

Early selection of diagnostic facial information in the human visual cortex

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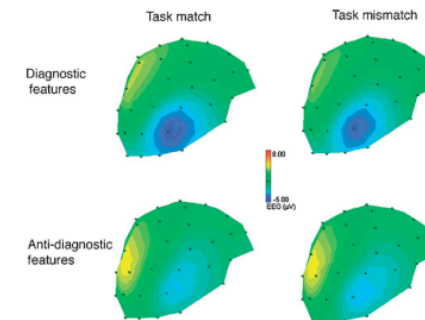
See also:

Goffaux et al (2003). **ERP evidence for task modulations on face perceptual processing at different spatial scales.** *Cognitive Science*, 27, 313-325.



VISION RESEARCH

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Main findings and conclusions

- The amplitude of the N170 in response to faces is not strictly driven by the stimulus: it can be modulated by the task at hand and the diagnosticity of the facial information for that task

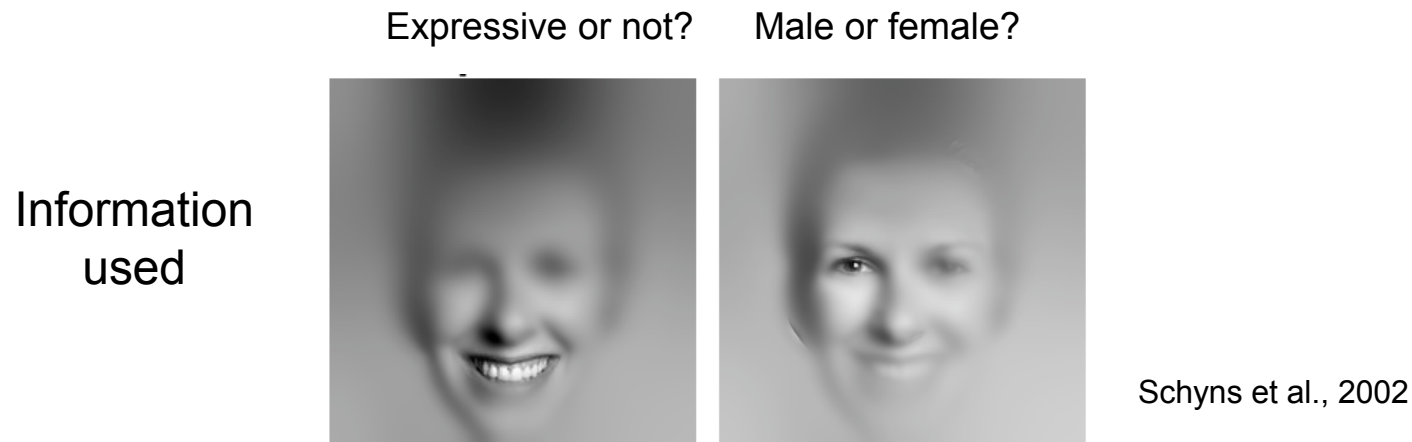
When subjects categorize faces according to **gender**, the **N170 is larger** if **diagnostic face gender cues** are contrasted with anti-diagnostic cues than if diagnostic cues for facial expression cues are contrasted with anti-diagnostic cues for expression

- These findings support a view according to which perceptual **representations** of faces **depend on the categorization task**

= EARLY SELECTION of information (>< Cognitive impenetrability of vision)

Introduction

When processing **faces** observers rely on distinct information (facial cues) to perform different face categorization tasks



The representations of faces can be either extracted **independently** of these tasks (= identical for all tasks) and **then** the relevant information (eyes vs. mouth for instance) is selected for **decision** = **LATE SELECTION**

Or, perceptual **representations** are not identical, i.e. **depend on the task**

= **EARLY SELECTION**

To clarify this question, we used a method that is able to measure brain activity with a high temporal resolution: event-related potentials (ERPs)

We focused on a visual ERP particularly large to faces, the N1 or **N170** (after Bentin et al., 1996).

Our goal was to test whether the N170, occurring between 130 and 200 ms and thought to reflect the **extraction of a perceptual face representation**, was ...

