Mood Estimation from Non-Contact Information

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Overview

This research and development project, conducted under the JST Moonshot Goal "Liberation from the constraints of body, space, and time through expansion of physical and perceptual capabilities" (PM: Kanai), is advancing foundational technology for estimating mood and psycho-physical states from non-contact physiological information, alongside demonstrations for social implementation. We measure heart rate, sweating, pupil dilation, eye movements, facial expressions, and body sway, among other factors, using wearables and smartphones in both laboratory and daily life settings. AI is then used to estimate the current state and predict the near future, which is translated into concrete feedback for schedule adjustments and self-care.

We particularly focus on high-risk populations who may lack access to support, such as those requiring PTSD prevention after accidents. In collaboration with medical and welfare institutions, we will also test the provision of safe communities utilizing anonymous avatars and cognitive behavioral training in virtual spaces. Our ultimate goal is to realize a society where everyone can benefit from BMI (Brain-Machine Interface) in their daily lives, without dependence on specialized experimental equipment or skilled experts.

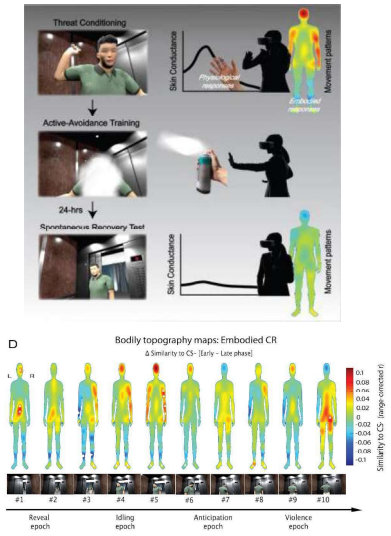
Estimating Individual and Collective Mood from Body Movement

We are developing technology to subtly interpret mental states based solely on body movement. First, we analyzed behavior and physiological reactions in a VR environment to extract movement patterns that reflect fear and tension. We demonstrated that when participants practiced avoidance maneuvers using their own gestures in a 3D VR space after fear conditioning, physiological indices (such as galvanic skin response) and movement indices remained significantly reduced even on the following day (24 hours later) (iScience 2024). The characteristic finding is that training through active body movement showed greater persistence of effect compared to observation only or conventional "fear extinction" methods. This research is also considering a prototype application that allows users to practice avoidance maneuvers using their smartphone as a controller (the effectiveness of which is yet to be verified). Through these attempts, we aim to eventually be able to monitor signs of individual mental distress using non-contact technology with anonymity safeguards, without disrupting daily activities.

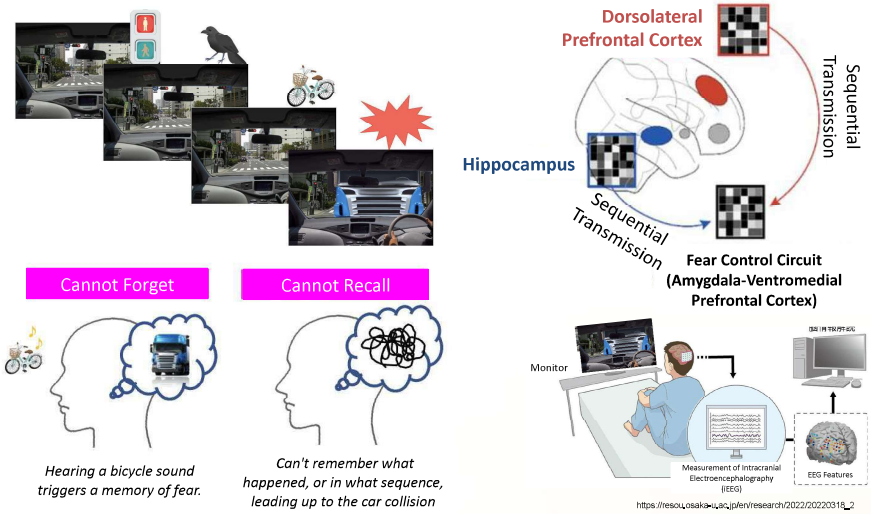
Tracing the Dynamics of Fear Memory Through Body and Brain

Fearful experiences can create a paradoxical phenomenon: simultaneously being "unforgettable" and "unrecallable." We demonstrated that on the day of a fearful experience, the scope of fear broadens due to associative memory, but on subsequent days, the scope narrows as the temporal sequence of the experience is consolidated. This day-to-day change can be explained by a shift in the balance of how the hippocampus and dorsolateral prefrontal cortex transmit temporal sequence information to the amygdala–ventromedial prefrontal cortex circuit.

Furthermore, this switching mechanism is weaker in individuals with anxiety traits, who are at higher risk for PTSD. The reduced encoding of temporal sequence information may contribute to the symptoms of being "unforgettable (associative)" yet "unrecallable (sequential)." These findings were reported in *Nature Communications* (2024). To transition these results into real-world implementation in line with the Moonshot goal, we are currently conducting detailed verification using intracranial recordings in collaboration with Yanagisawa SPM.



Extraction of Fear and Tension from Movement Patterns (iScience 2024)



Research findings using fMRI (Nature Comm 2024) and verification content using intracranial recordings (Ongoing)

Future Prospects

We will begin with small-scale pilot programs in schools and workplaces to test a system that "gently monitors" individuals using **non-contact technology while prioritizing anonymity**. This system visualizes mood fluctuations and connects them to simple feedback, such as **suggestions for breaks or basic breathing and avoidance training**. Collaborating with experts in medicine, welfare, and design, and while rigorously verifying **fairness and explainability**, we will expand this to **areas in need of support**, such as PTSD prevention and women's mental health. Through these efforts, we will steadily advance the implementation of a "daily life with BMI (Brain-Machine Interface)."

Ai Koizumi

Researcher

Graduated from the State University of New York (double major in Psychology and Film Studies), and obtained a Ph.D. in Psychology from the Graduate School of Humanities and Sociology, The University of Tokyo. After serving as a Postdoctoral Researcher at the Department of Psychology, Columbia University, and as a Researcher at the Center for Information and Neural Networks (CiNet), National Institute of Information and Communications Technology (NICT), became a Researcher at Sony Computer Science Laboratories, Inc. in January 2019. Currently serves as a Collaborative Researcher at the Advanced Telecommunications Research Institute International (ATR) and as a PRESTO Researcher at the Japan Science and Technology Agency (JST).

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Internet of Brains

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