ELSEVIER

International Journal of Psychophysiology 00 (2000) 00–00

INTERNATIONAL JOURNAL OF PSYCHOPHYSIOLOGY

www.elsevier.nl/locate/ijpsycho

Editorial

Gamma activity as a functional correlate of cognition Special issue

Oscillations were the very beginning of our research topic when Berger found the alpha rhythm to be recordable on the human scalp (Berger, 1929). The first gamma oscillations were found by Adrian when hedgehogs were stimulated with odors (Adrian, 1942). In their overview on gamma-band activity, Başar-Eroglu et al. called this the first stage of gamma research (Başar-Eroglu et al., 1996). In this taxonomy, the second stage was initiated by Freeman who found 40 Hz to play a key role in perceptual models of the rabbit's olfactory bulb (Freeman, 1975). In this stage gamma activity was also found in the human brain and in evoked potentials. The third phase started with the work of Galambos and made gamma oscillations generally accepted in studies of human perception (Galambos et al., 1981). When the synchronous firing of single neurons was revealed to be able to solve the binding problem, the fourth and so far most prominent phase began (Gray et al., 1989). According to Karakas, we are now in the fifth phase, which is marked by the enormous amount of different paradigms and methods applied to solve the 'gamma puzzle'.

The puzzle is an electrophysiological phenomenon in a highly complex biological organism which is only visible if special recording and processing techniques are applied. This is the reason why it needs the cooperation of a number of disciplines to solve the problem. On the one hand, there is the bottom-up approach of recording single or few neurons, which is the most precise in terms of the underlying mechanisms. However, we will probably never be able to record from enough single neurons at the same time to understand the complex interactions needed to generate cognitive behavior. This research is mainly carried out by neurophysiologists and biologists. On the other hand, there is the top-down approach of recording from the human scalp which reflects a gross measure of the whole system and can be associated with solving cognitive tasks. Due to the insufficient spacial resolution, this measure can only lead us to very global conclusions on where and when neural processes occur in certain tasks. Unfortunately, this approach will probably not be able to resolve the underlying mechanisms in detail. This work is mainly achieved by physicians and psychologists. Between the top-down and the bottom-up approach there still remains a gap which needs to be bridged in order to relate both results to each other.

Nowadays, it is cognitive neuroscience, with its global goal to understand higher cognitive brain

0167-8760/00/$ - see front matter
PII: S0167-8760(00)00164-1

functions, which unites researchers from many disciplines to address the problem of what are the neural correlates of human information processing. And it is still oscillations which fascinate the participants of the game and which we believe could give us a clue to how distributed neural activity in a huge network can be linked together to coherent percepts.

The current issue was derived from the contributions of a workshop on gamma activity in the human brain which was held at the Max-Planck Institute of Cognitive Neuroscience in March 1999. There, we tried to bring together the different disciplines which are required to solve such a big problem in order to exchange their newest results and methods and think about future concepts of investigating gamma oscillations. Invited papers on additional topics round off the issue and hopefully make it a comprehensive and worthwhile overview of the ongoing research in this area.

All articles have been peer-reviewed by at least two reviewers. I wish to express my thanks to them for valuable comments that surely increased the readability and consistency of all contributions.

Christoph S. Herrmann
Leipzig, June 2000

References

Adrian, E.D., 1942. Olfactory reactions in the brain of the hedgehog. J. Physiol. (London) 100, 459–473.

Başar-Eroglu, C., Strüber, D., Schürmann, M., Başar, E., 1996. Gamma-band responses in the brain: a short review of psychophysiological correlates and functional significance. Int. J. Psychophsiol. 24, 101–112.

Berger, H., 1929. Über das Elektrenkephalogramm des Menschen. Arch. Psychiat. Nerverkr. 87, 527–570.

Freeman, W., 1975. Mass Action in the Nervous System. Academic Press, New York.

Galambos, R., Makeig, S., Talmachoff, P., 1981. A 40 Hz auditory potential recorded from the human scalp. Proc. Natl. Acad. Sci. USA 78, 2643–2647.

Gray, C.M., König, P., Engel, A.K., Singer, W., 1989. Oscillatory response in the cat visual cortex exhibit intercolumnar synchronization which reflects global stimulus properties. Nature 338, 334–337.