- * of same amplitude and latency for different tasks and diagnostic facial information

 - Support for a **LATE SELECTION**

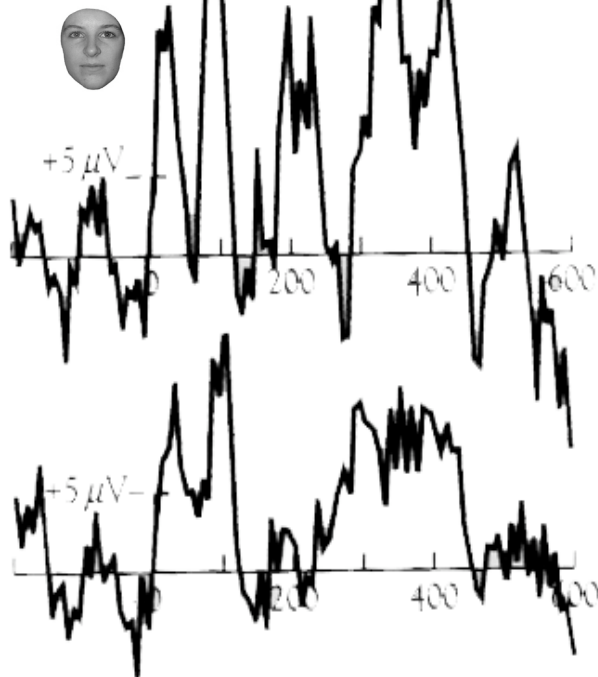
- * of larger amplitude and/or shorter latency when the categorization tasks matched the diagnostic facial information (e.g. eyes for gender judgment, not expression).

 - Support for an **EARLY SELECTION**

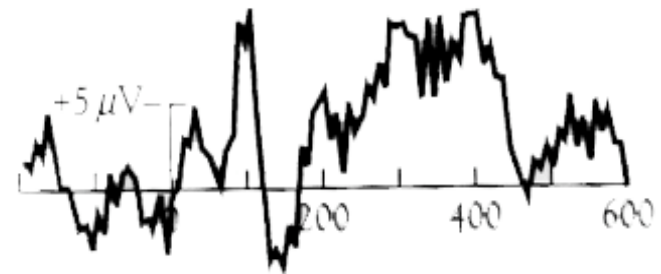
Method: averaging epochs of EEG time-locked to the onset of a face stimulus



