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Caffeine's Effects on Attentional Networks in Healthy Subjects: A Pharmacological Functional Magnetic Resonance Imaging Study

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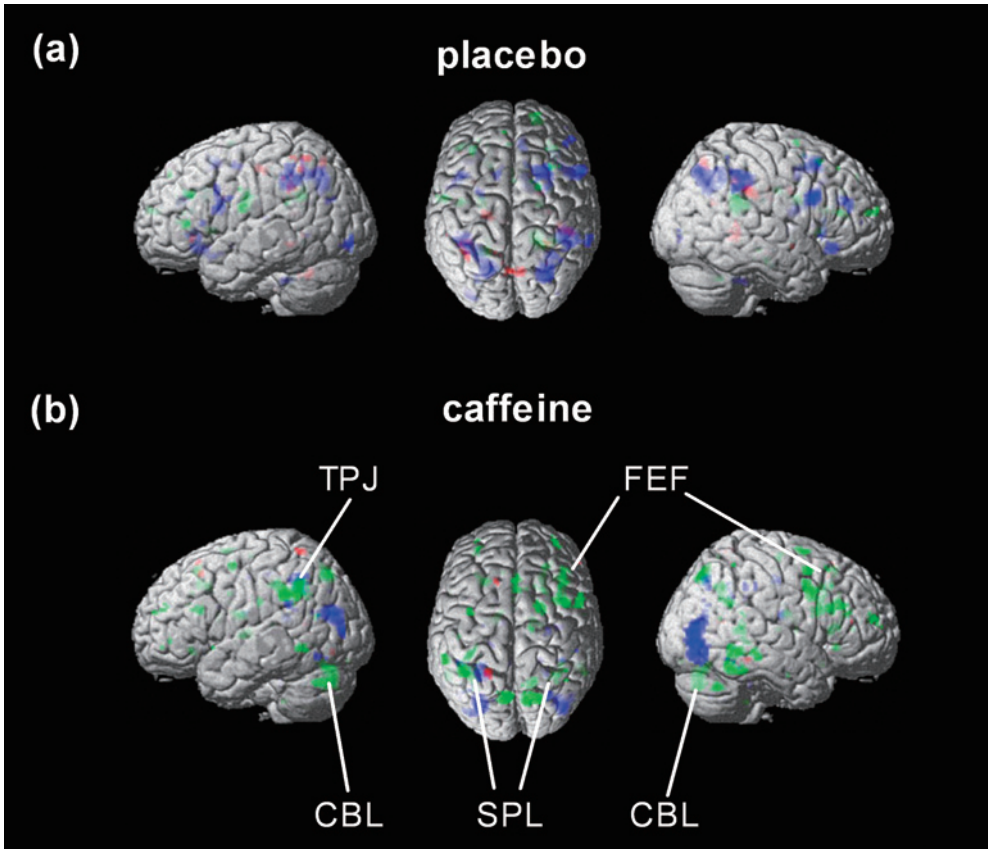

Fig. 1

Caffeine is one of the most widely used stimulants and is thought to enhance cognitive performance. We performed a pharmacological functional magnetic resonance imaging (MRI) study to assess the effect of caffeine on the human attentional process. Healthy adults participated in a single-blind, placebo-controlled crossover study. The subjects took either caffeine (186 mg) or placebo orally and were subjected to MRI. During MRI scanning, the subjects performed the attention network test (ANT), which is designed to measure 3 distinct attentional networks—the alerting, orienting, and executive control networks—in a single task[1,2]. Subjects given placebo showed activation in posterior cortical areas in the alerting network, parietal and frontal areas in the orienting network, and the anterior cingulate, prefrontal, parietal and occipital cortical areas in the executive

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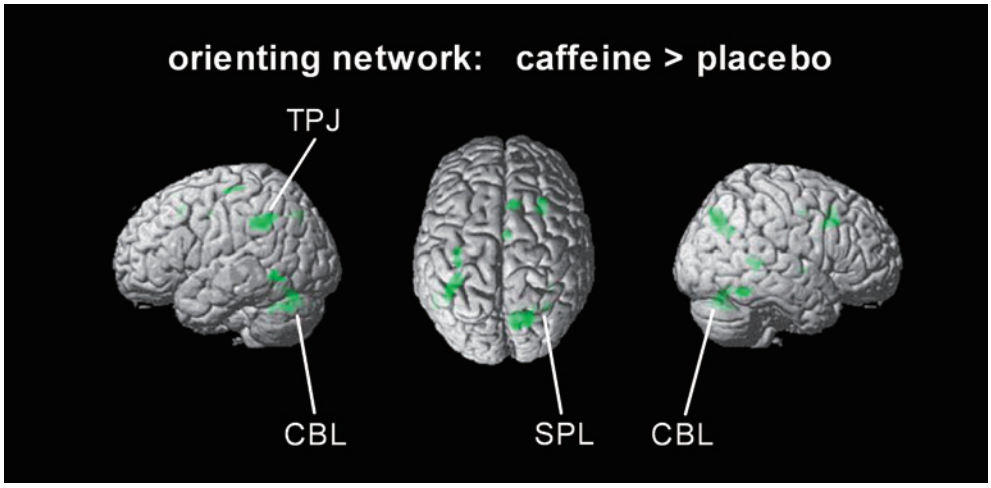

Fig. 2

control network **(Fig. 1(a))**. Subjects given caffeine showed activation in primary structures involved in the orienting network, including the superior parietal lobule, temporoparietal junction, and frontal eye field[1], and parts of the cerebellum involved in orienting visuospatial attention[3] **(Fig. 1(b))**. In the orienting network, treatment with caffeine increased activation in the frontal and parietal areas, including the superior parietal lobule and temporoparietal junction, and in the cerebellum, compared with placebo (**Fig. 2**). These results indicate that caffeine specifically enhances the orienting attention network.

Fig. 1 Activated brain areas of the 3 attentional networks in subjects given placebo (a) or caffeine (b). Red, green, and blue areas indicate brain areas involved in the alerting, orienting, and executive control networks, respectively. Activated brain areas were reported at $p<0.005$ uncorrected with a minimum cluster size of 10 voxels in one-sample *t*-tests for each treatment. CBL, cerebellum; FEF, frontal eye field; SPL, superior parietal lobule; TPJ, temporoparietal junction.

Fig. 2 After caffeine treatment, brain areas of the orienting network show increases in activation compared with placebo. $p<0.005$ uncorrected with a minimum cluster size of 10 voxels in paired *t*-tests between placebo and caffeine treatment. CBL, cerebellum; SPL, superior parietal lobule; TPJ, temporoparietal junction.

References

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