Stages of processing in face perception : an MEG study

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Scope

- to investigate whether *face perception* in humans
  proceeds through stages:

  (i) face categorization   (ii) face identification

- to exploit the high temporal resolution of MEG recordings
  in order to identify distinct neural processes
  into which *face perception* can be segmented

- The event-related response **N170 / M170**
  is known to be larger for face than nonface stimuli
  and is considered to reflect the structural encoding of a face.

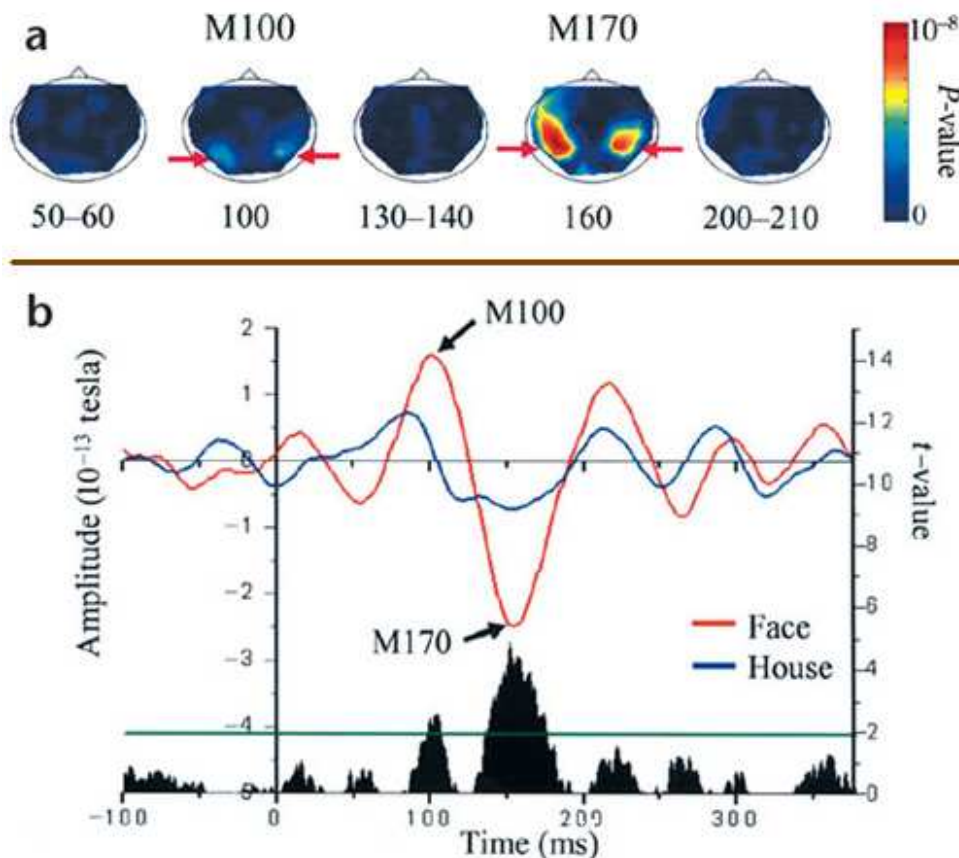 Is this the first face-selective response ?

  Ä the **M100** is reported

- To investigate the relation of M100 & M170
  with the success in face categorization / identification

