Tokyo Metropolitan University

Graduate School of Human Health Sciences

Department of Health Promotion Sciences

Introduction to Our Research

Graduate School of Human Health Sciences

- Department of Nursing Sciences
- Department of Physical Therapy
- Department of Occupational Therapy
- Department of Radiological Sciences
- Department of Frontier Health Sciences
- **Department of Health Promotion Sciences**

Our campus is full of greenery, and well-equipped with research facilities

Research facilities

Behavioral Neuroscience Laboratory, Exercise Psychology Laboratory, Motion Analysis Laboratory, Shield Room, Biochemistry Laboratory, Functional Food Science Laboratory compatible with P1/P2, Nutritional Science Laboratory, Cold Laboratory, Ether Laboratory, Precision Analytical Instrumentation Room, Counselling Room, Study Room for Graduate Students, and Integrated Culture Experiment Building. The RI Experiment Building, Library, and various physical education facilities are also available.

Nutritional and Food Science Research Building

The main street in the Minami-Osawa Campus

Building No. 13 (Physical Education Research Building)

Dedicated experimental equipment

Equipment for 64-channel electroencephalography, magnetic stimulators, devices for measuring the line of sight, floor reaction force gauges, high-speed cameras, three-dimensional motion analyzers, general-purpose electrophysiological experimental equipment, equipment for immunohistochemical experiments, fluorescence microscopy equipment, image analysis systems, sequencers, cryostats, Coulter counter equipment, real-time PCR, microplate reader, atomic absorption spectrometry equipment, HPLC, ion chromatography equipment, treadmills, exhaled gas analyzers, metabolism cages, and so on.

Behavioral Neuroscience Laboratory

Ichiro Kita

The brain regulates behavior, and the brain is changed by behavior

From the perspective of neuroscience, we aim to clarify the roles of emotion, arousal, and autonomic functions in the behavior of living organisms, and the mechanisms for adaptation phenomena in the brain due to environmental factors, such as exercise and stress.

Major research topics

1) **Behavioral neuroscience of exercise and emotion**

   Anti-depressant and anxiolytic effects of exercise; Reduction of stress by exercise training;

   Influences of exercise on eating behavior; Neurogenesis due to exercise

2) **Neural mechanisms of arousal responses**

   Relationships between yawning and arousal responses, and between emotion and arousal

3) **Brain science of environment, emotion, and learning**

   Reduction of anxiety by smell; Decision making and emotion; Background sound and learning efficiency

4) **Stress and autonomic nervous system**

   Neural regulation of blood pressure, arousal, emotion, and respiration

Lab tour: Introduction of experimental methods

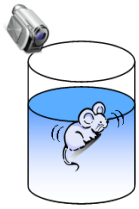
Evaluating the **anxiety** or **depression** of rats

Elevated plus-maze

Of the four arms put in a place higher than the floor, two do not have walls (open arms). Because an anxious rat would not want to go into an open arm, the degree of the rat's anxiety can be examined by measuring the time the rat stays in an open arm.

Forced swim

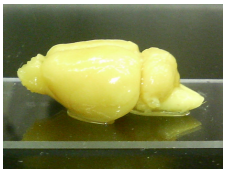
An initial 15-min swim session was conducted on day 1 followed by a 6-min swim test 24 h later. The immobility time during the last 5 min was recorded by an observer as a measure of depressive-like behavior.



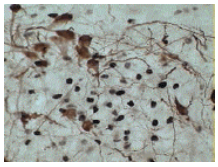
* In addition, we carry out studies making full use of various experimental methods, including neuro-pharmacology, electrophysiology, and so on.

Observing neurons

Rat brain



Neurons and c-Fos expression



Immunohistochemical staining:
Neurons can be visualized by thinly slicing the isolated brain (approximately 40 μm), and using an antibody that binds specifically with a certain protein. The photo on the right shows a stained image of nerve cells in the hypothalamus producing CRF (corticotropin-releasing factor) and c-Fos protein.

