The Dawn of Applied Brain Science.
A new field emerging through noninvasive brain function imaging

Hideaki Koizumi
Hitachi Fellow, Hitachi, Ltd., Japan
Director, R&D Division “Brain-Science & Society”
Japan Science and Technology Agency
Contact: http://www.hitachi.com/rd/fellow_koizumi.html

Abstract
The invention of the noninvasive brain function imaging technique was a turning point in the emergence of a new field by bridging and fusing the natural sciences, humanities and social sciences. In 1992, functional magnetic resonance imaging (fMRI), which allows the safe and repeated imaging of human brain functions was invented and developed [1-2]. This was followed by successful experiments with near-infrared optical topography (NIR-OT) using near-infrared spectroscopy (NIRS) in 1995 [3-5]. Further, significant advances took place in both technologies, making it easier to apply observations of sophisticated human brain functions to research on human learning and education [6-8].

The capability to safely measure sophisticated human brain functions is quite meaningful for a broad range of academic fields. It is believed that in the course of evolution, humans separated from the other great apes over six million years ago. Homo sapiens sapiens boasts sophisticated brain functions which are unparalleled among all other bio-species. In addition, modern humans have attained the functions of communicating will through the use of language, as well as projection, abstraction and perceptive capabilities, original aesthetic feeling and pathos, and a sense of morality. The noninvasive brain function imaging technique allows empirical studies to be conducted on these sophisticated human brain functions.

Research on the sophisticated brain functions unique to humans has been studied from the perspective of psychology, psychiatric medicine, praxeology, philosophy and linguistics. In particular, the distance between the disciplines which handle mind issues and neuroscience has narrowed rapidly due to the appearance of the noninvasive brain function imaging technique. It has become clear that many mental phenomena result from the functioning of neural circuits, and the relevant academic disciplines, which were previously difficult to include under the definition of neuroscience, are now being embraced under the name of brain-science (science involving the brain).

“Brain-Science & XYZ” is an attempt to create new academic disciplines by bridging and fusing brain-science (natural science) with the social sciences, the humanities and the arts. Such new disciplines include “Brain-Science & Education,” “Brain-Science & Ethics,”

Looking back at the history of science, astronomy advanced enormously due to the invention of the telescope and progress in biology was catapulted with the invention of the microscope. Empirical measurements and observations are truly the driving force of scientific development. Similarly, the development of noninvasive brain function imaging techniques, i.e., “brain-scope”, is considered a key factor for facilitating further progress in the transdisciplinary field of “Brain-Science & XYZ.”

Until now, conventional neuroscience and brain function measurement science were in general, limited to studying the brain function of an individual. Although sample size might increase, previous research did not address such issues as the functional interactions between several brains and phenomena involving a group of subjects. Today, a paradigm shift is taking place. The aforementioned NIR-OT system can be made more compact because, in principle, it is a semiconductor device, and a prototype wearable optical topography (WOT) system has already been developed. Hopefully, it will be in practical use soon. This technological achievement should allow the observation of the functions and interactions of numerous brains at the same time - almost on a real-time basis.

Until now, individuals have formed groups based on similar interests, beliefs, etc. The new knowledge we gain through increasing our understanding of brain functions in social interactions will lend a new perspective to those relationships, and hopefully serve to bring societies together under a new understanding. The dawn of “Applied Brain Science” through the accumulation of “Brain-Science & XYZ) [9] may not be so far from now.

References