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Presence of Motion Lines in Human Pictograms: Analyses and Evaluations

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A human pictogram is a graphic symbol with a human shape that is widely used in public signage. In this paper, we focus on the motion line in pictograms (i.e., the direction in which the human shape is moving) to improve the understandability of human pictograms, and we define understandability from the following three aspects. First and second, whether the meaning of the pictogram can be recalled rapidly and correctly, and third, whether the pictogram is easy to understand. A motion line is an expression technique that is used mainly in comic book illustrations to express quickness, surprise, shock, and so on. Ten topics of human pictograms both with and without motion lines were created through Pictogramming, a pictogram authoring tool. The experiment was performed with 39 examinees to verify the understandability of these ten topics. In the experiment, a questionnaire was used to assess the recalled meaning of the pictogram, the time that it took for examinees to recall that meaning, and the pictogram's value of understandability. We used the Mann-Whitney U test and Fisher's exact test and determined that human pictograms with motion lines are more understandable than human pictograms without motion lines in some cases. We concluded, therefore, that the understandability of pictograms can be improved with the inclusion of a motion line.

Keywords: human pictogram; motion line; Pictogramming

1 Introduction

A pictogram is a graphical symbol that is used to represent a semantic concept based on the meaning of its shape (Ota, 1993). Given the importance of standardizing, the ISO (International Organization for Standardization) or JISC (Japanese Industrial Standards Committee) deliberate and design the standards for pictograms. For example, the ISO standards for pictograms are represented through the “Graphical symbols – Public information symbols” (ISO 7001) and “Graphical symbols – Safety colours and safety signs –

Registered safety signs” (ISO 7010), whereas the corresponding JISC standard is the JIS Z 8210. Because of the work of these organizations, pictograms have been standardized in various fields such as counselling, safety, and facilities management. Additionally, ISO 3864 and JIS 9101 contain guidelines for symbols relating to prohibition, attention, instruction, and safety. Normally, pictograms are designed by the guidelines to provide information regarding a human’s action or status. Human-shaped pictograms, especially, are widely used in various international standard pictogram sets. The appendix of ISO 3864 provides guidelines for how to depict human-shaped pictograms.

Pictograms are used globally and are the subject matter of many recent studies in fields such as intercultural communication (Mori, Takasaki, & Ishida, 2009) and semiotics (Hassan, 2017) due to globalization and the rapid increase in tourism worldwide. There is an especially large body of research related to the use of pictograms as Augmentative and Alternative Communication (AAC) (Martínez-Santiago, García-Cumbreras, Montejo-Ráez, & Díaz-Galiano, 2016). At the moment, many pictograms are used at public facilities, such as airports, train and bus stations, bus stops, and other public locations around the city.

In this paper, we focus on the motion line in human pictograms and experimentally verify its understandability and other characteristics. We define understandability from the following three aspects. First and second, whether the meaning of the pictogram can be recalled rapidly and correctly, and third, whether the pictogram is easy to understand.

The motion line is a popular technique used in comic books and cartoons. It depicts information about the effects of an object, such as its speed, length of path, and degree of rotation (Kato, Shibayama, & Takahashi, 2004). The motion line has several potential characteristics, such as speed line, concentrated linework, flash, and so on. The speed line can express quickness, the concentrated linework can accentuate a person or a scene, whereas the flash can express surprise and shock.

2 Relevant studies

There are few studies that address the understandability of human pictograms; relevant studies include Kitagami, Inoue, and Nishizaki (2002), who evaluate the understandability of word-level visual symbols, and Fujimori, Ito, Durst, and Hashida (2007), who evaluate emotional awareness regarding different arrangements of pictograms. There are, however, many studies about motion lines. For instance, Kato et al. (2004) developed a tool that allows users to add motion lines and other animation effects easily and effectively. Carello, Rosenblum, and Grosofsky (1986) reported that the number of people who felt “Man is running” or “Man is moving” increased when a motion line was added to a pictogram depicting a “person who is running.” Many researchers reported that humans can intuit motion when an object that is accompanied by a motion line from as early as five years old (Friedman & Stevenson, 1975; Gross et al., 1991; Mori, 1995). Burr and Ross (2002) confirmed that streak which is drawn in the direction of the associated motion (i.e., motion streaks) influence recognition of motion direction. Kawabe and Miura (2008) demonstrated that when a motion line is added to a ball that is moving, humans can intuit the direction the ball is moving in depending on the direction of the motion line.