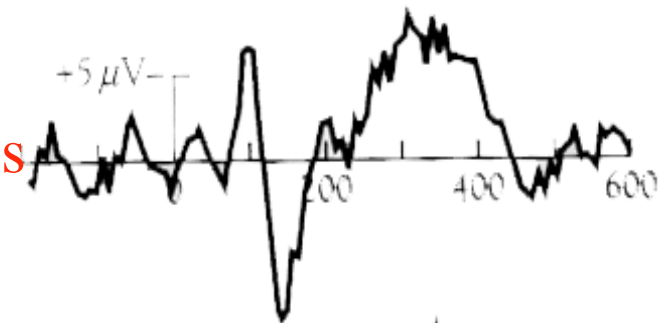
1 trial



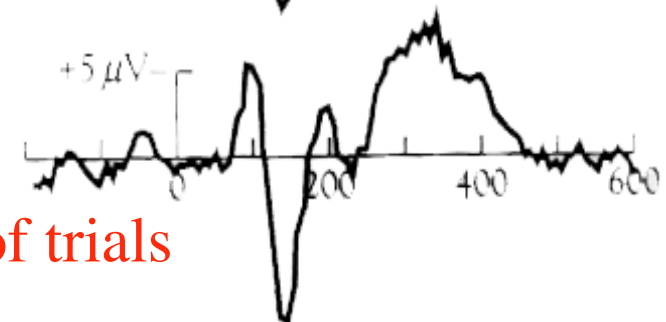
1 trial



10 trials



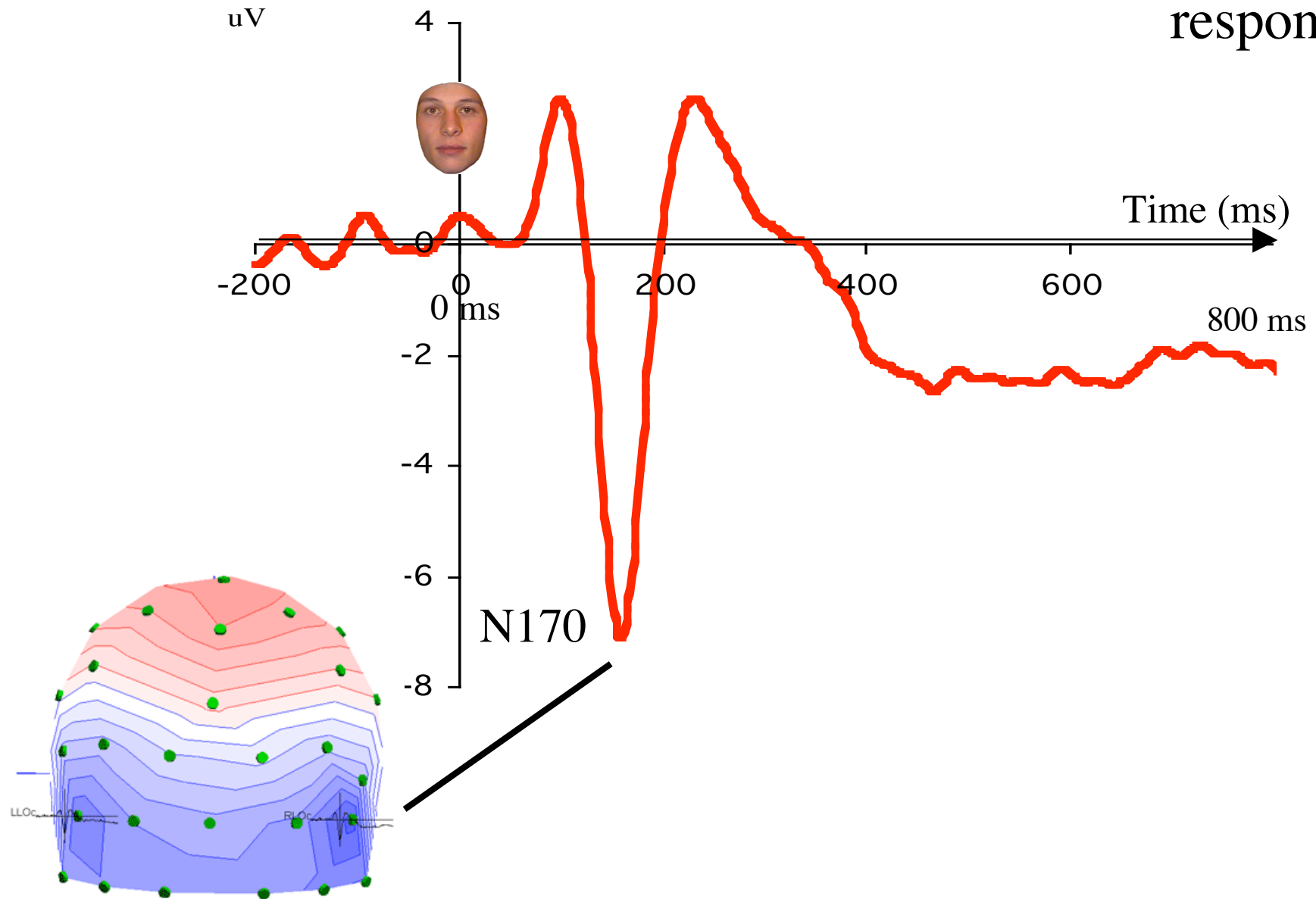
Tens of trials



Methods

Stimulation

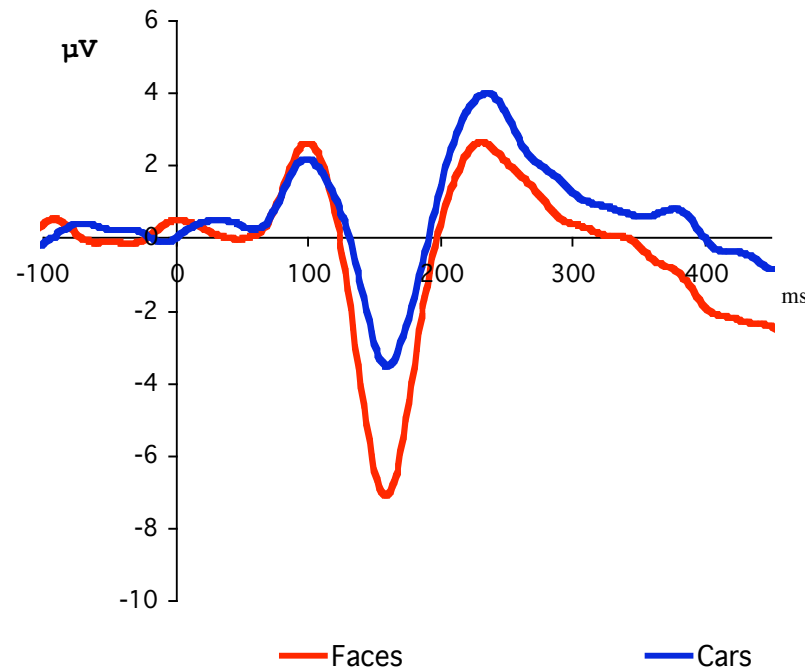
Motor response



Methods

N170

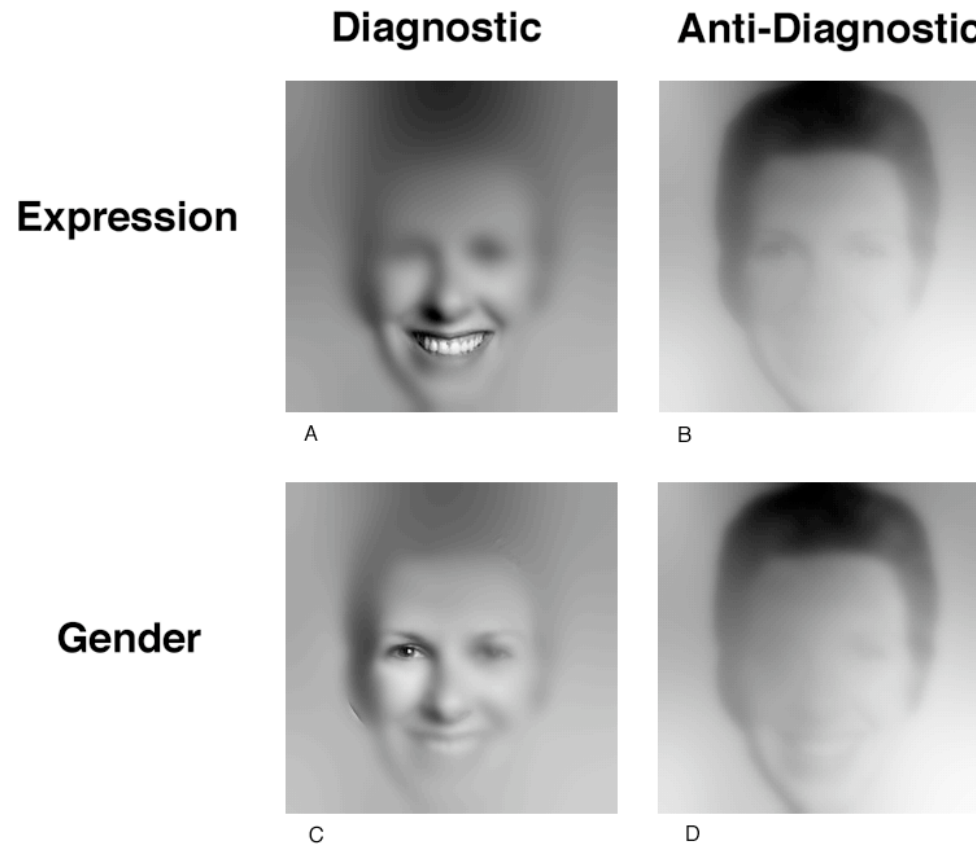
= Earliest and only consistent scalp electrophysiological response in humans that differentiates between faces and other object categories.



