CC/NUMBER 49
DECEMBER 5, 1983

This Week's Citation Classic

Galin D & Ornstein R. Lateral specialization of cognitive mode: an EEG study. *Psychophysiology* 9:412-18, 1972.
[Langley Porter Neuropsychiatric Institute, San Francisco, CA]

EEG asymmetry in normal subjects was studied during verbal and spatial tasks. The right-over-left ratio of whole band EEG power from the temporal and the parietal regions was greater in the verbal tasks than in the spatial tasks. This measure provides a means to distinguish these cognitive modes as they occur in normal subjects using simple scalp recording. [The *Science Citation Index*® (*SCI*®) and the *Social Sciences Citation Index*® (*SSCI*®) indicate that this paper has been cited in over 200 publications since 1972.]

David Galin
Langley Porter Psychiatric Institute
University of California
San Francisco, CA 94143

September 12, 1983

"Interest in hemispheric specialization and integration had been stimulated greatly by the dramatic studies of commissurotomy ('split-brain') patients by Sperry and his colleagues.[1,2] However, most of what was known was inferred from deficits following damage to one hemisphere or the other, or to their interconnections. Our paper is cited because it showed that the intact brain does make use of lateral specialization, and demonstrated a simple noninvasive method with which to study brain mechanisms in cognition in normal people.

"The EEG could be used during complex, naturalistic behaviors like speaking and drawing, unlike the event-related potential (ERP) method which required repetitive, transient stimuli, greatly restricting the kind of activities which could be studied. (We have recently described a 'probe-ERP' approach with advantages of both EEG and ERP.[3,4])

"In spite of great hopes since the EEG was discovered in the 1920s, there had been little previous success in relating electrophysiological recordings to cognitive functions. Luckily, we had naively taken into account three factors which had been neglected in the past: 1. Recording while the subject is engaged in a task. 2. Selection of cognitive tasks known to depend more on one hemisphere than the other. 3. Selection of temporal and parietal leads, which should be the most functionally asymmetrical. Unfortunately, occipital leads had been used most often.

"We subsequently showed that task-dependent asymmetry depended on the alpha band and studied a wide variety of tasks and task difficulty, individual differences (between lawyers and artists, between the sexes, and among handedness groups), and dyslexic children.

"This work was made possible by my Research Career Award from the National Institute of Mental Health which, in those days, endorsed a particular scientist and the general directions he wanted to take, rather than a specific experiment. This is difficult in our current, mission-oriented, publication-oriented, short-term funding climate.

"The work was also facilitated by the atmosphere of interchange at the Langley Porter Institute, where Research Director Enoch Callaway had gathered scientists with differing perspectives. I had been studying attention in cats and would have continued if not for my colleague Ornstein, then a fellow of our Interdisciplinary Training Program. He persuaded me that since my underlying interest was human consciousness it would be better to study it directly. Together we began to study the subjective state associated with EEG alpha using the biofeedback approach pioneered by Joe Kamiya at Langley Porter. In those days it was usually done by recording from a single midline occipital electrode, taking this as representative of the whole brain's activity. We quickly found this 'high alpha' with many different states. To get more specificity we pursued the idea that since the two hemispheres were associated with different types of thought, perhaps alpha from each side had a different significance, and that led us to this series of experiments."

1. **Sperry R.** Some effects of disconnecting the cerebral hemispheres. *Science* 217:1223-6, 1982.
2. **Bogen J E.** The callosal syndrome. (Heilman K & Valenstein E, eds.) *Clinical neuropsychology*. New York: Oxford University Press, 1979. p. 308-59.
3. **Galin D.** EEG studies of lateralization of verbal processes. *Neurological bases of language disorders in children*. Washington, DC: US Government Printing Office, 1979. National Institute of Neurological and Communicative Disorders and Stroke Monograph No. 22; National Institutes of Health Publ. No. 79-444.
4. **Johnstone J, Galin D, Fein G, Yingling C, Herron J & Marcus M.** Regional brain activity in dyslexics and control children during reading tasks. *Brain and Language*. To be published, 1984.