

# Autonomic Sleep Patterns with Polysomnography

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## Introduction / Motivation

### What is Electrodermal activity (EDA)?

Electrodermal activity (EDA) provides a fine measure of sympathetic nervous system arousal, one of the main branches of the autonomic nervous system. EDA is a measure widely used in psychophysiology.

### EDA is interesting during sleep

Studies have shown that EDA is more likely to have high frequency peak patterns called “storms” during deep sleep (Asahina, 1962). EDA has also been shown to have characteristic differences associated with wake and sleep, although its patterns are not uniquely associated with EEG-based sleep stages (Koumans et al., 1968).

Our work advances a quantitative characterization of the relationship between EDA and PSG.



## Data



One night of wrist EDA and polysomnography (PSG) from 8 healthy adults in a sleep lab

Actigraphy: sleep and wake detection with standard zero-crossing and Cole's function

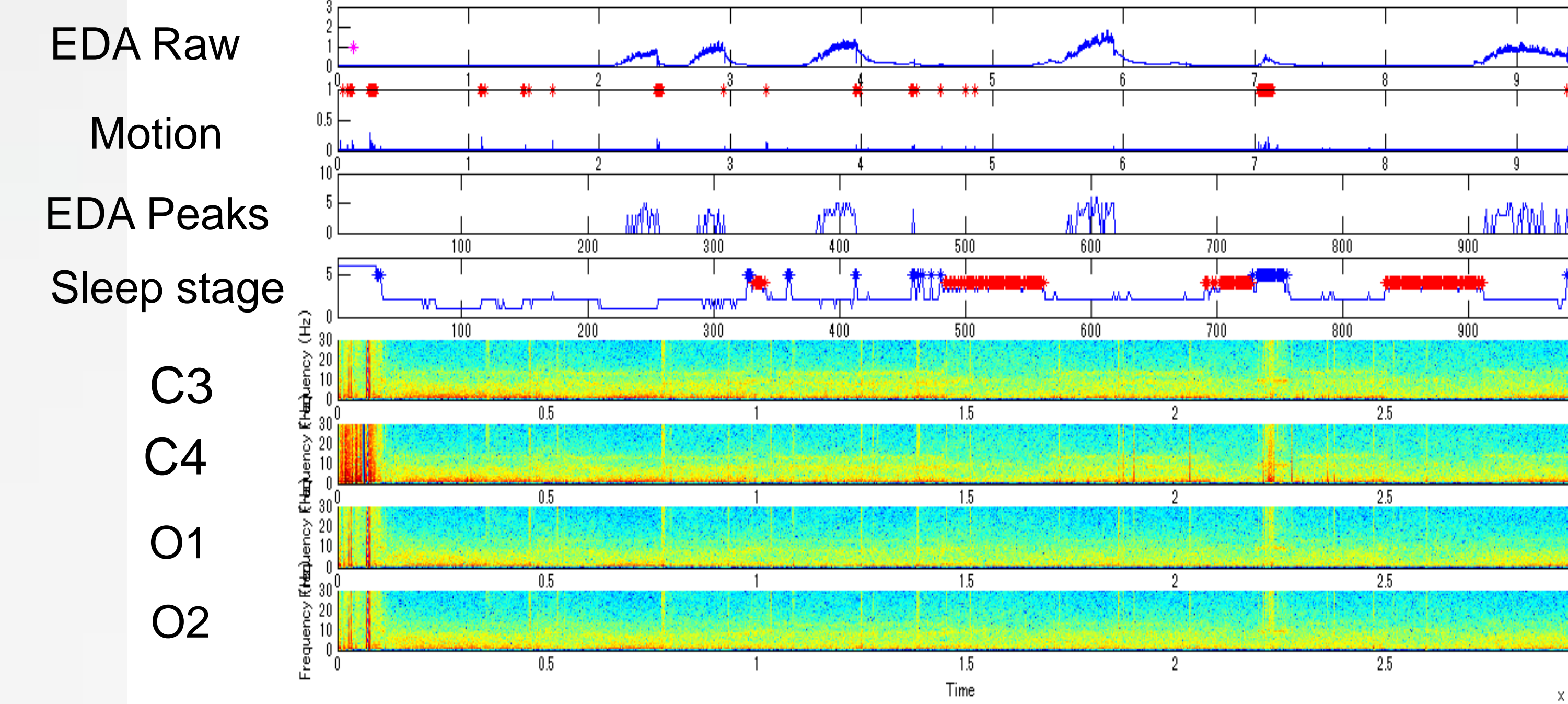
EDA: a low-pass FIR filter (cutoff frequency 0.4 Hz, 32nd order) and peak detection with the slope exceeding a value of 0.09 micro Siemens/s.

