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More Brains are Better than One: The Call to Socialize Neuroscience in Southeast Asia

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***Abstract*—**Since Southeast Asia is one of the richest regions in the world, consisting of 11 countries reaching from eastern India to China; it is generally divided into "mainland" and "island" zones. The mainland—comprising Burma, Thailand, Laos, Cambodia, and Vietnam—is an extension of the Asian continent, while Island Southeast Asia includes Malaysia, Singapore, Indonesia, the Philippines, Brunei, and the new nation of East Timor. These countries' diversity lies at the heart of the region's rapid economic growth. Southeast Asia's 11 countries have a combined gross domestic product (GDP) of $1.9 trillion; a population of almost 600 million people. Over the past decade, the countries have averaged a growth rate of more than five percent per year. If Southeast Asia were one country, it would be the world's ninth-largest economy. [10] It would also be the most trade-dependent, with a trade-to-GDP ratio in excess of 150 percent due to its resources and having the top population in the world, and as such, we should develop the center of excellent Human Brain Research based on above reasons; it is primarily "an integration project" to investigate everything that belongs to the human brain from molecular to whole brain and nervous system, and from neuron to the world.

***Keywords*—**Human brain research, Southeast Asia, neuroscience.

ADVANCES in neuroscience are changing our understanding of the brain and opening doors to potential treatment of previously intractable disorders. Research also has shown that the brain's function has reward pathways and centers for impulse control and executive function. A part of the brain that controls self-regulation is the ventral medial region of the prefrontal cortex (located at the front of the brain, just behind the forehead). In the adolescent brain, the ventral medial region is not fully developed, and as such, can lead to impulsive, risky behavior, and inappropriate decision making. [1]

Currently, scientist predicted the development of more sophisticated imaging devices that will allow even better insight on the inner workings of the brain and the central nervous system. Scientist noted that the best tool available today, the magnetic resonance imaging device or MRI, has been around since the 1980s. A variant, the functional MRI or fMRI, was developed in the 1990s. Another, imaging device is the positron emission tomography (PET) scanner; it detects gamma rays emitted after the decay of administered radioactive isotopes to positrons. This allows scientist to analyze the metabolism of the brain and has shown to be useful in analyzing epileptic events and Parkinson disease. In contrast, by tracking variations in blood flow, fMRI can detect activity in the brain as it happens. An MRI machine looks a lot like a PET scanner, but with the addition of a giant magnet. Certain atoms (like hydrogen, a major component of water) give off a wave of energy when surrounded by a magnetic field. Inside the magnetic field of an MRI machine, hydrogen molecules in the water in blood release pulses of energy [1, 2, 3].

The amount of energy released reflects blood flow, and, therefore, brain activity. A sensor detects this energy and a computer turns it into a picture. Energy travels through the atmosphere in waves that can be detected by a sensor. For example, gamma rays (detected by PET) contain much more energy than radio waves (detected by MRI). Also, advancement in neuroscience research has develop exquisite tools, which can detect activities of the brain even up to nanometer size, for examples, LSPS (Laser Scanning Photostimulation), VSD (Voltage Sensitive Dye Imaging), Optogenetic Channel Rhodopsin2 Scanning, and two-photon imaging, which can detect synapses and spine neuron activities [1, 2, 3].

The latest news in neuroscience research pertain to the Human Brain Project, which is an arduous to build a working model of the human brain from neuron to hemisphere level and simulate it on a supercomputer within the next 10 years. The brain is too complex, and currently there is no computer that processes all the information. Just imagining having to wait until 2020 for a computer that is powerful enough has many neuroscientists continues insisting it cannot be done [3].

We know a lot about the organization and interaction of individual neurons and there have been countless studies using fMRI of brain regions at the scale of hundreds of millions of neurons, but we have little information about the scales in between. In addition, we do not have an integrated understanding of how events at the level of genes, proteins and synapse cascades, spine, electrophysiological properties, anatomical connectivity, morphology through the brain to produce behavior and cognition well enough to understand the pathophysiology of many diseases. We know the brain

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contains 86 billion neurons. Furthermore, to fully understand the operation of every synapse and how they interact with neurons in other parts of the neo-cortex, scientists would need to trace all 100 trillion connections between them, something that is impossible to do experimentally. For that reason, instead of trying to map these neural structures piece by piece, we could tease out some underlying principles governing their morphology and architecture by using a supercomputer to run thousands of statistical simulations to predict the way those neurons are likely to combine and then check the resulting models against real data from human and animal model biology. In theory, we could predict those structures and use them to reverse engineer the human brain. As a result, neuroscientist will be able to map the human brain and understand the fundamentals of the human brain, so one day we can create a virtual brain.

Neuroscientist belief in the need for teamwork is rooted in his or her own experience as a brain researcher and conviction that only neuroscience is capable of solving the deeper mysteries of how the electrical signals zinging between neurons produce consciousness, as well as how interferences or malfunctions in those electrical channels produce disordered or "diseased" thinking [4, 5].

However, the strength of these connections varies according to when impulses arrive and leave. If an input spike of electrical current occurs before an output spike within a certain time window, on average, the input connection was strengthened. Alternatively, if the input occurred after the output spike within the same time window, then the connection was weakened. In other words, the wiring of the brain was plastic, for example, the hypothesis that the brains of autistic individuals are similarly hyperconnected and "hyperexcitable". Rather than suffering from a deficit in perceptual abilities, autistics experience the world too intensely and so take refuge by turning inward [2, 5].

By accumulating data on different cell types and the genes that encode for the expression of particular proteins and ion channels, neuroscientists were able to model the electrical properties of the synapses and form a picture of how they communicated and assembled links with synapses in other parts of the column. They then ran statistical simulations to predict structures in parts of the column for which there was no experimental data. The final stage was to compare this model to the brains of real human brain [6, 7].

Today, the ambitious programs on the brain-mapping projects are being sponsored billions of US dollars by governments in Europe, Japan and USA. Neuroscientists compare it to the Human Genome Project. Just as the decade-long effort to map the 3.3 billion base pairs that make up the 23 chromosomes in the human genome required close co-ordination between scientists worldwide, so neuroscientists argue mapping the human brain in all its neural complexity will take a similar co-operative international research effort [8].

The World Health Organization estimates that neurological disorders affect up to one billion people around the world. Here at home, it's estimated that neurological illness affects more than 40 million Indonesians annually. These numbers remind us that advancing Indonesia's understanding of neuroscience and the human brain is truly a grand challenge of this century. A source of input toward the future of neuroscience, in particular the next fifteen years, requires infrastructural and technological advancement that will enable us to solve challenges and answer research questions that would significantly impact our understanding of nervous system function and/or the treatment and prevention of disease. [9]

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