possible modulation of the hemodynamic response to IEDs by the respective sleep stage.
Conclusion: Our preliminary results suggest that personalized EEG-fNIRS monitoring is a promising approach to assess the cortical hemodynamic fluctuations during sleep in healthy and epilepsy conditions.

PRELIMINARY VALIDATION OF IN-EAR EEG AGAINST PSG SYSTEM FOR SLEEP STAGING

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Introduction: Conventional sleep staging methods based on electrophysiological signals involve time-consuming setup procedures and maintenance of devices. Conventional recording devices are bulky and expensive making long-term electroencephalography (EEG) monitoringimpractical except forcontrolled clinical environments. The mobile IDUN GUARDIAN system offers a lightweight 2-channel in-ear EEG system, optimised for wearer's comfort and long-term use. One intriguing application is daytime sleep monitoring of patients suffering from narcolepsy, which is characterised by severe drowsiness or sudden periods of sleep. The GUARDIAN may facilitate the narcolepsy patient journey by identifying sleep onset and narcolepsy attacks throughout the day and potentially offer to support treatment decisions regarding medications and lifestyle. Here, we present preliminary findings for the validation of the GUARDIAN for sleep marker detection in comparison to gold-standard polysomnography (PSG).
Materials and Methods: In order to compare the GUARDIAN to a gold-standard sleep staging device, we recorded 1 h daytime naps of a total of 10 datasets from 8 healthy participants (2 females; age range: 23-37). Sleep staging was based on the AASM (Version 2.6; Berry et al., 2020) criteria. The recordings were divided into 30 s periods, which were scored as wakefulness (W), non-REM 1 (N1), non-REM 2 (N2), deep non-REM 3 (N3), or REM sleep (R). PSG data (SOMNOscreen plus, Randersacker, Germany), involving 5 EEG channels (F3, F4, C3, C4, O1; referenced to contralateral mastoid), 2 EMG channels placed on the chin, 2 EOG channels placed around the eyes, and ECG channels (Lead II placement) on the torso. The GUARDIAN was connected directly to the PSG amplifier and referenced to contralateral mastoid in order to ensure time-synchronisation and identical preprocessing of all channels.
Results: Visual comparison between in-ear and scalp-EEG channels reveal a clear correlation in regards to neural activity differentiating sleep stages. Such sleep markers include alpha and beta activity during W, alpha-to-theta shift during sleep onset (W-N1), sleep spindles and K complexes during N2, slow wave activity in N3, and short bursts of arousal during different sleep stages. In addition, the GUARDIAN revealed - similar to frontal scalp-EEG electrodes - onset of slow rhythmic eye movements, characteristic for the transition between wakefulness and sleep in some participants. Sleep scoring was first performed on PSG channels (F3, C3, O1, EMG, EOG, and ECG), and in a second step, data of the in-ear EEG channel were scored. Pearson's correlation coefficients between scorings of PSG and the GUARDIAN revealed moderate to high correlations across all datasets (average: $r = 0.78$).
Conclusions: The IDUN in-ear EEG solution is able to accurately detect sleep markers, while ensuring wearer's comfort, enabling long-term mobile use. Themonitoring of narcolepsy patients with in-ear EEG is a possible application. By measuring sleepiness as well as onset and duration of narcoleptic attacks during the day in an unobtrusive and comfortable way, while only minimally interfering with everyday life activities, in-ear EEG-based biomarkers could be used for symptom monitoring and as surrogate endpoints in future clinical trials.

PSYCHEDELIC COMPOUND 5-MEO-DMT INDUCES AN ALTERED WAKE STATE IN MICE

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Introduction: The traditional view that the serotonergic system plays an important role in subcortical control of global sleep-wake states is supported by observations that administration of serotonergic psychedelics suppresses rapid eye movement (REM) sleep and results in increased sleep fragmentation. However, the possibility that potentiating the serotonergic system through psychedelics results in an occurrence of altered states of vigilance has received less attention. We hypothesise that the serotonergic system plays a role in controlling the quality rather than the quantity of specific sleep-wake states, as reflected in the EEG. The aim of this study is to characterise the effects of a short-lasting psychedelic compound, 5-methoxy-N,N-dimethyltryptamine (5-MeO-DMT), on brain activity and sleep-wake states in laboratory mice.
Materials and Methods: 10 adult male C57BL6 mice were implanted with frontal and occipital EEG screws and nuchal muscle EMG wires. The animals were kept under a 12 – 12 hour light-dark cycle and recorded continuously for 8 days. In a crossover design, each animal received an IP injection of 5-MeO-DMT (5 mg/kg, in a solution at a concentration of 1 mg/mL) and vehicle solution at light onset, with 2 days between injections. Vigilance states were manually scored in 4s epochs using SleepSign, and EEG spectra were analysed with Matlab. So far, only a subset of these animals has been analysed ($n = 4$), thus the values presented below are preliminary.
Results: We found that in the first hour following the injection of 5-MeO-DMT, wake was increased in three out of four animals, by on average 15.17 min (-3.2 min – 32 min) and the first episode of REM sleep was delayed by on average 45.6 min (63 min – 131.4 min). During the initial wakefulness (0 – 20 min after injection) in all the animals, EEG theta-frequency activity (6 – 9 Hz) was markedly suppressed by 42.18 % (-0.06 % – -70.34 %), while EEG slow wave activity (0.5 – 4 Hz) was increased by 23.43 % (10.16 % – 41.91 %). These changes returned to baseline levels within 60 minutes, and no further changes in the total amount of vigilance states were observed beyond this point.
Conclusions: Our data support the notion that the effects of 5-MeO-DMT are short-lasting, as the changes in vigilance states and the EEG were primarily apparent within 1 hour from the injection. Importantly, this compound did not merely change the amount and distribution of vigilance states but had an observed effect on state-specific brain activity patterns. Reduced theta-activity and increased slow wave activity during waking after administration of 5-MeO-DMT reflect an occurrence of qualitatively different, "hybrid" or "dissociated" state, having features of both waking and sleep.
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RESTNET-AROUSALS: A END-TO-END DEEP LEARNING APPROACH TO AROUSAL DETECTION

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Introduction: Arousals are defined as abrupt shifts of electroencephalography (EEG) frequency that last at least 3 seconds, preceded with at least 10 seconds of stable sleep. The identification of arousals is important for the evaluation of sleep continuity and diagnosis of sleep disorders. Arousals are difficult for human experts to score and the low inter scorer agreement makes this a particularly challenging task for artificial intelligence (AI) models to learn. However, a well designed AI model might be helpful in improving scoring consistency, leading to more consistent clinical results.
Here we present an end-to-end deep learning approach to robustly identify arousals from standard polysomnogram recordings (PSG) and from Self Applied Somnography (SAS) studies. The SAS setup allows patients to self-administer frontal EEG and EOG leads in a home sleep study, which reduces cost and is more convenient for the patients.
Materials and Methods: The ResTNet-Arousals model structure was inspired by ResNet convolutional neural network architecture, which has been highly successful in image recognition tasks. The model has the characteristic residual blocks with an added Temporal component to increase the temporal receptive field of the model.
The model makes predictions from the raw EEG, EOG and EMG signals, in