EEG: delta power was computed from the EEG (C3, C4, O1 and O2)

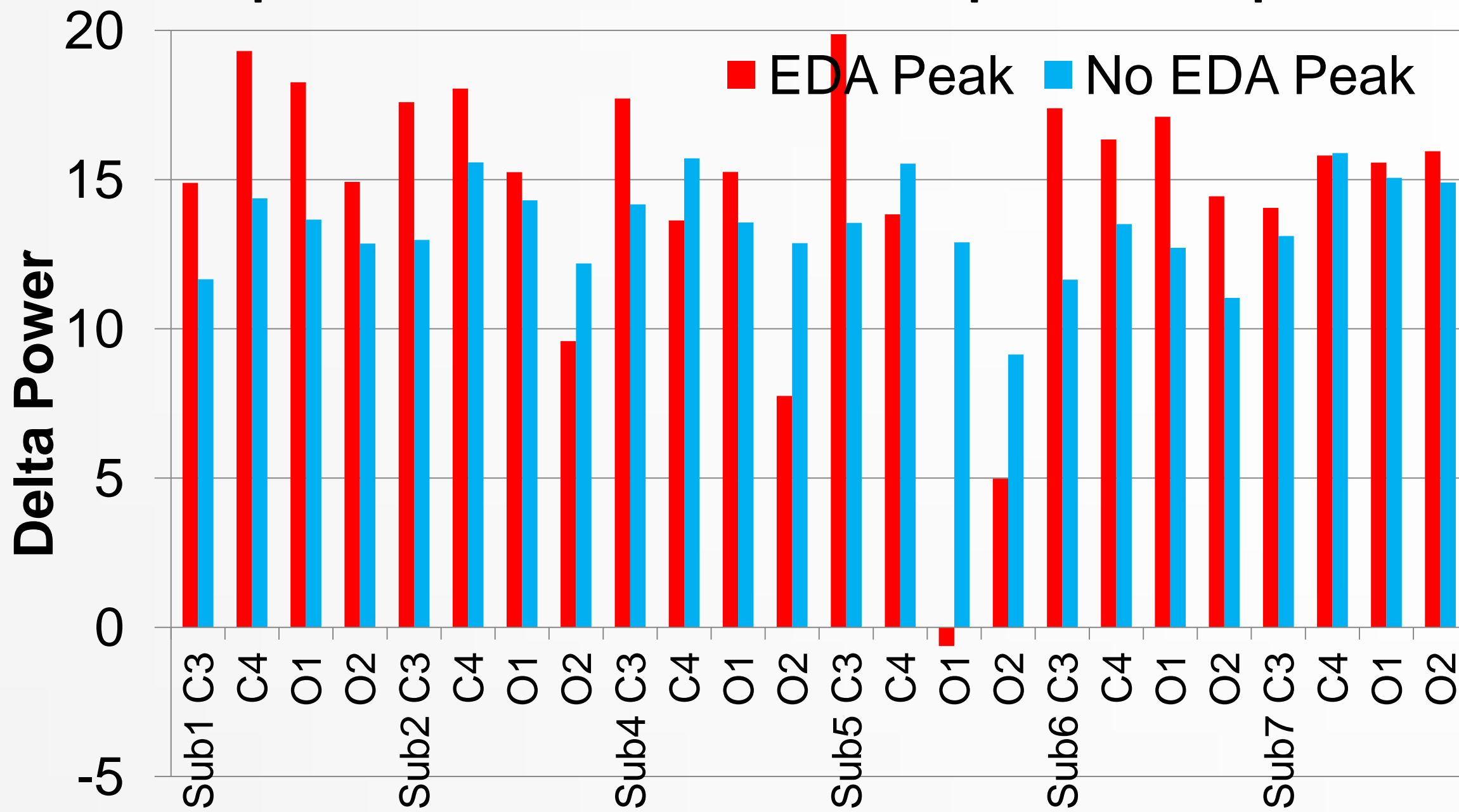
Correlation and cross-correlation between EDA amplitude and delta power of EEG were also computed.