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Molecular Biology of the Exercise

Nobuharu L Fujii, Yasuko Manabe, Yasuro Furuichi

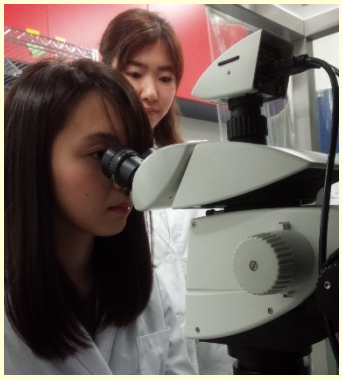
Expanding a New Biology of the Skeletal Muscle

We unravel the mechanism by which physical exercise can maintain and promote health and improve diseases at a cellular level

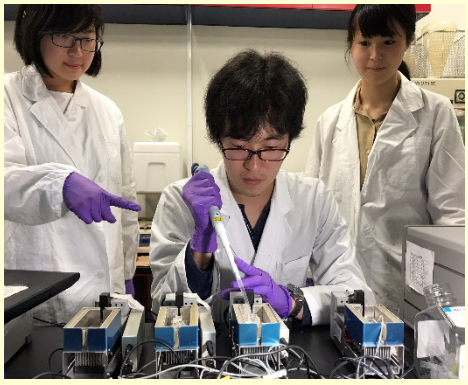
Major Research Topics

1. Discovery of myokines secreted by skeletal muscles
2. Elucidation of the molecular mechanism by which exercise controls diabetes
3. Search for an intracellular mechanism that controls plasticity of skeletal muscles

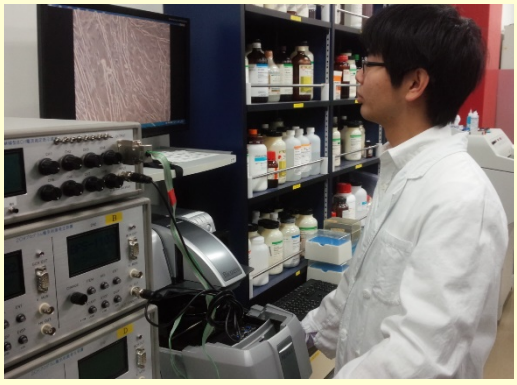
http://www.comp.tmu.ac.jp/muscle/



Primary culture of myotubes from satellite cells



In vitro contraction of isolated muscle tissue



Novel contraction system of cultured myotubes

Recently Published Major Manuscripts

1 Mandai S, Furuichi Y, et al., Sci Rep. 2017 *in press*
2 Kitamura K, et al., Biosci Biotechnol Biochem. 2017 *in press*
3 Inagaki A, et al., Biosci Biotechnol Biochem. 2017 *in press*
4 Tamura K, et al., J Phys Fitness Sports Med. 2017 *in press*
5 Inada A, Fujii NL, et al., Endocrinology, 157: 4691-, 2016.
6 Inada A, Fujii NL, et al., J Am Soc Nephrol, 27: 3035-, 2016.
7 Goto-Inoue N, et al., Mol Cell Biochem, 411, 173-, 2016.
8 Manabe Y, Ogino S, et al., Anal Biochem. 497: 36-, 2016.
9 Manabe Y, Fujii NL, J Phys Fit Sport Med, 5, 373-, 2016.
10 Manabe Y, Musculoskeletal Disease Associated With Diabetes, Springer, 139-, 2016.
11 Furuichi Y, Musculoskeletal Disease Associated With Diabetes Mellitus. Springer, 155- 2016.

Laboratory for Biological Functions and Neuromuscular Physiology

Junichiro Yamauchi

The human body is full of mysteries and possibilities.