However, there is a lack of research focusing on the efficacy of motion lines in human pictograms.

3 Outline of the experiment

3.1 Creating human pictograms and motion lines

We created human pictograms and motion lines for our experiment. We used "Pictogramming[1]" (Ito, 2018), which is based on two words: "pictogram" and "programming". The basis of this application is the use of a human pictogram, and it is a pictogram authoring tool developed by Ito.

Figure 1 is a screenshot of the Pictogramming application. A large human-shaped pictogram is displayed in area A, the human pictogram display panel. The panel can display either the front or side views of the human pictogram, as defined by the ISO 3864 Appendix, where both comprise nine parts: the body and head (considered as a single part), two upper arms, two lower arms, two upper legs, and two lower legs. The size of each part conforms to the dimensions specified in ISO 3864 (see Figure 2).

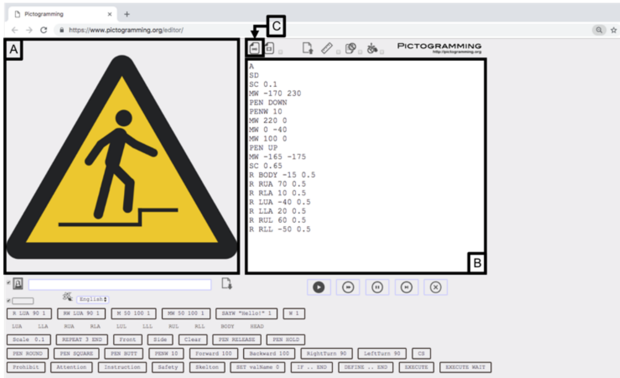


Figure 1. Screenshot of "Pictogramming"

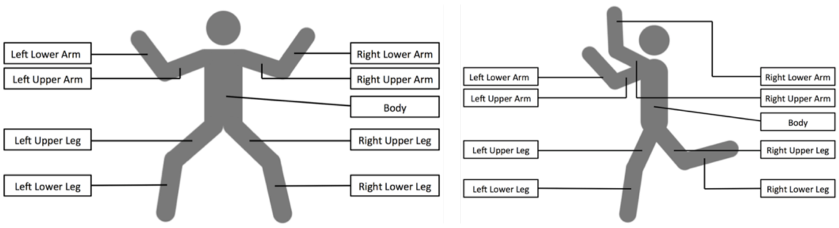


Figure 2. Front and side views of a human pictogram

Operations on the human pictogram are input and defined in area B, the program code description area. The commands are classified into two types: 1) the "Pictogram Animation Command," which changes the shape of the human pictogram and 2) the "Pictogram Graphics Command," which is very similar to turtle graphics in that it can draw a motion line easily. Turtle graphics is one of graphic outputs. In Turtle graphics, by giving instructions to move to the virtual turtle onscreen, we can draw the movement trajectory as graphic, so everyone including a person who does not understand coordinate system can draw graphic easily by combination simple procedures. Command names and arguments can be easily intuited from personal experiences and existing knowledge. The commands and movements of the human pictogram have fine granularity. Pictogram graphics focus on the movement of the human body, and pictogram animation focuses on the rotation of human body parts. The combination of these two types of commands is a unique feature of Pictogramming. Figure 3

[1] https://pictogramming.org/?page_id=470

shows an example of pictogram animation, pictogram graphics, and a combination of both types.

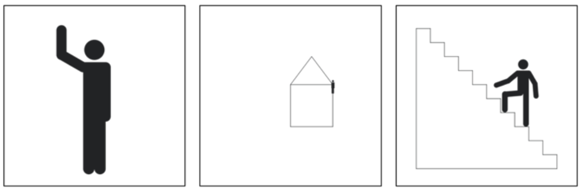


Figure 3. Examples of outputs from Pictogram Animation (left), Pictogram Graphics (center), and a combination of both types (right)

Also, the commands for creating the symbols for warning, prohibition, instruction, and safety are readymade. Figure 4 shows an example of the symbol created by Pictogramming.

