Basar E, Basar-Eroglu C, Rahn E, Schurmann M

Sensory and cognitive components of brain resonance responses. An analysis of responsiveness in human and cat brain upon visual and auditory stimulation.

Acta Otolaryngol Suppl (Stockh) 1991; 491:25-34; discussion 35

We performed an analysis of topographic and modality-dependent responsiveness of auditory and visual cortex in 5 cats and of vertex and occipital derivations in 12 human subjects. The evoked potentials were studied in the frequency domain by means of the Fourier transform. Furthermore, digital filtering was applied to confirm and extend the analysis. Preliminary results indicate that resonances were observed mainly in the 5, 10, 20 and 40 Hz frequency bands. The frequency of resonance maxima depended on the sites of measurement electrodes and stimulus modality. It is concluded that the analysis of resonance phenomena in the brain is a useful approach to understanding the relation between evoked potentials, evoked magnetic fields and single-cell recordings.

Brandt ME, Jansen BH

The relationship between prestimulus-alpha amplitude and visual evoked potential amplitude.

Int J Neurosci 1991 Dec;61(3-4):261-8

Root-mean-square (RMS) amplitude derived from power spectral measures in the alpha band of the 1 s prestimulus EEG were related to the peak-to-peak amplitude of the N1 and P2 components (N1P2PP) of the visual evoked potential (VEP) in 7 male subjects. Stimuli were low intensity flashes delivered randomly between 2 and 6 whole seconds. Trials were rank ordered according to the levels of prestimulus alpha amplitude and were partitioned into groups of 40 trials each (25 groups per data set). Averaged VEPs were computed from these groups and scattergrams of N1P2PP and enhancement factor (following the approach by Ba[sar, 1980) vs. prestimulus alpha amplitude were produced. There was a correlation of 0.74 (p less than .0001) between prestimulus alpha amplitude and N1P2PP, and all seven subjects displayed a general inverse relationship between VEP enhancement and prestimulus alpha amplitude, replicating the results of Balsar. However, we observed an exponential relationship, rather than the linear relationship reported by Balsar.

Duffy FH, Jones K, Bartels P, McAnulty G, Albert M

Unrestricted principal components analysis of brain electrical activity: issues of data dimensionality, artifact, and utility.

Brain Topogr 1992 Summer;4(4):291-307

Principal components analysis (PCA) was performed on the 1536 spectral and 2944 evoked potential (EP) variables generated by neurophysiologic paradigms including flash VER, click AER, and eyes open and closed spectral EEG from 202 healthy subjects aged 30 to 80. In each case data dimensionality of 1500 to 3000 was substantially reduced using PCA by magnitudes of 20 to over 200. Just 20 PCA factors accounted for 70% to 85% of the variance. Visual inspection of the topographic distribution of factor loading scores revealed complex loadings across multiple data dimensions (time-space and frequency-space). Forty-two non-artifactual factors were successful in classifying age, gender, and a separate group of 60 demented patients by linear discriminant analysis. Discrimination of age and gender primarily involved EP derived factors, whereas dementia primarily involved EEG derived factors. Thirty-eight artifactual factors were identified which, alone, could not discriminate age but were relatively successful in discriminating gender and dementia. The need to parsimoniously develop real neurophysiologic measures and to objectively exclude artifact are discussed. Unrestricted PCA is suggested as a step in this direction.

Evdokimidis I, Mergner T, Lucking CH

Dependence of presaccadic cortical potentials on the type of saccadic eye movement.

