# BOLD correlates of facial adaptation

J. Baudewig[1], G. Kovács[2], A. Antal[3], Z. Vidnyánszky[4], P. Dechent[1]

[1]MR-Research in Neurology and Psychiatry, Georg-August University of Göttingen, Göttingen, Germany, [2]Department of Cognitive Sciences, Budapest University of Technology and Economics, Budapest, Hungary, [3]Department of Clinical Neurophysiology, Georg-August University of Göttingen, Göttingen, Germany, [4]Neurobiology Research Group, Hungarian Academy of Sciences-Semmelweis University, Budapest, Hungary

**Introduction**

Face recognition is a complex process which nevertheless usually is a simple and effortless task for most humans. Numerous fMRI studies demonstrated highly specialised cortical areas which are involved in human face processing [1]. In this study we tried to identify these regions and took a closer look at effects of repeated presentation of identical faces. In a second experiment we used a prolonged exposure (adaptation) to an individual (female or male) face in order to influence the result of a subsequent gender-discrimination task. This gender specific facial adaptation could be measured by a change in perception as well as by altered components in event related potentials [2]. Here we try to identify a neuronal correlate as measured by a BOLD response due to facial adaptation.

**Methods**

BOLD fMRI was performed at 3T (Siemens TRIO) using EPI (TR 2000, TE 36, 22 slices, 2x2x4 mm$^3$) on 6 healthy subjects. In the first experiment (FACES) every 600 ms a new face (Fig. 1 A,B,C) was presented for 400 ms. 20 different faces resulted in a block length of 12 s. These blocks were repeated 12 times and separated by a control condition. During the control period Fourier transforms of these faces (Fig. 1 D) were presented using the same timing. In a second experiment (FACE) identical timing as in experiment 1 was used but instead of different faces only one face was presented repeatedly. A third type of experiments was done using an event-related design. Subjects performed a gender-discrimination task where a gender specific prototype (EVE or ADAM, Fig. 1 A, C) had to be compared with a computational derived morph of the face where a virtual amount of opposite gender was merged into (e.g. EVE75 / Fig. 1 B). As a control condition the gender-discrimination task was also done using pictures of male or female hands respectively (Fig1 E, F). In order to achieve face adaptation a gender specific prototype (EVE or ADAM; Fig. 1 A or C) was presented during the whole run. Events for the gender-discrimination task where the two 400 ms lasting blinks of either EVE/EVE75, ADAM/ADAM75 or HAND/HAND75 and a subsequent decision indicated by a key press. Events were separated by 16 s during which the adaptation face was continuously presented. The total number of events was 72 resulting in a total measuring time of 20 min which was separated into 4 runs.

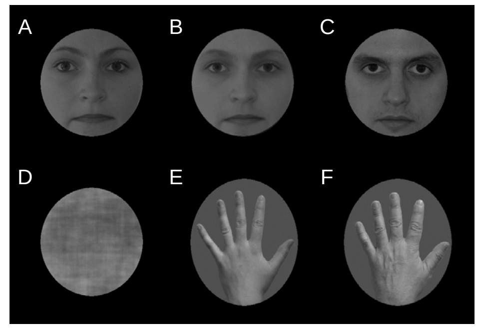


Fig.1 Stimuli

**Results:**

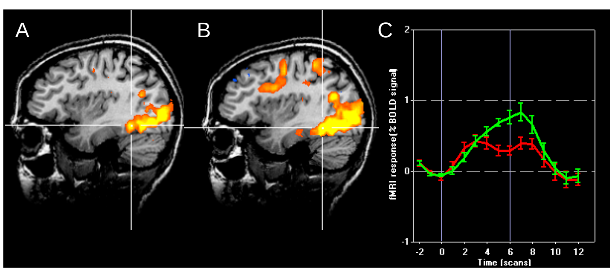


Fig.2: Individual BOLD activation maps demonstrating face sensitive areas activated by a single face (A) or by multiple faces (B). The signal time curves in (C) were taken from the fusiform gyrus and show a significant difference for a single face (red line) and multiple faces (green line).

In the first experiment (FACES) identification of brain areas known to be involved in face processing was achieved in all 6 subjects (Fig.2). These areas include portions of visual areas V1/V2, the fusiform face area (FFA), the superior temporal sulcus (STS), and the lateral occipital cortex (LOC). A single face (FACE) compared to multiple faces (FACES) caused a large decrease of the amplitude of the measured BOLD response and of the amount of activated pixels.

In the gender-discrimination-task a much more widespread pattern of BOLD activations was found (Fig.3). This pattern includes the face sensitive areas which were activated in the first set of experiments. Additionally, we found activation in the supplementary motor area (SMA), the left motor cortex, the thalamus, the intraparietal sulcus (IPS) and the insular cortex. Surprisingly, we found no substantial differences in the BOLD responses when using hands or faces in the gender-discrimination task – neither globally nor in the face sensitive regions determined in the first set of experiments.

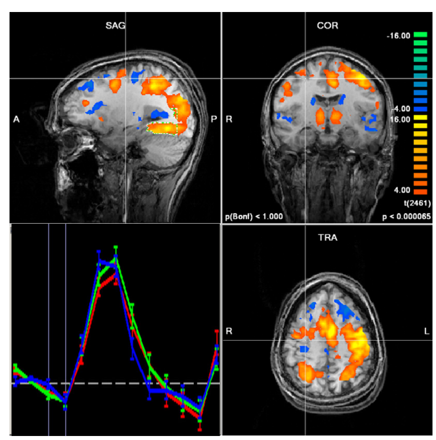


Fig.3: BOLD activation maps demonstrating the widespread activation pattern in the gender discrimination task (group results). The signal time curves from the fusiform gyrus show a remarkable concordance for BOLD response to hands (blue line) and BOLD for female or male faces (red and green lines).

**Discussion:**

In the first part of our experiments we could demonstrate, that repeated presentation of one single face resulted in a reduced BOLD response in several face sensitive areas when compared to the presentation of different faces (facial adaption). In the second part of the experiment we found a widespread network activated by a gender-discrimination task. This network contained face sensitive areas, the areas involved in decision making and the motor network, presumably activated by the required response using the right hand. On the other hand we were not able to find differences in BOLD responses due to facial adaptation by a female or male adaptor although these differences were found in ERP experiments as well as in distorted perception in our experiments. Further work will be necessary to clarify if this incongruity is due to different nature of ERP and BOLD signals or can be resolved by different evaluation strategies or experimental designs.

References:

[1 Haxby et al., The distributed human neuronal system for face perception, Trends Cogn Sci 2000.
[2] Kovács et al., ERP correlates of facial adaptation, Vision Science Society 2004.