Figure 4. Example of outputs from Warning (left), Prohibition (second from left), Instruction (second from right), and Safety (right)

Figure 5 shows a sample code. Pictogramming adopts original commands based on separating operation code and arguments with blanks. Figure 6 is executing the output “Warning; uneven access / up” with the sample code shown in Figure 5.

```
// Creates the mark of attention
A
// Changes the human pictogram to side views
SD
// Changes the scale of the human pictogram
SC 0.1
// Pictogram Graphics
MW -170 230 0
PEN DOWN
PENW 10
MW 220 0 0
MW 0 -40 0
MW 100 0 0
PEN UP
MW -165 -175 0
// Changes the scale of the human pictogram
SC 0.65
//Pictogram Animation
R BODY -15
R RUA 70
R RLA 10
R LUA -40
R LLA 20
R RUL 60
R RLL -50
```

Figure 5. Sample code

In the sample code in Figure 5, comments can also be written using the "`//`" sign. Lines 7 to 15 are in accordance with Pictogram Graphics; these lines draw a step. The "`M`(ove) `W`(ait)" command shown in Line 8 means move 170px in the positive x-axis direction and 230px in the negative y-axis direction. The next command is not executed until this movement is completed. Lines 19 to 25 are in accordance with Pictogram Animation. The "`R`(otate)" command means rotate a part of the body. For instance, "`R RUA 70`" shown in Line 20, means rotate the Right Upper Arm (RUA) 70 degrees counterclockwise. If a third argument is added, the time for rotating can be designated. However, a third argument is omitted in this paper because a non-animated image is needed.

Figure 6. "Warning; uneven access / up" by sample code (Figure 5)

Furthermore, Pictogramming can easily save the pictograms that are created. When users want to save the pictogram as a picture, they just click button labeled C in Figure 1.

Last, Pictogramming has another feature which the effect of syntonic learning can be obtained. Syntonic learning is noted to be important in programming by Papert who developed the programming language "LOGO" . To actualize syntonic learning, in Logo, the user can execute commands by pretending to be a turtle using their own bodies. On the other hand, in Pictogramming, syntonic learning can be obtained by using human pictogram instead of turtle because the human pictogram resembles a body that represents the ego and the illustrated pictograms represent one's culture.

3.2 The purpose

The purpose of this experiment is to assess our understanding of human pictograms with and without motion lines. Hereafter, a human pictogram without a motion line will be called "without motion line" and a human pictogram with a motion line will be called "with motion line."

The examinees answered three questions regarding "without motion line" and "with motion line" in this experiment. There are ten images each of pictograms "without motion line" and "with motion line." Hereafter, a "without motion line" OR "with motion line" pictogram will be referred to as a "type," whereas a "without motion line" AND "with motion line" will be referred to as a "topic." Moreover, in this experiment, we developed the questionnaire system to measure the time it takes the examinees to answer. The interface of the questionnaire system is shown in section 3.5.

3.3 Topics

Figure 7 shows the topics that were used in the experiment. We selected ten topics based on whether they met the following three conditions:

1. Being a safety sign as defined by ISO 7010 or JIS Z 8210.
2. Over half body of human pictogram is depicted in the pictogram.

3. Original pictogram consists motion line, or if not, human pictogram in which original pictogram is in a state of motion.

In Figure 7, the left side of each topic is “without motion line,” the right side is “with motion line,” and the types that are boxed are defined by ISO 7010 or JIS Z 8210. Additionally, the numbers under the topics denote the order of the questions, and the phrase in parentheses shows the associated meaning as defined by ISO 7010 or JIS Z 8210.

Table 1 shows how each topic is defined under either ISO 7010 or JIS Z 8210, and a brief explanation of motion lines is used in each type. In the column “Definition,” ISO means it is defined under ISO 7010, and JIS means it is defined under JIS Z 8210, and in the column “Topics,” the number represents the order of the question and the phrase in parentheses indicates the definition under ISO 7010 or JIS Z 8210.

