Brain reactivity to nonverbal emotional vocalizations during NREM sleep

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INTRODUCTION

Sleep is characterized by a relative disconnection from the external environment and prompt reversibility in response to salient stimuli. These properties reflect the biological need to ensure the sleep continuity necessary for sleep-dependent functions while minimizing the risks derived from potential threats in the sleeper's surroundings. In this perspective, detecting messages conveyed by conspecific during sleep might represent a crucial adaptive trait. While previous studies demonstrated some degree of affective processing during sleep [1,2], they mainly focused on negative emotions and/or verbal stimuli, which may involve high-level brain functions. In this study, we investigated how the sleeping brain responds to naturalistic non-verbal human vocalizations [3] (vocal bursts, VB) during NREM sleep.

MATERIALS & METHODS

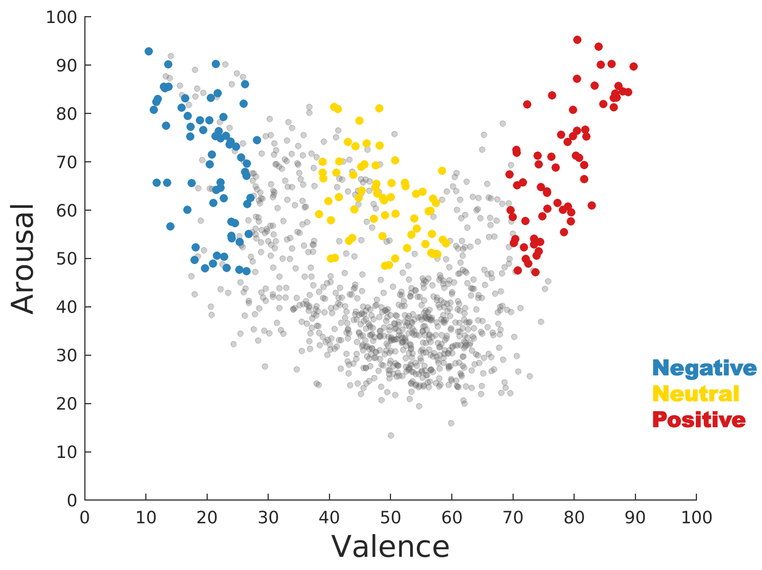
STIMULI SELECTION

Online repository containing 2196 vocal burst relying up to 24 emotion [3]

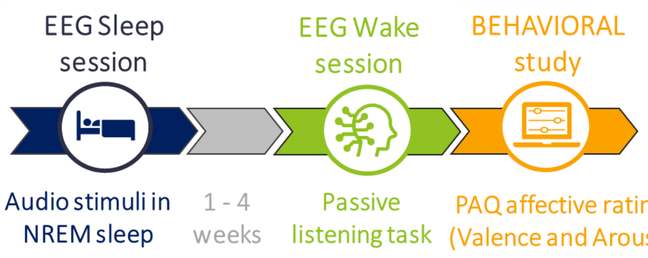
- Selection of stimuli according to duration
- stretching/compression to 850 ms

Behavioral study on 12 subjects (6F, 29.02±2.12y)
- 1008 vocal bursts
- Perceived Affective Qualities (PAQ) ratings on **Arousal** and **Valence** (visual-analog scales)

Data-driven stimuli selection:
- 192 stimuli divided according to arousal and valence scores