**Full Disclosure:** Picard is a full professor at MIT and also co-founder, chief scientist, and chairman of Affectiva, who made the Affectiva Q Sensors used to collect the EDA and actigraphy data in this study. The author participates fully in MIT's monitoring of conflict-of-interest procedures.

### Example: EDA with EEG spectrogram of channel C3, C4, O1 and O2



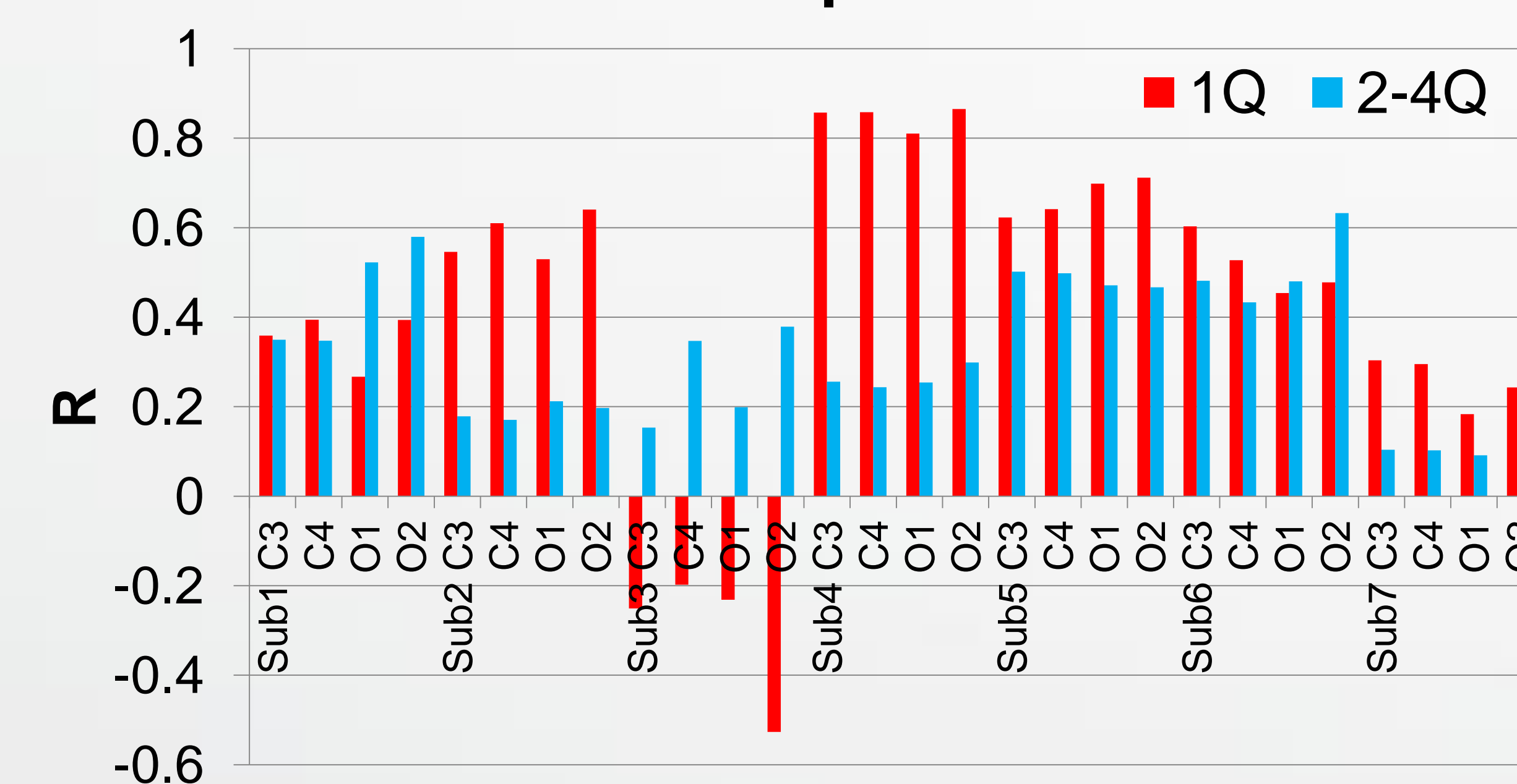
### Delta power of EEG when EDA peaks are present