15 subj. passively viewed 100 intermixed trials of **faces** and **houses**
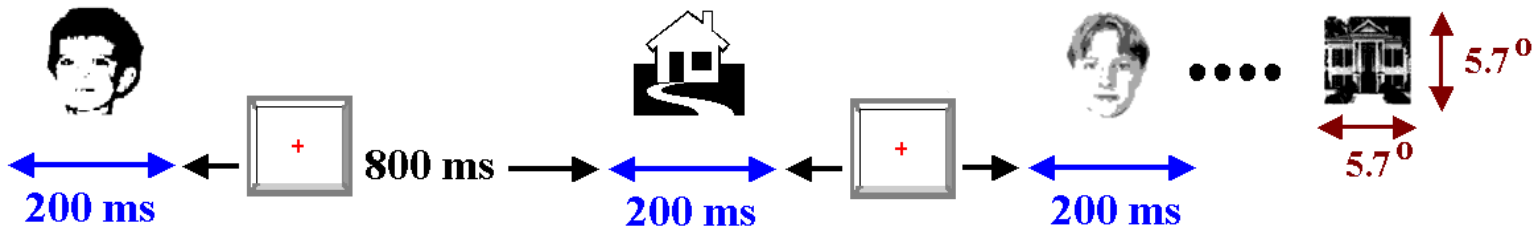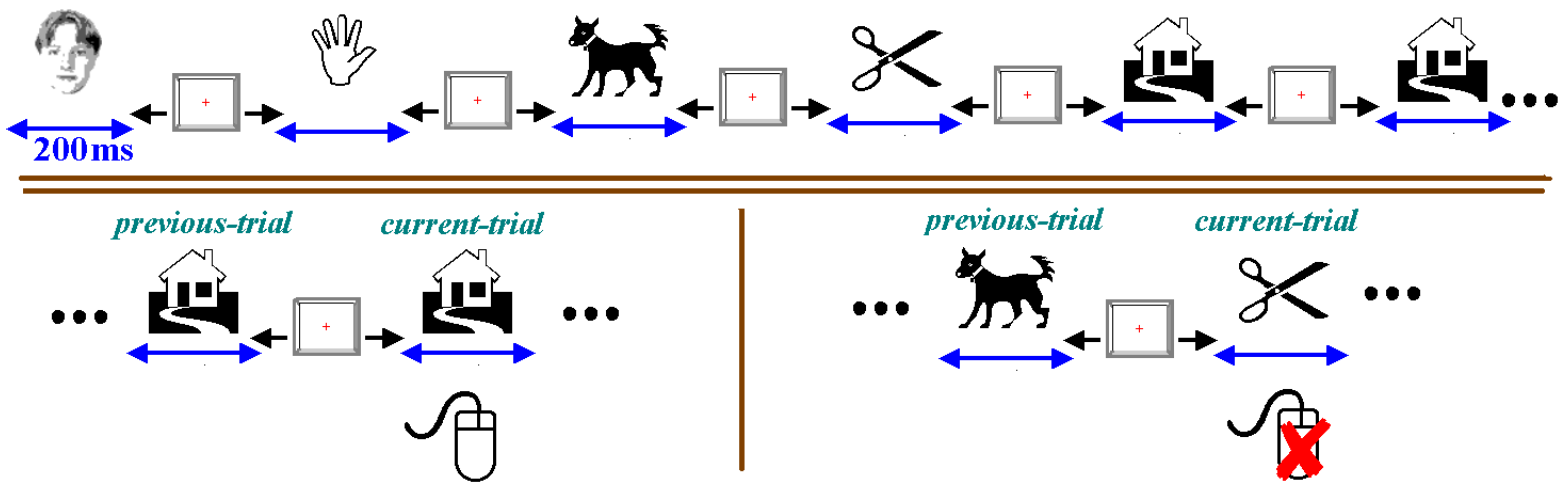

the statistical comparison of these responses (t-test) showed
➡ two face-selective responses in 13 out of 15 subj.

sensors of interest (SOIs) were defined and used
to test further the *face-selectivity* of M100 response
in a paradigm with a variety of control stimuli.

EXPERIMENT II

previous-trial   **current-trial**   **previous-trial**   **current-trial**

Task: button press whenever two consecutive images were identical

The M100 amplitude of the averaged signal in the SOIs
was compared between the different stimuli categories
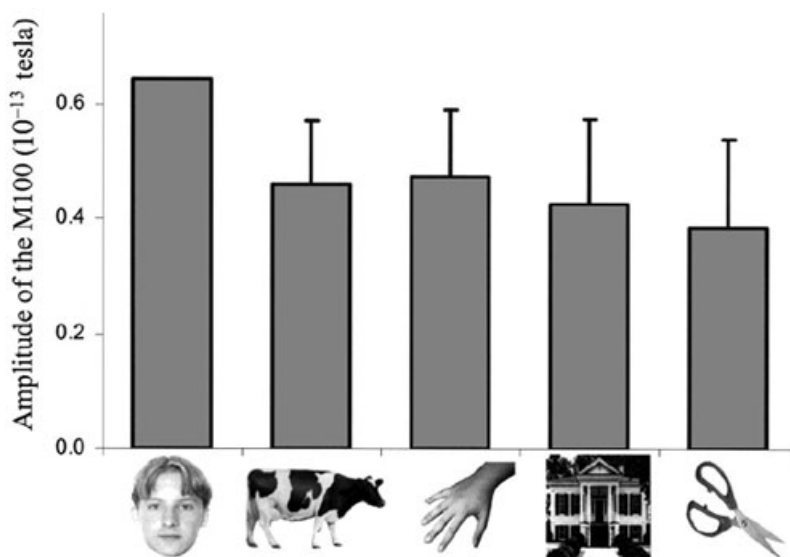
➲ The M100 response to faces is greater than that to animals,
human hands, houses and objects. Therefore M100 is not generally
selective for anything animate, or body part.