N170 = Time-locked and phase-locked response, in the alpha range (7-9 Hz)

Methods

We measured the N170 response to 4 types of stimuli, extracted from a behavioral study using *Bubbles* (Schyns et al., 2002)



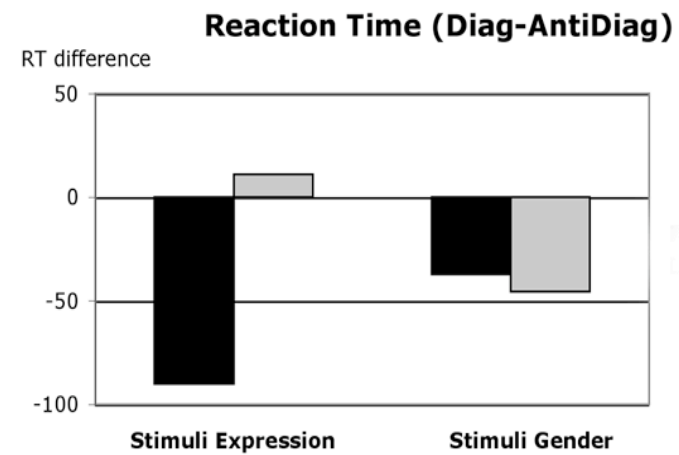
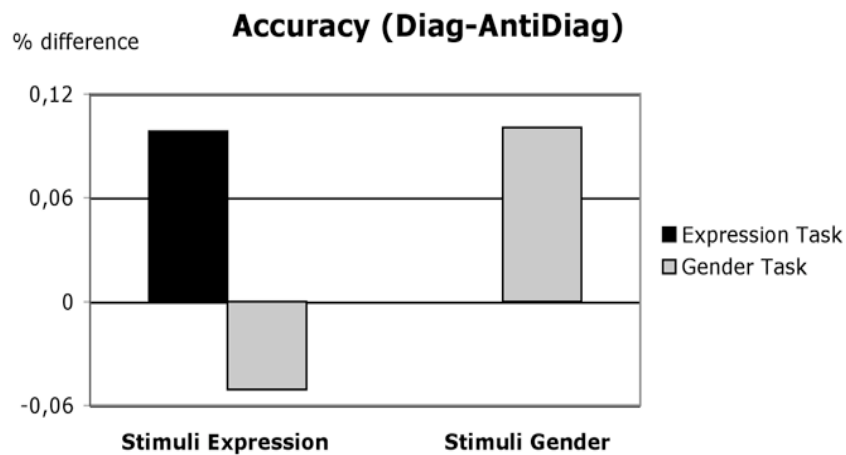
Order of stimulus presentation is fully randomized