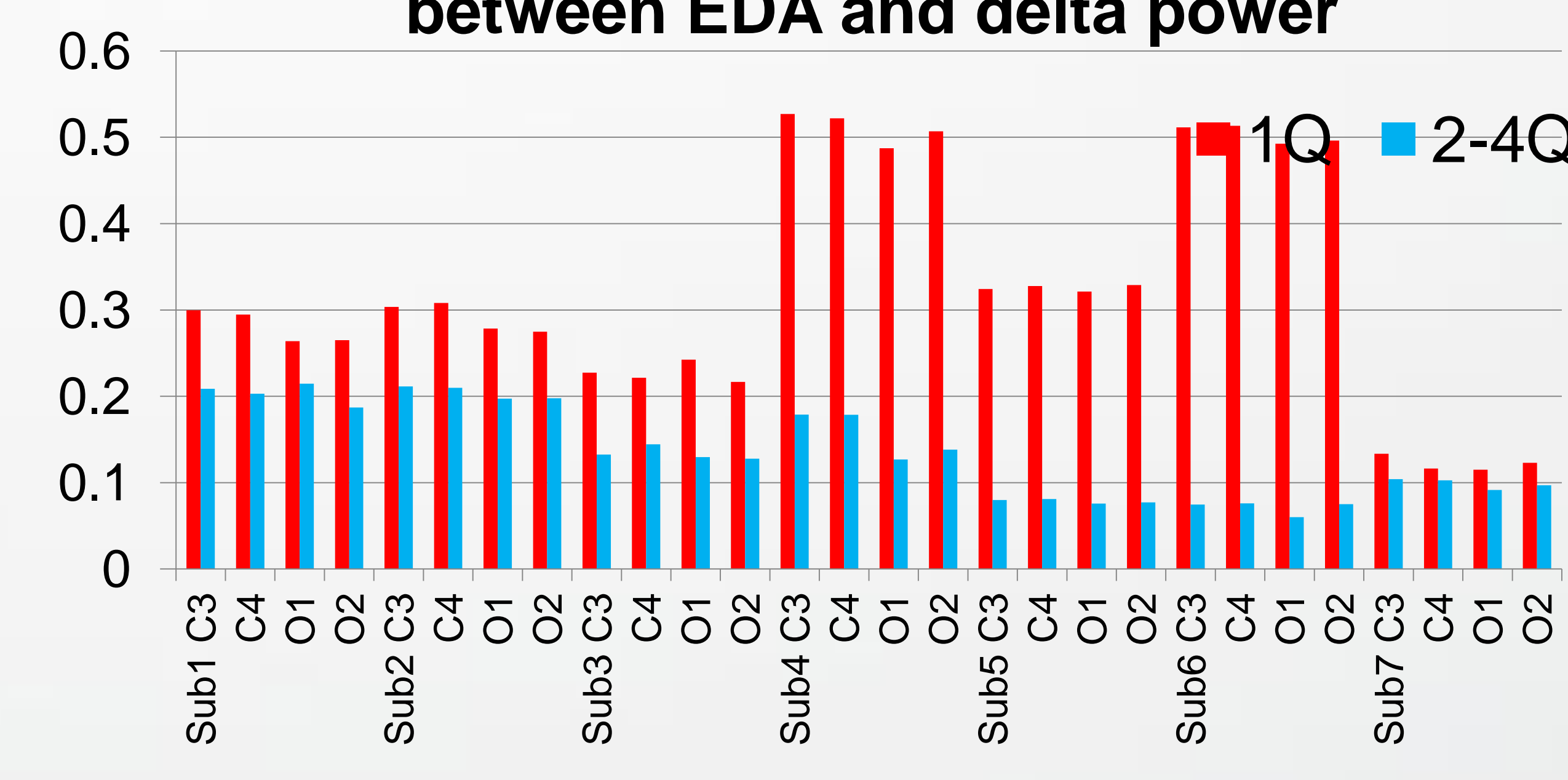
Higher delta power usually occurs when EDA peaks