Figure 7. Ten topics used in the experiment

Table 1 Ten topics adopted in the experiment

<table>
<tr><th rowspan="2">Topics</th><th rowspan="2">Definition</th><th colspan="2">Motion line</th></tr>
<tr><th>Style</th><th>Summary</th></tr>
<tr><td>1 (Warning; Obstacles)</td><td>JIS</td><td rowspan="2">Flash</td><td rowspan="2">Collision</td></tr>
<tr><td>2 (Warning; Overhead)</td><td>JIS</td></tr>
<tr><td>3 (Warning; Slippery surface)</td><td>JIS</td><td rowspan="8">Speed line</td><td rowspan="5">Motion by human pictogram</td></tr>
<tr><td>4 (Warning; Drop)</td><td>JIS</td></tr>
<tr><td>5 (Warning; Drop)</td><td>ISO</td></tr>
<tr><td>6 (Warning; Slippery surface)</td><td>ISO</td></tr>
<tr><td>7 (Warning; Floor level obstacle)</td><td>ISO</td></tr>
<tr><td>8 (Warning; Falling objects)</td><td>ISO</td><td>Motion by objects</td></tr>
<tr><td>9 (Prohibition; Do not rush)</td><td>JIS</td><td rowspan="2">Motion by human pictogram</td></tr>
<tr><td>10 (Prohibition; No pushing)</td><td>ISO</td></tr>
</table>

3.4 The examinees

The examinees comprised 39 students at the School of Social Informatics, Aoyama Gakuin University. All examinees were familiar with using computers and therefore, could easily operate the questionnaire system. In this experiment, the 39 examinees were divided into two groups: one for answering questions about pictograms “without motion line,” and the other for answering questions about “with motion line.”

3.5 The experimental procedure

The following is the experimental procedure.

1. The experimenter provides a simple explanation of human pictograms. The experimenter then explains the following (approximate duration of the explanation is three minutes).
    a. Pictograms are used worldwide as a symbol representation system, and they are used at public facilities such as airports, train and bus stations, bus stops, and at other public locations around the city.
    b. Given the importance of standardizing, ISO or JIS deliberate and design the standards for human pictograms.
    c. ISO and JIS design the guidelines for symbols denoting prohibition and attention, and in this experiment, the pictograms based on these guidelines are used.
2. The experimenter divides the examinees sitting in front of computers into two groups: one for answering questions about pictograms "without motion line" and another for answering questions about pictograms "with motion line."
3. The experimenter gives three directions to the examinees.
    a. The examinee must answer only questions asked of his or her group.
    b. The examinees must answer questions according to the questionnaire system.
    c. The questionnaire is configured with ten types, and each topic necessarily expresses a different concept.
4. The examinees answer about ten types in total, and each type has three questions. Therefore, there are 30 questions in total, and all questions are on the test by questionnaire system. They stare at all types of pictograms with 640x640 pixels in an area of about 3.5 cm x 3.5 cm, so the examinees can see the motion line clearly. The following are the three steps outlined by the questionnaire system, and Figure 8 shows an exam of a display screen in these steps.