➲ M100 is weaker than M170 both in strength and face selectivity

➲ M100 has a more posterior scalp distribution than M170

EXPERIMENT III

Does M100 originate in retinotopically-organized visual cortex ?
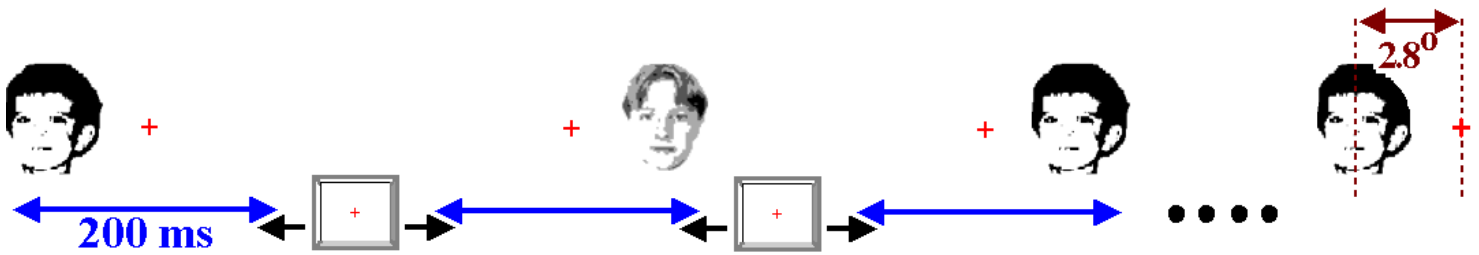
This manipulation, known to affect responses in **V1,V2,V3,VP,V3A** & **V4v** does not affect the M100 response indicating that
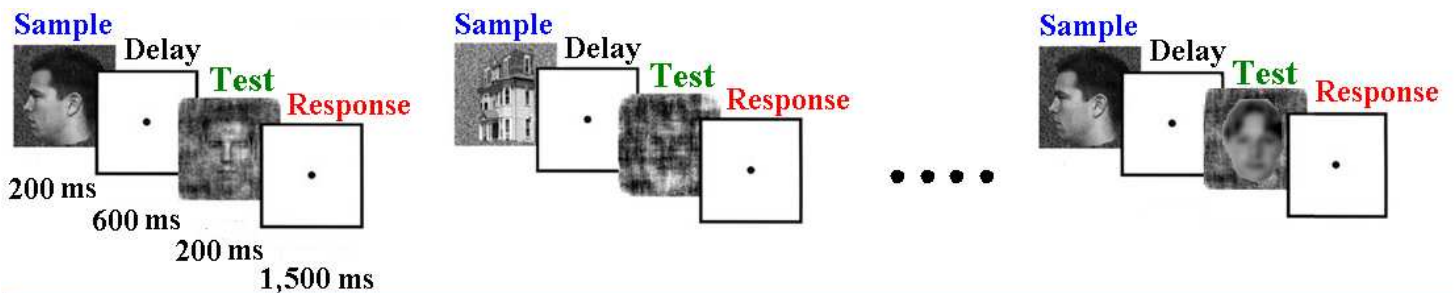
⮌ **the M100 source is beyond the retinotopic cortex**

EXPERIMENT IV
Decoupling categorization and identification

Are M100 & M170 involved in the categorization of a stimulus as a face ?
in the identification of a face ?   or both ?

