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, Molecular and Cellular Biology Laboratory (P1&P2 level), Cold Room, Cell Sorting 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 microscope, confocal microscope, fluorescence stereoscopic microscope, fluorescence image analyzer, cryostats, cell sorter (FACS), real-time PCR, microplate reader, automatic cell analysis microscope system, 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

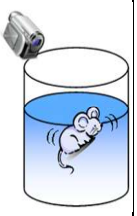
Evaluating the **anxiety** or **depression** of rats

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

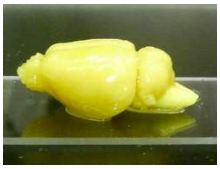
An initial 15-min swim session was conducted on day 1 followed by a 6-min swim test 24 h later. The immobility time during the last 5 min was recorded by an observer as a measure of depressive-like behavior.



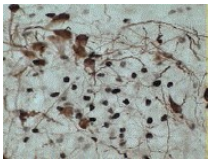
* In addition, we carry out studies making full use of various experimental methods, including neuro-pharmacology, electrophysiology, and so on.

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.

Contact information: Ichiro Kita (kita-ichiro [at] tmu.ac.jp)
http://www.comp.tmu.ac.jp/sport/personal/kita/kita.html

Molecular Biology of the Exercise

Nobuharu L Fujii,　Yasuko Manabe,　Yasuro Furuichi

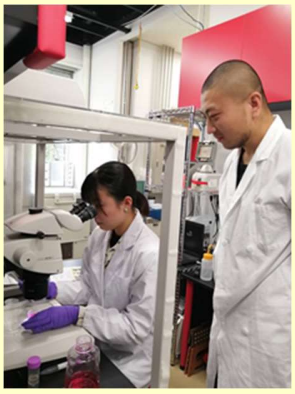
Expanding a New Biology of the Skeletal Muscle

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

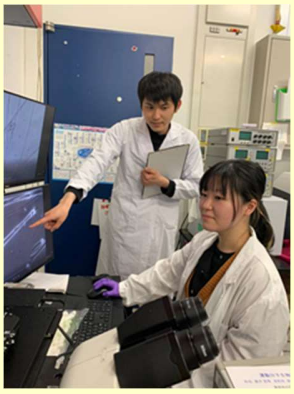
Major Research Topics

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

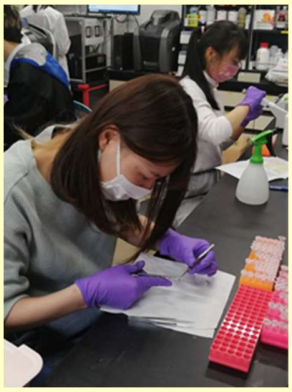
http://www.comp.tmu.ac.jp/muscle/



Primary culture of myotubes from satellite cells



Evaluation of the contractile force in myotubes



Analysis of transgenic mice

Recently Published Major Manuscripts

1 Mita Y, Ito M, et al. J. Phys. Fitness Sports Med. 2022
2 Furuichi Y, Kawabata Y, et al. Front. Cell Dev. Biol. 2021
3 Tsukamoto-Sen S, Mita Y, et al. Food Funct. 2021
4 Hoshino D, Furuichi Y, et al. iScience. 2020
5 Wada T, Hamaguchi H, et al. Cell Rep. 2020
6 Matsuda N, Hamaguchi H, et al. Qant. Biol. 2020
7 Tamura K, Manabe Y, et al. PLos One. 2020
8 Goto-Inoue N, Furuichi Y, et al. Rapid Comm Mass Sp. 2019
9 Sakamoto K, Furuichi Y, et al. EMBO Rep. 2019
10 Sato S, Furuichi Y, et al. Biosci. Biotechnol. Biochem. 2019
11 Furuichi Y, Manabe Y, et al. PLoS One. 2018
12 Hatsuzawa Y, Fujii NL. FASEB J. 2018
13 Mandai S, Furuichi Y, et al., Sci. Rep. 2017
14 Kitamura K, et al., Biosci. Biotechnol. Biochem. 2017

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

higuchit_at_tmu.ac.jp

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

Sport Neuroscience Laboratory

Takeshi Nishijima, Ph.D.

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 a quarter of world's population is physically inactive (Guthold et al., *Lancet Glob Health*, 2018). 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.