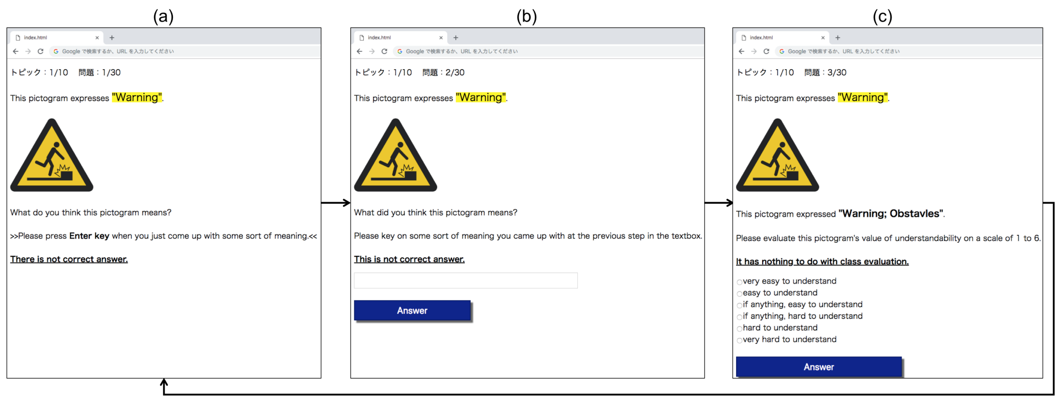


Figure 8. A display screen in the questionnaire system

    a. First, the questionnaire system displays only a picture of a human pictogram. Figure 8 (a) shows an example of a display screen. The examinees think about the meaning of the type displayed, and press the Enter key when they infer some sort of meaning. After this, the questionnaire system moves on to the second step. In this step, the questionnaire system measures the time it takes the examinees to answer, which is defined as "recall time."
    b. Second, the examinees type in the meaning they came up with in the first step in the textbox given. After that, the questionnaire system moves on to the

final step. Figure 8 (b) shows an example of the display screen. This answer is defined as “recall content.” If a textbox is empty, the questionnaire system does not move on to the final step.

c. Third, the questionnaire system displays each human pictogram type’s meaning as defined under ISO 7010 or JIS Z 8210. The examinees evaluate the type’s level of understandability on a scale from 1 to 6 after they compare the presumed meaning they came up with in the first step to the type’s meaning as defined by ISO 7010 or JIS Z 8210. The following is the 6-grade evaluation: 6-very easy to understand; 5-easy to understand; 4-if anything, easy to understand; 3-if anything, hard to understand; 2-hard to understand; and 1-very hard to understand. Figure 8 (c) shows an example of a display screen. This answer is defined as “value of understandability.” Also, if an examinee does not select the type’s “value of understandability,” the questionnaire system does not move on to the next question.

4 Experimental results and considerations

This section discusses the experimental results and considerations from the viewpoint of topics or persons.

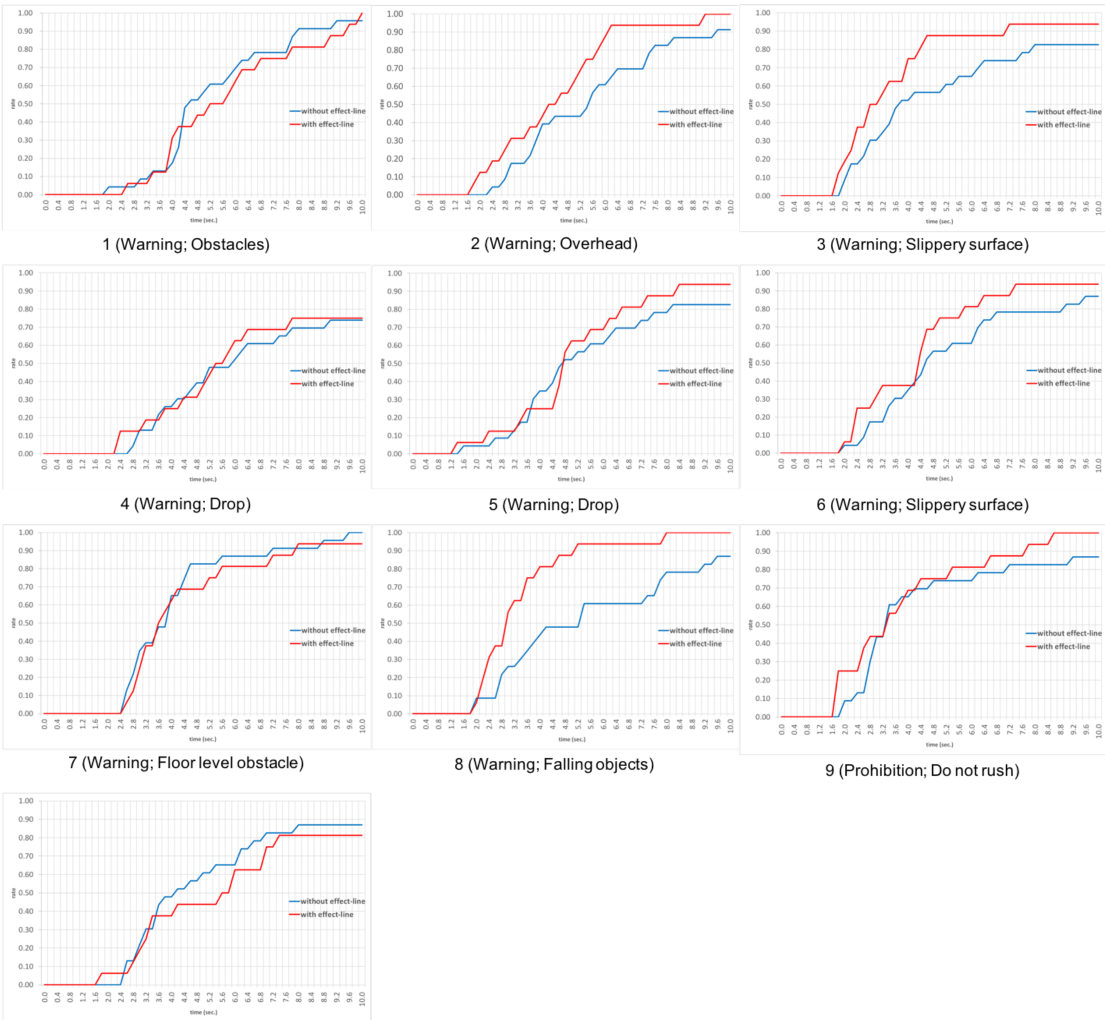
Table 2 Experimental results and results of the test

