Differences in brain activation between athletes and non-athletes during simple motor task

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Introduction
Many neuroimaging studies have shown changes in activation related to the level of motor skill. Several studies showed activation of prefrontal areas, prefrontal cortex, supplementary motor area (SMA), and premotor cortex when novel motor tasks were initially performed, and resources in the basal ganglia and cerebellum were introduced on the process of learning. In this study, we found that areas of brain activation during simple motor task were SMA and right premotor cortex in non-athletes, and basal ganglia in athletes.

Methods
A total of 34 right handed and footed normal females, age varied from 18 to 23 yrs, participated in the study. They were consisted of 12 non-athletes (group N; almost no sport activity) and 21 athletes (group A) including 9 footballers (group F), 13 volleyballers (group V). The footballers and volleyballers were all in the Japanese College Sport, division A level. All subjects performed the same simple motor tasks with hand fingers tapping, wrists flexion-stretch, elbows flexion-stretch, foot fingers flexion-stretch, and ankles dorsal flexion-stretch by each side of hands and foot. The fMRI measurements were executed on a 1.5T MR scanner (EXCELART, Toshiba, Japan) on single shot EPI during each task. Imaging parameters were TR=4000 msec, TE=40 msec, Flip Angle=90 deg., FoV=240 mm, Matrix Size=128x128, Slices=17, Thickness=4 mm, Gap=0 mm. Statistical comparisons across groups between the signal obtained with 5 tasks were made using a t-test on SPM99 at a significance uncorrected threshold of p<0.001.

Results
There were differences of brain activities across 3 groups in SMA, premotor cortex, basal ganglia. Compared N with V, we found stronger activation in SMA during the tasks with both right and left elbows (Fig. 1). And compared N with A, right premotor cortex was more activated during tasks with left foot (Fig. 2) while basal ganglia was more activated during tasks with right and left foot compared A with N (Fig. 3).

Conclusion
There were significant differences in brain activation between athletes and non-athletes during simple motor activity. For non-athletes, SMA and right premotor cortex were more activated than athletes, while athletes who have trained for sports for about a decade, showed more activations in body of caudate nucleus, putamen, claustrum. Several studies observed the shift of brain activation before and after one subject acquire motor skill for a task. The present results suggested that different neuronal strategies were used even for simple motor tasks in long term trained athletes. Complex movements required for playing sports consist of many simple motor designs. Continuous training for sports increases the variety of stored motor designs. Therefore athletes could choose the suitable motor design for the task unconsciously.

References