

This Week's Citation Classic

Spehlmann R. The averaged electrical responses to diffuse and to patterned light in the human. *Electroencephalogr. Clin. Neuro.* 19:560-9, 1965.
[Mayo Clinic and Mayo Foundation, Rochester, MN]

The electrical response of the human occipital cortex to patterned light differs from that to diffuse light and varies with the density of contrast borders between dark and light pattern elements. The pattern response represents the electrical correlate of the visual content of the stimulus. [The **SC**[®] indicates that this paper has been cited over 130 times since 1965.]

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"In the early 1960s, neurophysiological investigation of the human visual system was helped by the appearance of averaging computers capable of extracting small electrical cerebral responses to sensory stimuli from scalp EEC recordings. Many investigators, using flashes of diffuse light, described basic features of the human visual evoked potential. When I started my training in clinical neurology at the Mayo Clinic in 1962, I was assigned to the EEC laboratory where Reginald Bickford had just acquired a new averaging computer. Looking for a research project, I remembered my fellowship at the Neurophysiological Institute of Richard Jung in Freiburg, Germany. My colleagues there had worked on the ramifications of recent microelectrode studies from animal visual systems which had indicated that the projection of a contrast border between light and darkness onto the retina changes the firing of neurons representing that part of the retina in a manner that may serve visual discrimination of contours. This made me wonder if the computer could be used to show that visual evoked potentials in man follow the same rules as neuronal responses in animals. If the retina were stimulated with

densely spaced contrast borders, the resulting visual evoked potential, representing the summed activity of occipital neurons, should differ from the potential evoked by diffuse retinal illumination. I decided to test this idea by using checkerboard patterns, mainly because by decreasing the check size one can increase the density of contrast borders without changing the total luminance. So I drew the first set of checkerboard stimulus patterns at my kitchen table and used them on my fellow residents. I soon found that responses to diffuse and patterned light differed profoundly. The difference increased with interface density, was abolished by refractory errors, and persisted during fast stimulation causing steady state responses and during paired stimuli at various intervals. I used these pairs to plot excitability cycles in a few subjects willing to endure long hours of experimentation (the excitability cycles in figures 4 and 5 are from my wife).

"When I submitted the paper for publication, it was written so badly that it was saved from rejection only by an extremely kind reviewer who rewrote almost every one of my awful sentences. It has since been cited often perhaps because it showed that visual evoked potentials are not entirely determined by invariable, structural characteristics of the visual system but may contain correlates of the visual content of the stimulus and reflect important visual functions, notably discrimination. Checkerboard patterns were thereafter widely adopted for studies of human visual evoked potentials. Later, Halliday, McDonald, and Mushin¹ found that responses to patterned light are more sensitive to pathology than responses to diffuse light. Visual evoked potentials to checkerboard stimuli, now often generated by abrupt check reversal or shift, have become a useful clinical tool for the detection of conduction defects in the optic nerve and are finding their way into the diagnosis of cerebral lesions involving the posterior part of the visual path."

1. Halliday A M, McDonald W I & Mushin J. Delayed visual evoked response in optic neuritis. *Lancet* 1:982-5, 1972.