Subjects (16) performed two tasks: - face expressive or neutral?
- male or female face?

Methods

Subjects were **better** and **faster** when information matched the task a hand

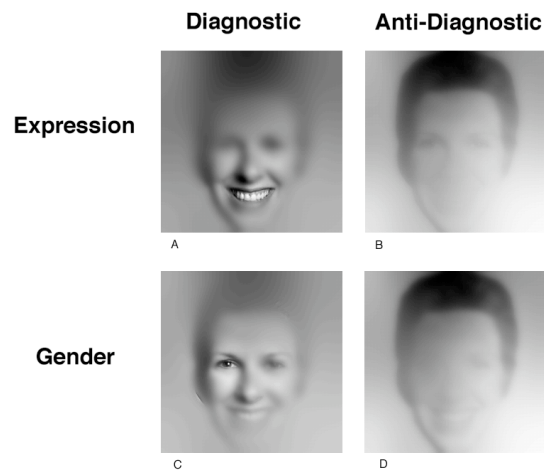
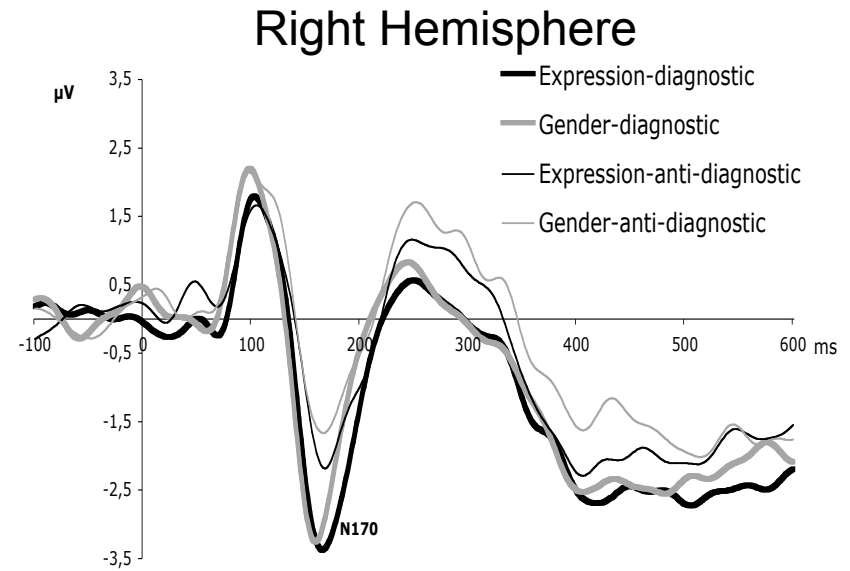
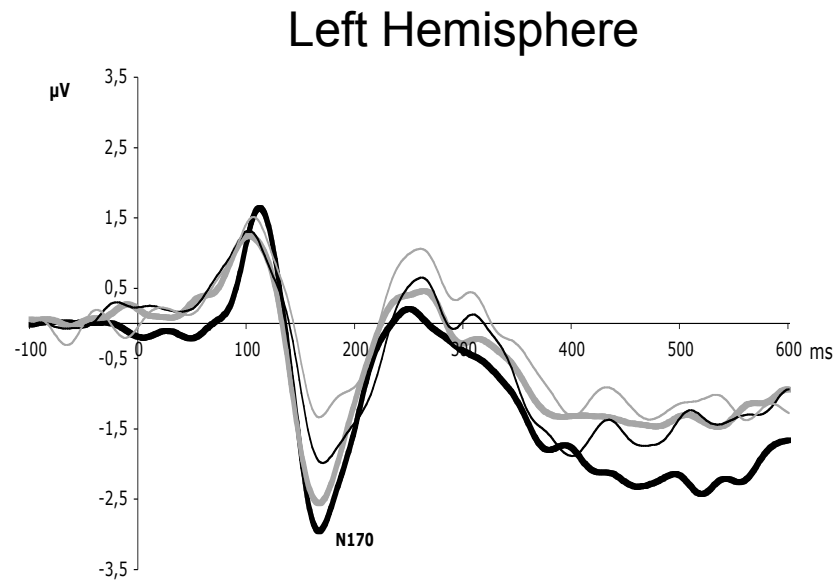
		Stimuli: Expression		Stimuli: Gender	
		Diagnostic	Anti-diagnostic	Diagnostic	Anti-diagnostic
Task	Expression	89 ± 1.1	79 ± 1.3	90 ± 1.4	90 ± 1.3
	Gender	78 ± 1.1	83 ± 1.1	93 ± 0.9	82 ± 1.2