Electroencephalogr Clin Neurophysiol 1992 Sep;83(3):179-91

Premovement cortical potentials were studied with 4 types of saccadic eye movement: (a) visually triggered saccades of normal reaction time (RT; regular saccades); (b) visually triggered saccades of extremely short RT (express saccades); (c) saccades towards predicted target locations (anticipatory saccades); (d) saccades back towards predicted location of fixation point (refixation saccades). With all 4 saccade types a "presaccadic negativity" with the maximum at the vertex (Cz) was observed. A bilaterally symmetrical component contained in this potential (being smallest with almost unconsciously performed refixation saccades and smaller in trained than in naive subjects) appeared to be related mainly to the subjects' volitional effort. In addition, anticipatory and refixation saccades were preceded by an early, widespread contralateral negativity, which we relate to cortical activities that prepare, in general terms, action within or towards the hemifield containing the saccade goal. During the 60 msec before anticipatory saccades, a negativity occurred over the contralateral central lead, which may reflect neural activation in the frontal eye field (FEF) and premotor cortex. In contrast, regular saccades were preceded 30 msec before onset by a negativity over the contralateral parietal cortex, which probably reflects an activation of parietal visuo-motor neurons. No lateralization of the cortical potentials was observed before express saccades, which suggests that these saccades are generated in a reflex-like way mainly by subcortical mechanisms.

Hughes JR, Kuruvilla A, Fino JJ

Topographic analysis of visual evoked potentials from flash and pattern reversal stimuli: evidence for "travelling waves”

In this mapping study of the entire scalp area, the responses to flash (FL) and pattern reversal (PR) stimuli were studied in 34 normal subjects. The N70, P100, N135 and P180 were similar from both stimuli but with some differences in amplitude and latency, especially the variability of the latency of P100 from FL. A polarity inversion was usually seen for all components, especially at opposite ends of the scalp and a zero-potential was noted for all four components near Cz Pz. Evidence is seen that the frontal N100 is likely not the other end of a dipole involving the posterior P100. Lateral components as P120, N150 and N200 were also described. The major finding was evidence of "travelling: waves that appear to move in both the AP and PA directions throughout the scalp that eventually arrive on the posterior regions and appear as N70, P100, N135 and P180.

Klimesch W, Pfurtscheller G, Mohl W, Schimke H

Event-related desynchronization, ERD-mapping and hemispheric differences for words and numbers.

Int J Psychophysiol 1990 Apr;8(3):297-308

Event-related desynchronization (ERD) is the amount of event-related decrease in alpha band power. In applying ERD as an index of cortical activation, the way in which attention and expectancy affect hemispheric differences for words and numbers was investigated. Subjects, 12 right-handed males, had to perform a semantic and a numerical classification task under two different counterbalanced expectancy conditions. Whereas under the high expectancy condition words and numbers were presented blockwise, they were presented randomly under the low expectancy condition. In the semantic task subjects had to indicate the category to which a word belonged; in the numerical task they had to judge whether a number was odd or even. Because 48 words and numbers were used in both expectancy conditions, each subject had to perform a total of 192 trials, practice trials not included. During each of the 192 trials, EEG-signals were recorded from 29 electrodes and analyzed in two frequency bands (6-10 Hz and 9-13 Hz). The data, which were also presented in the form of maps, were subjected to a 6-factorial ANOVA. The results reveal a complex pattern of interactions between the two frequency bands, expectancy conditions, stimulus types and the recording sites. The most important results concern the influence of expectancy. A consistent left hemispheric advantage could be observed under the high expectancy condition and in the lower alpha band only. This and other results seem to indicate that the lower alpha band is more sensitive to reflect expectancy and attentional processes.

Kushwaha RK, Williams WJ, Shevrin H

An information flow technique for category related evoked potentials.

IEEE Trans Biomed Eng 1992 Feb;39(2):165-75

We report a technique for studying interactions among many subsystems of a biological system. A general mathematical technique is developed for information flow among various subsystems of a system when two or more classes of stimuli are presented to the system. The technique is validated by various simulation studies and then applied to a brain system. The usefulness of the technique is demonstrated for visual event related potentials (ERP's) obtained from human subjects suffering from phobias. The stimuli are briefly flashed words and phrases. The word classes are pleasant, unpleasant, conscious, and unconscious. The conscious class consists of words known by the patient to relate to the problem, whereas the unconscious class of words consists of words related to deep conflicts which are not recognized by the patient. It is demonstrated that information flow is suppressed under supraliminal presentation of the unconscious class, but is strong under subliminal presentation. The technique has the potential of being an objective indicator of conflictual relationships in these patients. The principle of the technique can be applied to any system in which interactions among subsystems are to be analyzed.

Lang W, Starr A, Lang V, Lindinger G, Deecke L

Cortical DC potential shifts accompanying auditory and visual short-term memory.