Top5 Risk for Death

WHO, 2009, Global Health Risk

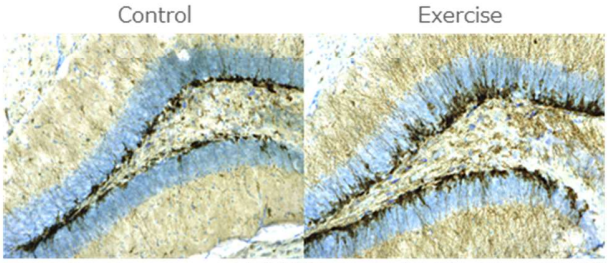
1	High blood pressure	12.8%
2	Tabaco use	8.7%
3	High blood glucose	5.8%
4	**Physical inactivity**	**5.5%**
5	Overweight/Obesity	4.8%

(percentage of total)

Research Topics 1

Effect of exercise on the brain

Exercise increases neurogenesis



Nishijima et al., *Plos One*, 2013

Current issues

- Exploring underlying mechanisms
- Enhancing the effect of exercise
  (synergy of exercise and nutrition)
  (increasing spontaneous activity)

Research Topics 2

Modeling physical inactivity

Cessation of exercise is anxiogenic

Nishijima et al., *Behav Brain Res*, 2013

Nishijima et al., Am J Physiol Reg, 2017

Current issues

- Elucidating negative impacts on the brain
- Establishing a valid model of physical inactivity for neuroscience study
- Exploring strategies to prevent the negative impacts of physical inactivity

"In order for man to succeed in life, God provided him with two means, education and physical activity. Not separately, one for the soul and the other for the body, but for the two together. With these tow means, man can attain perfection." (Plato)

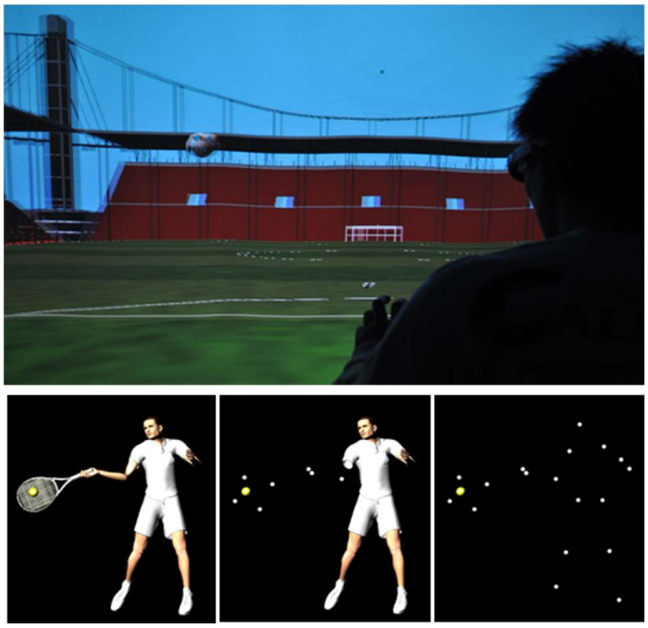
E-mail: t-nishijima@tmu.ac.jp

Perception & Action Laboratory

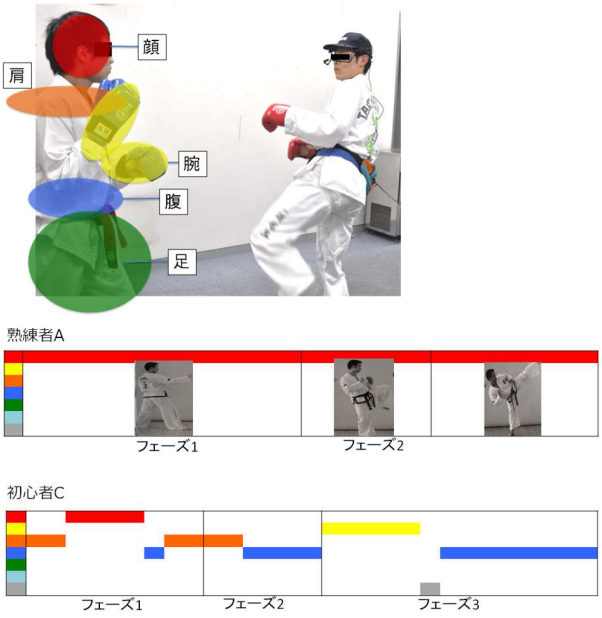
Kazunobu Fukuhara

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

Education List

Human Adaptation Science		
KITA Ichiro	Professor	Behavioral Neuroscience Exercise Physiology
FUJII L. Nobuharu	Professor	Molecular Biology Medical Science (Endocrinology)
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 Metabolism and Nutrition Science
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

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)

ADDRESS: 1-1 Minami-Osawa, Hachioji, Tokyo, 192-0397, Japan

Phone: +81-42-677-1111 (Main phone number for the university)

Phone: +81-42-677-2960 (Department office)

Fax: +81-42-677-2961 (Department office)