Results

ERPs

Gender task

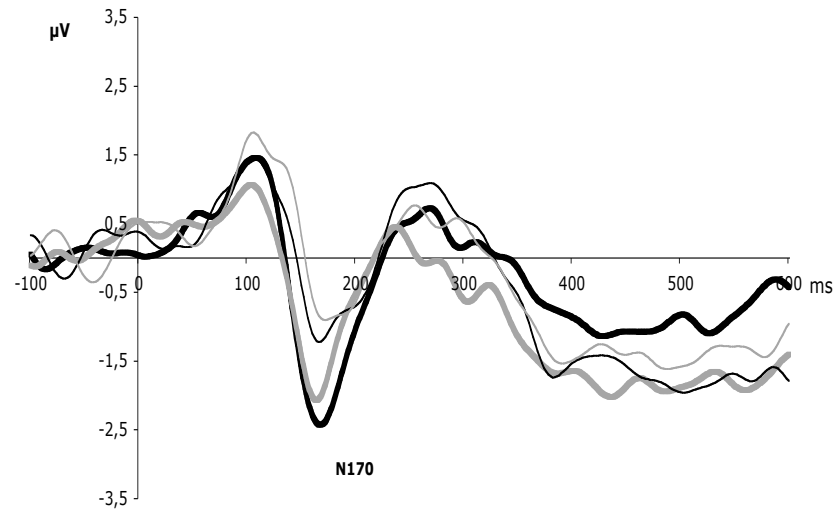


Results

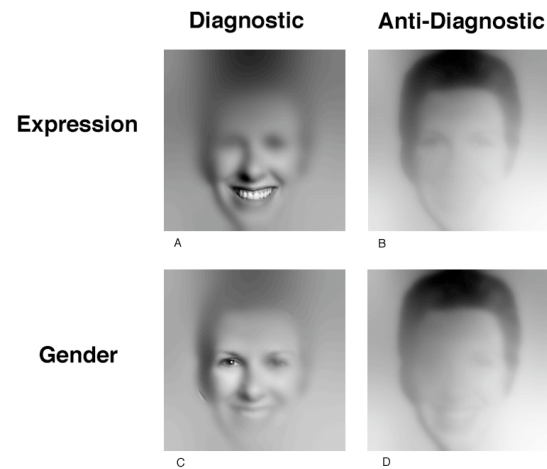
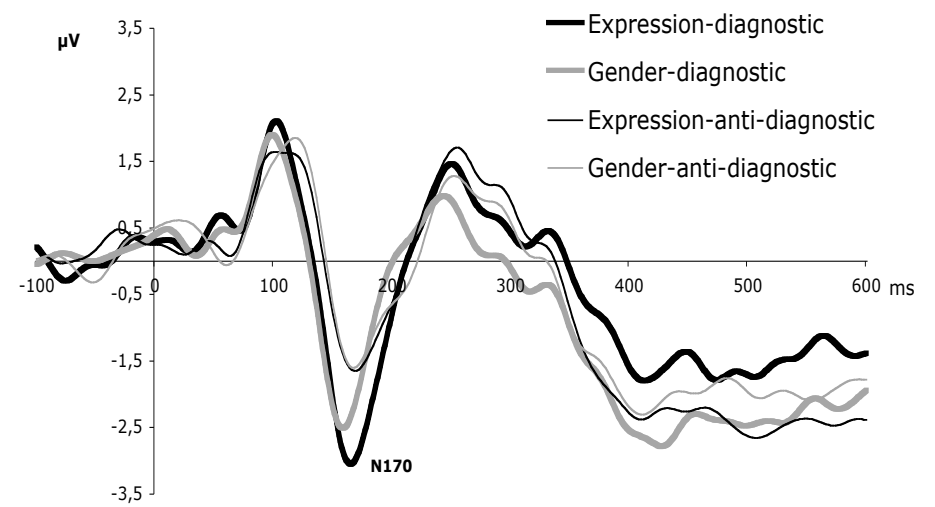
ERPs

