



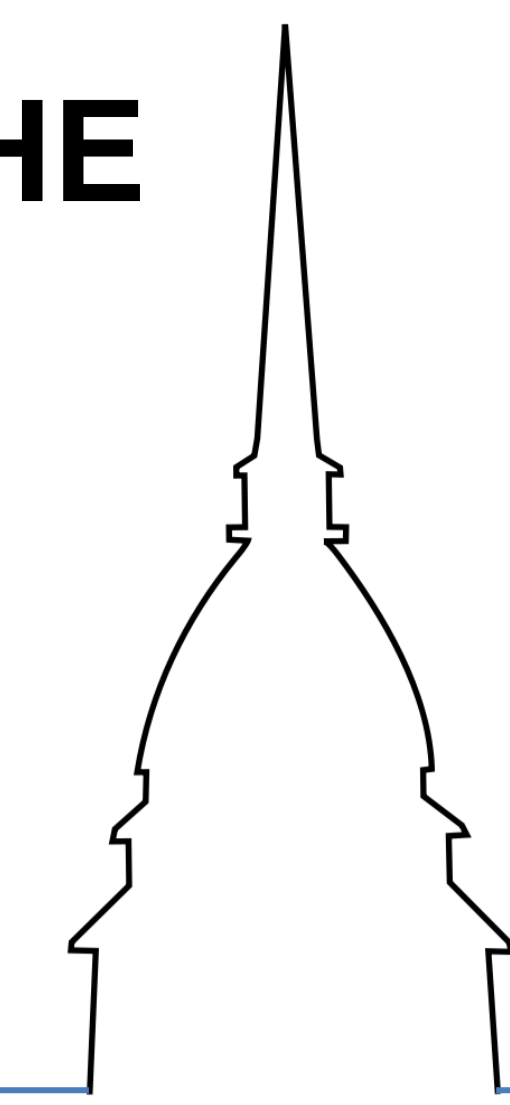
# SHARING PAIN: AN ELECTROPHYSIOLOGICAL STUDY ON THE EXPECTATION OF PAINFUL STIMULATION ON OTHERS.

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## INTRODUCTION

Pain is a complex experience that involves different factors. In particular, the context in which a painful stimulation is delivered is crucial: different contexts elicit different pain perceptions<sup>1</sup>. The aim of the present study is to investigate how physical, social and temporal cues modulate pain perception using contingent negative variation (CNV), a well-known electrophysiological measure related to the expectation of an imperative stimulus after the presentation of a warning stimulus<sup>2</sup>. In our study, **physical context** is represented simply by the difference between high intensity and low intensity electrical stimulation delivered to participants. **Social context** is represented by the fact that participants not only received the stimulation but also observed another participant receiving it. Finally, **temporal context** is represented by the order in which participants received or observed the painful stimulation.

## MATERIALS AND METHODS

### Contingent Negative Variation

*Contingent negative variation* (CNV) is a slow event-related potential that has been called “*expectancy wave*”. It has been previously shown that the amplitude of this wave is related to the expected intensity of the stimulus so that, for instance, expectation of an high intensity stimulus will result in bigger amplitudes<sup>2</sup>. To be elicited, CNV needs a warning stimulus (e.g. a colored cue) preceding and indicating an imperative stimulus that has to be stopped (e.g. a train of electrical stimuli).