In our laboratory, we are working on studies in the hope that we can someday realize as adults what we always believed we could do during our childhood. To put it in a more complex manner, we are on a quest for the possibilities and mysteries of the improvement of physical abilities and biological functions, focusing on clarifying the neuromuscular physiology of human movements and the adaptive system of biological functions under special circumstances. Although this may sound grandiose and greatly ambitious, what we are doing is very simple. We are exploring these mysteries from a wide range of perspectives without holding to stereotypes and preconceived notions by examining the electrical activity of muscles during exercise and cutaneous and muscle blood flows, and using MRI and electrical stimulation equipment. Based on the results obtained by our research, we hope to systematically establish simple, fresh theories and practices in the life sciences.

- What should humans do to run fast efficiently or jump higher? In order to find out about this, we will need to elucidate the neural and muscle regulatory mechanisms in animal (mainly human) movements. Wouldn't it be wonderful if humans could someday run in a swimming pool instead of swimming in it? Wouldn't it be impressive if humans in the future could take BBQ grilled meat to the third floor in a single bound?

- How could humans make muscles grow bigger or stronger? If we knew that, surely it wouldn't be unrealistic to do push-ups with one arm and run together with your grandchildren.

- What should humans do to live in special regions of extremes, such as space, high mountains, the deep sea, cold climates, extremely hot areas, and so on? Adaptation due to biological functions occurring in order to live in such regions will tell us about the potential of life. Wouldn't we then be able to find clues about treatment for patients with diseases?

- Is it not possible to improve circulation or metabolism using everyday objects (like a vacuum cleaner or hair dryer)? If it is, then we will be able to readily find ways to improve conditions of swelling and extreme sensitivity to cold, as well as dieting and home-based countermeasures against metabolic syndrome.

Wouldn't we be able to apply such knowledge and findings to rehabilitation for people with disabilities and the elderly, to develop equipment to enhance body functions, and so on? If we can do this, we will be able to make a direct contribution to society.

Laboratory for Sensorimotor Control

Takahiro Higuchi, Akiko Imura

Understanding sensorimotor control functions in the actions of moving through space and its applications

Our Mission

● The actions of moving through space, such as walking and running, are basic, important motor behaviors of humans, and various studies have been carried out on this topic all around the world. Particularly in recent years, there have been growing expectations for the application of research results in society from the perspective of preventing elderly people from falling, and so on.

● Based on techniques used in experimental psychology, our group aims to illuminate the sensorimotor control functions essential for realizing the action of moving through space. By conducting three-dimensional motion analysis, we are exploring the mechanism in humans for perceiving the relationship between space and body.

● We are trying to apply the results obtained by our research to the fields of rehabilitation, sports, and so on.

Research Topics

● We are currently working on a wide range of issues.

• Sensorimotor control when passing through a narrow space

• Sensorimotor training to prevent falling while walking

• Adaptation of tools for athletes

• Walking strategies and perceptual support for the visually impaired

● We conduct research making full use of various experimental devices.

• Three-dimensional motion analyzers

• Eye-mark recorders

• Liquid-crystal shutter goggles

• Moving doors (variable doors)

● We are conducting collaborative studies with researchers in the fields of psychology, sports science, and rehabilitation.

Contact Information

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http: //www.comp.tmu.ac.jp/locomotion-lab/higuchi/higu-index.htm

Sport Neuroscience Laboratory

Takeshi Nishijima

We determine the significance of proactive physical activity due to sports and exercise from the perspective of neuroscience.

Background and Purpose

The physical activity of humans markedly decreased with increased mechanization. In fact, we are currently facing a critical situation in which one out of three people around the world is physically inactive (Hallal et al., *The Lancet*, 2012). Physical inactivity not only increases the risk of death through lifestyle-related diseases (see the table on the right), but also damages mental health (brain functions).

Therefore, in this laboratory, we aim to **apply a neuroscience approach to elucidate the significance of increased physical activity due to exercise and the dangers of physical inactivity,** focusing on the close relationship between physical activity and brain function.

