ORAL PRESENTATION 2-1

뇌신경재활
발표일시 및 장소 : **10 월 26 일(금) 13:15-13:25 Room C(5F)**

OP2-1-1

A Comparative fMRI study of Brain Activity for Visual and Kinesthetic Motor Imagery

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Background
The technology of Brain-Computer Interfaces (BCIs) has evolved with remarkable breakthroughs during the last decade. However, the study to explore appropriate type of motor imagery for developing optimal training protocols has been rarely published. The aim of this study was to investigate functional brain activity comparing visual and kinesthetic (KI) motor imagery in healthy adults.

Methods
Twenty right handed, healthy adults over 20 years of age were enrolled in this study. The Kinesthetic and Visual Imagery Questionnaire (KVIQ), sympathetic skin response, electromyography, and mental chronometry were conducted to evaluate the ability of visual and kinesthetic motor imagery. Pre-scan training was conducted for motor execution (ME) and three types of motor imagery which were comprised of first- (VI-1) and third-perspective visual motor imagery (VI-3), and KI for sequential grasp and release of a right hand. In fMRI scanning sessions (by a 3T Siemens scanner), perceptual control was added in these four conditions as a baseline. Experimental procedure of fMRI scanning was visualized on Fig. 1. Data was preprocessed and analyzed through SPM 12 software.

Results
Fig. 2 A-D showed distinctive patterns of brain activity during the three motor imagery tasks and motor execution. The common areas of increased brain activity in three types of MI were the left inferior parietal lobule, supramarginal, and middle frontal area corresponding to the premotor cortex (Fig. 2 E). In addition, there were increased areas including left rolandic operculum occupying lower part of the motor strip in KI, and right inferior parietal lobule in VI-3. During ME, increased brain activity was observed in the brain areas including the right cerebellum, left postcentral, supplementary motor,

precentral, and rolandic operculum areas. There was no common area showing increased brain activity during both ME and three types of MI (uncorrected $P < 0.001$, cluster-level FDR < 0.05). There was no increased BOLD signal in VI-1 and VI-3 compared to KI condition. Conjunction analysis showed the increased brain activity in KI compared to VI-1 and VI-3 for the bilateral supramarginal, bilateral supplementary motor area, and left rolandic operculum areas (Fig. 3).

Conclusion

The present study showed that the activated brain regions during the motor imagery was significantly different with ME, even though the regions were still associated with motor planning and generation of mental images, particularly for KI. This findings can be applied in optimal setting of BCI training protocols for disabled patients.

