Some change in peripheral metabolism must also have resulted from the central 5-HT depletions, because juvenile rats continued to grow in size as adults, and showed no remarkable accumulation of abdominal fat at autopsy despite their elevated body weights. Thus, the observed hyperphagia might be secondary, or at least complementary, to an alteration in the secretion, metabolism, or effectiveness of pituitary hormone. In this regard, it is interesting to note that surgical isolation of the basomedial hypothalamus of rats, by knife cuts of areas through which serotonergic neurons might be expected to ascend, have been reported to increase food intake, longitudinal growth, and circulating levels of growth hormone (*20*).

Even if central 5-HT–containing neurons are involved in mediating satiety, there is no reason to restrict their function to the cessation of feeding. That is, serotonergic neurons have also been implicated in sleep (*21*), and the postprandial appearance of synchronized electroencephalographic activity (*22*) suggests a general behavioral inhibition rather than the removal of hunger per se. Thus, an anorexigenic agent like fenfluramine, which appears to increase 5-HT activity in the brain (*23*), may not be acting solely to reduce food intake. Similar arguments have been raised recently regarding the possible nonspecific mechanisms by which amphetamine and related drugs exert their effects on food intake (*24*).

CHARLES F. SALLER
EDWARD M. STRICKER

Psychobiology Program,
Departments of Biology and *Psychology,*
University of Pittsburgh,
Pittsburgh, Pennsylvania 15260

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11. This effect is not due to the NE depletions per se, since greater than 90 percent depletions of telencephalic NE do not always retard body weight gain (*3*).
12. It has recently been reported that complete protection of central NE is obtained in rats given 5,7-DHT when DMI is injected 45 to 60 minutes earlier [A. Björklund, H. G. Baumgarten, A. Rensch, *J. Neurochem.* **24**, 833 (1975)].
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12 January 1976

Anatomical Study of Cerebral Asymmetry in the Temporal Lobe of Humans, Chimpanzees, and Rhesus Monkeys

Abstract. *It is generally accepted that anatomical asymmetries in the temporal lobe language region of humans are associated with the asymmetrical representation of language function in the left hemisphere. Comparative measurements were taken of the length of the left and right Sylvian fissures of human, chimpanzee, and rhesus monkey brains. Measurements confirmed the findings of other studies that the human Sylvian fissure is longer on the left than on the right. The chimpanzee brains had a similar asymmetry but to a lesser degree than the human brains. The rhesus brains, however, showed no significant differences between left and right fissure lengths.*

Anatomical measurements of the adult human brain have shown that the posterior region of the superior surface of the temporal lobe (planum temporale) is larger on the left than its homolog on the right in about 65 percent of the specimens examined (*1*). Since the planum temporale is one of the cortical areas involved in language function (*2*), the asymmetry seen in the planum temporale has generally been interpreted as providing an anatomical basis for the lateralization of language function in one hemisphere (*3*). A recent study found asymmetries in the planum temporale of newborn as well as adult human brains with 86 percent of the newborn and 81 percent of the adult brains having a larger planum temporale on the left than on the right (*4*). The data from the brains

Table 1. Comparisons of left and right Sylvian fissures in humans, chimpanzees, and rhesus monkeys.

Species	Number sampled	Sylvian fissure length (mm) (mean ± standard deviation)		
		Left	Right	t
Human	25	83.6 ± 8.1	73.4 ± 8.0	4.83*
Chimpanzee	25	45.7 ± 4.6	43.7 ± 4.3	3.86*
Rhesus	25	33.1 ± 2.8	32.7 ± 2.3	1.45

*$P < .001$ (two-tailed test; d.f. = 24)

of newborns suggest that the anatomical asymmetry associated with language function is present in the human before the onset of language learning and preferred hand usage.

The basic question asked in our investigation is whether homologous anatomical asymmetries exist in the brains of nonhuman primates. Our aim was to conduct a comparative study of human, chimpanzee, and rhesus monkey brains with the use of a measure that could be applied to all three species. A direct measure of the planum temporale could not be made for the three species since the anterior boundary of the planum, the sulcus of Heschl's gyrus, was readily identifiable only in the human specimens we studied (*5*). Therefore, the length of the Sylvian fissure, which includes the length of the planum temporale, was selected as the comparative measure, since the anterior and posterior points of the fissure could be readily specified in all three species. Moreover, studies comparing the lengths of the human Sylvian fissures have found the left to be longer than the right (*6*), a difference that can be attributed to the greater length of the left planum temporale (*3*).

