Title of Project： **Development of speech communication and its correlates of brain, cognition and motor system:**
A longitudinal cohort study of typically and atypically developing infants

MINAGAWA, Yasuyo
(Keio University, Faculty of Letters, Professor)

【**Purpose and Background of the Research**】

Autistic spectrum disorder (ASD) is characterized by difficulties with verbal and social communication. Previous studies on cognitive neuroscience have pointed out that ASD primarily involves problems with brain function, in particular with brain connectivity. Although it is assumed that this difference in functional brain connectivity is expressed from an early developmental stage, there is hardly any studies examining both the typical and atypical development of language, social functions, functional brain connectivity and activities in the first year of life.

This study aims to reveal the longitudinally evolving characteristics of brain function development, including functional brain connectivity, various perceptions, cognitions, and motor abilities in infants who are at risk for ASD (risk infants) and typically developing (TD) infants (Figure 1). The purpose of this project is to clarify (1) how these developmental characteristics are involved in the acquisition of language communication, and (2) which developmental characteristics predict future developmental disorders.
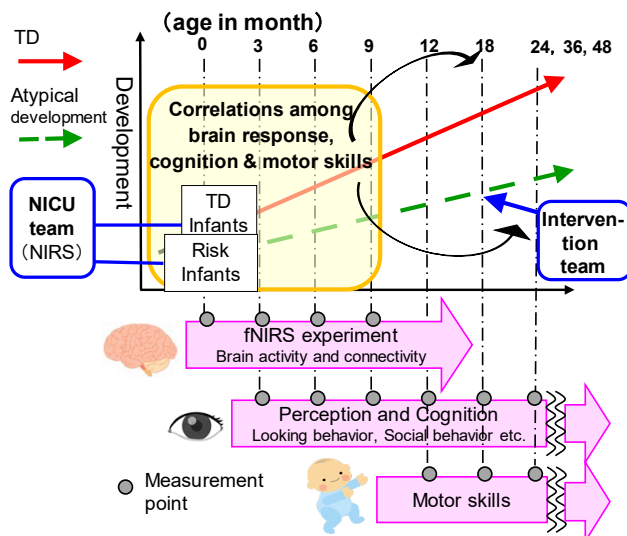
【**Research Methods**】

Figure 1.　Overview of the project

The cohort consists of two groups, namely risk infants (siblings of ASD or very premature infants) and typically developing infants. Their brain function, cognitive functions, and motor abilities will be measured longitudinally every 3 or 6 months until 3-4 years-old. Since this study aims to continue and develop the small-scale cohort of the previous project (Kiban A), this study, as in the past, consists of 3 types of experiments: (1) brain function tests using fNIRS (speech and social stimuli), (2) tests for various cognitive functions using behavioral methods (e.g. eye tracking, tests for fine and gross motor skills), (3) developmental examinations and questionnaires. We will develop new analysis methods for the brain function data and motor skill data. In particular, the motor data involves the use of the latest image engineering techniques to quantify and evaluate the data and is modeled by applying deep learning to the large-scale data sets obtained. While conducting this study, a system will be in place to appropriately evaluate and intervene when necessary should participating infants develop language or other problems.

【**Expected Research Achievements and Scientific Significance**】

From objective (1), it will be possible to explain the relationships between motor skills and social cognitive abilities and how these relationships are involved in language acquisition and development. This will not only illustrate the cognitive neuroscience basis behind language development but will also provide important insights into the specificity and universality of human language. We will also elucidate the mechanisms behind the communication disorder in ASD and provide insights into the intervention methods. Objective (2) will be significant in that it will provide adjunct indicators to help with the early detection and diagnosis of ASD.

【**Publications Relevant to the Project**】

・Arimitsu, T., Minagawa, Y* et al. (2018) The cerebral hemodynamic response to phonetic changes of speech in preterm and term infants: The impact of postmenstrual age. *Neuroimage: Clinical*, 19: 599-606.
・Liang, Z., Minagawa, Y. et al. (2018) Symbolic time series analysis of fNIRS signals in brain development assessment. *Journal of Neural Engineering* 15(6): 066013.

【**Term of Project**】FY2019-2023

【**Budget Allocation**】147,300 Thousand Yen

【**Homepage Address and Other Contact Information**】

http://duallife.web.fc2.com/i/next.html
keio.infantg@gmail.com