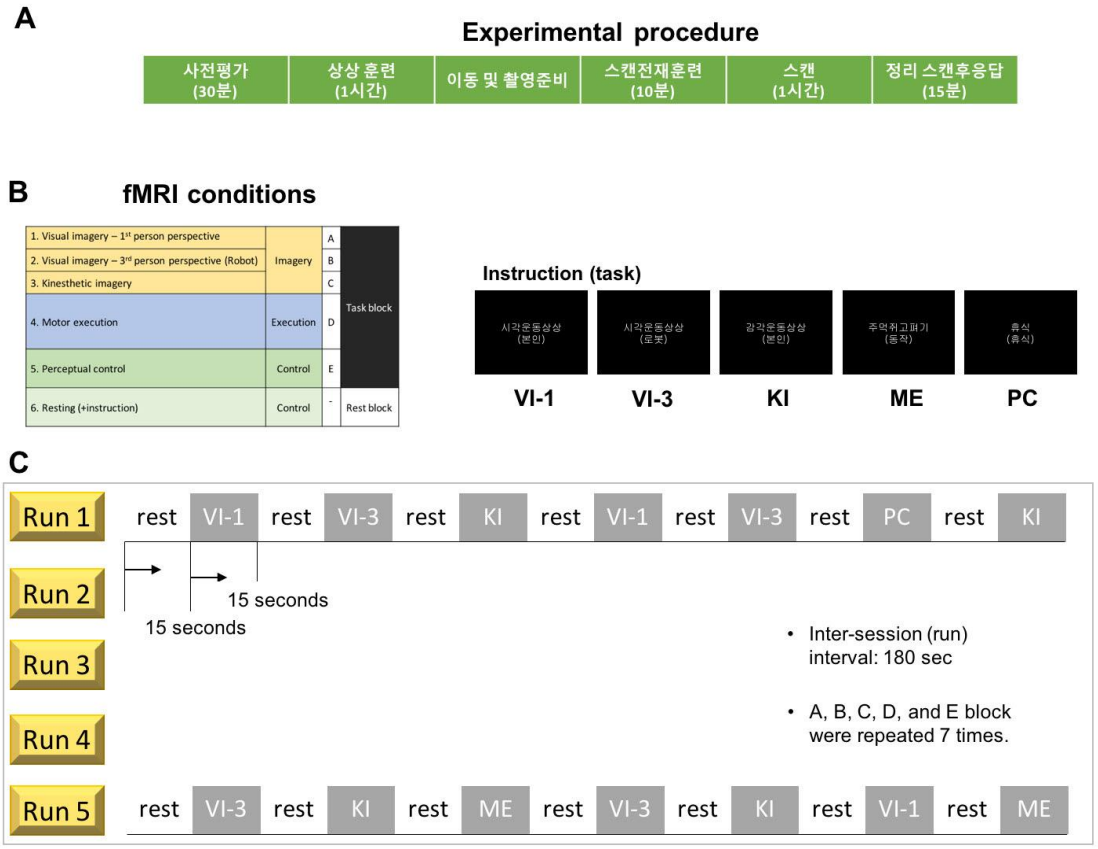

Fig 1. Experimental procedure of this study. (A) The overall process included pre-scanning test, training, preparation, scanning, and post-scanning questionnaires. (B) fMRI scanning conditions were comprised of 5 task and rest. Task instruction was visualized on the screen as counterbalanced order. (C) The task and rest conditions was alternated 15 seconds, and 5 runs were presented to the participants. Inter-session interval was 3 minutes.