EXPERIMENTAL PROTOCOL



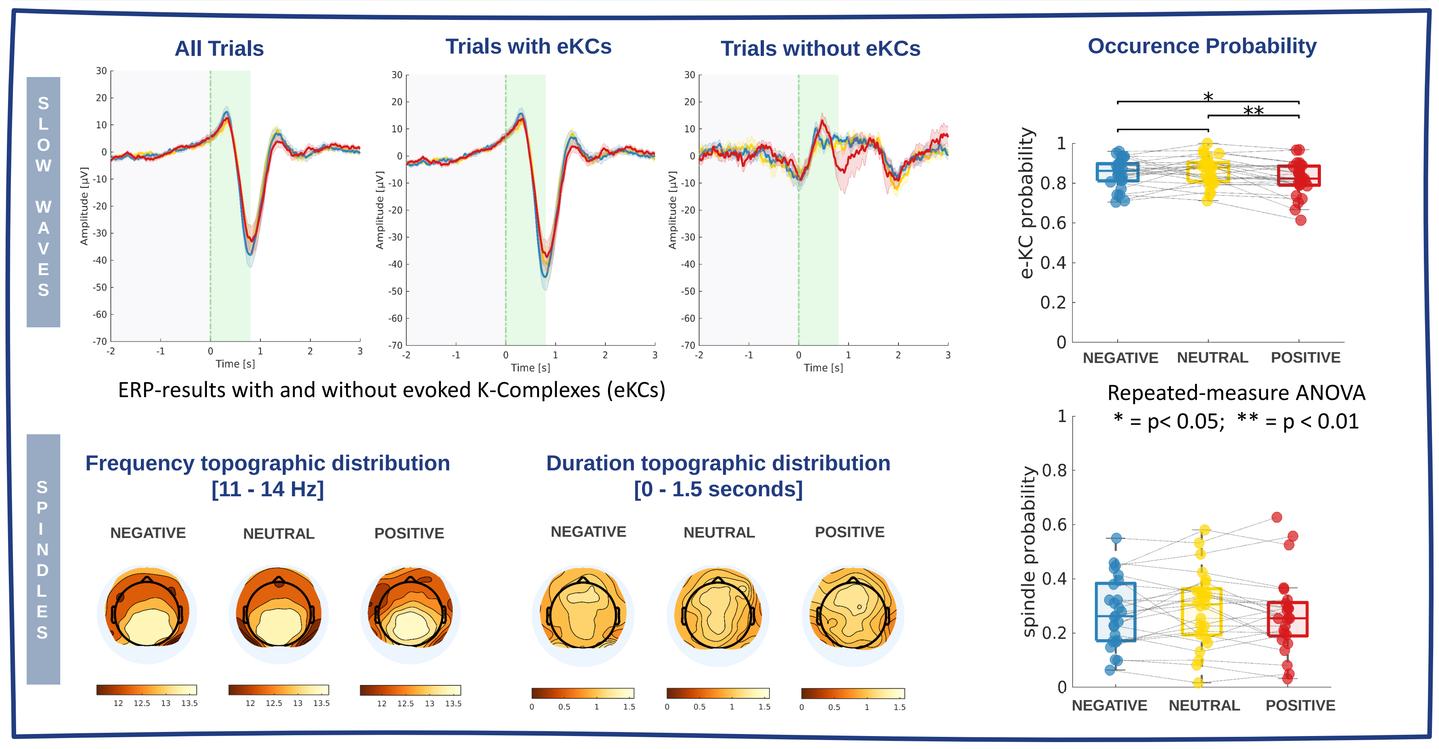
- 25 participants (12f, age 28 ± 3.7 years)
- Supervised auditory stimulation during NREM Sleep
- No stimulation in case of micro/arousals and awakenings
- In-ear stimuli presentation (<40 db)
- ISI of 10 ± 2 sec
- EEG relaxed wakefulness (eyes closed) during a passive listening protocol
- Behavioral subjective ratings of Valence and Arousal