Expression task

Left Hemisphere



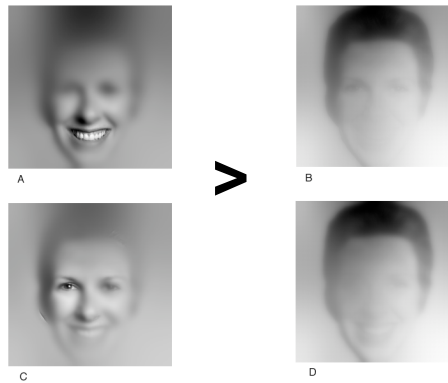
Right Hemisphere



Results

Result 1

Main effect of stimulus: the face stimuli that are diagnostic (either for expression or gender tasks) lead to faster and larger N170 responses, independently of the task

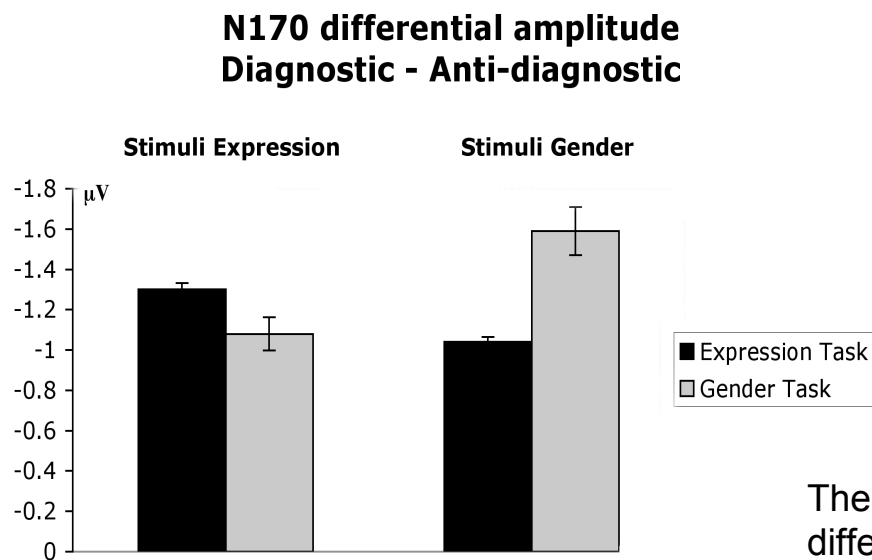


However (result 2),

N170 amplitude is larger for diagnostic information when it matches the task at hand

= **the exact same stimuli** (e.g. eyes cues for *gender*) lead to **increased** N170 when subjects perform the *gender* task relative to the expression task

The effect are best observed when subtracting responses to diagnostic and anti-diagnostic stimuli



Gender task:



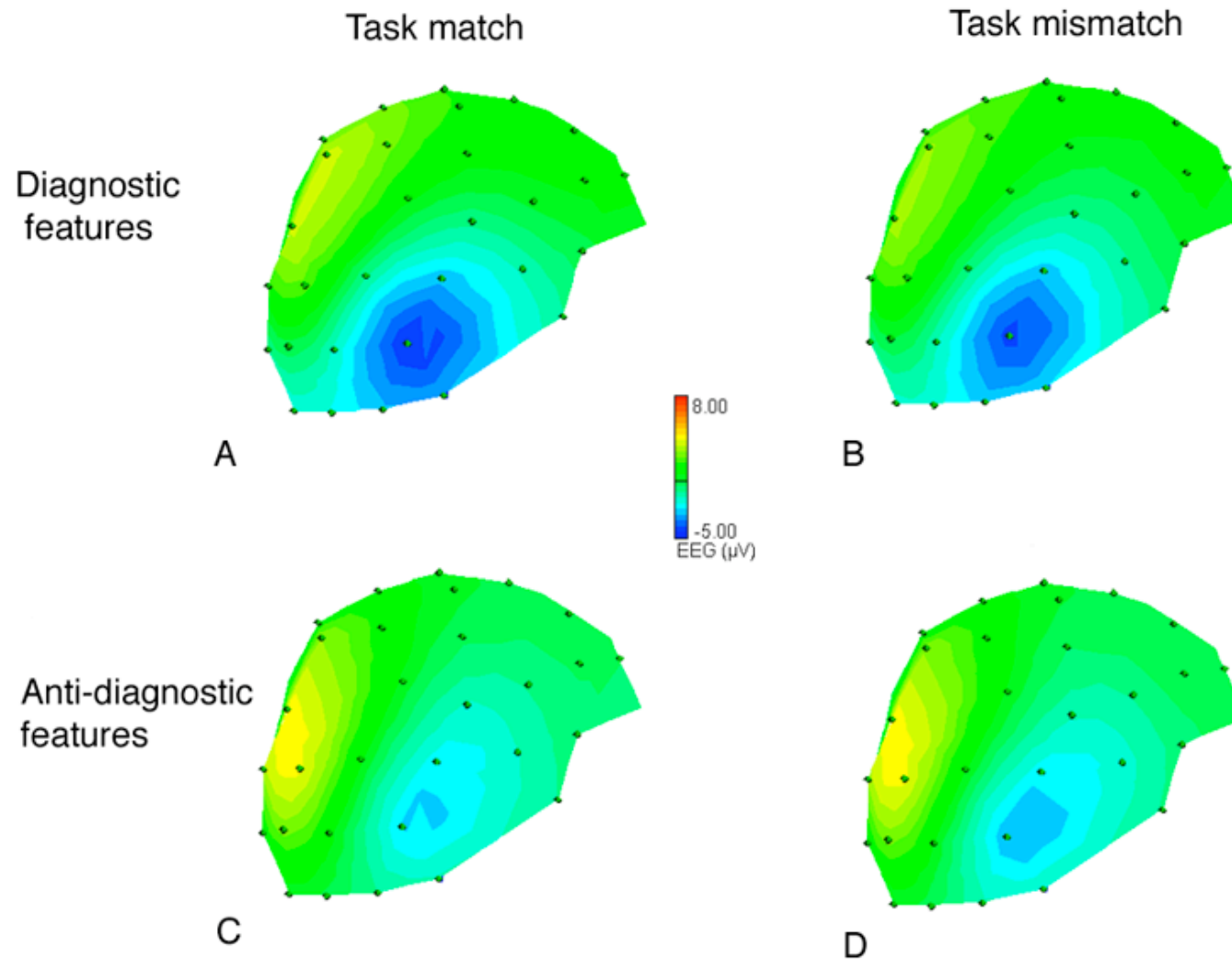
Expression task:



The effect reached significance only for the gender task: larger difference for gender stimuli than expression stimuli

Results

Conditions averaged - topographical map - right occipito-temporal sites



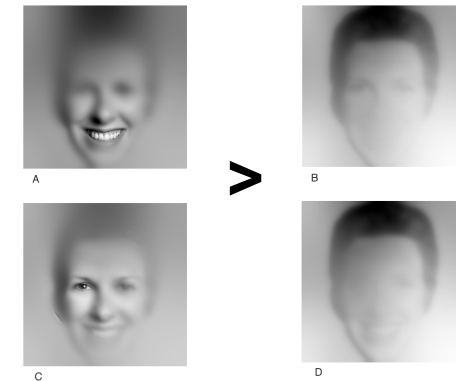
Interaction diagnosticity and task: (A- C) > (B-D)

Results

Discussion

Result 1

This result suggests that there is a large part of early visual face-related processes that are tuned to specific feature information, regardless of the task at hand



Result 2:

This result suggests that the face representation that is extracted as early as 100-200 ms following stimulus onset is modulated by the task at hand (i.e. different depending on the categorization task).

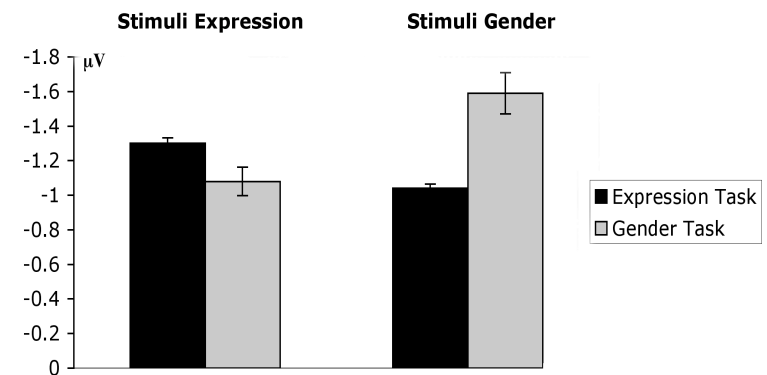
Gender task:



Expression task:



**N170 differential amplitude
Diagnostic - Anti-diagnostic**



Discussion