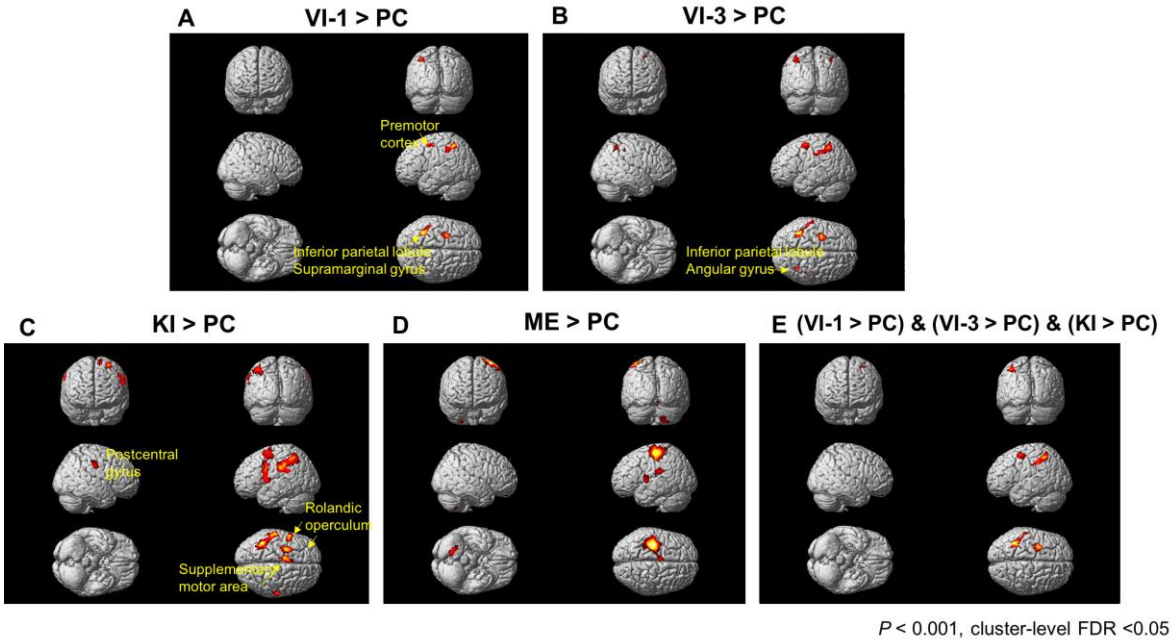

Fig 2. The distinctive patterns of brain activity during the motor imagery and motor execution (A-D). The common areas of increased brain activity observed in three types of motor imagery (E).

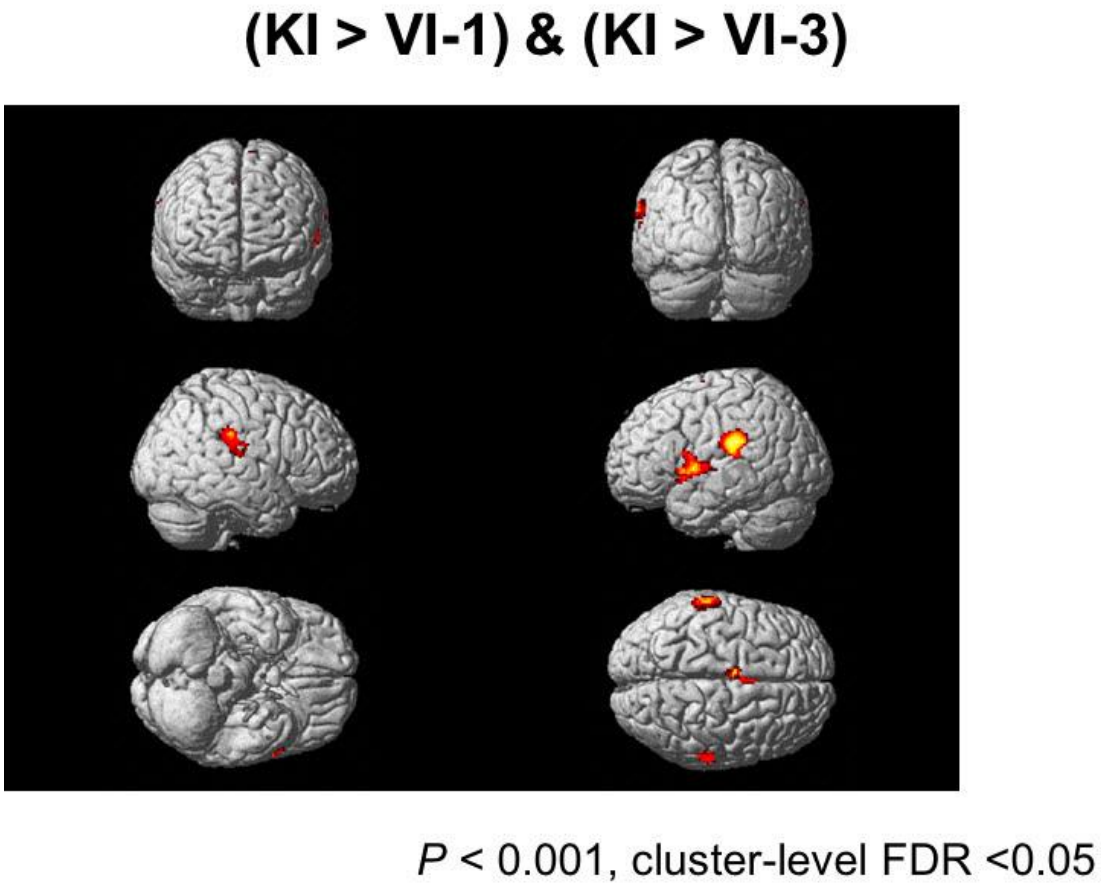

Fig 3. The brain areas with increased activity for kinesthetic motor imagery compared to first- and third-perspective visual motor imagery.