Electroencephalogr Clin Neurophysiol 1992 Apr;82(4):285-95

Negative DC potential shifts appeared over the scalp during the performance of verbal and non-verbal short-term memory tasks. Three items were successively presented (presentation of memory items) and then had to be retained in memory for 3 sec (memory retention) before being compared to a probe which was either a member (in set) or not a member (out of set) of the memory set. Verbal items (the digits "1" through "9") were tested in the auditory and visual modality and non-verbal items (musical notes) were tested in the auditory modality. Stimulus modality had a significant effect on DC potential shifts during both presentation of memory items and memory retention. There was a sustained negative shift during these periods which was larger over frontal regions with auditory than with visual material whereas the negative shift was larger over posterior temporal regions with visual than with auditory material. Out of 21 subjects who participated in the study, 9 reported the use of visual images in the auditory task, 5 used subvocal auditory rehearsal in the visual task and 7 used imagery concordant with the stimulus modality being memorized. These different strategies had a significant effect on the amplitudes and distribution of the DC potential shifts. The speed of response affected the amplitude of the DC potential shifts in the frontal regions, being larger with fast RTs than with slow RTs but only when verbal items were being processed. These results indicate that stimulus modality, modality of mental imagery, and speed of scanning of the memory store affect DC potential shifts during a 3 sec period of memory retention.

Lebedeva NN; Pavlygina RA; Davydov VI

[The motor dominant in man]

Language: Rus
Zh Vyssh Nerv Deiat 1991 Jul-Aug;41(4):647-54

Study of the motor dominant in man has shown that in aftereffect of rhythmic electrocutaneous stimulation of hand, a latent focus of excitation is formed in the CNS. When using sensory stimuli (light, sound) and also stimuli, addressed to the second signal system, a hand motor reaction appears in the rhythm of earlier electrocutaneous stimulation, what testifies to preservation of rhythmic nature of excitation in the dominant focus. Summation process in the dominant focus is not reflected in human consciousness. Study of the brain biopotentials has shown that at formation of human motor dominant, typical changes of spectral-coherent characteristics of the neocortex electrical activity appear: within the "dominant" hemisphere, the spectrum power, increases in the range of low frequencies; highly coherent connections of electrical processes appear in the delta-range of the frontal-parietal area at conjugate decrease of combination of processes in the parietal-occipital area of the cerebral cortex. Formation of the dominant focus in one hemisphere causes general reconstruction of the structure of intercentral relations of both hemispheres electrical activity.

Nogawa T; Katayama K; Okuda H; Uchida M

Changes in the latency of the maximum positive peak of visual evoked potential during anesthesia.

Nippon Geka Hokan 1991 May 1;60(3): 143-53

The relationship between the latency of visual evoked potential (VEP) and the anesthetic concentration was investigated in surgical patients in order to examine the applicability of VEP in monitoring of the depth of anesthesia. The VEP was recorded with a standard EEG electrode from the midline parietal region in reference to both earlobes linked to the ground. An array of light-emitting-diodes mounted in opaque goggles was used to stimulate both eyes simultaneously and photic stimuli were delivered at random inter-pulse intervals with uniform distribution ranging from 2 to 5 seconds. Fifty trials of data were averaged to estimate that Pmax latency, i.e., the latent period from the photic stimulus to the maximum positive peak arising after 170 msec. Increases in the Pmax latency following the administration of anesthetics and restorations to preanesthetic values after recovery from anesthesia were found. A significant correlation was demonstrated between the Pmax latency and the inspiratory concentration of enflurane. The latency of the Pmax showed a drastic and a sensitive prolongation from about 200 msec in the awake state up to about 600 msec at the stage where the EEG exhibits large-voltage slow waves. Thus the measurement of the Pmax latency of VEPs was found to be useful for monitoring the depth of anesthesia.

Maccabee PJ; Amassian VE; Cracco RQ; Cracco JB; and others

Magnetic coil stimulation of human visual cortex: studies of perception.

