auditory features and its development over time after receiving a cochlear implant.

Methods: Syllables of different vowel lengths were presented in a classical oddball paradigm. A total of nine children (age at first fitting: 1; 0–3; 9 years, mean: 1; 6–age at first measurement: 1; 0–3; 10 years, mean: 2; 1) were tested electrophysiologically after first fitting of the implant and in intervals of two months, with each hearing age group (0, 2, 4, 6 months) consisting of at least five children.

Results: Preliminary data suggest that first signs of discrimination can already be seen a few days after the implant has been first turned on, with ERPs becoming more robust with increasing hearing experience. It seems that in the beginning long vowel deviants are detected easier than short vowel deviants.

Conclusion: Despite no prior auditory input with all its implications to the still developing neural pathways the implanted children seem to discriminate different vowel lengths already shortly after first fitting of the implant. With an increasing sample size there will be more evidence for whether the observed ERPs may be interpreted as mismatch negativity and P3 and how they develop with increasing hearing experience.

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ERP assessment of word processing under broadcast bit rate limitations

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In telecommunication research, audio quality is typically assessed with behavioral tests. Neurophysiological data can complement these as an objective and non-intrusive measure, potentially revealing neuronal differences in quality processing below the threshold of conscious perception that might affect a user's long-term satisfaction. Recently, subconscious processing of noise in phonemes was found in event-related potentials (ERPs) [1]. The present EEG study ($N=8$) applies this approach to a more realistic setting. In a forced choice task, subjects had to rate whether a given word was of maximal quality or degraded. Stimuli were presented either in wideband quality (60%) or were impaired by four progressive levels of bit rate reduction, using a standard telecommunication codec [2]. The ERP analysis allowed qualifying those trials where subjects correctly indicated a loss of quality: The higher 'neural uncertainty' involved in detecting more subtle degradations is reflected in a decreased amplitude of the P3 component. Additionally, we used a linear classifier to single out trials where quality impairment was not reported, but still evoked an ERP pattern similar to when it was processed consciously (three subjects). Thus, the approach demonstrates that even if no quality impairment is noted consciously, the degradation can still be processed in the cortex. Concluding, the ERP paradigm previously developed for noisy phonemes can be transferred successfully to full words degraded by realistic broadcast limitations. This supports the potential of ERP analysis combined with machine learning not only to complement conventional methods of audio quality assessment, but also to extend their sensitivity to sub-threshold stimuli.

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Enhancement of learning with EEG neurofeedback

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There is solid evidence that sleep improves motor performance after an initial training period. We hypothesized that consolidation of memory during sleep is associated with slow EEG waves and used neurofeedback (NF) for increasing this pattern in order to improve performance without actual sleep. 35 subjects were trained to perform a motor sequence task. Following initial training and testing, the subjects went through a neurofeedback session, while a control group took 45 min of a break instead. We measured speed and accuracy before motor training, post-training, post-NF, one and two days later, and a week after training. Similar to sleep-related improvements, results of this study, showed a significant improvement in speed, following slow waves training but not in the group that took a break. This effect was found to be constant for a week.

Results of this study suggest that a single NF session of 45 min may support enhancement of motor learning. These findings have theoretical implications, on the role of spectral EEG and sleep in learning. Our findings also have practical implications in learning of motor tasks such as athletics and musical performance or any other procedural skill.

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Recurrent brain states during single-trials and evoked responses

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The recent years have seen an explosion of studies reporting functional connectivity of brain activity as measured either by EEG and fMRI. In most of studies functional networks are derived from the so-called "resting-state" activity of subjects performing no particular task. Here, we study functional networks at the electrode space of high-resolution EEG recordings during simple cognitive task which elicit characteristic event-related potentials. Our aim is twofold. On the one hand, we are interested in the temporal evolution of the functional networks during each individual trial in order to capture transient brain states of few milliseconds. On the other hand, we aim to recognise stable functional networks which can be related to brain states elicited by the experimental conditions. We find that during short time-scales the brain oscillates between few preferred configurations which recur after few milliseconds. We also find unique patterns of functional connectivity which occur, trial-after-trial, only as a consequence of the experimental condition.

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