Sleep architecture, emotional reactivity, and emotion regulation

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Note: This registration document is created based on the "Prereg Challenge" registration form on Open Science Framework.

Study Information

Research questions

The overarching goal of the current study is to understand the relationship between sleep architecture, emotional reactivity, and emotion regulation. Based on previous research, the current study focuses on how rapid eye movement (REM) sleep and slow wave sleep (SWS) relate to emotional reactivity and emotion regulation. The research questions are:

1. Is REM sleep or SWS related to emotional reactivity?
2. Which sleep stage is more strongly related to emotional reactivity?
3. Is REM sleep or SWS related to emotion regulation?
4. Which sleep stage is more strongly related to emotion regulation?
5. Is sleep architecture related to emotion regulation while controlling for emotional reactivity.

Hypotheses

1. Both REM sleep and SWS are related to emotional reactivity. We have a non-directional prediction about the relationship between REM sleep and emotional reactivity. We predict a negative relationship between SWS and emotional reactivity.
2. REM sleep is more strongly related to emotional reactivity than SWS.
3. Both REM sleep and SWS are related to emotion regulation. We have a non-directional prediction about the relationship between REM sleep and emotion regulation. We predict a positive relationship between SWS and emotion regulation.
4. We have no directional hypothesis about which sleep stage (REM or SWS) is more strongly related to emotion regulation.
5. Sleep architecture (REM and SWS) is still related to emotion regulation while controlling for emotional reactivity.

Sampling Plan

Existing data

Registration following analysis of the data.

Explanation of existing data

The data collection has been completed. We have calculated the descriptive statistics of the measures of emotional reactivity and emotion regulation for another research study using the same dataset. We have not accessed any data of sleep architecture nor conducted any analyses related to the research questions of the current study.

Data collection procedures

PSG Screening: A team of two research assistants went to the participant's home and brought the equipment with them. They equipped the participant with the PSG electrodes and sensors, tested that the data recording is working appropriately, and performed a set of biocalibrations. They instructed the participant on how to appropriately handle the equipment, including carrying the purse during the evening and if getting up at night and how to remove the equipment in the morning. Research assistants then left the equipment with the participant overnight for recording. They came back to the participant's home the next morning at an agreed upon time after the participant's wake time and pick up the equipment. The equipment returned to the lab for data downloading and cleaning.

In Lab-testing: Participants were equipped with psychophysiological electrodes and sensors for data collection, which includes sensors for ECG, ICG, respiratory bands, EEG, temperature, EMG, GSR. At first, they were instructed for the baseline task, that the participants perform right after. Further, they were instructed on the ER task, and performed the ER task while their psychophysiological responses are being collected. The last experimental part was a second baseline measurement, which was instructed before, but similar to the first. Participants subsequently were detached from recording equipment, debriefed, paid, and thanked for their study participation.

Sample size

Our target sample size for analyses is 84 participants. To account for possible drop-outs and missing data, we plan to recruit 100 participants.

Sample size rationale

We used the software program G*Power to conduct a power analysis. In order to detect a medium-sized correlation (r = .3) with 80% power at the standard .05 alpha rate, 84 participants are needed.

Stopping rule

The data collection has stopped for the purpose of another bigger research study. We stopped recruiting new participants once at least 35 participants who are sleep bruxism positive and 35 participants who are sleep bruxism negative have been included. We ended up having 104 participants included regardless their state of sleep bruxism (positive, negative, or uncertain).

Variables

Manipulated variables

NA

Measured variables

Polysomnography (PSG) - Polysomnography will be recorded for one whole night's sleep. The PSG data will be scored by an external registered polysomnography technician.

Emotion Regulation Task - In each trial, a neutral or a low/medium/high negative emotional picture is presented. We will measure (a) subjective valence and arousal ratings, (b) corrugator EMG reactivity, and (c) EEG late positive potential (LPP) amplitudes at P3, Pz, and P4 (referenced to linked mastoids).

