

The relation between force production, muscle activity and brain activation

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Because of its noninvasive nature functional magnetic resonance imaging (fMRI) is increasingly used for studying human brain function. To investigate brain activity during motor tasks it is also important to measure muscle activity (EMG) and muscle output (force). However, due to the disruption of fMRI-signals by magnetic electrical equipment and the influence of fMRI-scanner on force and EMG recordings, only a few labs are able to measure EMG and force simultaneously with the brain activity.

We have designed a MR-compatible force transducer. This transducer is made of fibreglass and the recording components are electrically shielded (Faraday cage) from the MR-signals. The force signals are amplified and optically transmitted to a custom-made converter. The signal is digitised and saved on a computer. EMG signals are recorded by fMRI-compatible electrodes and transmitted with fibre-optics to a dedicated computer system (Brainproducts, Germany). The used fMRI-protocol consisted of sparse sampling, i.e. 3 seconds with followed by 2 seconds without scanning.

In this experiment the relationship between index finger abduction force (of the right and left hand), the related muscle activation (EMG of the first dorsal interosseus) and brain activation was studied. The maximal voluntary contraction forces (MVC) of 10 right-handed subjects were measured, thereafter subjects were asked to produce 5, 15, 30, 50, and 70%-MVC (in random order) with their right index finger followed by the left index finger. Subjects received on-line feedback of the target-force and the produced force. These tasks were performed in the lab (outside the scanner), and in a 3T-MR-scanner. Our (preliminary) results show a good correlation between the force levels and the intensity of brain activation. In further analyses the relation between the recorded EMG-data during the non-scanning periods and the EMG, after correction for scanner-artefacts, will also be taken into account.

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