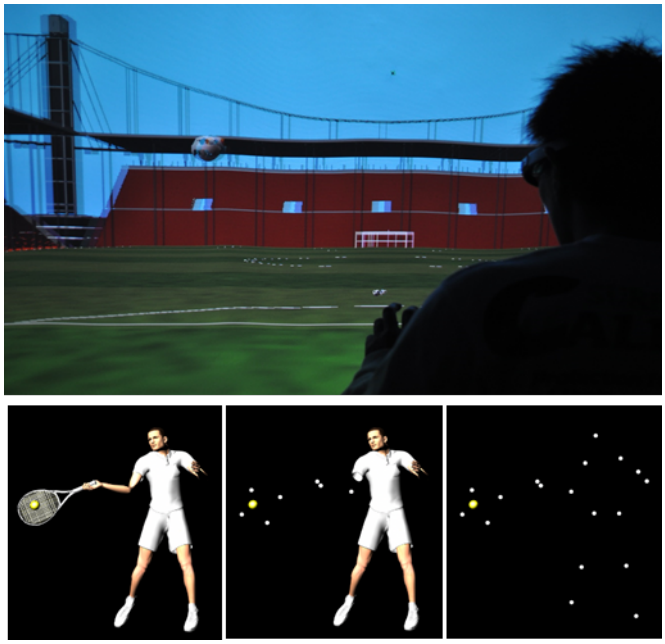
Issues • Clarification of regulatory mechanisms • How can the effects of exercise be enhanced? < Synergistic interactions between exercise and nutrition > < Increase in spontaneous activities >	**Issues** • Clarification of adverse impacts on the brain • Establishment of a more valid model of physical inactivity • What are effective strategies to minimize the adverse impacts of physical inactivity?

Perception & Action Laboratory

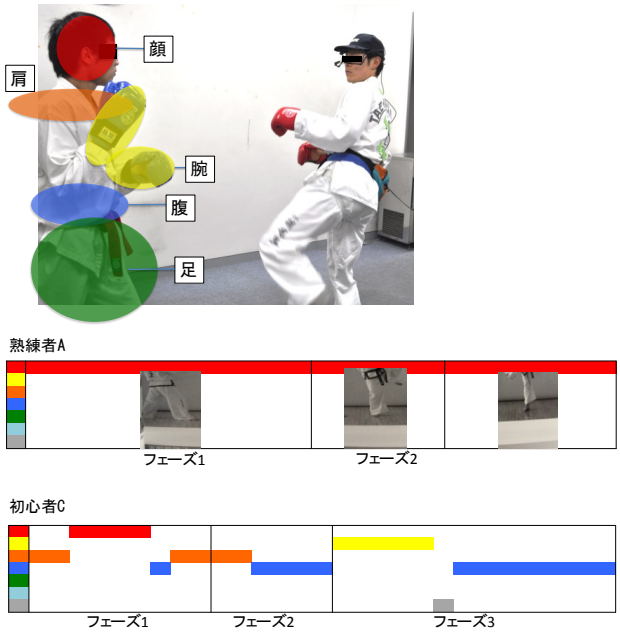
Kazunobu Fukuhara

We aim to clarify the mechanism of “perceptual-cognitive skills” underlying expert performance in sports. Based on the perspective of cognitive science and sports psychology, we examined the relationships perception and action with virtual reality (VR) and real environment.

Anticipatory Judgments in VR environment



Perception-Action Coupling in Real Environment



Research Themes

1. Perceptual-Cognitive Skills (Anticipation & Decision-Making)

2. Expertise & Perception-Action Coupling

3. Development of Perceptual-Cognitive Training with VR Environment

Our research themes will be contributed to the construction of novel perceptual-cognitive training or motor learning for athletes

Contact Info fukuhara-k [at] tmu.ac.jp

Nutritional Biochemistry Laboratory

Shoko Shinoda

In the Nutritional Biochemistry Laboratory, we conduct research on the regulatory mechanism for the absorption of minerals in the gastrointestinal tract. In the gastrointestinal tract, various regulatory mechanisms occur in response to deficient or excessive nutrients, inhibiting or promoting factors of digestion and absorption, and the body's nutritional status. We study these phenomena using animals and gastrointestinal cells.

