R&D Theme

Development and Measurement of Maemuki (Forward-looking) indices

Progress until FY2022

1. Outline of the project

Our R&D theme aims to conceptualize Maemuki (forward-looking), develop a subjective index for it ("Maemuki scale"), and establish a method for estimating the subjective degree of "Maemuki" from physical/physiological/neurological information.

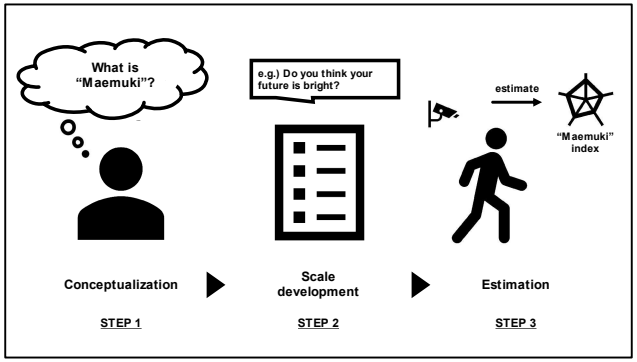

Fig.1 Outline of our R&D theme.

In FY2022, the first year of our R&D theme, we began conceptualizing "Maemuki" and developing a subjective index of it ("Maemuki scale"). We also prepared for laboratory experiments to estimate subjective "Maemuki" from physical/physiological/neurological information.

2. Outcome so far

● Conceptualization of "Maemuki" and Development of the subjective index for it ("Maemuki scale")

We conceptualized "Maemuki" by both deductive (top-down) and inductive (bottom-up) approaches. The deductive approach included discussion in a working group that consisted of researchers who have various specialties (e.g., cognitive neuroscience, clinical and sports psychology, biomechanics, psychiatry, and philosophy) and literature reviews of existing related concepts. The inductive approach included semi-structured interviews on "Maemuki" with healthy adults (Dr. Yamada's group; National Institutes for Quantum Science and Technology: QST) and top athletes (Dr. Kashino's group; NTT).

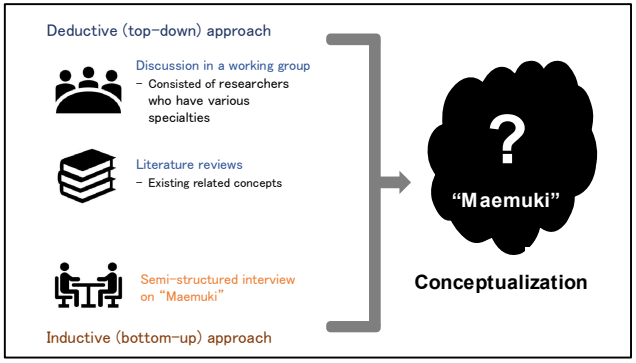

Fig.2 Procedure of conceptualization of "Maemuki"

Groups of Dr. Yamada and Dr. Hamada (Araya Inc.) applied natural language processing methods to the obtained interview data to conceptualize "Maemuki" in addition to typical qualitative methods.

Based on this, we developed a preliminary version of the "Maemuki Scale" (a subjective index for "Maemuki"; undisclosed at this time).

● Preparation for laboratory experiments

In collaboration with groups of Dr. Hirao (National Institutes for Quantum Science and Technology) and Dr. Sado (University of Tsukuba), Dr. Yamada's group set up the laboratory experiments to estimate the subjective degree of "Maemuki" from physical/physiological/neurological information. To be specific, we selected the indices of psychological, physical, physiological, and neurological aspects that have possibilities to represent the subjective degree of "Maemuki". We also conducted some preliminary experiments using the indices above to prepare for full-scale experiments to be launched in the following fiscal year and beyond.

3. Future plans

In FY2023 and beyond, we will conduct (1) the reliability and validity examination of the preliminary version of the "Maemuki scale", and (2) the multidimensional (i.e., psychological, physical, physiological, and neurological aspects) assessment experiment. Based on these results, we will also start to develop the preliminary version of the application tentatively named "Body2Positive" which estimates the subjective degree of "Maemuki" from physical and/or physiological information.

