

Differences in fMRI brain activation between left and right handed subjects executing diverse tasks.

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Introduction:

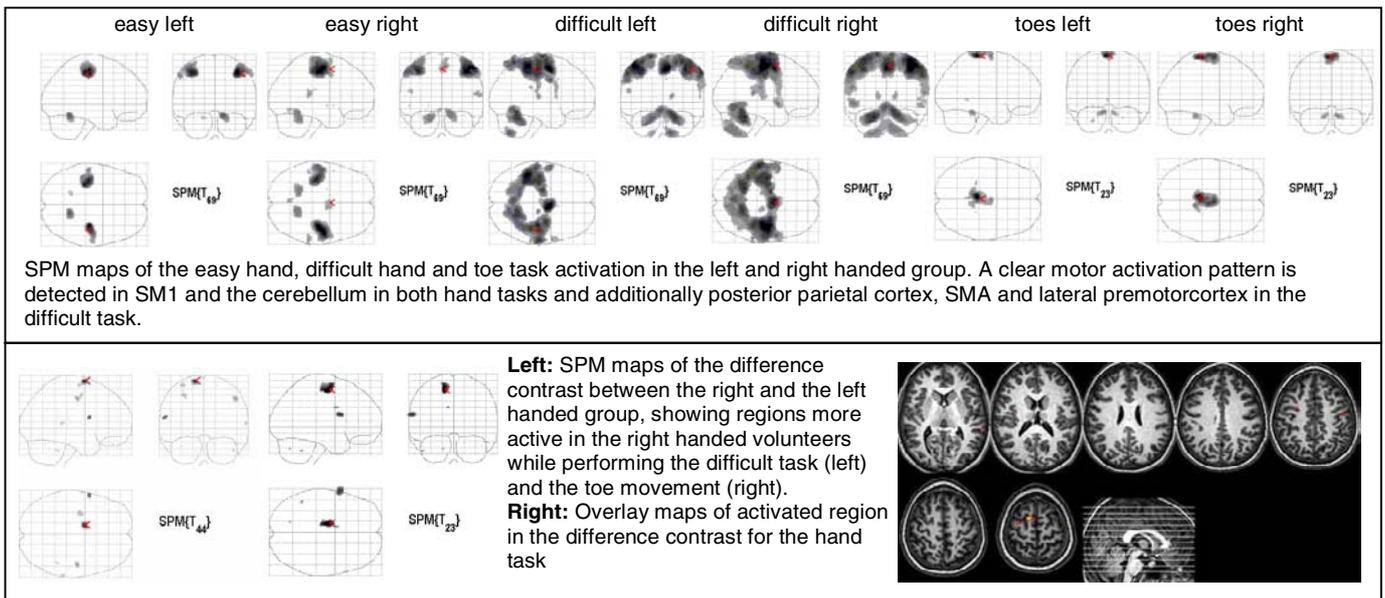
Differences between left and right handed persons have been studied in several fMRI experiments executing different types of tasks, e.g. motor and language tasks. In some of these experiments left-right asymmetry has been demonstrated, but there is still no consensus about a possible difference in information processing between right and left handed subjects. In this experiment we wanted to explore the differences between groups of left and right handed subjects while performing identical tasks for both subjects and aim to find a possible correlation between the results of different experimental paradigms with the handedness of the subjects.

Material and methods:

All scans were acquired on a 3T Intera Scanner (Philips Medical Systems, Best, The Netherlands). An 8 channel phased array receive only coil (MRI Devices Corporation WI, USA) was used for image acquisition. The sequence for the acquisition of the fMRI datasets was an FFE-EPI sequence, imaging 36 transversal adjacent slices with a matrix size of 80X80 and a voxel size of 2.75x2.75x3.5mm, TR/TE = 2000/30ms, a SENSE acceleration factor of 2. 24 healthy volunteers (age 19-27) were scanned (12 right and 12 left handed with mean Oldfield test scores of -0.57 and 0.8 respectively). For every volunteer the functional runs consisted of 180 volume scans while the subject performed the two motor tasks. The motor hand task consisted of 3 conditions: rest and 2 different bimanual finger movements (a simple ritmic finger to thumb opposition: easy task and a sequential ritmic fingertapping task in an externally defined order: difficult task). Every condition lasted for 12 scans (24 secs) and was repeated 5 times. The motor foot task consisted of simple bipedal toe bending. During the performance of the task volunteers were instructed not to look at their fingers or toes, to eliminate differential visual activation. The resulting fMRI datasets were analysed using SPM2, both at a single subject and rfx group level. On the group level the following contrasts were calculated: Easy fingertapping versus rest, difficult versus rest, difficult versus easy, toe movement versus rest. For these contrasts, differences between the left and right handed groups were studied.

Results:

In the fingertapping task a difference is observed between the easy and difficult task, which is reflected in the number of activated voxels and the recruitment of several additional regions. In both (left and right handed) groups M1, S1 and the cerebellum are active during the easy task. During the difficult task S1, M1 and the cerebellum are also active, but several premotor areas, SMA, posterior parietal areas and bilateral cerebellar areas are additionally recruited. We can observe in SM1 a larger signal change of the non-dominant hand area for both the left and right handed groups. For the foot movement task M1, SMA and cerebellar regions are active. In these results a task difficulty dependence can be observed. The activity in the lateral premotor areas is correlated with an increasing degree of task difficulty. To observe group differences between left and right handed subjects, we tested for the difference contrasts between the tasks for both groups. In the difficult hand task we observe activation of right M1, central SMA and inferior frontal gyrus, for the difference contrast between the right and the left handed group. In the toe movement task, central SMA and the inferior frontal gyrus are differentially active in the right versus the left group. In the reversed differential contrasts for these tasks and in both group differences of the easy fingertapping task no resulting activations were observed.



Conclusion:

Activation differences have been observed between the groups of left and right handed volunteers in several regions of the brain performing different motor tasks. These differences can be explained by the larger effort which the right handed subjects have to commit to perform these tasks with their non-dominant limb, in comparison to left handed subjects who live in and have adapted to a right hand dominated world.