Effectiveness of the Text Display in Bilingual Presentation of JSL/JT for Emergency Information

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Abstract. This paper describes an experiment on the message transmission effectiveness achieved by adding Japanese text (JT) to a Japanese sign language (JSL) video. The transmission efficiency of information and the understanding of information are quantitatively measured. The situation assumed is that information about a vehicle accident is to be displayed in a railroad carriage to deaf people. Three information methods are examined JT, JSL, and JT+JSL. We show that JT and JT+JSL yield high correct answer rates; JSL yields low rates. Furthermore, the subjects' impressions of the three methods show that they responded favorably to JT.

1   Introduction

The demand to the information presentation by a universal design is becoming high in recent years. One of the public space for which universal design is needed is a railroad vehicle. For example, when disasters such as an earthquake and a railroad accident occur, it is necessary to transmit urgent information to a passenger quickly and certainly. In order to achieve the reliable transmission of information to deaf people, the process of prompting the awareness to information presentation first and then assisting an understanding to information is required. It is effective to use tactile interactions, such as a vibrator, at the awareness achievement to information presentation. With support of information understanding, it has been said that what is necessary is just to perform information presentation by sign language. However, in an emergency, there is very little research on which information presentation method is suitable for deaf people.

This paper describes an experiment on the message transmission effectiveness achieved by adding Japanese text (JT) to a Japanese sign language (JSL) video. The transmission efficiency of information and the understanding of information are quantitatively measured. The situation assumed is that information about a vehicle accident is to be displayed in a railroad carriage to deaf people. Three information methods are examined JT, JSL, and JT+JSL. We show that JT and JT+JSL yield high correct answer rates; JSL yields low rates. Furthermore, the subjects' impressions of the three methods show that they responded favorably to JT.

2   Experiment

2.1   Subjects

The subjects were 20 men and women aged from 20 to 60. All had lost their hearing before 9 years old and used JSL in everyday life.

2.2   Procedure

The subject was guided in the room in which the experimental device was installed, and was given about the outline of an experiment task and the assumed situation. On the desk of a laboratory, the 21-inch display for an experiment (ProLite H540S / II-YAMA) was installed, and the experimenter took a seat on the chair next to the desk. The sizes of the display were 324mm long and 432mm wide, and resolution was vertical 1200dot and width 1600dot. The distance of a subject and a display was adjusted by about 50cm.

Fig. 1 shows the example of a message display used in the experiment task. The experiment challenged each subject with 30 unique messages; after reading each message, the subject was asked to answer a series of questions about the message's content. Ten messages were shown using each method and the combinations of message and display method were randomly selected.

Fig. 2 shows the example of a display of a reconfirmation test. In the reconfirmation test, the question sentence was displayed by both a Japanese text and sign language, and the choice for a reply was shown by only the Japanese text. In the message display screen, the text was displayed on the left-hand side of the screen, and sign

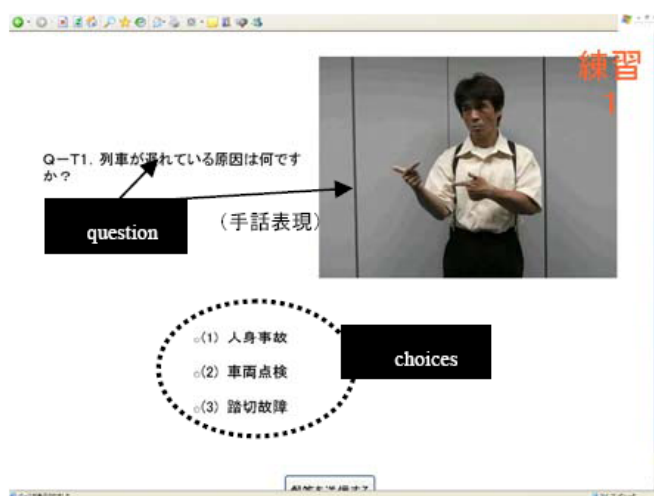**Fig. 1.** An example of message display in the experiment

Fig. 2. An example of a display of a reconfirmation test

language video was displayed on right-hand side. The length of a text box is ten characters per line, and it was adjusted so that it might start a new line within a text box, in exceeding ten characters by one line. The Gothic character (27 points) was used for the font for a text display. Each subject read the message displayed on a liquid crystal display on a desk in a laboratory, and responded to the recognition test displayed immediately after that. In the experiment, the time taken to "read" the message and the percentage of correct answers to the questions were recorded. The subject was told to assume the situation where the train in which the subject was riding stopped suddenly and the message was shown on the display in the carriage. Before beginning the experiment, a list of the words used to make the messages was shown to the subject; they were explained until the subject understood them.