Topics	Motion line	Recall time			Recall content		Value of understandability								
		mean (sec.)	SD	p-value	concordance rate	p-value	the number of answers 1	2	3	4	5	6	mean	SD	p-value
1 (Warning; Obstacles)	X	5.427	2.228	0.767	1.000	0.008	0	3	5	8	5	2	3.913	1.164	0.114
	O	5.728	2.269		0.688		0	0	3	4	7	2	4.500	0.966	
2 (Warning; Overhead)	X	7.948	10.213	0.133	0.478	1.000	0	4	3	6	7	3	4.087	1.311	0.236
	O	4.353	1.887		0.500		1	1	3	0	6	5	4.500	1.592	
3 (Warning; Slippery surface)	X	5.526	3.928	0.079	0.783	0.370	1	2	7	7	4	2	3.739	1.251	*0.002
	O	3.662	2.444		0.938		0	1	2	0	5	8	5.063	1.289	
4 (Warning; Drop)	X	8.310	5.994	0.855	0.391	1.000	1	4	8	5	3	2	3.478	1.310	0.892
	O	8.264	7.349		0.375		1	5	1	4	3	2	3.563	1.590	
5 (Warning; Drop)	X	5.912	3.195	0.832	0.261	*0.004	2	5	7	4	4	1	3.261	1.356	0.158
	O	5.188	2.283		0.750		0	4	2	4	2	4	4.000	1.549	
6 (Warning; Slippery surface)	X	5.972	3.860	0.251	0.783	0.370	1	5	3	8	6	0	3.565	1.237	0.055
	O	4.484	2.322		0.938		0	1	2	5	6	2	4.375	1.088	
7 (Warning; Floor level obstacle)	X	4.151	1.883	0.657	0.957	0.139	1	2	3	4	7	6	4.391	1.469	0.207
	O	5.963	7.467		0.750		2	2	0	6	5	1	3.813	1.515	
8 (Warning; Falling objects)	X	5.747	3.187	*0.009	0.870	0.415	2	5	1	2	6	7	4.130	1.817	0.230
	O	3.333	1.516		0.750		0	0	1	4	5	6	5.000	0.966	
9 (Prohibition; Do not rush)	X	5.011	3.970	0.458	0.957	1.000	0	2	0	4	10	7	4.870	1.140	0.033
	O	3.801	2.155		1.000		0	0	0	1	5	10	5.563	0.629	
10 (Prohibition; No pushing)	X	5.560	3.930	0.563	0.565	0.785	1	3	3	7	6	3	4.000	1.382	0.271
	O	6.404	4.560		0.625		0	1	2	4	6	3	4.500	1.155	

Note: The number of answers is 23 “without motion line” and 16 “with motion line” in every Topic.