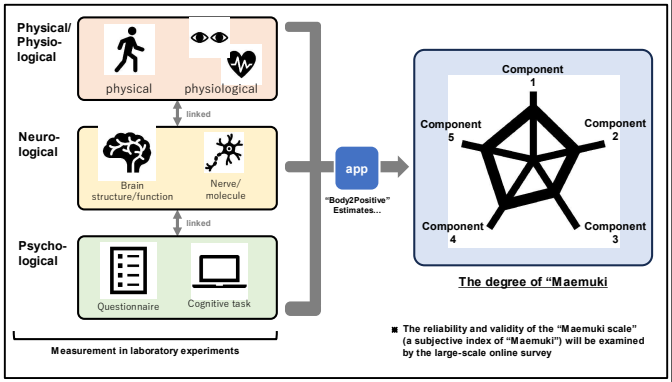

Fig.3 Our future plan

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R&D Theme

Assistance and training for Maemuki (Forward-looking)

Progress until FY2022

1. Outline of the project

In this R&D theme, we will develop training technology to enable sustained improvement of the "Maemuki (forward-looking)" factor and technology to assist in improving the "Maemuki" factor. The goal is to establish "Maemuki" assistance/training/education technologies that can be used in a manner that is tailored to the individual's situation.

2. Outcome so far

In FY2022, the first year of our plan, we focused on building the technical foundation for "Maemuki" training and assistance, and on conducting preliminary experiments in preparation for the start of the main experiment in the following year and beyond.

● **Establishment of a technical foundation for "Maemuki" assistance and training**

In order to measure gait in the laboratory, we created computer graphics (CG) images that are synchronously projected with walking speed of a treadmill (Fig. 1a). In addition, taking advantage of the CG images, visual stimuli that are candidates for "Maemuki" manipulation were implemented in the CG.

● **Development of a technological foundation and preliminary experiment for physical intervention**

In preparation for the verification of the relationship between "Maemuki" mind and the body, Dr. Yamada (National Institutes for Quantum Science and Technology), Dr. Hirao (National Institutes for Quantum Science and Technology), and Dr. Sado (University of Tsukuba) collaborated to construct an environment that can simultaneously measure multiple signals such as electroencephalogram (EEG), gaze behavior, electrocardiogram (ECG), respiration, and gait. Dr. Sado also constructed a posture measurement environment focusing on biomechanical indices by using motion capture cameras, force plates, and electromyography (EMG), with the aim of establishing a method for a detailed evaluation on posture (Fig. 1b). Preliminary data acquisition and analysis of gait are underway to improve the measurement accuracy.

As the preliminary experiment on body posture intervention, the data on the effects of posture intervention by eye-movement guidance of CG images on the "Maemuki" factor were collected. The analysis is currently underway, and the results will be used in planning for the next year's main experiment.

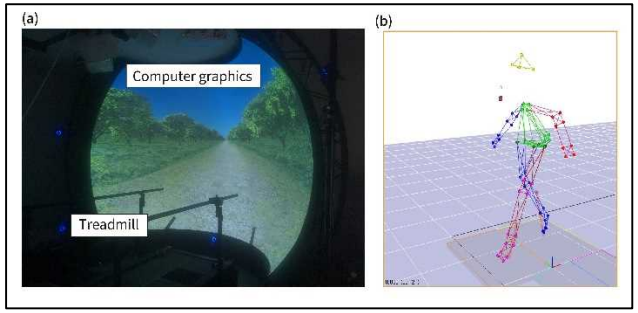

Fig. 1 (a) CG images projected synchronously with the walking speed of the treadmill. (b) Gait measurement environment focusing on biomechanical indices.

3. Future plans

We plan to accumulate data for the purpose of verifying the effect of the training intervention on the "Maemuki." In addition, we will construct a biofeedback system using multiple signals by utilizing the technological foundation established in FY2022 (Fig. 2).

Moreover, Dr. Minamimoto (National Institutes for Quantum Science and Technology) and Dr. Inoue (Kyoto University) are planning to start their studies on this R&D theme. They are engaged in research on designer receptor exclusively activated by designer drugs (DREADD) to investigate how pharmacological and chemogenetic neurotransmitter manipulation in monkeys can lead to "Maemuki" with a view to human application in 2050.

