§ 4 The necessity of psychology from an historical perspective

The Universe began with a Big Bang around 14 billion years ago. It is said that our galaxy and earth were born approximately 4.6 billion years ago.

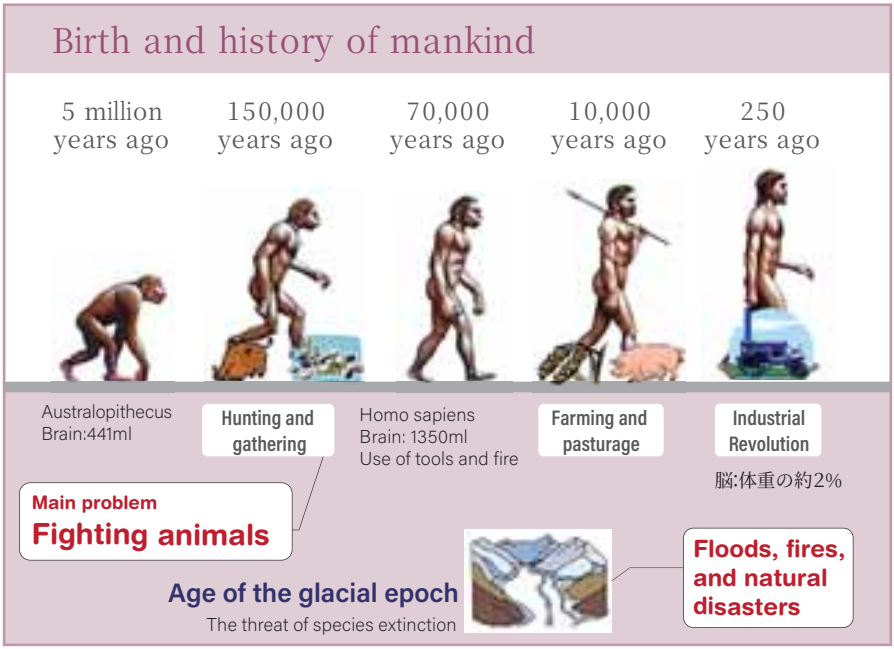

Figure 16 Evolution of the human race

It is said that the birth of the human race was approximately 5 million years ago. The human race at that time, Australopithecus, had a brain that weighed only around 441 ml. Hunting and gathering began approximately 150,000 years ago. The main problem they faced in this era was fighting against animals. Then, about 70,000 years ago, the human race evolved into homo sapiens, when they started using tools and fire. The weight of the brain at this time increased to around 1,350 ml.

Climate changes during these times were dramatic. In the past 400,000 years, the earth saw the glacial epoch repeat several times and warmed for a short period every 100,000 years. During this period, the glacial epoch (the era when there are glaciers all over the earth) and the glacial stage (the coldest period in a glacial epoch) were repeating. Although this glacial epoch comes along in cycles of 11,500 years, the last glacial epoch was about 11,500 years ago. Therefore, the present period is the age of the glacial epoch, and we are about to move into the next glacial epoch.

Farming and pasturage began approximately 10,000 years ago, and the problem of fighting animals was replaced by floods, fires, and earthquakes etc. Although there was a threat of species extinction during the glacial stage, humans managed to overcome this. This is the reason why our DNA tells us to take in and not discharge excess energy.

At present, without exercising appropriately, middle-aged people tend to gain weight because of the slow down in their metabolism. This mechanism works because of this DNA.

Industrial Revolution

In 1769, which is just 250 years ago, a Scottish mathematician and engineer, James Watt invented the steam engine, which was epoch making for humanity.

Now, mechanical disasters were added to floods, fires and earthquakes, which had been troublesome for humans.

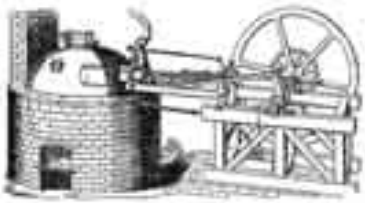

Figure 17
Industrial revolution and James Watt

ANSWER

Only 250 years have passed since human beings came into contact with machines. Quiz 2. Regarding the question, "If the lifetime of our planet (4.6 billion years) was compressed into 1 year, when would the Industrial Revolution have started?" The answer is 31 December at 23:59.58.003. The Internet, which began in 1985, would have started on 31-Dec at 23:59.59.008, only 0.02 milliseconds up to the end of the year. Also, if the lifetime of homo sapiens (70,000 years) was compressed into 1 year, 250 years would equate to 1 day 7 hours 17 minutes 8 seconds and 006 milliseconds, and the Industrial Revolution will have started on 29-Dec at 16:51.04.

Looking closely at the relationship between machines and human beings since the Industrial Revolution, technology has become highly developed and complicated. The speed of development is advancing exponentially. Consequently, the causes of disasters have also become complicated. Regarding a recent electric controlled engine, there is an accident report, of which a large-sized ocean-going vessel stopped its operation for a few days because it took time to investigate the cause which happened to be a tiny faulty micro chip.

Also, huge and disastrous disasters are conspicuous. The crash of one aeroplane caused more than 500 casualties.

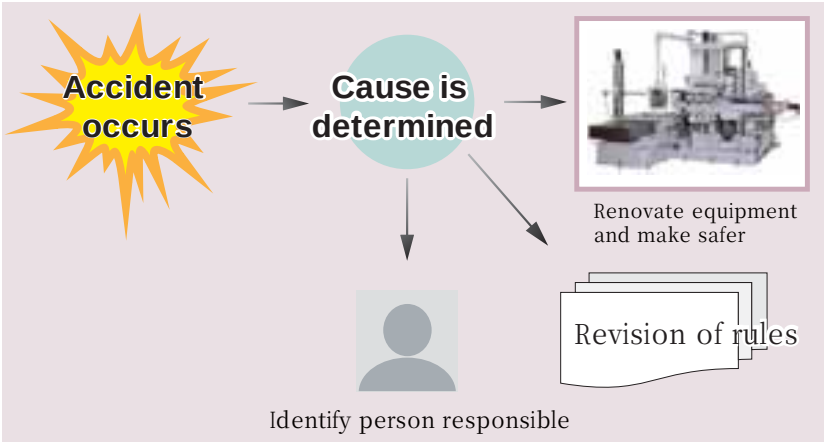

Figure 18 Cause investigation graphic

Currently, in the event of anaccident occuring, the related personnel carry out an investigation to determine the cause. As the following three actions are to be taken, we must imagine that the bud of a potentially new accident is existent as a result these actions taken.

◆ When there is mechanical trouble

Renovate equipment and make safer.

As a result, the equipment will be more complicated and will require a higher level of expertises when operating. Educational expenses for companies will be significantly higher. On the other hand, crew who are required to handle complicated equipment may get stressed, which in turn may be sowing the seeds of a new mistake to take place. Also, in the case of the repaired equipment being out of order again, the difficulty involved in trying to fix it will be amplified, which may cause an accident (from bud to shoot).

◆ Revision of operation manual and regulations

If there is a defect in the manual or regulation, it is to be revised.

Procedures and laws have been revised, multilayering has begun, and recordability has been requested. As a result, administrative work, including paperwork, will increase. This may again put further stress on the crew, and, in reality, recording will be repeating itself, of which it may lose substance in the operation manual and regulations. The lecturer is afraid that this may again form a new bud that may lead to another accident.

◆ Identify the person in charge

Identify the person who caused the accident and punish him/her.

The train accident that occurred on the JR Fukuchiyama Line in 2005,

triggered the importance of how it will have affected the victims emotionally. Then, a manhunt to bring the perpetrators to justice was carried out. However, the lecturer believes that this kind of investigation will not get to the "real" heart of the matter behind the cause of the accident. As explained in Loss Prevention Bulletin No. 35 "Thinking Safety", there are still "grave-post type" safety measures that are frequently seen; analysing only technical aspects and closing the case file by punishing the person in charge, may only make the crew feel wilted, which causes stress, of which a new accident may occur (a shoot from the bud).

As is summarized in Figure 19. It seems that on the part of the hardware side, the revision of handling manuals and regulations are increasing more and more and that aspects related to humans are shrinking. This seems to be mounting to a serious amount stress.

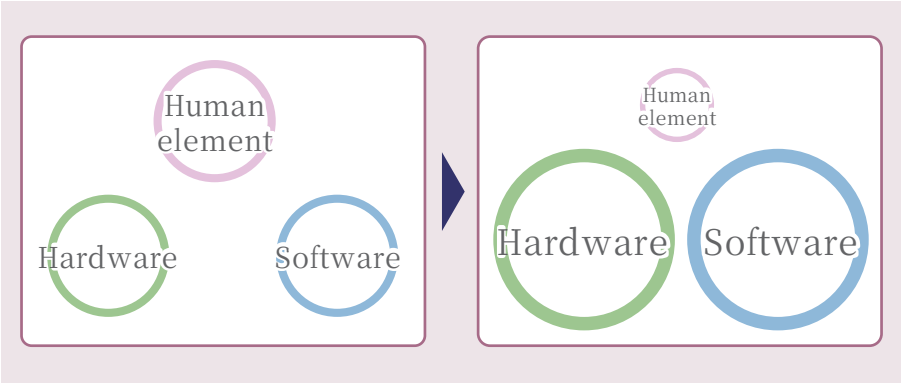

Figure 19 Cause investigation graphic

4－1　History of Navigation

In ancient Egypt around c.3000 BC, ships were built by applying planks to the skeleton. This is a prototype of current vessels.

Figure 20 Ancient Egyptian vessel: prototype of a ship

① The history of navigation

Figure 21 The history of navigation

Until the middle of the 18th century, there was mainly coastal navigation and geographical navigation referred to as the 3Ls.

3L	Log	Lead	Look-out

Later, in the Age of Discovery, Latitude and Longitude are discovered and celestial navigation starts. With the addition of the above 3Ls, it is now known as the 5Ls.

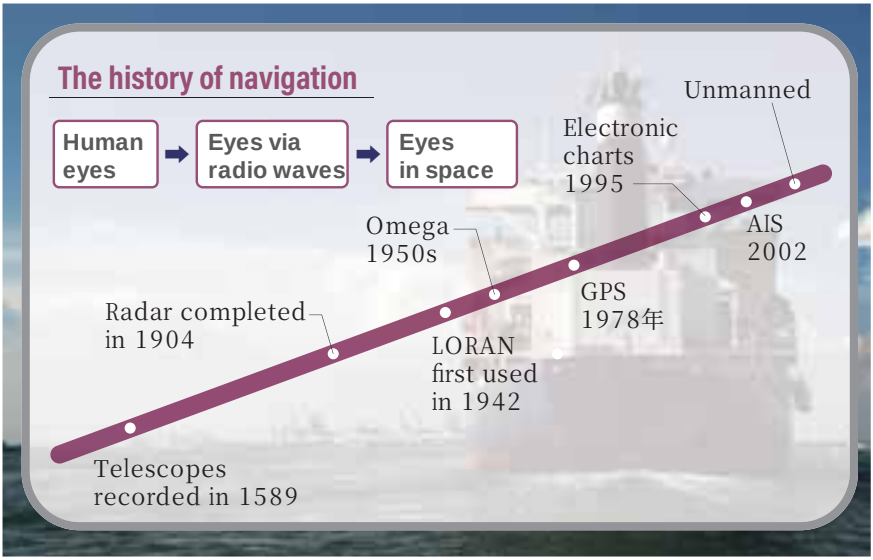

Figure 22 The history of navigation (Look-out and positioning)

It was in the 16th century that people started using telescopes; geographical and astronomical navigation had been used until then.

In the 20th century, Radar was developed. Then, LORAN, Dacca and Omega systems were developed as nautical instruments. At present positioning is carried out by GPS. Moreover, electronic charts and AIS have been developed. Research on unmanned ships has started and it will no longer be a dream for a ship to navigate without crew in the near future.

② The history of power systems

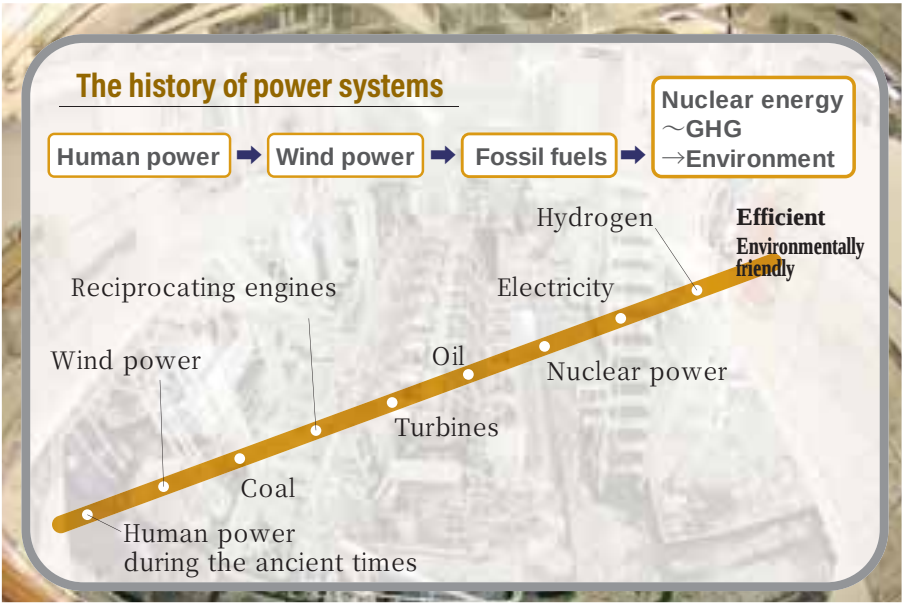

Figure 23 The histroy of power systems

Looking through the historical lens of power systems, we can see that they started with human power during the ancient times and progressed to sails on a sailing ship powered by the wind in the Age of Discovery. The use of coal and a reciprocating engines were developed during the industrial revolution. Then, reciprocating engines were replaced by turbine engines. After oil started to be used, coal which was manually put into the boiler, was replaced with automatic fuel injection. This also led to the development of the internal combustion engine (diesel engine) and nuclear-powered ships. Currently, electric propulsion engines are now in practical use. The development of engines using hydrogen have also been making progress.

Human ⇒ wind power ⇒ fossil fuels ⇒ nuclear energy ⇒ and hydrogen powered systems have become very efficient over the years and are becoming more environmentally friendly.

③ The history of information processing systems

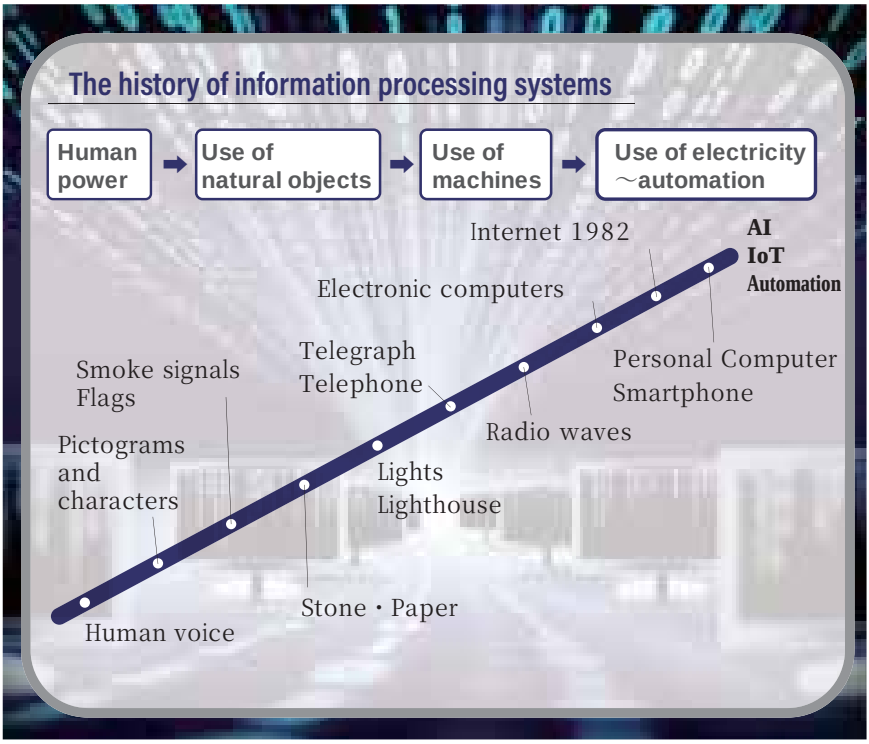

Figure 24 The history of information processing systems

In the ancient times information was relayed directly by voice. Then characters and pictograms written on stone and paper began to be used in Egypt c. 5,000 BC. In addition, smoke signals and flags were used as a means of communication between distant places. Lights and lighthouses were also developed. In 1825, a painter and inventor, Samuel Finley Breese Morse (1791-1872), received a message from his father which was handed over to a messenger and sent by horse. As the message informed him that his wife was in a critical condition, Morse immediately headed to their home in New Haven, but it was too late when he arrived as she was already buried. Morse, who was deeply hurt by not being able to be by his wife's side during her final hours, started researching high-speed long distance communications methods, and invented a telegraphic instrument.

Also, Alexander Graham Bell (1847-1922) invented a communications device in 1876, which went on to become the commonly used telegraph and telephone.
Later, a satellite communication system (Inmarsat) was introduced in 1979.

Then, the Internet, which can be said to be one of the greatest revolutions of all time, was developed in 1982. The means of communication has rapidly evolved from electronic computers to personal computers and now smartphones. Today, we are entering the era of artificial intelligence (AI) and Internet of Things (IoT).

4－2 "We are the first generation" from a psychological perspective

As described above, the period of technological innovation has seen rapid progress from minute to minute, and it has been only 40 years since Inmarsat was introduced, yet the speed at which it has evolved is striking.
Meanwhile, our DNAs which were inherited from 70,000 years ago would not change in the last 40 years. Thus, we should still regard ourselves as being "the first generation." Namely, it is important to be conscious of the following:

- Our relationship with the machine has not been integrated into our genes.
- Regulations and instructions are only measures that prevent the same accidents that occurred in the past from reoccurring.
- It is difficult for humans to grasp and follow all changes in technology and the environment.
- To keep up with these changes, we constantly need education, training, learning, experience and research.
- Accidents based on human characteristics that cannot be prevented by science and technology will not be eradicated.
- Still, accidents due to human error have occurred. In order to prevent such accidents from occurring, it is important to learn the principles of human behaviour, which is why the study of psychology is important.

4－3　Human Brain Capacity

The reason why we can say that the human brain is a very inefficient organ is because it occupies only 2% body weight, yet consumes 20% of all the energy. When we were students and studying for examinations after dinner, most of us would have felt peckish around midnight. Why did we become hungry by simply sitting in front of the desk? It is because the brain had consumed most of the energy which we had taken in and that we were suffering from a shortage of energy.

Our brains are programmed to save energy as much as is possible, while aiming to achieve maximum energy consumption. The following are examples of its energy-saving mode programme:

- Avoids thinking deeply (it gets tired)
- Is not good at thinking logically
- Forgets and does not remember easily
- Not able to reject our assumptions
- Tends to believe that our choice is correct
- Tends to make choice based on first impression etc.

Presumably, the “Twelve human characteristics” which were introduced in “Thinking Safety (Vol.35)” have a deep connection with the energy-saving mode programme of the brain..

12 human characteristics

1. Human beings sometimes make mistakes
2. Human beings are sometimes careless
3. Human beings sometimes forget
4. Human beings sometimes do not notice
5. Human beings have moments of inattention
6. Human beings sometimes are sometimes only able to see or think about one thing at a time
7. Human beings are sometimes in a hurry
8. Human beings sometimes become emotional
9. Human beings sometimes make assumptions
10. Human beings are sometimes lazy
11. Human beings sometimes panic
12. Human beings sometimes transgress when no one is looking

Table 25 Twelve Human characteristics

4－4　Twelve human characteristics

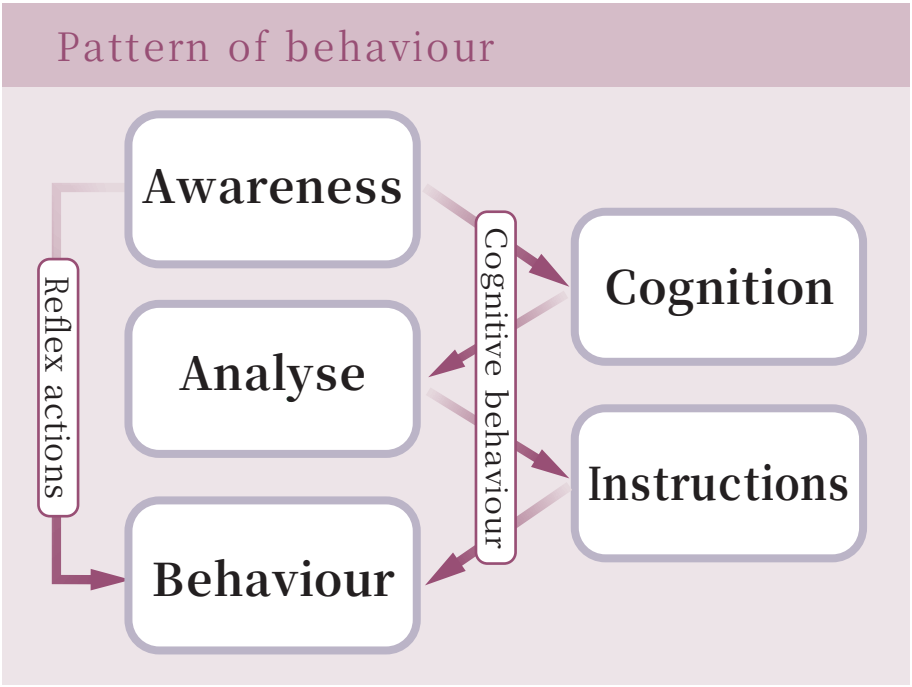

Figure 26 Patterns of human behaviour

Figure 26 illustrates this. There are two patterns of human behaviour, one of which is reflex. A couple of examples of conditional reflexes are those such as tapping the knee to make the shin move, or closing one's eyes when something flies towards them.

However, what we normally do is called cognitive behaviour. Awareness comes first, then cognition, analysis, instructions and then behaviour.

Firstly, awareness will be explained. Awareness means "visible" or "audible". In other words, "visible " is the state when light reaches the retina. Also "audible" is the state when sound waves are vibrating the eardrum.

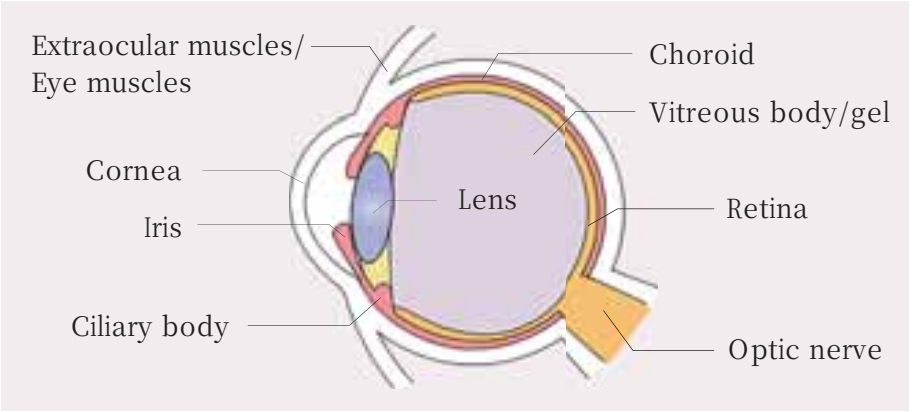

Figure 27 Retina

Meanwhile, we only select and recognize what we choose to “watch” or “listen” to because it is of interest to us.

Field of vision

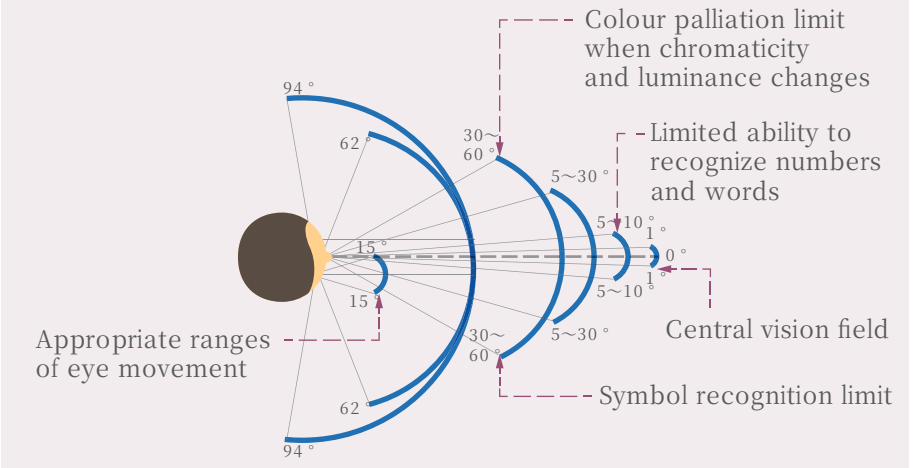

Figure 28 Cognition

For example, when you are concentrated on reading a book, the visible range is only 5 to 10 degrees on both left and right sides, as shown in Figure 28. You may not even notice if someone is approaching you.

The lecturer held a seminar titled “A Psychological Approach to Safety Behaviour” at 16 locations in Japan from April to June of this year, 2019. In the seminar, the participants experienced the following experiments about optical illusions.

He used 3 different illusions, including the Delboeuf Illusion, which is when two pieces of meat of the same size are placed on different sized plates; the meat on the small plate looks larger. The second was the Ponzo Illusion; when the actual size of an object is the same, but looks larger when on the horizon at the top of a triangle, and smaller when it is near the bottom of the triangle. The last illusion was the most famous one that consists of two straight lines of which both have arrows pointing inward or outward at the ends (Müller-Lyer Illusion). The lecturer changed the length of one line slightly on purpose in jest, as most of the participants new it was an optical illusion. This was apparent by the fact that most raised their hands indicating they though they were same in length. There were few participants who thought they were different lengths. Naturally, most participants judged they were the same lengths, including the fourth one whose length had been changes intentionally. When analysing this psychologically, it can be understood that the following cognitive behaviours were apparent.