Table 2 shows the results of the experiment as well as the results of the Mann-Whitney U test about “recall time” and “value of understandability,” and the results of Fisher's exact test about “recall content.” The Mann-Whitney U test is conducted in order to verify whether a significant difference is acknowledged between “without motion line” and “with motion line” regarding “recall time” and “value of understandability;” Fisher's exact test is conducted in order to verify whether a significant difference is acknowledged between “without motion line" and "with motion line" regarding "recall content." Also, an asterisk (*) is used to designate items with a significant difference ($p < 0.01$). Student's t-test is general statistical significance test, but because normality about "recall time" and "value of understandability" between "without motion line" and "with motion line" is not acknowledged by the Shapiro-Wilk test, the U test is utilized. In Table 2, a number in the column "Topics" shows the sequence of questions and the phrase in parentheses shows the meaning as defined under ISO 7010 or JIS Z 8210.

Next, Figure 9 shows a graph of cumulative ratio for "recall time" by persons. The horizontal axis shows time (sec.) and the vertical axis shows rate of answers. The rate is cumulative, so the values of rate represent answers that have been given by the time shown on the horizontal axis. For instance, in "with motion line" of a topic for 1 (Warning; obstacles), the value of 5.2 on the horizontal axis means that half of the examinees have finished answering by the 5.2 second mark. In Figure 9, the maximum value of the horizontal axis (sec.) is 10. In some types, the rate does not approach 100% because there are examinees who did not finish answering until after the 10-second mark. Also, the number of answers in the time range (0.2 seconds) is large enough to make the slope steep. Note, the numbers that are written under the graphs represent the order of the question, and the phrase in parentheses indicates the meaning as defined under ISO 7010 or JIS Z 8210.



1 (Warning; Obstacles)

2 (Warning; Overhead)

3 (Warning; Slippery surface)

4 (Warning; Drop)

5 (Warning; Drop)

6 (Warning; Slippery surface)

7 (Warning; Floor level obstacle)

8 (Warning; Falling objects)

9 (Prohibition; Do not rush)

10 (Prohibition; No Pushing)

Figure 9. Cumulative ratio for "recall time"

4.1 Understandability

Regarding “value of understandability,” a significant difference was identified, implying that “with motion line” is more understandable than “without motion line,” which is acknowledged in topic 3 (Warning; Slippery surface). In topic 3 (Warning; Slippery surface), the horizontal plane is not drawn although it is drawn in every topic except for topic 9 (Prohibition; Do not rush). For that reason, it is difficult for examinees to regard the motion direction of human pictograms as being either vertical (dropping) or horizontal (slipping). This phenomenon can be caught from some examinees' description "Caution; Fall" in "recall content" for "without motion line." of topic 3 (Warning; Slippery surface)

Incidentally, in topic 9 (Prohibition; Do not rush), the horizontal plane is not drawn either, but no significant difference is acknowledged in this topic, presumably because of the high penetration rate on this topic. Today, this topic is presented at many public transportation depots and public facilities in order to improve public etiquette and the examinees are likely to have learned this topic in advance. Therefore, because it is easy for the examinees to recall the meaning even when the horizontal plane is not drawn, the “concordance rate” and “value of understandability” are high in both categories, “without motion line” and “with motion line.”

4.2 Recall time

In “recall time,” we found a significant difference with the “with motion line” being more understandable than “without motion line” in topic 8 (Warning; Falling objects), two features of which can be read from Figure 9. First, when we compare the rate at which the examinees have finished answering in the same timeframe both “without motion line” and “with motion line, the ratio in “with motion line” is almost higher than it is in “without motion line.” Second, the convergence of answers is fast in “with motion line,” but slow in “without motion line.” In total, 93.75% of the examinees had finished answering within 5.2 seconds in “with motion line,” but 48.00% of them had finished answering by the same time in “without motion line.” Additionally, whereas all examinees have finished answering by 10.0 seconds in “with motion line,” the rate is less than 90.00% in “without motion line.” In short, the rate by 10.0 seconds in “with motion line” is very high, and the gap between “with motion line” and “without motion line” is more than 10.00%.