3   Results

3.1   Message Reading Time

Fig. 3 shows average message read time. 3. A vertical axis shows time (second), and a horizontal axis shows each message displaying method. Average message read time was 32.1 seconds (SD=7.0) with JSL, 13.0 seconds (SD=5.7) with JT, and 22.5 seconds (SD=10.8) with JT+JSL. The message read time was JT < JSL + JT < JSL. The difference was significant ($F(2, 57) = 27.65$, $p= 0.000<0.01$) at the 1% level as indicated by the ANOVA test. The result indicates that message reading is quickened up by text display in the JSL/JT bilingual presentation.
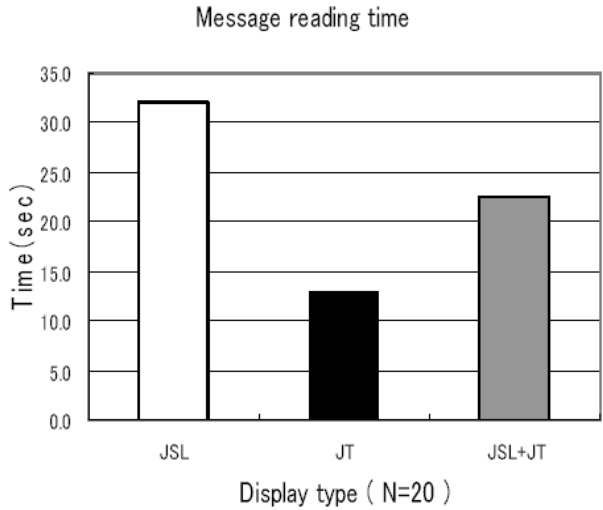
Message reading time

Fig. 3. Message read time

3.2 Percentage of Correct Answers

Fig. 4 shows the percentage of correct answers to the recognition test questions. In Fig. 4, vertical axis is a percentage of correct answers, and horizontal axis is each message displaying method. As shown in Fig. 4, the correct answer rates were 0.79 (SD=0.14) for JSL, 0.88 (SD=0.08) for JT, and 0.89 (SD=0.12) for JT+JSL. The difference was significant ($F(2, 57) = 4.29$, $p= 0.018<0.05$) at the 5% level as indicated by the ANOVA test. A multiple comparison using the method of Tukey showed that there was a significant tendency with regard to JSL versus JT ($p= 0.063>0.05$, <0.1), and a significant difference at the level 5% between JSL and JT+JSL ($p= 0.023<0.05$). The results show that the using text display raised the level of message understanding.

3.3 Subjective Evaluation

The subjects' impressions of the three methods were collected at the end of the performance measurement using a questionnaire. The questionnaires consist of five items as following:

1. Accuracy: I think that a message is transmitted correctly.
2. Quickness: I think that a message is transmitted quickly.
3. Easy understanding: I think that it is easy to understand a message.
4. Conformity in an emergency: I think that this displaying method is suitable for an urgent message like this time.
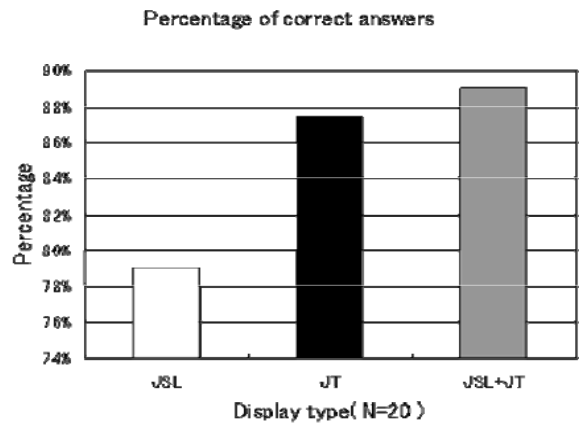5. Sense of security: I think that this display method has sense of security.