Ten subjects matched front-view test images of faces to profile views and front-view test images of houses to three-quarter views
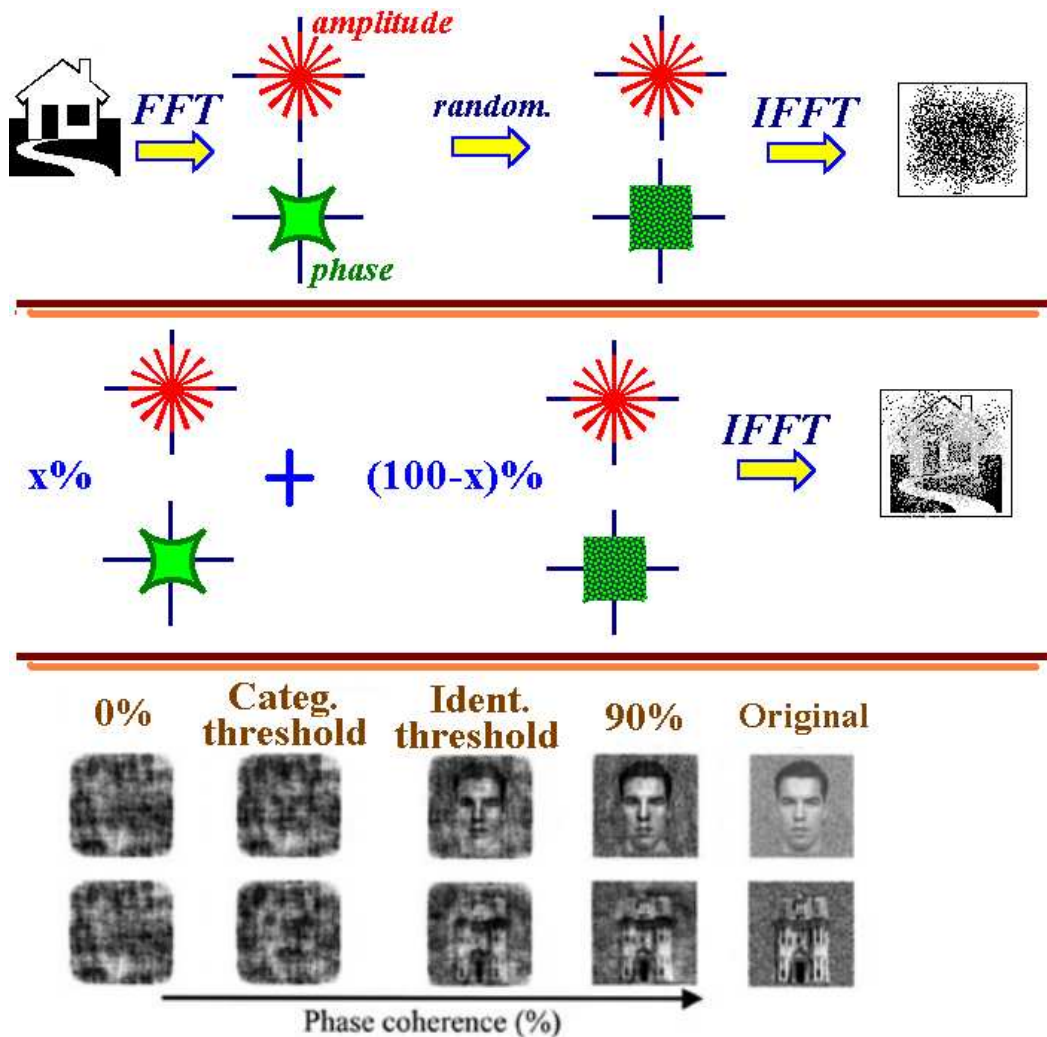

A set of 5 stimuli for each (face and house) category was used.

~ First, the subjects were trained to match each face (and house)

with its profile.

~ Then, a ***psychophysical staircase procedure*** (RISE) was followed,
in which each test image was gradually degraded,
via *randomization* of the FFT phase-spectrum
until the subject reached threshold performance (75% correct)

In this way, for each subject 5 thr.-Stimuli for houses and 5 for faces were

constructed for each task (categorization and identification) separately.

~ Finally, the matching task was repeated in the MEG scanner

using the subject-adapted stimuli.

By measuring both categoriz. & identif. performance on each trial, they attempted to decouple the MEG correlates of success in the two tasks.

