Can blessing influence fMRI results?

J. Olsrud[1], A. Nilsson[2], P. Mannfolk[2], A. B. Waites[1]
[1]MR-department, Lund University Hospital, Lund, Sweden, [2]Department of Medical Radiation Physics, Lund University, Lund, Sweden

Introduction In BOLD fMRI activation/blood flow changes are measured through small induced changes of the local magnetic field. Other task correlated changes of the magnetic field, not originating from the BOLD effect, will therefore also easily be detected and influence the results. For example, even slight motion of the head influences the local magnetic field distribution [1]. Likewise, external objects close to the MR scanner are known to disturb the magnetic field. If the position of an external object is altered in a task correlated manner it can therefore be anticipated that this might affect the results of an fMRI study. In this study we investigate the possible influence on GRE-EPI signal when an object (hand) is extended into the patient tunnel during image acquisition.

Materials and Methods Two scans were performed on a volunteer using a clinical fMRI protocol (TE/TR=30/3000ms, 3x3x3 voxel, 100 dynamic scans) The subject was in a resting state during both scans. In one of the scans a second person standing behind the scanner reached the hand into the patient tunnel, held it close to the head of the subject without touching (which we denote "blessing") and removed the hand again. The hand position was alternated in 30s blocks (in/out). Standard block design fMRI analysis was performed using SPM2 (www.fil.ion.ucl.ac.uk/spm). The time series for each experiment was transformed to standard space and smoothed (8 mm Gaussian kernel).

Results Figure 1 shows t-maps from the "rest" and "blessing" experiments. Figure 2 shows the signal time course for the voxel with the highest correlation (t=8.31) during both experiments. No activation above the threshold ($p<0.05$, corrected for multiple comparisons) was seen in the "rest" experiment, whereas large areas are present in the "blessing" experiment. The time course correlates well with the act of alternating the position of the hand, but lacks the delay due to hemodymamic response.

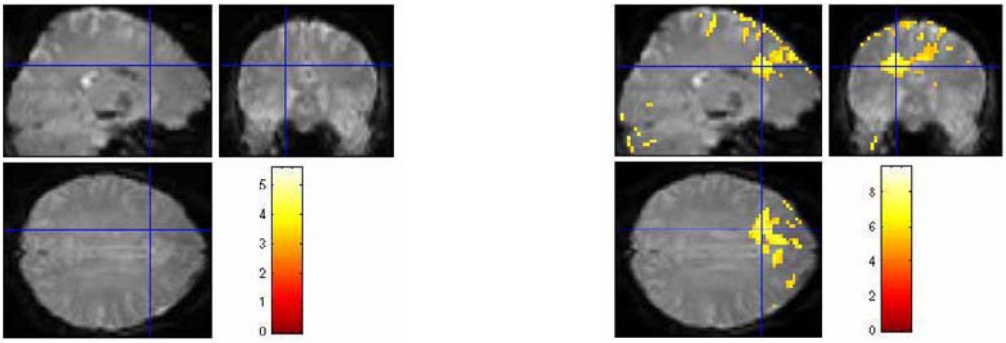

Figure 1: t-maps for the rest experiment (left) and the blessing experiment (right). The cross indicates the maximum t-value.

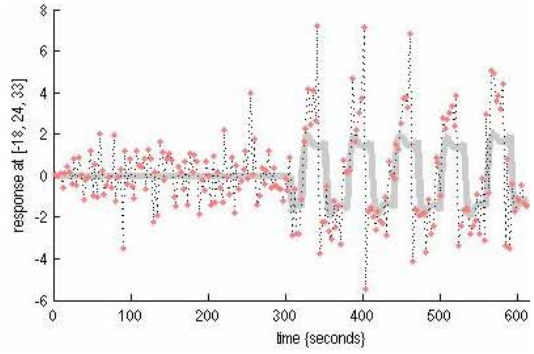

Figure 2: Signal time course for the rest experiment (left) and the blessing experiment (right)

Discussion: We have shown that alternately holding the hand close to the head of the subject and removing it again induces temporally well correlated signal changes. The signal change lacks the hemodynamic delay expected for true activation but the magnitude is quite comparable to those normally found in activated areas during an fMRI study. The occurrence of activation distant from visible brain structures/edges indicates that it is not motion related. The situation described here is somewhat extreme, but shows that inserting an object into, or moving the body inside, the scanner tunnel induces a change in the local magnetic field over a wide area within the brain. This can cause false activation that may be hard to separate from true BOLD response.

References

[1] Andersson JLR, Hutton C, Ashburner J, Turner R, Friston K, Modeling geometric deformations in EPI time series, Neuroimage, 13:903-919 (2001)