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# Embodied emotions interact with syntax

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## Introduction

Decades of research demonstrate that facial expression by itself can induce emotional states and influence affective information processing. Facial expression has usually been manipulated by asking subjects to hold a pen between the lips to inhibit smiling, or else hold the pen between the teeth to facilitate smiling. To induce negative emotions, researchers affixed golf tees to the participants' eye-brows, to further instruct subjects to bring the ends of the golf tees together. These studies on embodied emotions show that there is a reciprocal relationship between the facial expression of emotion and the activation and processing of emotional information (Niedenthal, 2007).

Recently, it has also been demonstrated that linguistic emotional information can affect language comprehension, including syntax. Emotional effects on syntax have been reported for left anterior negativities (LAN) and P600 syntactic components, challenging the traditional view of syntax as an encapsulated module (Jiménez-Ortega et al. 2012; Martín-Loeches et al 2012; Vissers et al. 2010). Our aim is to investigate whether and how induced face emotional expressions in the reader may affect syntactic comprehension during sentence reading.

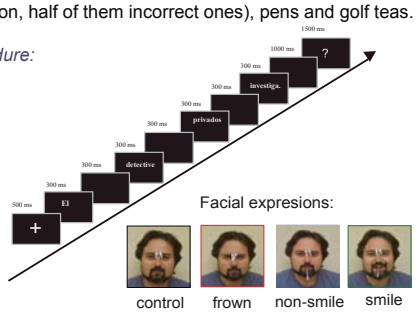
To this aim the participants main task was to judge the sentences correctness that could be either acceptable (50 %) or contain morphosyntactic disagreements (gender or number) while taking four different unconscious facial expressions.

## Methods

- *Subjects:* 24 native Spanish speakers ( 16 women, mean age = 26.5, SD = 8.4)

- Materials: 360 sentences (90 sentences per type of facial expresion, half of them incorrect ones), pens and golf teas.

-*Procedure:*




- *EEG recordings:* 60 Ag-Cl electrodes recordings, mastoid averaged, blink and artefact removed.

- *Data Analyses:* We calculated 2x3x2x4 ANOVAs with factors: Hemisphere (right, left) x Region (anterior, central, posterior) x Correctness (correct, incorrect), Facial expresion (control, frown, non-smile, smile).

## Results

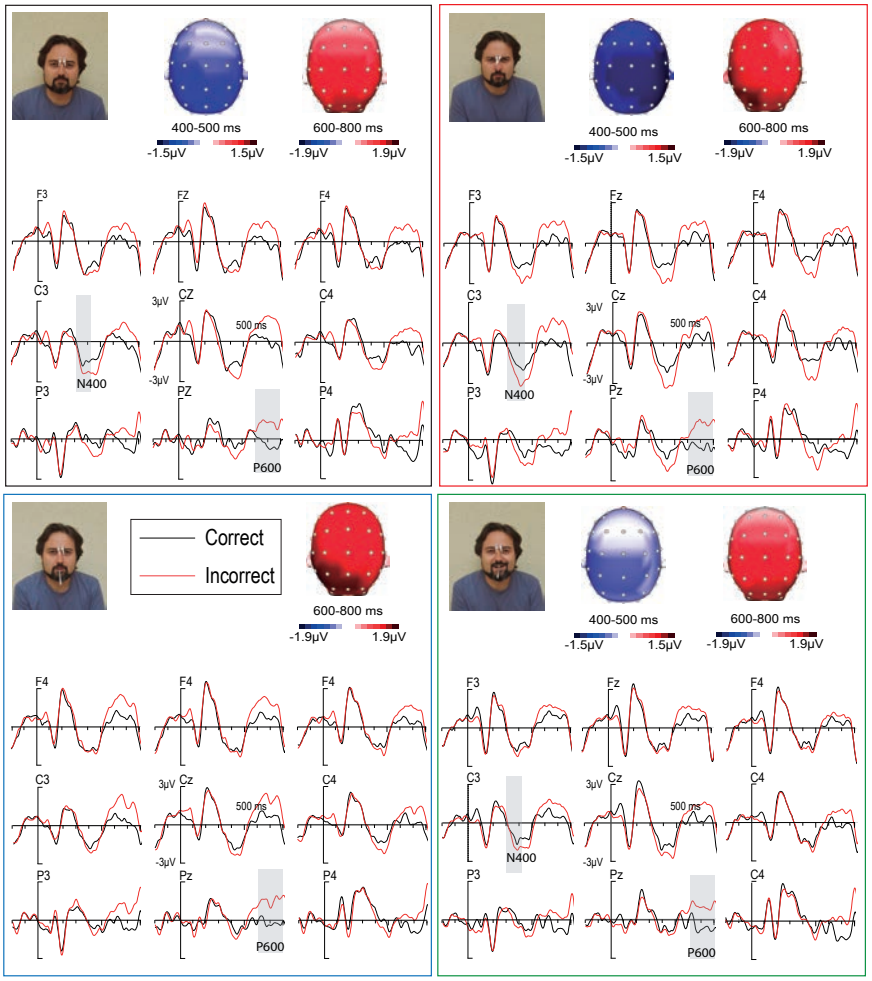



*Fig. 1. Correction x Facial expresion effects*

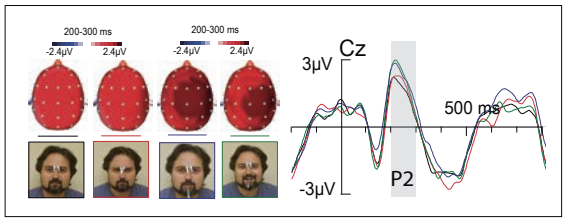



*Fig. 2. Facial expresion effects*

***Behavioural Results:***
Incorrect trials were harder to discrimante than correct ones (11,1% vs 7,7% of error rates respectively; $F_{1,23}$= *5,65, p<.05* ).

***ERP results:***
- A main effect of Facial expression appeared exclusively for 200-300 ms time window *($F_{3,69}$= 3,76, p<.5).*

- A Correctness x Facial expresion significant interaction for 400-500 window *($F_{3,69}$= 2,7, p<.5)*

- *A Correctness effect between 600 and 800 ms ($F_{1,23}$= 8,02, p<.05).*

## Conclusions

While no effects were observed for the P600 component amplitude, facial expressions significantly modulated early components. However, N400 componets to syntactic anomalies appeared instead of anterior negativities (see similar findings: Molinaro, 2011; Jimenez-Ortega 2017).

Signficant N400 were observed for the control, smile, and frown conditions. N400 amplitude was larger for frown copared to control and smile facial expresions. In addition, the smile expression triggered a weak N400 compent, significantly smaller than the N400 control component. However, in the no-smile condition neither anterior negativities nor N400 components appeared.

Induced facial expressions affected syntactic processing and consequently language comprehension. These data add to embodiment theories of language comprehension while also supporting the facial feedback theory of emotions. Overall, our data also add to growing evidence indicating that emotions significantly impact syntax processing, supporting an integrated, less modular view of language processing.

## References

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