Indices

Sleep stages - REM sleep will be quantified as the total duration of REM sleep and the percentage of REM sleep in total sleep duration of the PSG night. SWS will be quantified as the total duration of SWS and the percentage of SWS in total sleep duration of the PSG night.

Emotional reactivity - There are three conditions in the emotion regulation task, that is, *watch, reappraise, and distract*. Emotional reactivity will be measured as the average (a) subjective valence and arousal ratings, (b) corrugator EMG reactivity, and (c) EEG late positive potential (LPP) amplitudes at the parietal region (the average of P3, Pz, and P4) across the *watch* trials of low/medium/high negative emotional pictures.

Emotion regulation - Emotion regulation will be quantified as the reduction in emotional reactivity as measured by subjective ratings, corrugator EMG reactivity, and LPP amplitudes from the *watch* condition to the *reappraise* or *distract* condition during trials of low/medium/high negative emotional pictures.

Design Plan

Study type

Observational Study - Data is collected from study subjects that are not randomly assigned to a treatment. This includes surveys, "natural experiments," and regression discontinuity designs.

Blinding

No blinding is involved in this study.

Study design

This study follows a cross-sectional design.

Randomization

In the Emotion Regulation task, a total of 180 trials is presented in a pseudo-random order across 5 blocks.

Analysis Plan

Statistical models

1. Zero-order Pearson correlations will be obtained among all indices of REM sleep, SWS, emotional reactivity, and emotion regulation.
2. Linear regressions in prediction of emotional reactivity* will be conducted with REM sleep duration and SWS duration as the predictors.
3. Linear regressions in prediction of emotional reactivity* will be conducted with REM sleep percentage and SWS percentage as the predictors.
4. Linear regressions in prediction of emotion regulation* will be conducted with REM sleep duration and SWS duration as the predictors.
5. Linear regressions in prediction of emotion regulation* will be conducted with REM sleep percentage and SWS percentage as the predictors.
6. Linear regressions in prediction of emotion regulation* will be conducted with REM sleep duration and SWS duration as the predictors while controlling emotional reactivity.

7. Linear regressions in prediction of emotion regulation* will be conducted with REM sleep percentage and SWS percentage as the predictors while controlling emotional reactivity.

All analyses above will also be also conducted in a Bayesian approach to get a Bayes factor (BF). * subjective rating, EMG, and EEG indices of emotional reactivity/emotion regulation will be tested in separate linear regression models.

Transformations

NA

Follow-up analyses

NA

Inference criteria

We will use the standard $p < .05$ criteria for determining if the relationships between IV and DV are significant. We will use the BF < 1/3 criteria for supporting the null hypotheses.

Data exclusion

Participants without PSG data or Emotion Regulation Task data will be excluded listwise.

PSG data - PSG data will be excluded if the total sleep duration is less than 3 hours. PSG data will be also excluded if there is insufficient number of properly functioning PSG channels for the sleep technician to score the sleep architecture.

Emotion Regulation Task data - Out of a total of 180 trials, if there are valid data (rating, EMG, or EEG) of less than 90 trials for a participant, the data of this participant will be excluded from further analyses. For EMG and EEG, data of malfunctioning channels will be excluded across all trials. For EEG data, trials will be excluded if it is artifacts contaminated. For calculating LPP, a participant has to have at least 2 properly functioning channels with at least 90 valid trials.

Outliers - Outliers are identified as more than 3 standard deviations above or below the mean. Outliers will be excluded from analyses.

Missing data

See Data exclusion. Missing data will be excluded analysis-wise.

Exploratory analysis

All analyses listed in the section of *Statistical Models* will be conducted while controlling for the following possible covariates: bruxism state, habitual sleep quality, habitual sleep duration, sleep quality during the PSG night, sleep duration during the PSG night. We will also explore quantifying REM sleep and SWS in EEG power spectral density (e.g., delta, theta, alpha, beta, and gamma waves) and relating the power densities in a certain sleep stage with the outcome variables.