


Early human development for individuality and co-being

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Purpose and Background of the Research

● Outline of the Research

We are facing challenges such as the declining birthrate and aging population, environmental problems, and pandemics. Under these circumstances, understanding the principle of co-being with the world while deepening the individuality as a unique existence will contribute to building a foundation for a sustainable society where individual dignity and human survival can be maintained. In recent years, advances in technology for observing dynamic changes in the brain, body, and environment have made it possible to capture the dynamics of human development and evolution on multiple spatio-temporal scales.

This research addresses the following questions. By what mechanisms do spontaneous activities of the brain and body that emerge in the fetal period constrain the development of action, perception, memory, self, and language in infants? How is individuality formed through private experiences in everyday life and sleep? How do infants interact with the physical, biological, and social environments on various spatio-temporal scales to achieve the co-being with the world?

● Purpose of the research

An infant's individuality is based on spontaneous activities in daily life such as sleep and movements, and is formed through interaction with the environment. The purpose of this research is to elucidate these mechanisms from the entire history of the dynamic states of the brain, body, and environment. We focus on not only the co-being with the physical environment, but also the symbiosis with the biological

environment such as gut microbiota, and the social co-being through language. In particular, we will clarify the mechanism of language acquisition by studying the evolution of human brain, the formation of brain networks in the fetal period, and spontaneous vocalization and integration of speech perception in infants.

We will practically relate the dynamics of infant development to natural history and cultural history towards construction of a theory of human evolution and development that encompasses the humanities, social, and natural sciences.

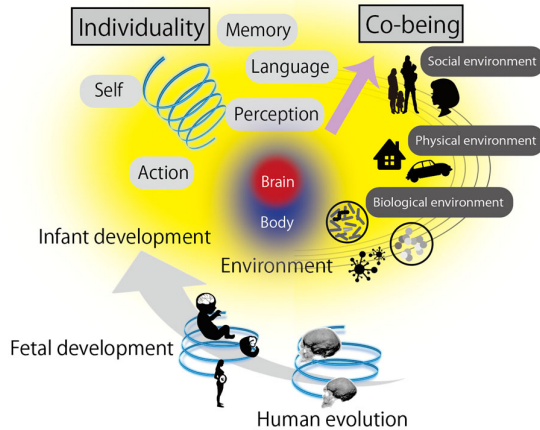


Figure 1. Development of individuality and co-being

Expected Research Achievements

● Dynamics of early development

Many of the fetal and newborn's spontaneous behaviors disappear and reappear as intentional behaviors, suggesting that metamorphosis occur in the infant brain. Through comprehensive observation including brain imaging, the details of the reorganization will be clarified.

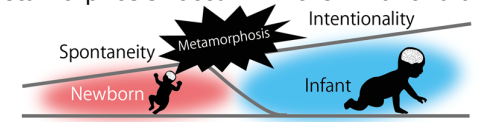


Figure 2. Metamorphosis from newborn to infant

● Individuality

In infants who frequently switch between wakefulness and sleep in ordinary life, we will clarify the mechanism that individuality is formed through private experiences by capturing the entire history of the dynamic state of the brain and body with a new brain imaging and behavior measurement method.

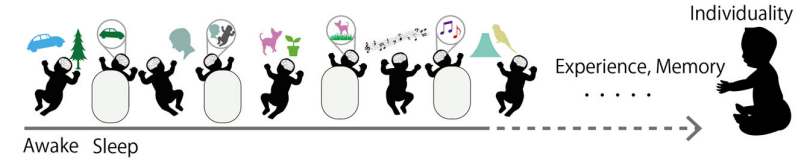


Figure 3. Formation of individuality in ordinary life

● Co-being

We will reveal the mechanism by which the gut microbiota contributes to the development of the brain and immunity in early infancy, and explore new concepts of co-being, including dynamic changes in the boundary between the inside and outside of an individual.

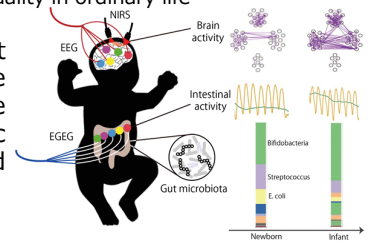


Figure 4. brain-microbiota interaction

● Language

Aiming to elucidate the mechanism of the language acquisition for thinking and communication, we will clarify the rhythmic integration of spontaneous articulatory movements in infants and their own and others' speech perception. We will also clarify the formation of long-distance brain networks related to language from fetal to infancy.

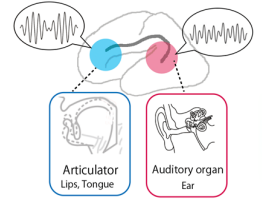


Figure 5. Rhythm and network in language

● Brain evolution and development

We will establish a new method to estimate the development of brain network in early Homo and Jomon and Yayoi people from the brain morphology determined based on the skulls. The estimated brain networks would provide a clue to understand the the evolution and development of language and cognitive functions.

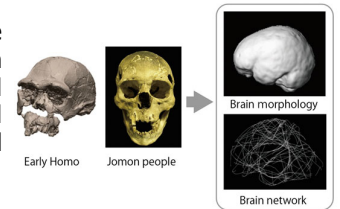


Figure 6. Evolution of brain network

● Educational practice and museum display

Fundamental knowledge about human development is expected to have an impact on the society. We will conduct classes at childcare and education sites and perform a museum exhibition that links human development with natural and cultural history.