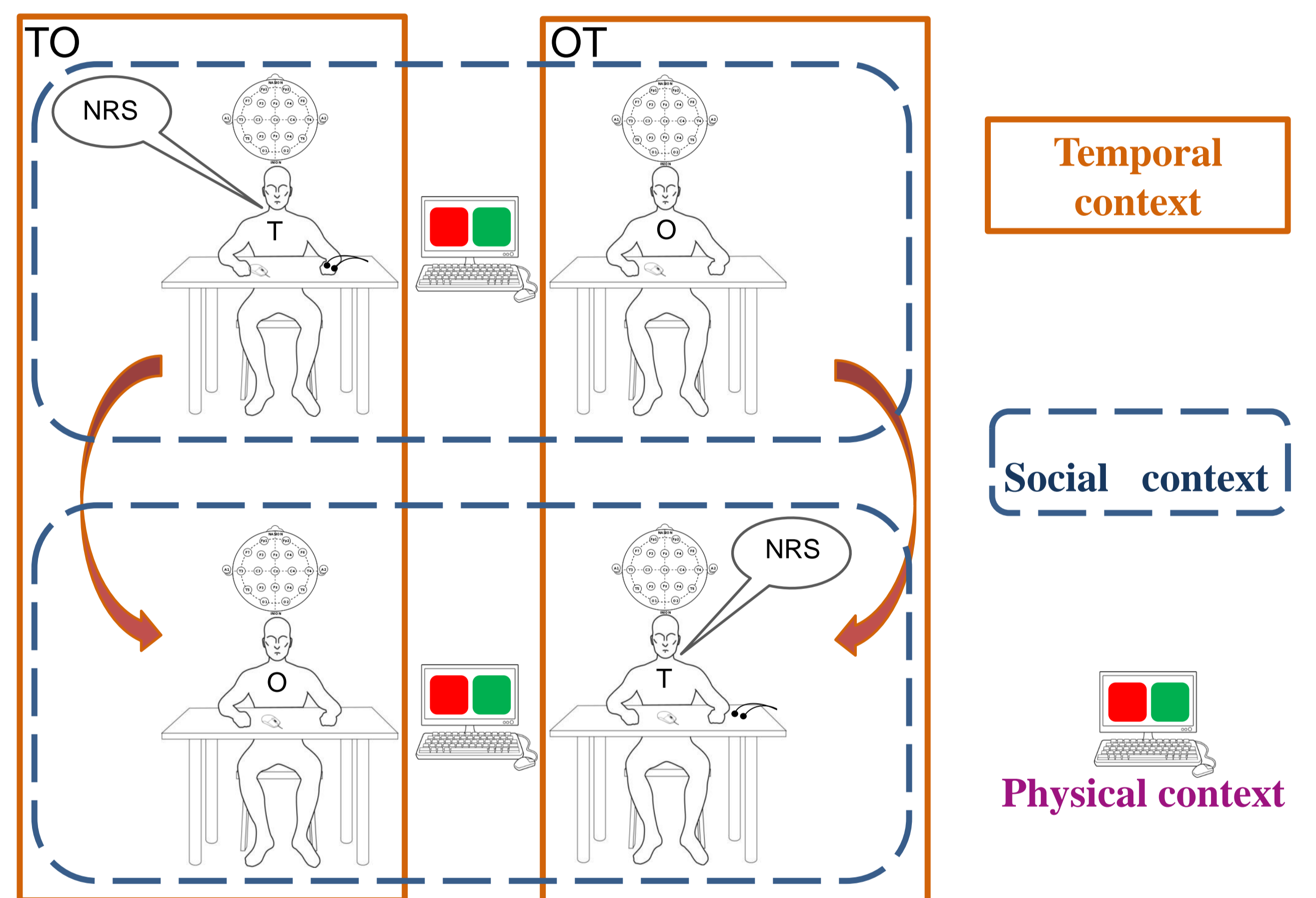
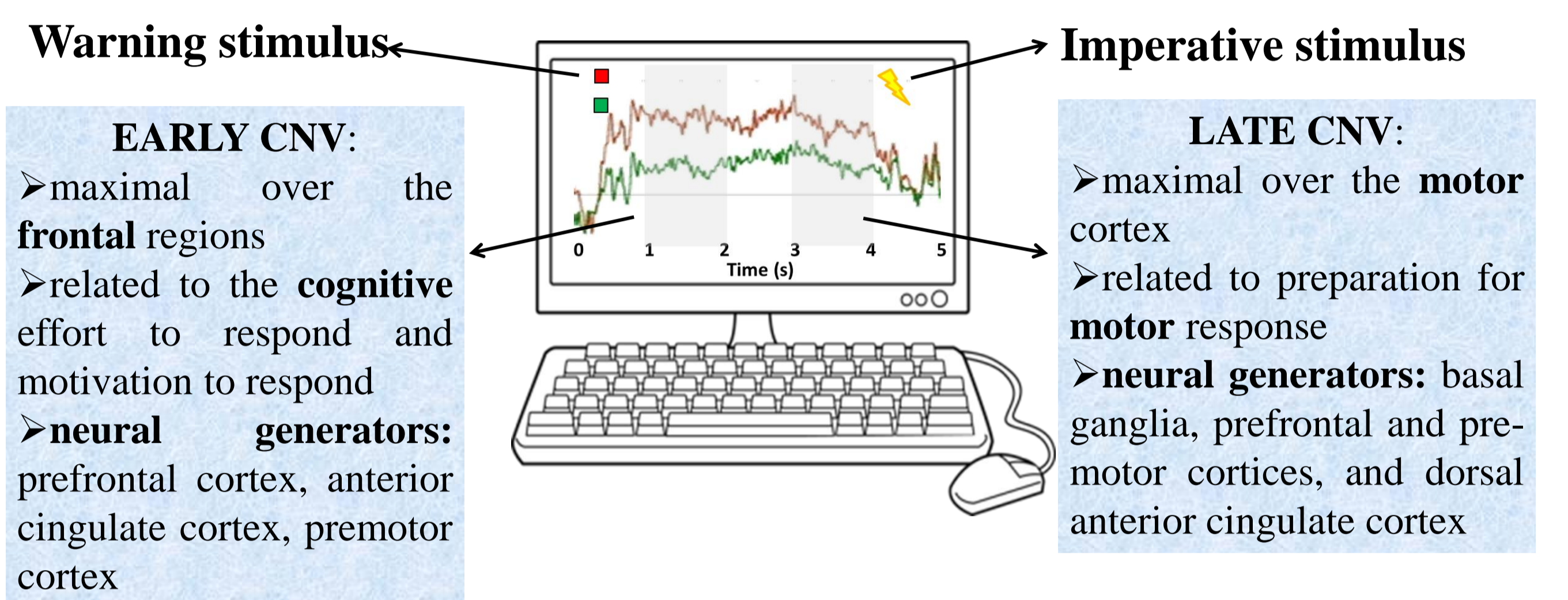
### Participants and materials

