# Differential effects of sleep on emotion regulation: An ERP study

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## Introduction

- There are several factors have been associated with healthy emotional regulation, the role of sleep in this process has been largely ignored.
- Converging evidence suggests that sleep deprivation may impair the connectivity between the PFC and amygdala, resulting in so-called “executive dysfunction,” which can have direct and significant impacts on an individual’s ability to regulate emotions. Fewer studies have attempted to access the electro cortical dynamics of emotion regulation across sleep.
- The main purpose of the present study is to investigate the effect of sleep manipulation on emotion regulation effectiveness supporting by electro cortical dynamics of emotion regulation. We hypothesize the reduced LPP in sleep condition of emotion regulation group than sleep deprived condition of emotion view condition.

## Method

**Participants:**

6 (Male, Age: 20.2±2.8) undergraduate students from Institute.

**Design:** The study follows a crossover design with two sleep condition: full night sleep and sleep deprivation. The interval between the sessions was at least seven days and the order of the two was at random. After full night sleep hours or Sleep deprived hours subjects completed the emotion Behavioral task. EEG was recorded while performing the task.

**Measures:**

- Behavioral:To check if the participant followed the instructions for emotion regulation we calculated the subjective rating (SAM scoring) for valance in emotion and emotion regulation group across both conditions (Sleep/ Sleep deprived).
- Electrophysiological: EEG recordings were obtained with standard Ag/AgCl electrodes from 32 sites on the scalp, based on the 10–20 system. During recording, AFz served as the ground and Pz as the online reference. The electro-oculogram (EOG) generated from eye-blinks was recorded from sites 2 cm below and above the right eye. During recording, the EEG signal was sampled at a rate of 500 Hz and band-pass filtered from 0.05 Hz to 100 Hz. Next, all activity was re-referenced to the average of the left and right mastoids, and low-pass filtered at 20 Hz.
- Sleep recording: 10 channel sleep polysomnography was used for recording and staging sleep. Recordings will be obtained from scalp site A1, A2 (linked earlobes), C3, C4 (scalp electrodes), EOG V, EOG H (eye movements), EMG 1, EMG 2 (for chin EMG) & Fpz (Ground).

## Results

**1. Behavioral : Self-reported rating of valance at regulation (post sleep/deprivation) were submitted to repeated-measures ANOVA [condition (sleep/deprivation), instruction type (view/ regulate); affect (negative/neutral)]. Significant main effect of instruction type [F (1, 5) = 5.23, p=0.06] and affect [F (1, 5) = 7.8 p=0.03] were reported.**

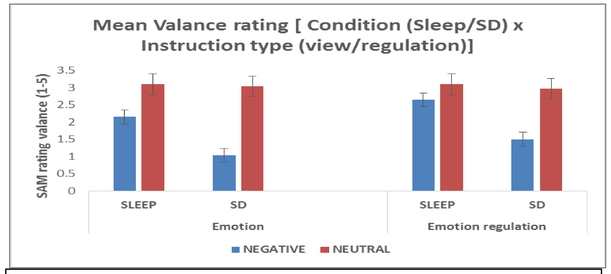


**Fig.:-1 | Valance ratings by Condition (Sleep/Sleep deprivation) and instruction type (view/reappraise) for negative and neutral picture type are shown. Data represented as group means.**

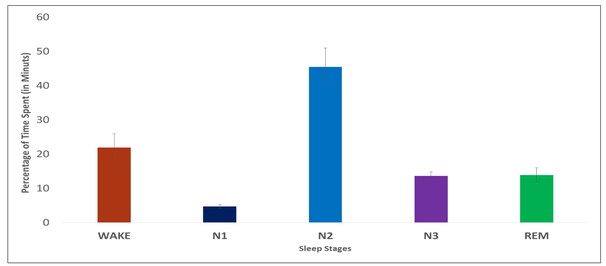


**Fig.:-2 |Average time spent (in percentage) in each stages of sleep**

**2. Electrophysiological: Late Positive Potential component was analyzed. Mean amplitudes of 300-1700 ms post stimulus, collapsed across centro-parietal sensors (Cpz, CP1, Pz & Cp2) were obtained across conditions. Total epoch was further segmented into seven (200 ms) epochs. Repeated ANOVA [condition (sleep/deprivation), instruction type (view/regulate), epoch (7 x 200ms) revealed significant main effects of instruction type at 900-1100 ms segment [(F (1, 5) = 7.13, p = 0.05] (see Table 1).**

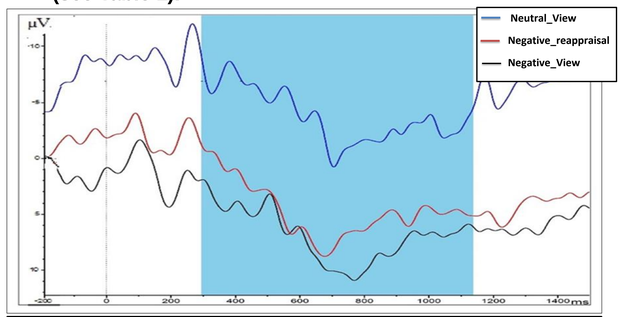


**Fig. 3|** ERP by instruction type during picture presentation of the regulation task. LPP by instruction type during the 300-1500ms time window is shown.

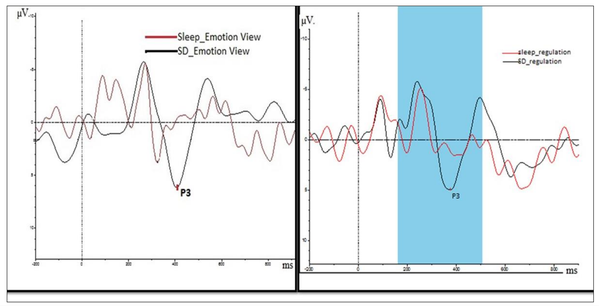


**Fig.4 |** ERP by condition type (sleep/sleep Deprivation) and instruction type (view/reappraise) type during picture presentation of the regulation task. P300 component by condition are overlay for comparison during the 0-1000ms time window is shown.

| Time (ms) | Negative watch | Negative reappraise | t-value | p-value |
|---|---|---|---|---|
| 300-500 | 2.37(5.28) | 2.35 (5.4) | 0.02 | .98 |
| 500-700 | 6.60 (6.09) | 5.79 (6.1) | 1.15 | .26 |
| 700-900 | 8.93 (5.58) | 7.83 (5.59) | 1.42 | .17 |
| 900-1100 | 8.15 (4.31) | 6.08(5.2) | 3.90 | .013 |
| 1100-1300 | 8.48 (4.8) | 6.76 (5.1) | 2.34 | .03 |
| 1300-1500 | 8.66(4.7) | 7.68 (5.02) | 1.37 | .18 |

**Table.1 |** Means (standard deviation) for pair-wise comparison between negative-watch and negative-reappraise at each 200 ms time increment with in the first 1500 ms (300-1500) of the LPP.

## Conclusions

- Study showed that stimuli valance was effectively regulated by explicitly instructed cognitive reappraisal.
- Sleep showed enhanced emotion regulation over sleep deprivation in valance dimension of negative emotions.
- Temporal dynamics revealed that reappraisal began attenuating Late Positive Potential during 800-1100ms time window independent of sleep modulation.
- Future directions include utilizing process model of emotion regulation and comparing all the strategies across sleep and sleep deprivation group. It is also suggested to use positive emotions in further studies for a comparative analysis.

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