Recognition of Emotional Affect in Dreams and Short Videos Using Convolutional Neural Networks on High-Density EEG Signals

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Previous studies have proposed theories about the role of emotions in dreams. However, relying on participants' ability to recall dreams often becomes a bottleneck in scaling up large-scale dream research, hindering a deeper understanding of dream emotions. With an increasing number of studies using electroencephalography (EEG) and deep learning techniques to estimate emotions, this study aimed to develop classification models for emotional states while watching short video clips and dream reports. EEG signals were recorded from 7 healthy participants (27±1.5 years) wearing a 128-channel EEG cap during two-night sessions. Each night involved viewing emotionally arousing 40-second video clips without sound from the Emotional Movie Database, followed by serial awakenings during sleep to report dream emotions, both evaluated in terms of valence and arousal using the Self-Assessment Manikin. The EEG dataset consists of 728 video responses and 146 dream reports, from which the EEG epochs were extracted from the 40 seconds while watching a video clip and the 40 seconds preceding a dream report. Each epoch was divided into 2-second segments, underwent band-pass filtering (0.01-35Hz), downsampling to 256 Hz, and referencing using the common average reference. Valence and arousal were labeled as low (1-4) or high (5-9) categories, the dataset was divided into 50% for training, 25% for validation, and 25% for testing. Binary classification models were created using a convolutional neural network called EEGNeX, and performance was evaluated using 5-fold cross-validation. The performance of the models indicated high classification accuracy for both dreams and video clips, with average accuracies of 99.3%±0.6 for dream valence, 98.6%±0.5 for video clip valence, 97.8±0.6 for dream arousal, 98.5%±0.6 for video clip arousal. Although this preliminary analysis showed high classification accuracy for emotion classification in both dreams and video clips, the potential overlap of instances from training, validation, and testing datasets within the same epoch from a participant may have influenced the results, limiting the real-life implementation. Future research will focus on exploring models that segregate data by participants, epochs, and sessions, as well as the use of low-density EEG.