A total of 40 healthy right-handed volunteers participated in the study. Painful and non painful stimuli (red and green cues) were delivered by an electrical stimulator (Neuroscan) on the dorsum of the left hand. CNV was recorded with 19 electrodes (following the international 10-20 system) and using two EEG systems, one for each participant (i.e. one receiving the stimulation and the other observing it). The two EEG systems were synchronized using a specific software (Presentation, Neurobs Inc.).

Empathy (ES) and Relationship questionnaires were administered and collected from all participants.

### Experimental task

Pain was induced by a train of electrical stimuli: participants were asked to stop as soon as possible the stimuli (imperative stimuli) and reaction time (RT) and pain rating (NRS from 0 to 10) were measured. Two participants were engaged in the study at the same time: when a participant was tested with the electrical stimuli (*T session*), the other observed the experimental procedure (*O session*). Thus, two groups have been designed (i.e. **social context**): a group composed of participants who were first engaged in the T session and then in the O session (*TO group*) and a group of participants who were engaged in the O session and then in the T session (*OT group*). In the T session subjects were presented a red or green cue (warning stimulus), followed by a train of electrical stimuli, and expected less pain after the green and more pain after the red cues (i.e. **physical context**). After 2 blocks of electrical stimuli, consisting in either painful and non painful stimuli, the participants inverted their role (i.e. **temporal context**).