Clarification of the mechanism for inhibition of the absorption of excessive iron in the mucosa of the small intestine with anemia

In the small intestine of animals, the levels of iron transporters increase in order to enhance the absorption of iron in a case of iron deficiency. On the other hand, when the level of iron is high, a mechanism to inhibit its absorption occurs immediately.

We measure iron absorption in conditions of iron deficiency and excess iron, examine the expressions of genes and proteins of iron transporters DMT1 and FPN1 as well as the iron storage protein ferritin, and conduct research on the responses of small-intestinal mucosal cells to drastic changes in mineral concentration. We are also carrying out studies on the antioxidant system working in the small intestine against iron, which is a source of oxidative stress.

Examinations of the interaction between phytic acid and minerals and various factors affecting the degradation of phytic acid in the gastrointestinal tract

Digestion and absorption of nutrients and food components are affected by the form of their existence in food and coexisting substances. Phytic acid, a factor that inhibits the absorption of minerals, is also anticipated to have functions such as suppressing colorectal cancer. Its degradation rate is greatly influenced by coexisting substances in the gastrointestinal tract and the body's nutritional status. We are analyzing this mechanism *in vivo* and *in situ*.

Analysis of the mechanism for absorption of nutrients and food components using cultured gastrointestinal cells

Subculture cells, such as human colorectal carcinoma-derived Caco-2 and IEC-6 derived from rat small intestine, form a single layer film on an artificial membrane, and small-intestinal epithelial cell-like functional properties are expressed (microvilli and tight junctions are formed). Using this single layer film, we assess the digestion and absorption of nutrients and functional components, evaluate the inhibition or promotion of absorption, analyze its mechanisms, and examine the nutritional status of gastrointestinal cells and its effects on digestion and absorption, and so on.

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URL: http://www.comp.tmu.ac.jp/Food_and_Nutrition/index.html

Education List

Human Adaptation Science		
KITA Ichiro	Professor	Behavioral Neuroscience Exercise Physiology
FUJII L Nobuharu	Professor	Molecular Biology Endocrinology & Metabolism Skeletal Muscle Biochemistry
YAMAUCHI Junichiro	Associate Professor	Exercise and Environmental Physiology Bio-Phisio-Mechanical Model of the Neuromuscular function of the Movements Integrative Nature Expedition
MANABE Yasuko	Associate Professor	Cell Biology Molecular Biology of Exercise Physiology of Taste
FURUICHI Yasuro	Assistant Professor	Exercise Biochemistry Skeletal Muscle Energy Metabolism
Human Behavioral Science		
HIGUCHI Takahiro	Professor	Cognitive Science Visuomotor Control of Locomotion
NISHIJIMA Takeshi	Associate Professor	Exercise Neuroscience Exercise Physiology
FUKUHARA Kazunobu	Assistant Professor	Perceptual-Motor Skills Virtual Reality Expert Performance
IMURA Akiko	Assistant Professor	Sports Biomechanics Dance Kinesiology
Nutrition and Food Science		
SHINODA Shoko	Professor	Nutritional Biochemistry Mineral Nutrition

Please refer to our website for the latest information on entrance exams, etc.

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Website: http://www.tmu-hps.jp

Tokyo metropolitan university, Graduate School of Human Health Sciences
Department of Health Promotion Sciences
Human Adaptation Science / Human Behavioral Science / Nutrition and Food Science

Conferred degrees: Master's (Health Sciences) / Doctorate (Health Sciences / Philosophy)

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