The graph in topic 3 (Warning; Slippery surface) fits the said two characteristics in topic 8 (Warning; Falling objects). In topic 3 (Warning; Slippery surface), we found that “with motion line” is significantly more understandable than “without motion line,” which was acknowledged regarding “value of understandability” in section of 4.1. Then, we inferred that short “recall time” is relative to understandability intuition; thus, “recall time” is relative to “value of understandability.” However, in topic 8 (Warning; Falling objects), “with motion line” is significantly more understandable than “without motion line,” which we acknowledged about “value of understandability,” as mentioned in section 4.1. Moreover, “recall time” is not correlated with “value of understandability” ($r = -0.262$). Therefore, we observed answers for each person; however, there are a few answers where “value of understandability” has a high value, although “recall time” is over 10.0 seconds. This experiment was done in small groups—39 people—so a few errors have a huge effect on experimental results. Hence, we designed the experiment for large crowds of over 100 people to reverify our results.

4.3 Recall content

Regarding concordance rate of “recall content,” there was a significant difference in “with motion line” being more understandable than “without motion line,” as acknowledged in topic 5 (Warning; Drop). By contrast, in topic 4 (Warning; Drop), regarding the concordance rate of “recall content,” “with motion line” is less than “without motion line.” Moreover, in topic 4 (Warning; Drop), the mean value is almost the same between “without motion line” and “with motion line” with regards to “value of understandability” and “recall time.”

“With motion line” of topic 4 (Warning; Drop) and “with motion line” of topic 5 (Warning; Drop) have similar meanings but their pictographic representations differ. For both types, the motion line’s style is a speed line, and these lines represent motion in human pictograms. There are seven types of speed lines in usage. Please refer to Table 1 in section 3.3 for details. Speed lines are drawn in the opposite direction of the associated motion except for in topic 4 (Warning; Drop) because speed lines wherein multiple lines are drawn in the direction opposite to the direction of objects that are side by side is the most typical (Hayashi, Matsuda, Tamamiya, & Hiraki, 2012). By contrast, in topic 4 (Warning; Drop), it is difficult to draw motion lines based on said theory without changing the design and size of the original pictogram. Therefore, in topic 4 (Warning; Drop), the motion line is drawn in the same direction as the motion, and we researched the impact on understandability. As a result, in topic 4 (Warning; Drop), it proved difficult for the examinees to understand the motion direction depicted in a human pictogram, so it is assumed that understandability in “with motion line” is not high. This phenomenon can be caught from some examinees’ description “Warning; Jump” in “recall content” for “with motion line” of topic 4 (Warning; Drop). Hence, given the experimental results of topic 4 (Warning; Drop) and topic 5 (Warning; Drop), it is suggested that the most typical motion line by Hayashi et al. (2012) is valid for human pictograms too.

4.4 Considerations for use in real life

Pictograms are seen from a distance in real life. This is because pictograms are used as a way of not only communicating the notions of attention and prohibition, as we focus on in this experiment, but also for instruction and safety. Pictograms are designed so that many people can see them easily. However, because the ease of visibility in pictograms relates to their size, color, figure, and so on, one could speculate that a particular kind of display method for pictograms would increase their visibility further. For instance, in the case of motion lines, making the line thicker could improve visibility from long distances.

5 Conclusion and foresight

In this paper, we researched the difference in levels of understandability between pictograms with and without motion lines experimentally in order to improve the understandability of pictograms based on the results of “recall time,” concordance rate of “recall content,” and evaluation of “value of understandability.” Some topics showed a significant difference in human pictograms with motion lines in that they were more understandable than human pictograms without motion lines. Hence, we conclude that the understandability of pictograms is improved by the addition of motion lines.

However, there are two limitations in this experiment. First, the number of examinees is small, as mentioned in section 4.2. Second, the order of questions is fixed. Hence, the influence due to the order of questions is observed in some topics. For instance, in topic 6

(Warning; Slippery surface), there were some examinees who answered, “Warning; Slippery surface” as “recall content.” “Warning; Slippery surface” is the meaning defined by ISO 7010 or JIS Z 8210 in topic 3 (Warning; Slippery surface). Therefore, from now on, we will conduct experiment the by increasing the number of examinees and changing the order of questions in order to verify our results. Furthermore, we will research the drawing method and creation guideline of motion lines. Finally, we will address the expression of pictograms and function enhancement of Pictogramming (Ito, 2018).

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