【Grant-in-Aid for Scientific Research (S)】

Broad Section A

Title of Project : Dynamics of Mother-infant interaction: Foundation of the emergent mechanism of diversity of human development

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【Purpose and Background of the Research】

Issues surrounding child development and parenting continue to worsen in Japan. One reason behind these is that the biological systems of parents and children are "heterogeneous." This study will focus on social interactions between caregivers and infants during the period when caregivers are likely to experience childrearing stress. To elucidate the mechanisms which emerge from this diverse interaction, we will visualize their physiological and behavioral dynamics and examine the causality of the information processes and its association with the phenotypes of each individual. Based on these findings, we will construct a model for predicting the dynamics of interaction in each caregiver-infant pair. Using this model, we aim to propose guidelines for "individualized" childcare support, which can lead to a stable caregiver-infant interaction and facilitate self-efficacy in parenting.

【Research Methods】

Compared to interactions among adults, caregivers' interactions with infants are difficult as the latter's behavior cannot be predicted through exteroceptive signals. Accordingly, this study focuses on interoception within and between caregivers and infants. Interoception refers to the sense of the internal state of the body. These, together with fluctuations in the internal organs, autonomic nervous system, endocrine system, and immune system, are the source of emotions and our subjective awareness of those emotions (feelings). We intend to create a new approach combining developmental science, biology, informatics, and robotics to reveal the processes by which interoception is integrated with exteroception, and the biological constraints therein. Thereby, we elucidate caregiver-infant interaction and the principles of the emergence of diversity within it. Specifically, caregiver-infant interactions will be evaluated using two time constants. These will be multi-point evaluations of 1) interindividual physiological and behavioral dynamics, and 2) interaction dynamics of early human development (6 months) tracked to determine how they have changed or diversified between pairs after one year. Furthermore, we will examine how the interaction dynamics relate to the phenotypes of caregivers and infants, specifically, the internal physiological state and mental function (Fig. 1). We will also examine factors influencing interaction dynamics, and the emergence of diversity along with their biological bases in mouse mothers and offspring. Using these findings, we will develop a model that can predict individual interactions and propose guidelines for individualized childcare support that can be applied to diverse pairs.

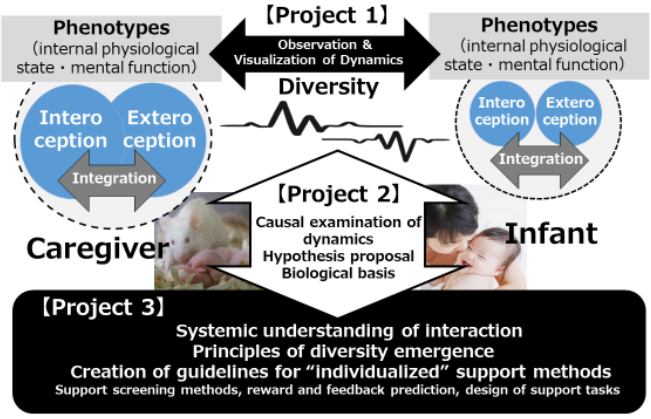

Fig. 1 The three research projects

【Expected Research Achievements and Scientific Significance】

This approach allows us to estimate the parameters that enable the dynamics arising between each caregiver-infant pair to mutually stabilize (stress recovery, from negative to neutral), and further increase that stability (reward system enhancement, from neutral to positive). In doing so, it will be possible to propose "individualized" childrearing support methods that work effectively for diverse parents and children. By positioning the increasingly serious issues surrounding child development and parenting as a task for basic research centering on life and information sciences, we can expect to create unprecedented problem-solving methodologies.

【Publications Relevant to the Project】

Tanaka, Y., Kanakogi, Y. & Myowa, M. (2021) Social touch in mother–infant interaction affects infants' subsequent social engagement and object exploration. *Humanities and Social Sciences Communications*, 8, 32.

Françoise Diaz-Rojas, F., Matsunaga, M., Tanaka, Y., Kikusui, T., Mogi, K., Nagasawa, M., Asano, K., Abe, N., & Myowa, M. (2021) Development of the paternal brain in expectant fathers during early pregnancy, *NeuroImage*, 225, 117527.

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