Dynamic coordination of functional networks in the cerebral cortex: Mechanisms, development and psychiatric diseases

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Higher cognitive functions require the coordination of large assemblies of spatially distributed neurons in ever changing constellations. It is proposed that this coordination is achieved through synchronisation of oscillatory activity in specific frequency bands. Since there is no supra-ordinate command centre in the brain, the respective patterns of synchronous activity self-organise which has important implications on concepts of agency. Evidence will be provided that synchronisation supports response selection by attention, feature binding, subsystem integration, short-term memory, flexible routing of signals across cortical networks and access to the work-space of consciousness. The precision of synchronisation is in the millisecond range suggesting the possibility that information is encoded not only in the co-variation of discharge rates but also in the precise timing of individual action potentials. This could account for the high speed with which cortical circuits can encode and process information. Recent studies in schizophrenic patients indicate that this disorder is associated with abnormal synchronisation of oscillatory activity in the high frequency range (beta and gamma). This suggests that some of the cognitive deficits characteristic for this disease result from deficient binding and subsystem integration.

References:


