Newsletter

Committee on Certification of Professional Ergonomists
March, 2020
CPEJ Newsletter Editorial board

A Plenary Meeting/Lecture Meeting was held at the CPEJ in April 2019. Newsletters No.59 to No.62 were issued, and practical examples of ergonomics were reported. Some of the articles within the newsletters have been translated into this English version.

Report from Professional Ergonomist

Development of an assistance device for the lower back

Ryojun Ikeura (Mie University)

I specialize in mechanical engineering, with a particular focus on robot engineering. When I was a student, I was interested in ergonomics; therefore, I studied the interaction between humans and robots. As part of this, I would like to discuss the assistance device for the back, in whose development I am currently involved.

In recent years, the development of robots and devices that assist in work by being attached to the body has flourished, and some of these have been commercialized. The author is also developing a device that supports the lower back (see diagram). It achieves this by placing a flexible material from the back to the legs, with the result being that the bending force generates a torque around the lower back to reduce the burden on the lower back. In developing this device, I investigated the load on the musculoskeletal system. From this, I realized that there was a risk in using an assistance robot or device, which I would like to explain herein.

As you are aware, the trunk is supported by the spine, and posture is maintained using the abdominal and the back muscles. For easier understanding here, I will avoid using technical terms for the muscles and bones. If you bend your lower back to lean your body forward, your back muscle is activated to support your body; however, if force is applied to your spine simultaneously, this will put pressure on your intervertebral discs. If you carry something heavy and adopt a forward-leaning posture, you will produce much greater muscular force than if you were not carrying anything, and the intervertebral discs of your spine will be pressed by a significant force. Even if a robot or device attached to the body and supporting the lower back can suppress the load on the back muscle, it will be unable to decrease the pressure on the intervertebral discs. However, in contrast to the type of support that you pull with rubber across the back, the type that the author has created, which produces support by using torque around the lower back, has been shown to cause less pressure on the intervertebral discs. Additionally, it is possible to reduce pressure on the intervertebral discs by increasing the pressure on the abdomen in a manner similar to that of a corset. However, compressing the abdomen can be painful. Of course, if you can use a robot that you could get on and manipulate, such as a “Gundam” robot, you would not face any of these problems. However, this is obviously not practical. When you feel pain in your back muscle, you know that a load has been placed on it; but in the case of the intervertebral disc, people are often unaware of pain until it has been damaged. Therefore, lower back pain caused by intervertebral disc damage is worse than that caused by the back muscle, and there is often no

simple treatment.

With the above considerations, as assistance robots or equipment attached to the body cannot reduce pressure on the intervertebral discs, it is important that these are not so easy to use that people put excessive trust in them. Without the use of assistance equipment, people with pain in the back muscle naturally refrain from excessive exercise. However, if assistance is used, people who do not really feel pain in the back muscle may continue to exercise excessively and damage their intervertebral discs even if excessive pressure is placed on the intervertebral discs. Given this, the author considers that assistance robots and equipment should not be used for delivery work with heavy objects: their use should be limited to back support, such as when it is necessary to adopt a forward-leaning posture for long periods of time.

The use of these devices would not be a problem if we could develop an assistance device that can be easily attached, and which can reduce the pressure on the intervertebral disc without placing a burden on the body as a whole. I truly hope that such a device will be developed in the future.

Assistance device for the lower back being developed by the author

Self-introduction by the author

Ryojun Ikeura:

I completed my PhD at Tohoku University Graduate School in 1991. Following that, I became a professor in the Engineering Research Department of Mie University Graduate School in 2007, which is my current post. I am engaged in research on the development of collaborative controls between humans and robots, driving assistance for drivers, and power-assisted devices.

Report from Professional Ergonomist

Attempts at early detection of dementia using smell

Keisuke Suzuki (Kagawa University)

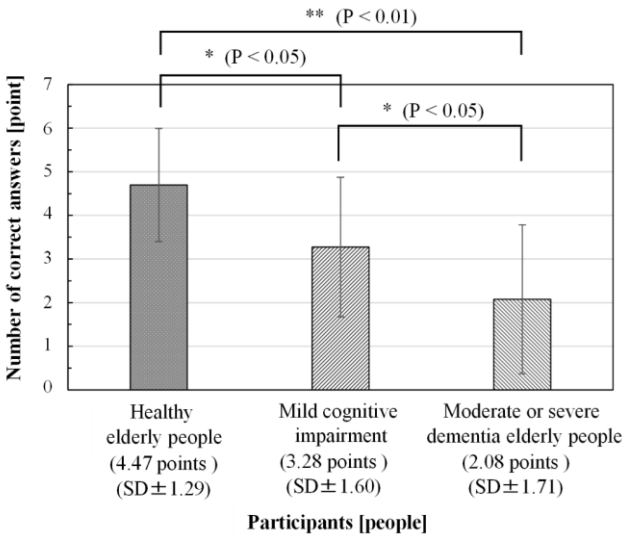
Medical examinations by interview are widely used in the diagnosis of dementia. In domestic dementia tests, questionnaires called the HDS-R (Hasegawa Dementia Scale-Revised) and MMSE (Mini Mental State Examination) are prevalent. By evaluating the scores obtained from these tests, it is possible to predict the severity of dementia. However, as the content includes questions that any healthy person would be able to answer, such as a patient's own name, the date, and location, there is a concern that this may damage the self-esteem of the patient and that they may not wish to continue with the tests.

It has been confirmed that the initial-stage symptoms of Alzheimer's dementia and Lewy body dementia, which account for the majority of dementia cases, involve the decline of functions related to olfactory stimulation. If we can establish a method of simply detecting dementia based on the decline in the olfactory function, it may be possible to detect more than half of all dementia cases at an early stage. Additionally, as tests using aromas are unlikely to be considered methods of screening for dementia, they can possibly reduce the patient's resistance toward

the examination.

Our research team has focused on the decline of the olfactory function and demonstrated examples of screening for dementia in a way that places less burden on the body and mind. To achieve this, we developed a method of screening for the onset of dementia based on the results of the patient sniffing seven different aromas and then selecting the aroma that they have smelled from among several options. It was considered that as only a short amount of time is required for this test, because it is unlikely to be considered a test for dementia, and because the fragrances are unlikely to cause a sense of discomfort or distaste, the pressure felt by the test subject with respect to the test would be reduced. In proposing this method, we selected seven different aromas, and targeted the study at 102 people considered to suffer from dementia, as well as healthy people. We divided the subjects into three groups: healthy elderly people, patients suffering from mild dementia, and patients suffering from moderate to severe dementia. We then compared the number of correct answers scored by each group on the olfactory test. The results revealed that as the dementia symptoms worsened, there was a significant decrease in the number of correct answers. Moreover, thresholds that enabled us to roughly categorize the subjects according to the severity of their symptoms were derived. Furthermore, we confirmed that the significant decrease in the number of correct answers in the olfactory test was not a result of aging but represented a decline in cognitive ability with respect to smells, based on the severity of dementia.

As this method was based on the results of a survey covering 102 people who were considered to suffer from dementia or to be healthy, we plan to further validate the appropriateness of the method of screening for dementia using aromas by increasing the amount of verification data. By including mild dementia, it should be possible to screen for dementia at an early stage.



Relationship between symptoms and number of correct answers in the olfactory test

Aroma stick and answer panel

References
Sora Kobayashi, Keisuke Suzuki, Masayuki Karaki, Motomi Tanaka: Method of screening for dementia using aromas-2nd report, Collection of Journals from the Society of Life Support Engineering, Vol. 29, No. 3, pp. 81-87, September 2017

Self-introduction by the author

Keisuke Suzuki:

I completed a doctoral course from the Engineering Research Department of Seikei University in 1996, following which I was engaged in the estimation of the efficiency and evaluation of the usability of various driver-support devices at the Japan Automobile Research Institute (JARI). In 2000, I was a visiting researcher at the Swedish Transport Administration (VTI). Since 2009, I have been engaged in research related to the optimization of various device interfaces based on the theme of human support at Kagawa University. My hobbies include restoring old vehicles, motor sports, the overhaul of silver halide cameras, and skin diving.

Report from Professional Ergonomist

A story that have been adventurously stuck to the goals of research

Chizuru Nakagawa
(Railway Technical Research Institute)

I have been researching the numerical quantification of feelings of discomfort due to railway vibrations for nearly 10 years. The starting point for this research was feedback from the technicians in charge that the previous method of evaluation, which had been in existence since the national railway era, did not match the feeling produced by ultra-high-speed railways, wherein vibrations increase to 30 Hz or more.

The Ergonomic Laboratory was requested "to develop a method for evaluating comfort when riding an ultra-high-speed railway." At first glance, this was a reasonable request. However, if different evaluation methods were required for each type of usage, there would be no end to it. I pondered: what was it that we were trying to measure? Actually, it was not only differences in vehicle vibration but also the "feelings of humans." That being the case, we should be able to create a method of evaluation that can be widely used if we can accurately express human feelings regarding vibrations.

The previous method was based on international standards, but I started experiments using a 3-axis electrodynamic vibration system (Fig) in which I evaluated feelings about vibrations depending on the frequency. In promoting this research, I stuck to two things: "estimating ride comfort of real passengers in response to vibrations while riding the railway" and "developing a practical method of evaluation that anyone can use." These were to be helpful in making improvements and devising countermeasures. Therefore, in the experiments, certain restrictions were imposed: a railway seat with a complex vibration system was used and the acceleration measurement point was limited to one area on the floor.

