Neural Network Associated with Dual-task Management Differs Depending on the Combinations of Response Modalities

VIII. 7. Neural Network Associated with Dual-task Management Differs Depending on the Combinations of Response Modalities

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Many researchers have been interested in how the human brain processes two things simultaneously (dual task)[1,2]. Several functional imaging studies have demonstrated the importance of fronto-parietal network in dual-task management[3,4]. However, it was still whether a common brain network managed dual tasks regardless of the combination of response modalities. Therefore, we investigated the relationship between brain activity associated with dual-task management and the combinations of response modalities.

Fifteen healthy male volunteers (22 ± 2.3 years old, mean ± SD) participated in this study. The single tasks used in this study were the visual discrimination task requiring finger response (left hand) (VT-finger) and the auditory discrimination tasks requiring finger responses (right hand) (AT-finger) and oral responses (AT-oral). The dual tasks were combination of VT-finger and AT-finger (the DT-same) and that of VT-finger and AT-oral (the DT-different). Cerebral blood flow (CBF) images were obtained at whole-brain levels using a positron emission tomography (PET) scanner (Shimadzu SET-2400W, Japan), with an average spatial resolution of 4.5 mm at full-width half-maximum (FWHM) and a sensitivity for a 20 cm cylindrical phantom of 48.6 k.c.p.s. KBq^{-1} ml^{-1} in the 3D-mode. The brain activity during the performance of the tasks was measured using PET and [^{15}O]-H_2O for 70 sec. CBF images were processed and analyzed using a Statistical Parametric Mapping 99 (SPM 99).

Figure 1 shows the brain activity during each single task. These brain regions were also activated during the dual tasks, but the neural activity activated in the single task condition was not significantly different from that in the dual task conditions. The premotor cortex, precuneus and posterior parietal cortex were significantly activated in the

DT-same condition, whereas the anterior and posterior parietal cortices were significantly activated in the DT-different condition (Fig. 2). These brain regions were not observed in the single task conditions. In addition, the neural activities in the right premotor cortex, precuneus and right posterior parietal cortex were significantly higher in the DT-same condition than in the DT-different condition, whereas the neural activities in the right anterior parietal cortex and right posterior parietal cortex were significantly higher in the DT-different condition than in the DT-same condition (Fig. 2). These results demonstrate that neural network associated with dual-task management differs depending on the combination of response modalities.

References

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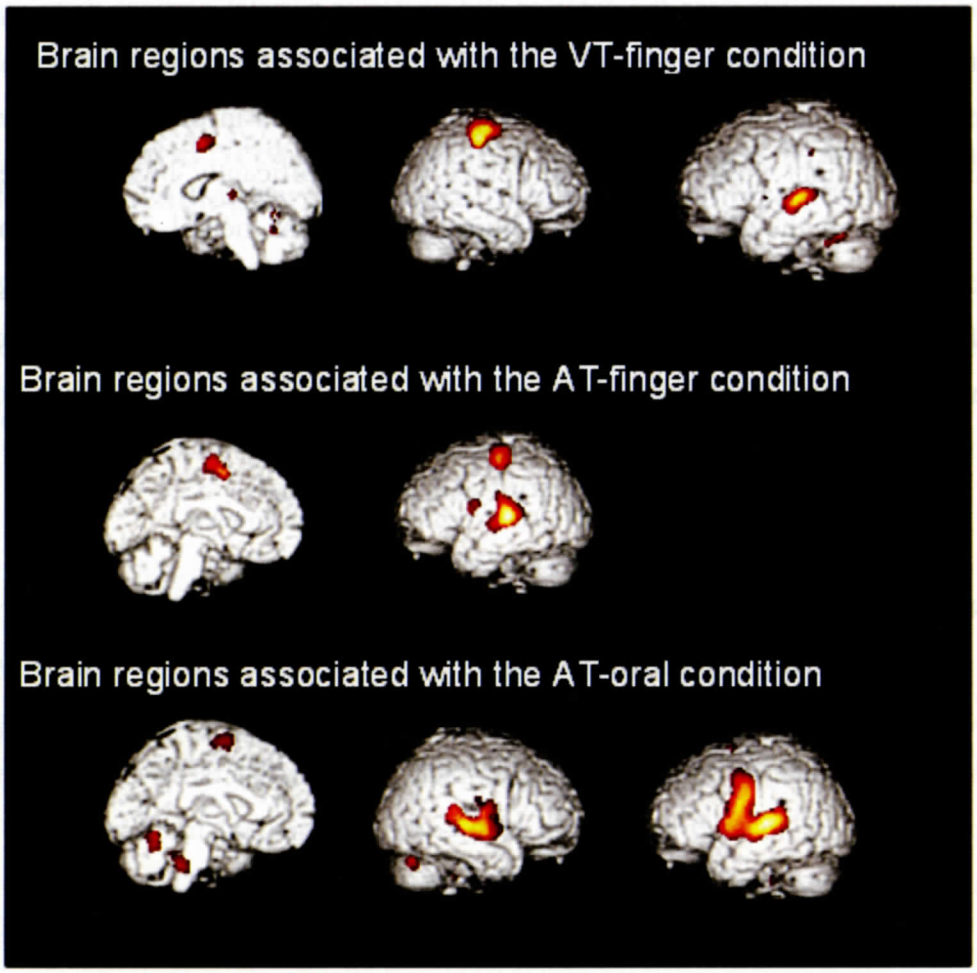

Figure 1. Brain regions activated in each single-task condition.

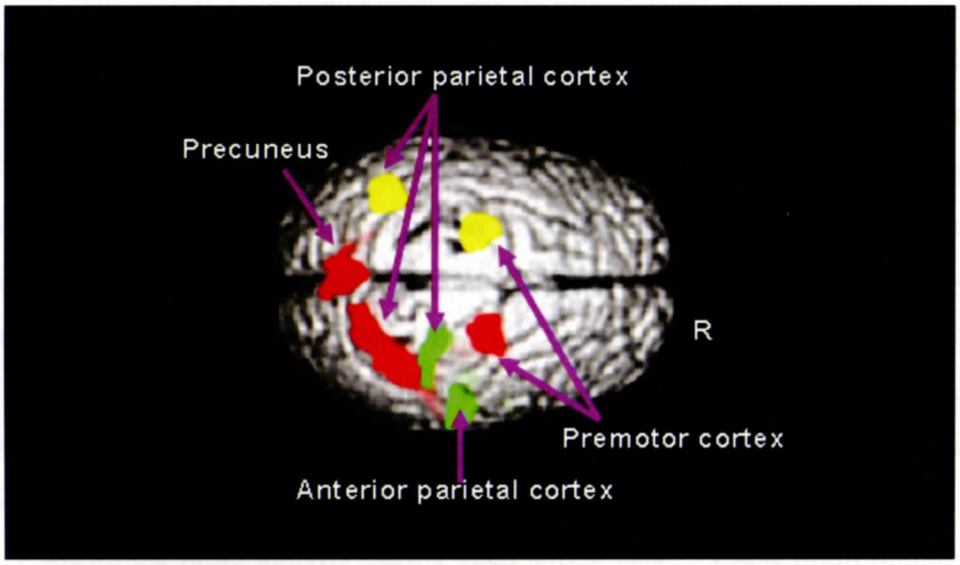

Figure 2. The difference in brain activity between the DT-same and DT-different conditions. Yellow: common brain regions, Red: specific for the DT-same condition, Green: specific for the DT-different condition. R: right hemisphere.