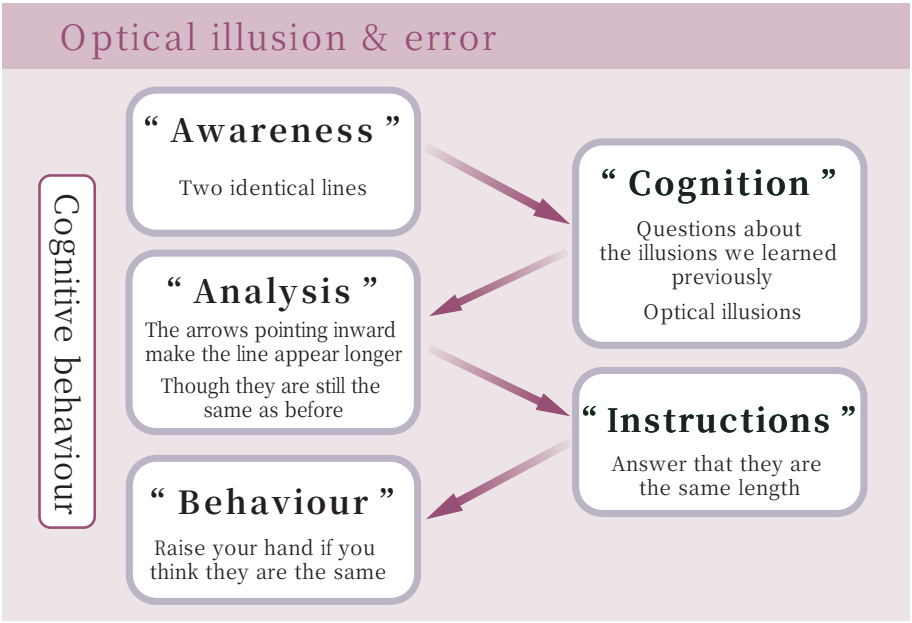

Figure 29 Optical illusion & error

1. As visual information (visible), the two identical lines and arrows reach the retina.
2. Because the questions about the illusions are those we learned about (experienced) previously, we recognize (see) these illusions.
3. Even though we feel that the arrows are pointing inward making the line appear longer because of the illusion, the previous three illusions were all the same.
4. The brain instructs your right hand to answer “they are same” with a weak electric signal.
5. Recognizing the lecturer having said, “Do you think they are the same?”, you behaved in a way so as to raise your hand.

These different five actions occur instantly. Therefore, cognitive behaviour could cause errors. For example, cognitive disfunction regarding colour, size and perspective. In addition, it is another cognitive deficit to think it is a different subject. Regarding the

Müller-Lyer Illusion, though the audience was expecting the lines to actually be the same length, the lecturer changed the length of one of the lines slightly on purpose in jest.

In other words, this can be regarded as analysis deficit. Also, questions may be ordered differently, wrong predictions and even instructions that that not everyone can follow. The causes of error behind cognitive behaviour may be influenced by the following disfunctions and deficits:

- Colour, size and perspective (cognitive disfunction)
- Different subject (cognitive deficit)
- Assuming and patterns (analysis deficit)
- Order and prediction (analysis and instruction deficit)
- Default, the impossible and another behaviour (behavioural deficit)

These parts are the “root cause” of human error. If you think about it in this way, you can see the original cause of human error. Bias and intuition are collective human strengths and this explains why people raised their right hands. The lecturer told everyone to not feel embarrassed, as it was testimony that they are fully developed.

However, it is essential to know that sometimes this can be a hindrance when it comes to satisfying or perfecting safety behaviour. It is also important to ensure that we measure lengths or distances; if length, be sure to use a ruler rather than guessing intuitively, and if it is the distance between your vessel and another, be sure to use the radar without allowing yourself to be confused by the strength of the lights and the size of the other ship.

ANSWER

To exemplify this Cognition, we were shown Quiz 3: At an elementary school's sports festival. **The correct answer being that the son is an elementary school teacher and older brother of the young lady.** Were you able to come up with the correct answer? There were about 540 participants in total at the seminar, but only 8 answered correctly.

The explanation intentionally suggests that their son is an elementary school boy. "He is a naughty son. Every time he comes back from school, he always has cuts, scrapes and scratches...These days, he is very tall and eats a lot. He is a very active son. He is running around wearing a pair of shorts right now. Oops, he just tripped over again!" Also, the lecturer led the audience to believe that there was something complicated about this family judging by the daughter's response.

The parents mentioned that they have a son and the daughter declared that she has no younger brother, which are all key to unravelling this riddle. Their son is one of the teachers. Moreover, with the help of visual aids (Figure 30), you were led to believe that the sone was an elementary school child.

This is known as "confirmation bias" which makes it difficult for one to undo the impression that one has already pictured and has set in one's mind. (Details will be described below.)

Figure 30 Confirmation bias : At an elementary school's sports festival

Almost all kindergarten children would come up with the correct answer, if we tested them with the same quiz. Because their capacity to listen and think of an explanation comprehensively has not developed yet. There is no shame in assuming and thinking instinctively, because it is a proof of human experience and growth. However, as described above, such kinds of biases sometimes interfere, when we need to be thinking more objectively to ensure safety - such as ship operations.

＊ Bias

A term which is used to refer to the broblem of perception that is caused by unbalanced information obtained by not only trends, biases, preconceptions, biases in data, etc., but also assumption factors which bring about specific biases in thoughts and judgements.