sures to different dynamic states of the brain as reflected by EEG. These measures, known as dimensions, provide a way to distinguish between levels of dynamic complexity in the brain. The methods used in computing such descriptive numbers, however, are computationally expensive and of limited applicability for experimental time series such as the EEG.

Anew method, based on the probabilistic aspect of the EEG as a time series will be presented. It is assumed that different conscious states should lead directly to EEG time series of different complexity or predictability. The joint probability of the EEG signal in time gives a measure of its predictability. Using Shannon's formula it is possible to extract an entropy from the measured time series directly.

This method has been tested on EEG data from healthy subjects in different conscious states. The subjects were asked to do various mental tasks. The results show that the entropy measure can in fact distinguish between such states. Tasks including mental imagery produce highest entropy in the EEG. Data from patients suffering from the apallic syndrome were also investigated. The dynamic activity in such patients is highly variable in time.

The results will be compared with dimensions and related measures computed from the same data. Moreover, multichannel recordings allow the construction of the topographical distribution of dynamic complexity in the brain.

The functional relation between different methods for analysis of dynamic aspects of the EEG and their psychological plausibility will be discussed.

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Human memory and cholinergic function in the brain

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Impairment of memory and cognition in aging and dementia has been attributed to alterations of central cholinergic function. This hypothesis is based on the finding that the degree of cognitive impairment in patients with dementia of the Alzheimer type is correlated with the reduction of central cholinergic markers such as choline acetyltransferase activity. Marked alterations of muscarinic and nicotinic cholinergic receptors in the brains of patients with Alzheimer-type dementia or other neurodegenerative diseases have been described. These findings, implicating altered cholinergic function in the brain as the underlying mechanism responsible for the decline in memory and cognition in Alzheimer's disease, have stimulated interest in the possibility of treating cognitive dysfunctions by enhancing central cholinergic transmission. Major pharmacological treatment strategies affecting cholinergic mechanisms include acetylcholine precursor loading, inhibition of acetylcholine metabolism and administration of cholinergic receptor agonists. Although cholinergic drugs appear to affect memory processes in humans, there is evidence suggesting that some effects of these compounds may be other cognitive functions such as perception, attention, and information processing. These functions can be improved in patients with Alzheimer's disease by the administration of cholinergic agonists including nicotine.

An early proposal concerning the function of acetylcholine in learning and memory was that cholinergic synapses were themselves the site of memory storage. The finding that most of the acetylcholine in the neocortex has its origin in the basal forebrain makes this hypothesis implausible. The ascending, widely projecting cholinergic pathways appear better suited as a modulatory system than as an information-storing system. Findings in slice preparations of the olfactory cortex suggest that selective suppression by acetylcholine of excitatory intrinsic fiber synaptic transmission prevents recall activity due to previously modified synapses from interfering with the learning of new memories. The neuromodulatory effects of acetylcholine appear to enhance associative memory function in cortical structures.

Objective assessment of "olfactory" and "trigeminal" perception of odors in patients with lesions of the olfactory system

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Anosmia is a frequent symptom in patients with lesions of the olfactory system, but occasionally spared olfactory perceptions are reported. In this investigation four patients with circumscribed lesions were studied with respect to olfactory thresholds and chemosensory evoked potentials

(CSEPs). Thresholds were assessed by means of 14 different concentrations of either Linalool or Menthol. Linalool is a relevant stimulus for olfactory bulb processing; Menthol stimulates trigeminal nerve endings. Probes were presented in random order by using the staircase methods of limits. Thresholds were determined by means of a three bottle odor test. CSEPs were recorded from Fz, Pz, and Cz, referred to linked mastoids. The olfactometer used allowed stimuli within a constantly flowing air stream, with controlled temperature, humidity, and an exactly defined stimulus duration of 200 ms to be offered. Mean ISI was 50 s; 25 trials per patient and odor were performed.

Prior to the investigation, the neuropsychological status of each patient was assessed. Results show that both procedures can effectively distinguish between olfactory and trigeminal odor perception and that residual functions can be reliably assessed. At least in one patient a – probably compensatory – enhancement of Methanol perception could be detected.

On the search for an anatomical locus of retrograde amnesia

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Until about two years ago there were hardly any reports of cases with selective and enduring retrograde amnesia in whom this behavioral disturbance could be related to the existence of a specific, focal anatomical damage. We had the opportunity to study a patient with profound and chronic retrograde, but minor anterograde amnesia. The patient was of average intelligence, high level professional background, and in the forties in age.

The most surprising finding was that his retrograde amnesia was mainly restricted to the field of episodic memory with semantic and procedural memories being generally intact. His brain damage was principally limited to a bilateral involvement of the temporo-polar region and of the inferior lateral prefrontal cortex, that is, of two brain foci which are inter-connected by the uncinate fascicule.

We conclude from this case and from two related ones, reported by others, that the lateral temporo-polar cortex (i.e., an area excluding the hippocampal formation) is – with or without the inferior-lateral prefrontal cortex – necessary for the retrieval of long-term stored information.

Improved interactive detection of micro-events and classification of wake and sleep stages using instantaneous spectral analysis (FTFT)

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Severe methodological problems have been reported in computerized analysis of physiological signals. In general, insufficient ability to cope with large interindividual variability of signals and problems with sensitivity, being too high for artifacts and too low for short-lasting micro-events have prevented a breakthrough for automated systems. The upper bound for consensus between visual and computerized analysis of, e.g., sleep is around 75% for healthy sleep and 60% for pathological sleep. For detection of micro-arousals and micro-sleep or subtle fluctuations of daytime alertness, the consensus is even worse. Such consensus rates in fact are too low for a reliable diagnosis in clinical applications.

Most computerized methods apply traditional Fourier spectral analysis. Obviously, for short-lasting events such as alpha and theta bursts and spindles, the period over which the spectrum is calculated should be in the order of 1 s or less. The frequency resolution, being the reciprocal of the observation time, then is limited to 1 Hz. Due to this limitation of both the time and frequency resolution, the subsequent detection method, acting upon these spectral features, suffers from a low sensitivity. To be precise, the low resolution of Fourier analysis contributes to the low reliability of computerized methods.

To improve on time and frequency resolution, we applied a method recently introduced for instantaneous spectral analysis, the so-called Fast Time Frequency Transforms (FTFT). Corresponding to a given bandwidth of, e.g., 4 Hz for the various EEG rhythms, the instantaneous spectrum is calculated as much as 8 times per second while the frequency remains a continuous variable. Our first results show a greatly improved instantaneous detection of both artifacts and subtle burst patterns. Obviously, this also gives rise to an improved subsequent sleep/wake classification. Furthermore, an additional improvement of about 10% can be reached when applying interactive adjustment of reference val-