Our material consisted of 25 brains of each species, fixed in formalin. All specimens were undistorted and free from any neurological pathology (*7*). The anterior and posterior points of the left and the right Sylvian fissures were marked by pins. The anterior point of the Sylvian fissure was derived in the following manner. The specimen was held so that the ventral surface of the brain was in direct view. A ruler aligned perpendicular to the sagittal plane was placed against the anterior division between the frontal and temporal lobes. The anterior pin was inserted at the point where the ruler touched the Sylvian fissure. In order to place the posterior pin, a portion of the temporal lobe was separated from the adjacent parietal lobe to expose the posterior boundary of the fissure. The pin was inserted at the point where the Sylvian fissure terminated on the lateral edge of the temporal lobe. In cases where the fissure branched, as sometimes seen in the human and chimpanzee specimens, the pin was placed at the end of the deeper branch. For eight human specimens where the fissure bifurcated and both branches were equally deep, the end of the descending branch was chosen as the posterior point. Calipers were used to measure the straight-line distance between the pins (*8*). Another pair of observers repeated our procedures on a sample of six specimens from each species and found no significant differences from our set of measurements.

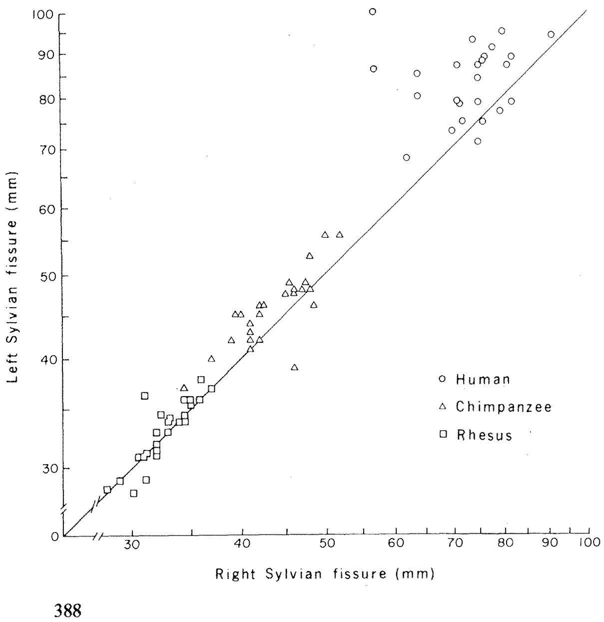

Fig. 1. The length of the left Sylvian fissure plotted against the length of the right Sylvian fissure for the 25 specimens in each species. The diagonal represents equal left and right fissure lengths.

In Fig. 1 the length of the left Sylvian fissure is plotted against the length of the right Sylvian fissure for each specimen of each species. A longer left Sylvian fissure was seen in 84 percent of the humans, in 80 percent of the chimpanzees, and in 44 percent of the rhesus monkeys. Equal left and right fissure lengths were seen in none of the human, in 12 percent of the chimpanzee, and in 36 percent of the rhesus brains.

Table 1 summarizes the results. The Sylvian fissure was significantly longer ($P < .001$) on the left than on the right for the human and chimpanzee brains. The mean difference between the lengths of the left and right fissures was 10.2 mm for the human and 2.0 mm for the chimpanzee brains. The rhesus brains showed no significant difference between the left and right fissure lengths. The differences between the left and right fissure lengths are also expressed as ratios (left to right) in order to compare the proportional differences in fissure length among the three species. The largest ratio, 1.15 (left fissure 15 percent longer than right), is for the human and this ratio differs significantly from the chimpanzee's ratio of 1.05 ($t = 2.75$, d.f. = 48, $P < .01$). The ratio for the chimpanzee in turn is significantly larger than the rhesus's ratio of 1.01 ($t = 2.40$, d.f. = 48, $P < .05$). These results show that the human and the chimpanzee, but not the rhesus, tend to have a longer left than right Sylvian fissure, and that the degree of the asymmetry is greater for the human than for the chimpanzee.

Our finding that the total length of the Sylvian fissure in the human is longer on the left agrees with earlier studies (*6*). Geschwind and Levitsky (*1*) reported a 9-mm difference between the length of the left and right planum temporale, which is remarkably similar to the 10-mm difference in the entire Sylvian fissure length that we found. Also, the proportion of specimens with a longer left Sylvian fissure in our study (84 percent) is comparable to the proportion of adult specimens (81 percent) with a longer left planum temporale in the study by Witelson and Pallie (*4*).

In the case of the chimpanzees, our finding of a longer left than right Sylvian fissure is in agreement with the conclusion of a study published in 1921 by Fischer (*9*), who examined 24 chimpanzee brains. Fischer did not report the mean difference in fissure length but did state that 50 percent of his specimens had longer left fissures (1 to 6 mm) and 17 percent had longer right fissures. In our sample 80 percent of the specimens had longer left fissures while only 8 percent had longer right fissures. The discrepancies between the two studies could be attributed either to measurement techniques, which Fischer did not describe, or to sampling differences.