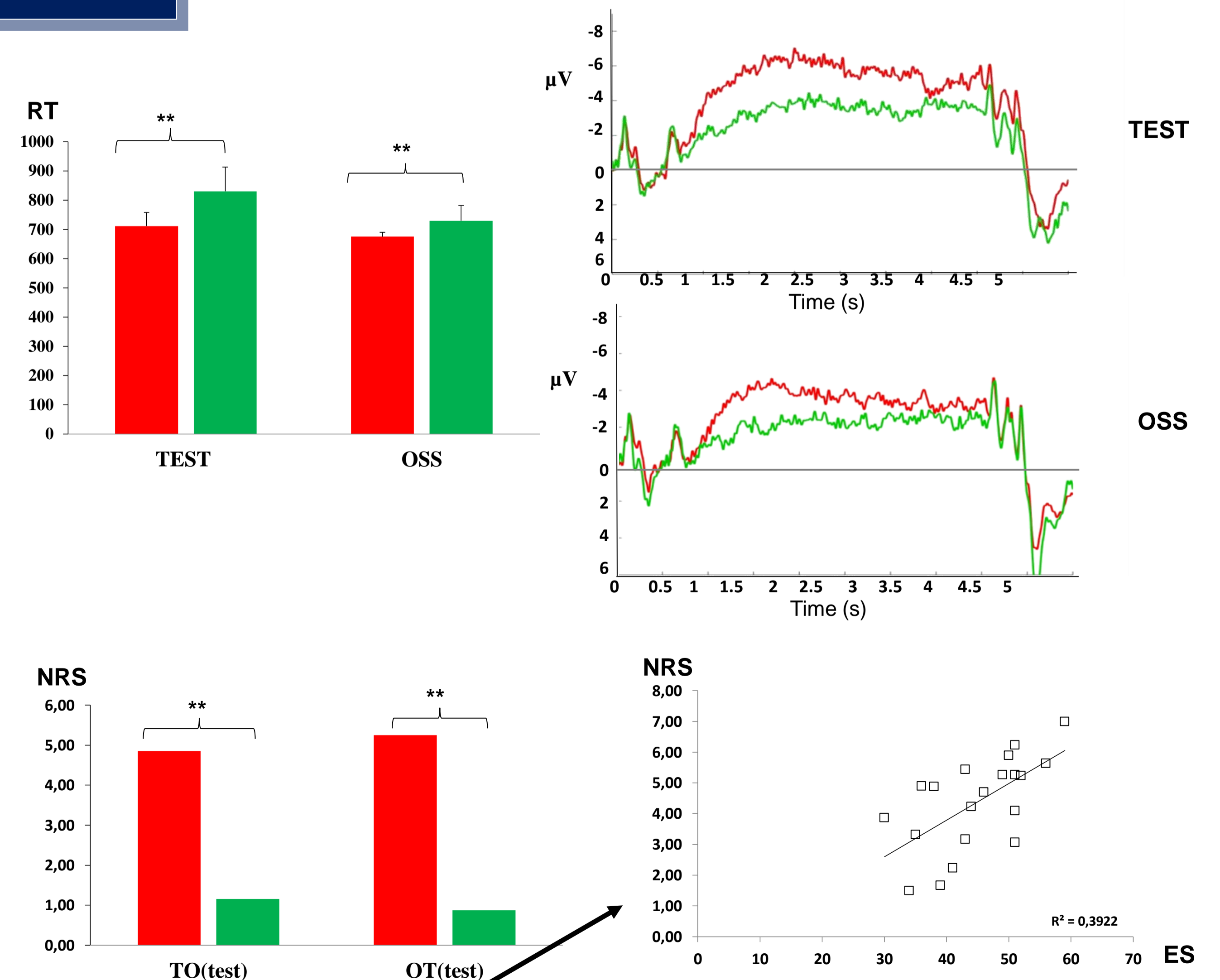
## RESULTS AND DISCUSSION

### Results

Results of the study showed an increase in pain perception (NRS), an increase in CNV mean amplitude (i.e. a bigger CNV) and a decrease in RT when electrical stimuli followed the presentation of the red light compared to the green light (**physical context**). Aside from the NRS, this result was confirmed not only in participants who received the stimulation (*T group*) but also in participant who observed (*O group*) the stimulation (**social context**). Moreover, participants who first observed the stimulation and then received it (*OT group*) presented a significant increase of CNV mean amplitude in comparison with participants who first received the stimulation (*TO group*) and a positive correlation between their NRS and empathy scores (**temporal context**).

### Discussion

In this study we found that, first, that the physical context of pain (i.e. difference between high and low painful stimuli) is indeed correlated to different expectations and thus, to different CNV amplitudes (i.e. higher amplitudes with higher stimulation). Secondly, in line with other studies of observational learning<sup>3</sup>, we found that the social context can influence expectation so that changes in the CNV amplitude were observed not only in participants who received the stimulation but also in participants who observed it. Finally, our data show that the temporal context can influence pain expectation so that participants who first observed the stimulation showed in general higher CNV amplitudes and when they later received the stimulation their pain perception (i.e. their NRS) was positively correlated with their empathy scores.



## REFERENCES

[1] Piedimonte, A et al. Measuring expectation of pain: contingent negative variation in placebo and nocebo effects. *European Journal of Pain* (2016), in press.

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