DATA ANALYSES

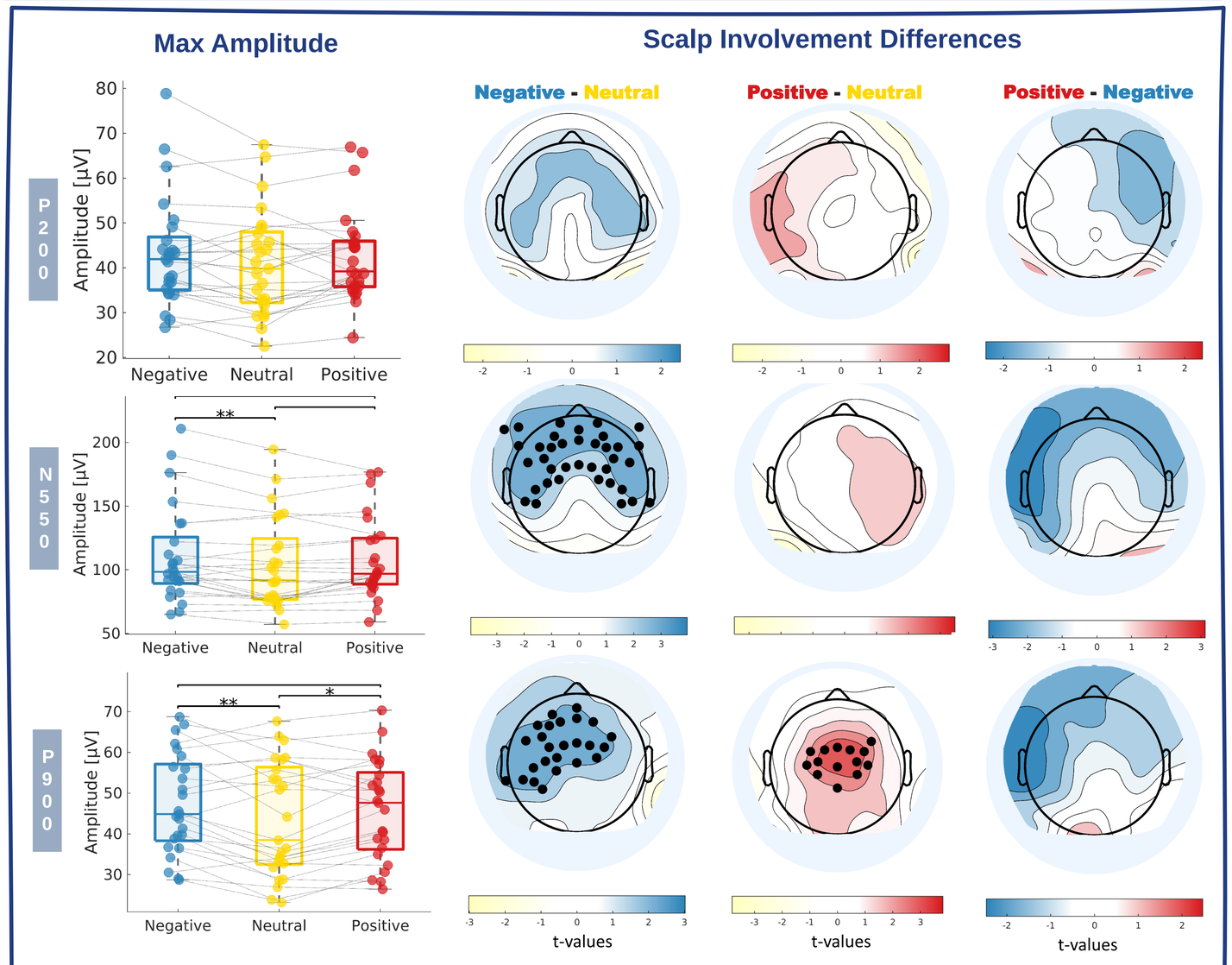
- An automated preprocessing pipeline was used to detect and interpolate bad channels, reduce artifacts through an independent component analysis (ICA), and reject bad stimulation trials
- Channel-by-channel automatic detection of slow waves [4] (0.5-2 Hz) and spindles (10-16 Hz) [5]
- The amplitude of KC's components was computed as the mean signal in a 40 ms window around detected peaks
- Topographic analyses were performed using t-tests and cluster-mass corrections for multiple comparisons.

RESULTS

AUTOMATIC DETECTION



K-COMPLEX COMPONENTS



Topographic differences between valence classes, black dots indicate significant electrodes after cluster mass correction ($p < 0.05$)

CONCLUSIONS

Our results revealed different processing of negative, neutral, and positive stimuli, consistent with a preserved encoding of affective valence during NREM sleep. Maintaining the ability to detect affectively-charged communicative stimuli during sleep could have conferred positive benefits in our evolutionary past.

REFERENCES

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[2] Ameen et al., 2021 /doi.org/10.1523/JNEUROSCI.2524-20.2021
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[5] Parekh et al., 2015 /doi.org/10.1016/j.jneumeth.2015.04.006

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