and Damasio (2000), von Bonin (1948), and Holloway (1964, 1968) suggested that the frontal lobe of humans is essentially the size one would expect for a primate of its brain size. Thus one of the long-standing myths regarding relatively larger frontal lobes in humans appears to have been replaced with excellent empirical studies showing that the situation is more complex. Still outstanding, however, is the possibility that the prefrontal cerebral cortex might be enlarged in *Homo* relative to the great apes, for which Deacon (1997) has strongly argued, mostly on the basis of earlier tables by Brodmann (1909), based on surface areas and his cytoarchitectonic maps which were then used by Blinkov and Glezer (1969, their Table 196) to arrive at the relative expansion for *Homo*. Not all observations suggest this to be the case. Uylings and van Eden (1990), using *Pongo* as their pongid example, showed that frontal lobe expansion in *Homo* was not statistically significantly enlarged, and that the prefrontal cortex of *Homo* was almost exactly on the regression line for the primates in their sample, and that allometric slopes were essentially 1.0 These

figures contrast strongly with those of Deacon (1997) (cf. Holloway, 1998), which suggested that the human prefrontal cortex expanded +200% from a primate ancestor during hominid evolution. The work of Brodmann (1909), and the compilations of Blinkov and Glezer (1968), did not use allometry to test whether or not the absolute increases in surface area/volume of prefrontal cortex are really significantly larger than expected for a primate with a human brain size. Given the increasing perceived importance of the prefrontal cortex in human complex cognitive behavioral patterns coming out of MRI, fMRI, and PET studies, it would be useful to have a more accurate assessment of the volumetric differences between humans and pongids, to which Semendeferi et al. (2001) have been adding newer information.

MATERIALS AND METHODS

Using the data base of both Semendeferi et al. (2001) and Stephan et al. (1981), the amount of

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Received 16 April 2001; accepted 28 December 2001.

DOI 10.1002/ajpa.10090
Published online in Wiley InterScience (www.interscience.wiley.com).