The result of this was that a diverse range of factors were intertwined, and experiments lacking in beauty in terms of research were accumulated over several years. I was unsure, for example, about whether it was worth researching vibration sensitivity again, despite the fact that the vibration sensitivity curve had already been defined in ISO2631, or whether the impact of differences in seat types could be excluded. The more I considered it objectively, the more my anxiety grew; however, I wanted to numerically express the feeling of comfort felt by a railway passenger. I considered it my role to communicate the feelings of humans to technicians, so I

persisted. Fortunately, the impact of the seat type was limited, and I was able to propose a method of evaluation. When this method was applied to buses in addition to the railway, the subjective evaluation had a correlation of 0.8 or above. However, this method has not yet been completed as "a practical method of evaluation that anybody could use". I am painfully aware every day of the difficulty of making research practical.

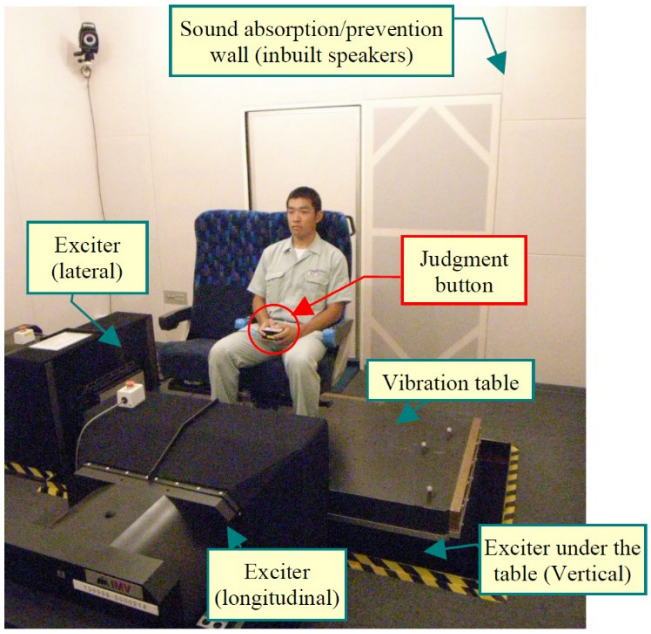


Image of the experiments using the electrodynamic vibration system (Inbuilt shaking and sound evaluation simulator)

Self-introduction by the author

Chizuru Nakagawa:

I completed an undergraduate course in biomedical engineering and a doctorate in engineering at Keio University. I am also the head of the Ergonomic Laboratory of the Railway Technical Research Institute. I am engaged in evaluating feelings of discomfort due to vibrations, motion sickness detection based on physiological indices, and research on estimates of driver status. Hobbies: Activities related to the expansion of environments in which children can play in a truly child-like manner.

Report from Professional Ergonomist

Toward ease of use for all people

Yuka Yamazaki (Integrated Design Center, Mitsubishi Electric Corporation)

I like "people."

I first became aware of the discipline known as ergonomics when I became engaged in work involving the evaluation of the usability of products. Usability evaluations related to hardware design and interface design as an industrial designer were the starting point for my growing interest in this field. Some time after this, I was given charge of universal design, and my range of vision broadened to include manufacturing.

The protagonists causing this increase in my range of vision were a wide variety of users. Because of a low birth rate and aging society, for example, there has been an increase in the number of elderly workers even at professional sites, and there has been a diversification of users across all fields. Furthermore, in terms of the products handled by Mitsubishi Electric, the users of a variety of products, such as electrical appliances, public products, telecommunications, and factory devices and equipment have become highly diversified. Through my experience of coming into contact with a wide variety of device users, ranging from those who utilize rice cookers to heavy electrical machinery and defense systems, I have realized anew that the same nucleus, that is, people, goes beyond the field of manufacturing.

We pursue the ideal design. We provide functionality that actualizes technology. We determine standards for this purpose. The former only takes form when we observe people and are interested in people. We explain the progress toward that form in ways that anyone can understand using ergonomics. The attainment of a qualification as an accredited ergonomic specialist last year was an opportunity to review

the things I had been involved with thus far.

As part of enlightening people about ergonomics and disseminating concepts and knowledge related to the field, we are currently conducting training on universal design within the company. People with a wide range of ages and experience are taking the course, and when looking at ways of interacting with and understanding the course content, I feel that interest in people is an important element in the utilization of ergonomics.

As a company, our concept of universal design involves “Creating user-friendly products and environments that make life more comfortable for as many people as possible.” People who use products use them in diverse situations, with various objectives, and are highly diverse themselves. At a certain exhibition, a visually-impaired person said when touching our rice cooker, “with this, I can do what I wanted to do.” This rice cooker was developed by the usability evaluator, designer, and technician all listening to the people concerned and repeatedly evaluating the product’s usability. Our products are made based on an interest in people, and we will continue to pursue our activities with the aim of making many people happy.

Self-introduction by the author

Yuka Yamazaki:

I am a member of the Solution Design Department of the Integrated Design Center, Mitsubishi Electric Corporation. My areas of expertise include industrial design, usability, and universal design. I am working toward visualizing concepts such as the evaluation of results in an artistic way, and mutual understanding with the development team.

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