Higher EDA amplitude and more EDA peaks occur in deeper sleep stages

### Correlation Coefficient between EDA and delta power



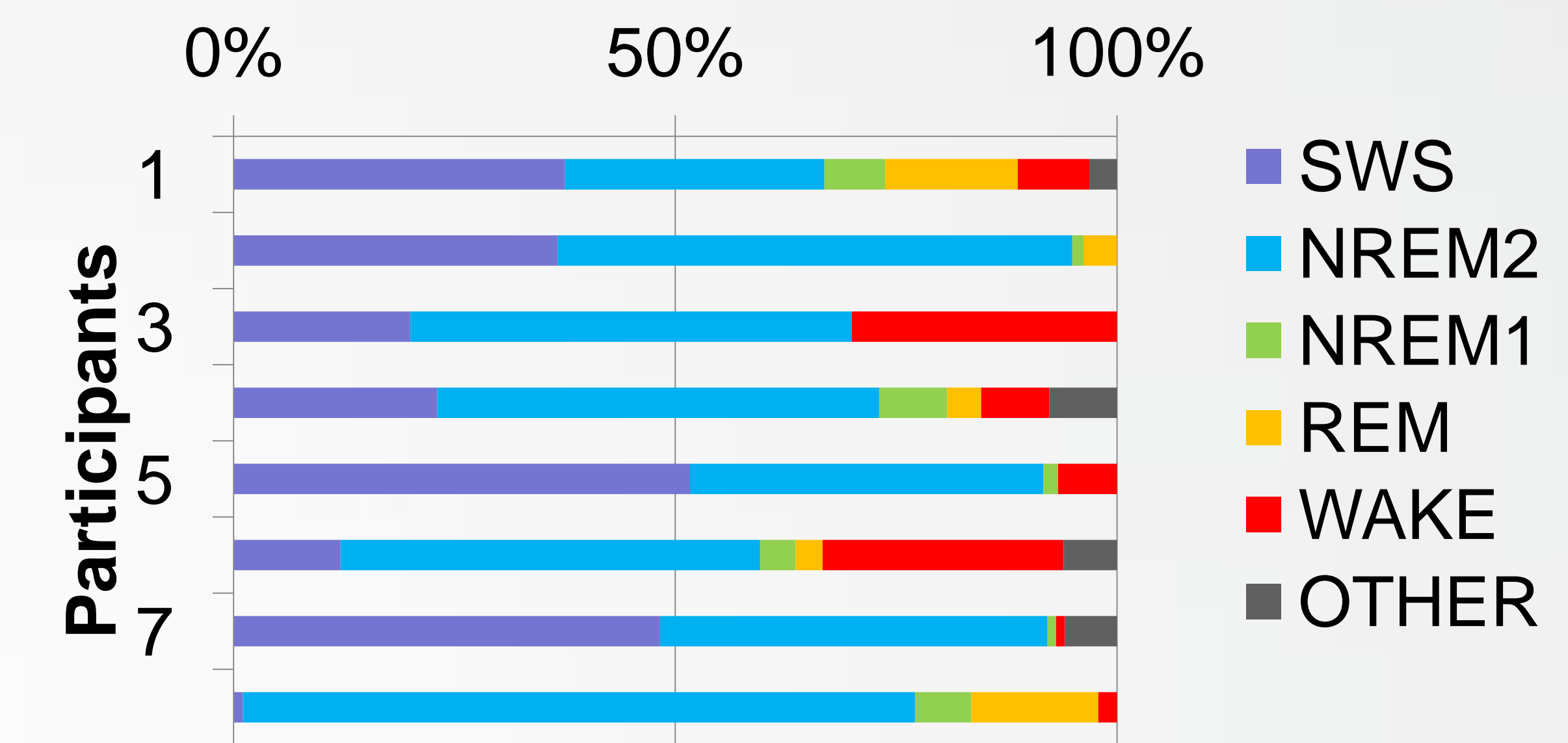
### Cross-Correlation between EDA and delta power



EDA amplitude and delta power usually have a higher correlation coefficient and a higher cross-correlation in the 1Q of sleep than in later quarters of sleep.