To obtain the MEG correlates of <u>successful categorization</u> ,

the average response to a specific test image when it was correctly categorized BUT not identified was compared with the response to the same image when it was categorized incorrectly.

To obtain the MEG correlates of <u>successful identification</u> ,

the average response to a specific test image when it was correctly identified was compared with response to the same image when it was correctly categorized but not identified.
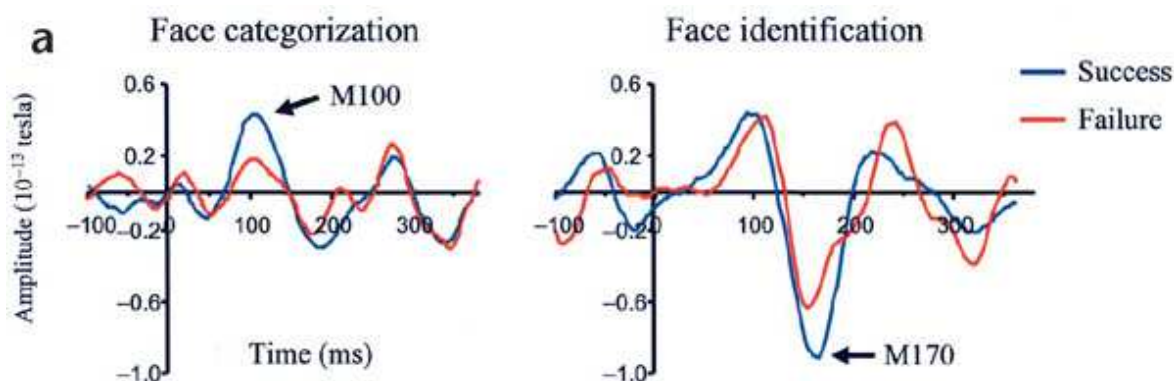
Across subjects averaged responses in SOI
from the face categorization and identification tasks (with thr.-Stimuli)

➲ Both M100 & M170 were larger for successful than unsuccessful categoriz.

➲ Only M170 was higher for correct than for incorrect face identification
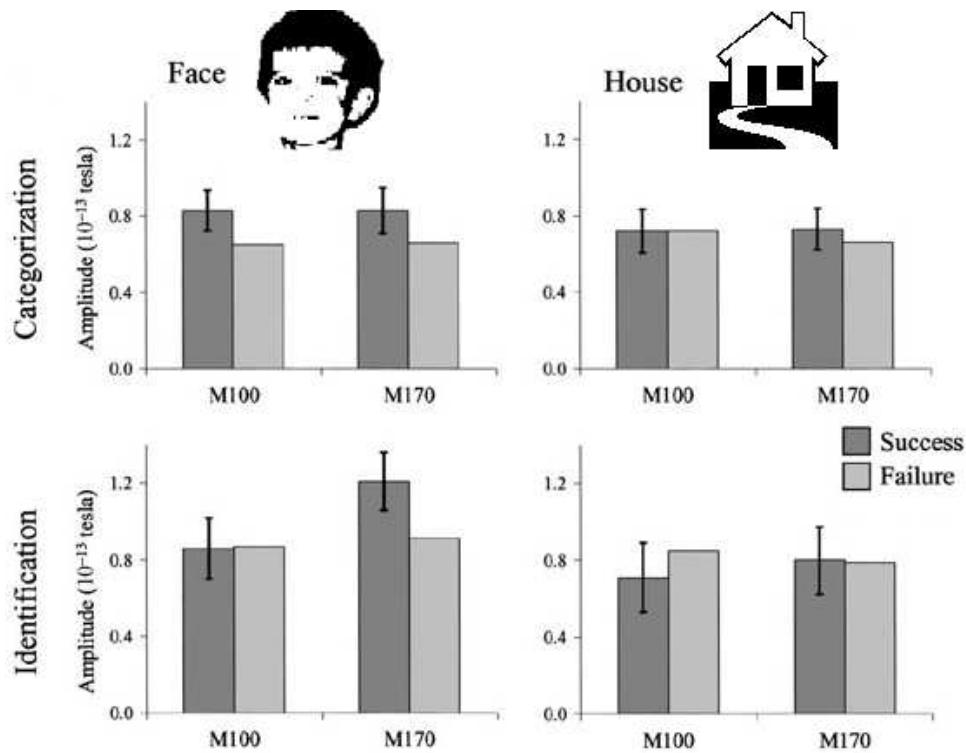
⮞ For house stimuli, neither M100 nor M170

differed for correct vs incorrect task

The accuracy on the two tasks was the same for faces and houses

Table 1. Accuracy as a function of task and stimulus category

|	Categorization task		Identification task	
	Face	**House**	**Face**	**House**
Categorization threshold	74%	72%	26%	19%
Identification threshold	95%	95%	73%	65%

