Pre-congress

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Running and the Brain

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Abstract

I started jogging when I was 46 years old. Since then, I might become to be addicted to the running and I started investigation about running and brain. By using functional Near-Infrared Spectroscopy (fNIRS), we first measured changes of the frontal lobe activity. Although walking at a speed of 1km/h activated the lower limb motor area bilaterally, running at 9 km/h activated the dorsolateral prefrontal cortex. We also demonstrated that two months running training may improve frontopolar activities. This result is impressive, because this part of the prefrontal cortex is only present in the human. In order to tell those brain functions related to running, I wrote book about "Running and the Brain".

On this occasion to start the "International Society for Sportology", an opportunity was given to me to talk about my experience on the running in daily living and in neuroscience research.

In one summer day of 1971, I talked with physiologist colleagues in The Tokyo University about a recent study of Dr. Michio Ikai (Cardiac physiologist, Professor of Tokyo University) who just came back from the USA, finishing his research, as a visiting scientist, on jogging. After this, I decided to run and bought a pair of jogging shoes and started to run in a warm summer day. I was 46 years old. It was not possible. I could not run. I could move forwardly with about 50 steps. My purpose of running was to reduce my bodyweight which was 83.5 Kg. My BMI value was 30.3. Since then I continued to run for several times per week. With running for one year and half, I became slim, with 60 Kg bodyweight, my purpose of running was accomplished, therefore I may quit running and return to a pre-running, immobile and quiet living. Since then, if I do not run for two successive days, I become so unpleasant and do not want to do research works. And if I run for more than

30 min, I become pleasant and vivid, wishing to do works. I may become to be addicted to the running. My experience, as a beginner-runner of these days was so wonderful. And an idea came out to publish a book on my experience. After studying literatures on running and reading many books written to recommend running to the general public. I wrote a book, titled as "Running and the Brain", --A running brain physiologist, and published in 1983¹⁾. Though the title suggests to how the brain works, it was totally unknown how the brain is involved in the running. I wrote my hypotheses "the brain would work while running". I said that the primary motor cortex may be involved in starting and sustaining the running.

In these days I wanted to do some research works on running and the brain, but I thought it inappropriate to do in the Primate Research Institute, Kyoto University, because the Institute is for primate, and not for human-primate. And I decided to work after I had retired from the Kyoto University. Being only continuing to run habitually almost every day 10-15 Km. Still know I am running almost every day, carrying potable telephone in the pocket with a foot step meter. I run about 6-7 Km with about 10,000 steps, spending for an hour. I am 77 years old.

My first research work on running and the

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brain appeared in 2001²⁾. Using functional Near-Infrared Spectroscopy (fNIRS), changes of oxygenated hemoglobin (OxHb) concentration of the frontal lobe were measured. While walking at a speed of 1 Km/h on the tread mill, the lower limb motor area was activated bilaterally. This is the first evidence, showing that the human motor areas are active during natural walking. In the second paper published in 2004³⁾ showed that, while walking at 2 and 4 Km/h activated bilaterally the lower limb motor area and the lower limb premotor area respectively. running at 9 Km/h activated the dorso-lateral prefrontal cortex (corresponding to Brodmann's Area 46) bilaterally. Thus, that the prefrontal cortex is activated during running for the first time. Recent neuroimaging studies showed that examined voluntary movements are started from the prefrontal cortex⁴⁾. This finding of a prefrontal activation during running surprised very much, though how prefrontal neurons are involved. At least some of them will activate hind limb motor area neurons which would lead to an activation of hind limb motor neurons of the spinal cord, eventually inducing hind limb muscle contractions.

Following these works, I worked how the prefrontal cortex influences the running performance. I coined a branching task, i.e., a task for which the frontopolar cortex (corresponding to BA 10) is essential. Combining the Delayed Response task and a reversed form of GO-NO · GO task of which prefrontal neuronal activities in the monkey were very much familiar to me due to my own researches in 70-80ies, a new branching task was made and effects on the running performance were studied⁵⁾. If the running was continued for two months for

20-30 min running for 2-3 times per week, task performance became better, indicating that the frontopolar activities are improved. This part of the prefrontal cortex is only present in the human being and is said unique brain area to the human. In order to tell that brain functions related to running, I wrote a book⁶⁾. Though the title more attractive to the public, this book should have more appropriately the title of my original book "Running and the Brain".

Now it is 2010 and I will be 78 years old, my running speed became very slow but my interest to the running research continues. My contribution would be minimal.

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