Symposium proposer: Hideyuki Okano (Keio University School of Medicine, Japan)
Alfons Schnitzler (University of Düsseldorf, Germany)
Field: Medical Science/Neuroscience
Session Topic: Evolution of Cognitive Functions in Primates.
Speakers:
Dr. Josep Call (Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany):
Dr. Ferdinand Binkofski (Department of Neurology, University of Lübeck, Germany)
Dr. Kuniyoshi L Sakai (University of Tokyo, Japan)
Dr. Hidemi Watanabe (Hokkaido University, Graduate School of Informatics, Japan)

Concepts and summary of the session:

How did the remarkable ability to communicate in words first evolve? Advances in genetics, neuroscience, and brain imaging have enabled a new contingent of researchers to go ever deeper into our brains and our biological past. Archaeologists have identified various milestones in human behavior in the 5-million-year evolutionary void between animal communication and human speech, but there is no consensus on which achievements imply the capacity for language.

Important advances in identifying possible evolutionary milestones have recently come from molecular genetic studies. In 2000, the international collaborative team (the Human Genome Project) completed the rough draft sequence of human (*Homo sapien*s), which provide us with reference data to conduct comparative genomic research on primates. In 2002, a Japanese Research Group at RIKEN, presented a first-generation human-chimpanzee comparative genome map and its initial analysis. Surprisingly, results of this group indicate that we human beings (*Homo sapien*s) and chimpanzee show only a 1% genetic difference. However, it might be considered that this 1 % difference could include critical mutations that make us human beings the remarkable thinking, speaking creatures we are. Language is a uniquely human trait likely to have been a prerequisite for the development of human culture. Researchers at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, reported that the *FOXP2* "speech gene," which affects both language and the ability to articulate, was apparently a target of natural selection. This gene may have undergone its final mutation fewer than 100,000 years ago--and no more than 200,000 years ago--perhaps laying the groundwork for a new level of linguistic fluency. Human-chimpanzee comparative genome research is essential for narrowing down genetic changes involved in the acquisition of unique human features, such as highly developed cognitive functions and the use of complex language.

Meanwhile, notably, there has been a great progress in comparative studies between monkeys and human beings on information processing within the brain that are associated with language and cognitive functions by taking advantage of functional MRI. Now these facts presented fascinating questions whether these intraspecific differences in the cognitive functions can be explained by molecular terms.

Dr. Hidemi Watanabe will summarize the recent progress of genome projects of human and chimpanzee. Similarities and dissimilarities of their genomic information (e.g. *FOXP2* “speech gene”) will be demonstrated. Dr. Kuniyoshi L Sakai will talk about language processing that is unique to human, proposing that sentence comprehension characterizes human languages, and that its neural basis is uniquely human. In this session, he is will focus on three fundamental issues

concerning language processing in the human brain, and update recent advances made by functional mapping studies of language. Dr. Josep Call will elaborate on social cognition in non-human primates. Behavioral studies on how apes use tools, how they search for hidden food and how they deceive competitors demonstrate that great apes have cognitive abilities for causal understanding, inferential reasoning and social cognition. Dr Ferdinand Binkofski will talk about a recently discovered neural system in both monkeys and humans that seems to be involved in understanding movements and gestures of others, thus being fundamental to social communication and interactions. The functional anatomy of this so called “mirror neuron system” has become accessible in humans through non-invasive functional neuroimaging studies and will be illustrated in this presentation.

Taken together, the genome analysis of various primates including modern human and ancestral human as well as comparative studies on brain functions greatly contribute to understanding ourselves, i.e. human beings. In this symposium, the interdisciplinary session between molecular biologists and cognitive scientists, will highlight our understandings of the evolution of cognitive functions as exemplified by language and social interactions.