⮞ Any difference between faces and houses seen in MEG responses

cannot be explained in terms of behavioral performance

Both M100 & M170 are correlated with successful face categorization, but only M170 is correlated with successful face identification.
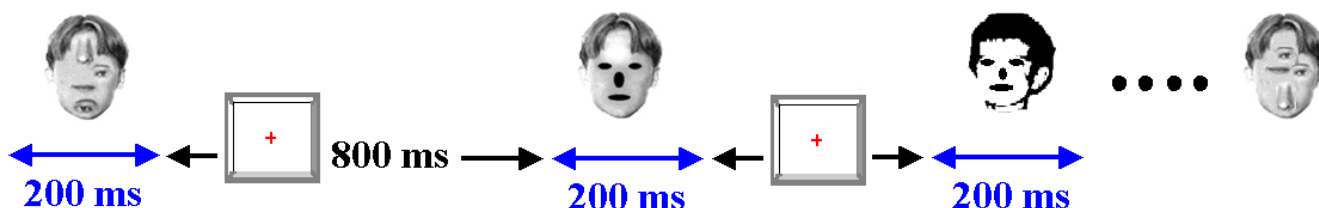
Does selectivity of the underlying neural population
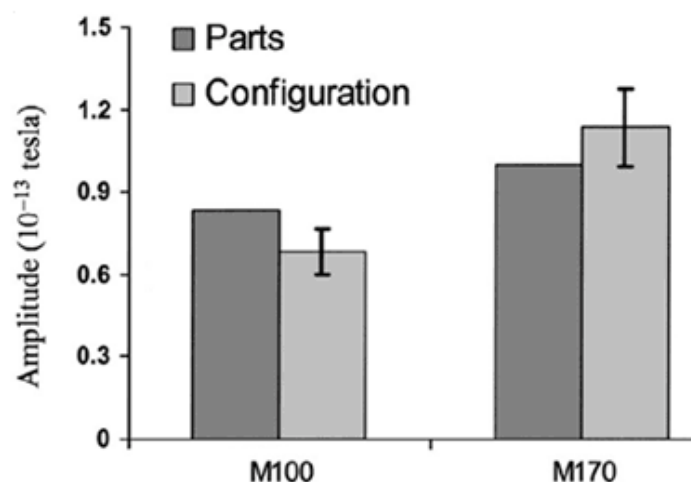continuously sharpen over time ?

Two face-like stimulus categories were constructed from veridical faces

Configuration   Parts
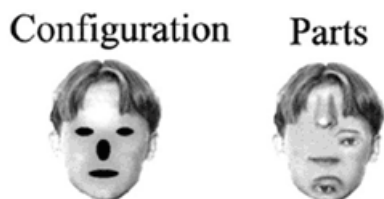
14 subj. passively viewed two sets of such stimuli (50 from each category)

200 ms   800 ms   200 ms   200 ms

The amplitudes of

M100,M170 responses

to confuguration and parts stimuli,

measured at SOIs,

were averaged across subjects

⇨ M100 is larger for parts-stimuli than for configuration-stimuli,
while M170 shows the opposite trend.

Thus there is a qualitative difference between the two responses
and NOT just a difference in the degree of selectivity

CONCLUSIONS

♦ **Categorization of stimulus as a face**
   begins within 100ms after onset, earlier than previously thought

♦ **M100 reflects the subject's percept and not low-level stim-features**
   (stronger for the same face when it was correctly recognized as a face)

♦ **While both M100 & M170 are correlated with categorization success, only M170 is related with successful face-identification.**

♦ **Two stages of processing in face perception :**

an earlier critical for categorization,
                          which relies on information about face parts

and a later critical for identification ,
                          which relies on information about face configurations