Electroencephalogr Clin Neurophysiol Suppl 1991;43:111-20

The effects of magnetic coil (MC) stimulation of human visual cortex on the foveal perception of briefly presented letter trigrams include: (1) letters were nearly always reported correctly at visual stimulus-MC pulse intervals less than 60-80 msec or greater than 120-140 msec. Thus, by 120-140 msec, information related to letter recognition is relayed from calcarine cortex. (2) Presentation of equiluminant chromatic stimuli (specifically green letters against a red background) results in suppression curves which commence at longer latencies than those obtained with achromatic stimuli. (3) At a stimulus-MC pulse interval of 100 msec, shifting the MC laterally or rostrally resulted in suppression of the contralateral or caudal-most letter respectively. This implies a focal, topographical effect on visual cortex. (4) Two trigram stimuli separated in time (e.g. 100 msec) resulted in classical backward masking in which S1 (the target) was suppressed by S2 (the mask), using an S2/S1 luminance-contrast ratio of 4:1. When the MC was subsequently discharged 80-100 msec after S2, and S2 was suppressed, the response to S1 was easily retrieved (unmasked). Presumably, by 160 msec, S1 has been transmitted to the next processing, extrastriate level. (5) The unmasking phenomenon has been used to track information flow from visual cortex to higher cortical centers (e.g. Wernicke's, Broca's, and related areas). (6) Using a prototype repetitive stimulator, a consecutive train of single MC pulses given 70, 143 and 216 msec following a brief alphabetic trigram stimulus elicited a significant reduction in letter perception. This notably contrasts with the absence of suppression when a single MC pulse was given 70 or 143 msec following presentation of the alphabetic trigram. The results with 3 pulses suggest that the first MC pulse (at 70 msec) delays but requires repetition to prevent processing and/or transmission of information from visual cortex.

Shevelev IA; Kostelianetz NB; Kamenkovich VM; Sharaev GA

EEG alpha-wave in the visual cortex: check of the hypothesis of the scanning process.

Int J Psychophysiol 1991 Aug;11(2):195-201

In computer-controlled experiments the recognition by seven human observers of tachistoscopically presented geometrical figures of different size (from 0.5 to 9 angular degrees) or of different eccentricity (from 3 up to 16 degrees) in the visual field was studied. The onset of figures presentation coincided with different phases of the EEG alpha-wave in the occipital region. According to the criterion of an increase of recognition probability, an inverse dependence was revealed between the distance of the figures contour from the gaze (up to 9 degrees) and the succession of phases of alpha-wave. Small or more centrally localized figures were significantly better recognized when presented at relatively earlier phases of EEG alpha-wave, while bigger or relatively more peripherally localized figures - at earlier phases. At 16 degrees form the gaze no reliable dependence of recognition on the alpha-wave phases was revealed. The data obtained are discussed in connection with Pitts and McCulloch (1947) hypothesis about a periodical (with alpha-wave frequency) scanning wave spreading over the visual cortex. Possibility of a synchronous excitability fluctuation in the whole visual cortex with alpha-rhythm frequency that imitated the spreading process is also discussed. Data obtained and simulation of the mentioned possibilities confirmed the first explanation and thus confirmed Pitt's and McCulloch's ideas on the EEG alpha-wave as a reflection of the scanning process in the visual cortex.

Vassilev A, Manahilov V, Mitov D, Nevskaya AA, Leushina LI

Hemisphere asymmetry of the visually evoked potentials elicited by gratings of varying spatial frequency.

Acta Physiol Pharmacol Bulg 1991;17(2-3):54-60

Visually evoked potentials (VEP) were recorded upon hemifield stimulation with sinusoidal gratings of varying spatial frequenc (SF). Recording was bipolar from 0.1-0.2. The gratings were presented randomly in the left, in the right or in both visual hemifields. No systematic VEP asymmetry was observed at low SF. At SFs above 1.5-2 cpd, however, the early wave peaking at about 100 msec after grating onset was usually of greater amplitude when the grating was presented in the left visual field. In previous experiments of our, contrast sensitivity was almost the same in both hemifields. Thus, the VEP data suggest right-hemisphere specialization in processing high SFs and their comparison with the contrast sensitivity data suggests that this specialization occurs at a level higher than stimulus detection or is evident at suprathreshold contrast levels only.