The significance of finding an asymmetry in the region of the planum temporale is due to the fact that the planum temporale is part of Wernicke's area, which is known to be of primary importance to language function (*2*). Since the sulcus of Heschl's gyrus, which is the anterior boundary of the planum temporale, is poorly developed in the chimpanzee and absent in the rhesus (*5*), it is difficult to identify the planum temporale in these species by macroscopic observation. From cytoarchitectonic studies, however, it has been demonstrated that the human planum temporale is part of the auditory association areas TA and TB (*10*). These cytoarchitectonic areas have been identified in the chimpanzee (*11*) and the rhesus (*12*) and are located, as in the human brain, on the superior surface of the temporal lobe. Thus, Sylvian fissure length may be considered an indirect measure of the homolog of the human planum temporale in the chimpanzee and rhesus brain.

Our results suggest that anatomical asymmetries may be part of an evolutionary development that is reflected by the trend toward asymmetry among some of the living members of the order Primates (*13*). If functional asymmetries are associated with anatomical asymmetries then our findings suggest that asymmetry in hemispheric function should not be limited to humans (*14*). The demonstrations of some degree of language capability among chimpanzees (*15*) also raises speculation as to whether a neuroanatomical substrate of asymmetry is a prerequisite for language acquisition.

GRACE H. YENI-KOMSHIAN
Department of Otolaryngology, Johns Hopkins University School of Medicine, Baltimore, Maryland 21205
DENNIS A. BENSON
Department of Biomedical Engineering, Johns Hopkins University School of Medicine

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7. The rhesus and chimpanzee specimens were juvenile brains. Their mean brain weights were 75 and 226 g, respectively. The human specimens were adult brains with a mean weight of 1293 g. The rhesus and human brains were stored for less than 2 years, while the chimpanzee brains were stored for 22 to 27 years. Because of the length of storage time, we estimate that the loss in chimpanzee brain weight was at least 16 percent [S. M. Blinkov and I. I. Glezer, *The Human Brain in Figures and Tables* (Basic Books, New York, 1968), p. 3].
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14. Our findings predict functional asymmetry in the chimpanzee. However, we are not aware of any study which has investigated functional asymmetry in the chimpanzee. The fact that our measurements did not show differences between left and right in the monkey does not exclude the possibility that the monkey could have lateralized functions associated with anatomical asymmetries in areas other than the one we measured. In fact, preliminary results suggesting some degree of functional asymmetry in monkeys have been reported by C. R. Hamilton, S. B. Tieman, and W. S. Farrell, Jr. [*Neuropsychologia* **12**, 193 (1974)] and J. H. Dewson III, A. Burlingame, K. Kizer, S. Dewson, P. Kenney, and K. H. Pribram [*J. Acoust. Soc. Am.* **58** (Suppl. 1), S66 (1975)].
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16. We thank Dr. D. Bodian for making the specimens available to us, and for his advice and help. We also thank Dr. J. Sinnott and Dr. R. Hienz for repeating our measurement procedures on a sample of the specimens. Supported in part by NSF grant BMS 74-19040 and NIH grant NS 09994.

5 September 1975; revised 23 December 1975

The "Pincushion Grid" Illusion

Abstract. *The illusion generated by a "pincushion grid" is not predicted from the two-dimensional Fourier transform of the grid. This implies that the visual system may not perform two-dimensional Fourier transforms of observed patterns.*

The threshold of a given pattern has been predicted by determining the two-dimensional Fourier transform of that pattern. For example, when a checkerboard is observed at low contrast levels, diagonal lines are seen. The two-dimensional Fourier transform of the low contrast checkerboard has components along the diagonal (*1*). This has suggested that the visual system performs a two-dimensional Fourier transform of the observed pattern (*2*). I now present an illusion that is not predicted from the two-dimensional Fourier transform of the pattern.

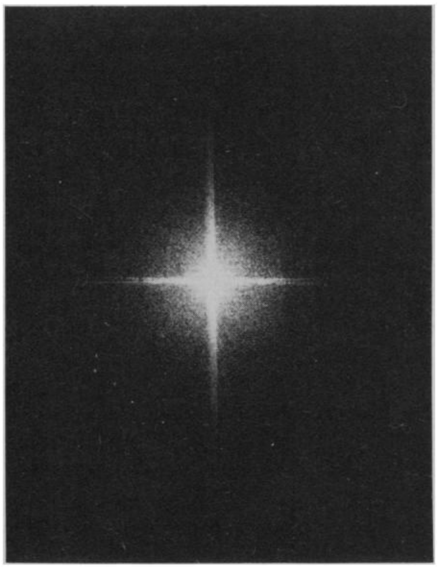
Fig. 1. Photograph of the two-dimensional optical Fourier transform of the pincushion grid. There are no diagonal components.

When the "pincushion grid" (see cover photo) is observed with the dark lines horizontal and vertical, the illusion of crisscrossing white diagonal lines extending between the points of the pincushions is observed. When the pincushion grid is rotated 45°, the white lines appear vertically and horizontally and the illusion is intensified. A negative of the pincushion grid (black pincushions separated by white spaces) produces the illusion of diagonal black lines. The color of the pincushion determines the color of the illusion. For example, if the cover photo is viewed through a red filter, the illusory lines appear red. The illusion disappears when the grid is out of focus. A