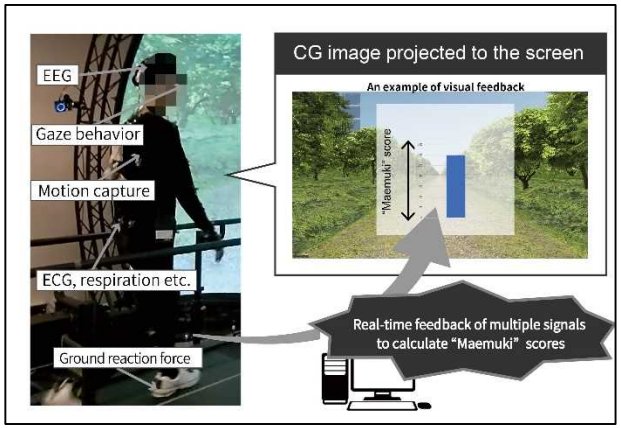

Fig. 2 Biofeedback system to be constructed.

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R&D Theme

Maemuki (Forward-looking) ELSI and social applications

Progress until FY2022

1. Outline of the project

This R&D theme is responsible for the ELSI and social application of "Maemuki (forward-looking)". By accomplishing this R&D theme, we will evaluate Maemuki in various social situations and clarify the elements and degree of Maemuki leading to desirable mental states in populations with various attributes and situations (different life stages such as children, adults, and the elderly; different mental states such as palliative care patients and mania and depression) This will contribute to the project's goal of developing positive estimation and assistive technologies.

The challenge in achieving this goal is that the definition of "Maemuki" is different depending on life stage and health status, and at the same time, it is difficult to conduct an objective evaluation method of Maemuki based on the same criteria because of differences in physical functions and body size. We are also working on the development of Maemuki evaluation and intervention methods that take ELSI into account, with the idea of assisting and training Maemuki in accordance with the individual's situation and needs.

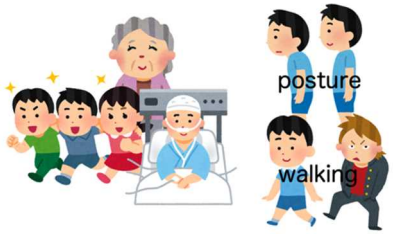

Fig.1 Evaluation of developmental stage, aging stage, and patient's Maemuki based on posture.

2. Outcome so far

(1) Multi-faceted definition of Maemuki: Literature review and discussions were conducted, and a total of nine study meetings were held during the fiscal year. In relation to Maemuki concept and resilience research, we focused on the medio-passive view of Maemuki. This was considered to be an important perspective when considering ELSI for Maemuki assistive technology.

(2) Interview survey with palliative care patients: Through direct interviews with cancer patients, we clarified the psychological state unique to cancer patients and the way they perceive Maemuki.

(3) Interview survey of patients with psychiatric disorders: Through direct interviews with patients with depression, mania, and addiction, the unique psychological states and Maemuki of patients with psychiatric disorders were clarified.

(4) Improvement of the experimental environment for patients: We established a recruiting and experimental support system necessary for conducting surveys and measurements on palliative care patients and patients with neuropsychiatric disorders.

(5) Interview survey targeting the developmental period: Through direct interviews with students from early elementary school to high school, we clarified the psychological state and Maemuki during the developmental period.

(6) Development of an experimental environment for the developmental period: We held meetings with the principals of elementary schools, junior high schools, and high schools, and prepared an experimental environment to conduct posture measurement and Maemuki questionnaire survey targeting the developmental period.

(7) Construction of a simple posture measurement system: We combined two digital cameras and body motion measurement software using AI video analysis to construct a system that enables posture measurement in a short period of time per person, and can collect large scale data.

Fig.2 Motion capture and plantar sensor with AI

Fig.3 Posture measurement for college students

3. Future plans

In FY2023 and beyond, we will collect data from palliative care patients, patients with neuropsychiatric disorders, and children in the developmental period. As these data are obtained, patient-specific, life-stage-specific, and developmental age-specific characteristics will be identified, and "Maemuki" evaluation methods for each will be developed. In parallel, the ELSI for "Maemuki" assistive training based on the needs of society will also be studied.

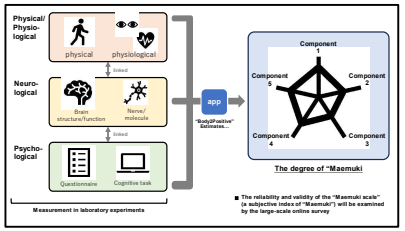

Fig.3 Our future plan

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