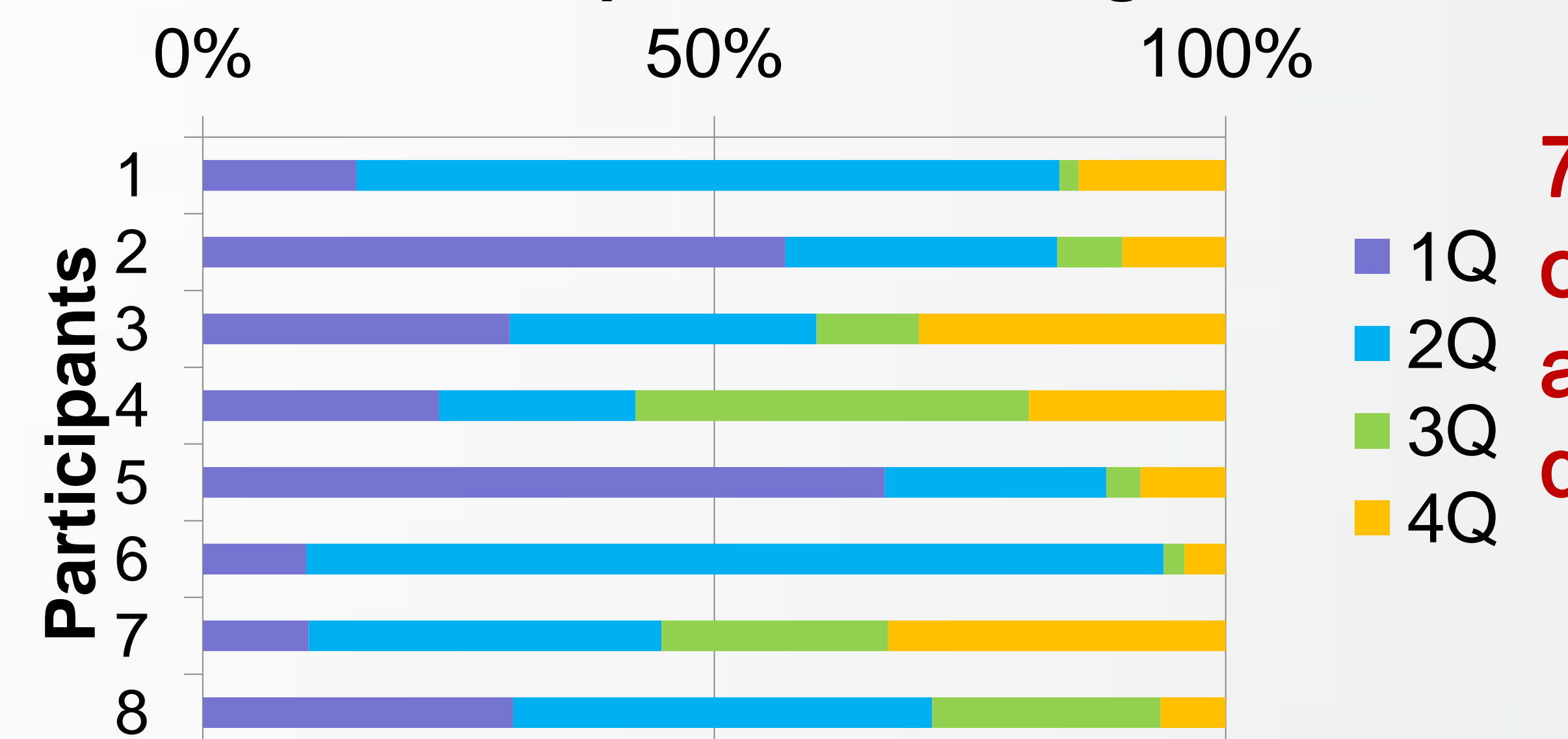
## Results

### When EDA peaks happened, which stages did they occur in?



78% of EDA peaks occurred in Non-REM2 and SWS.

### EDA peaks in each quarter of the night



73% of EDA peaks occurred in the first and the second quarters of the night

## Conclusions

EDA high frequency peaking, measured over 8 nights in healthy adults, occurred in Non-REM2 and SWS, usually in the first half of the night. The EDA amplitude was most highly correlated with EEG delta power early in the night for most participants.