Percentage of correct answers

Fig. 4. Percentage of correct answers of the recognition test

Fig. 5 shows the results of the subjects' impressions of the three different methods. Vertical axis is a rating value, and horizontal axis is each questionnaire. In the figure, white stick express JSL, a black stick express JT, and the gray stick expresses JSL+JT, respectively. As shown in the figure, the JSL was scored remarkably low by all subjects in all questionnaire areas. As a result of performing a Kruskal Wallis test about each evaluation criteria, the significant difference of the 1% level was detected with all the questions (accuracy, quickness, understanding ease, conformity in an emergency, sense of security). This confirms that message presentation is improved by using text display.
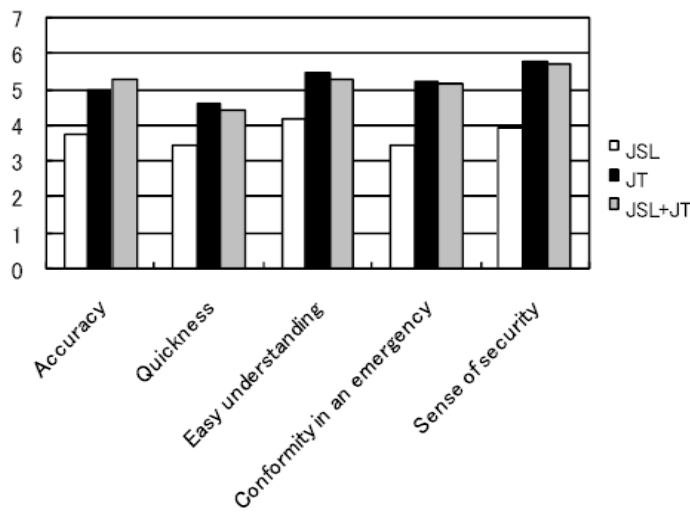

Fig. 5. Impression evaluation to the three message displaying methods

4   Discussion

Free discussion with a subject was held after the performance test finished. In the discussion, opinions were freely exchanged about the distinctness of the message displaying method used in this experiment, and about unclearness of words used in a public transportation facility in everyday life.

4.1   Distinctness of the Message Displaying Method

Some comments were obtained from the subject about the distinctness to the message displaying method. Opinions from the subjects are summarized in Table 1.

Table 1. Opinions from the subjects

Category	Comment
Expression of JSL	A name of the station, a name of a place, etc. may be unclear by sign language.
Expression of JSL	The translator who is appearing on sign language video seemed to have been hard to do sign language, in order that there might be no reaction of a partner (the camera was a conversation partner). Therefore, possibly there was an unclear portion by sign language expression. Reactions, such as a partner's expression, are required of the conversation in usual sign language. However, I think that it was the sign language different from usually since there was no reaction of a partner this time.
Expression of JSL	In the case of an area which is visited for the first time, I may be unable to understand the sign language (dialect) of the area immediately.
Sequentiality of JSL	In order to understand the meaning of sign language, a certain amount of time is required. The sign language cannot be seen the whole simultaneously.
Sequentiality of JSL	When checking a departure time, I can check it quickly with a text, but with sign language, I have to see sign expression one by one.
Symbolic for deaf	The display of sign language shows that an information display is for deaf persons. Moreover, I think that an understanding of a deaf person increases by sign language display in public space.

Numeric representation such as time, nouns such as the name of a place and a station may be unclear by sign language. Moreover, it was suggested that message understanding may be disturbed by a regional dialect. Since sign language was a sequential language on condition of a dialog with a partner, in an urgent scene which was assumed in this experiment, the subject felt a feeling of irritation, and impatience.

It was suggested from the experimental result that the text display in a Japanese text can cover the minus aspects of sign language especially in an emergency.

4.2 Difficult Japanese Words for a Deaf Person

Various opinions were obtained when a question was asked about "whether there are any difficult words when you use a public transportation facility usually." The words indicated to be difficult for understanding are special terms which a railroad contractor uses, and are not generally used in daily life. There were some subjects who claim that such words need the additional explanation for using transportation facilities.

4.3 Gaze Analysis of Message Reading

Fig. 6 shows an average gaze duration of message reading in JSL/JT bilingual presentation. Vertical axis is duration time, and horizontal axis is the degree of advance of reading which divided message reading time into three stages. As shown in Fig. 6, subject's gaze is distributed almost equally to both JSL area and JT area. This means that visual comparison of JSL and JT is frequently performed in every three stage. When a message cannot understand enough only by sign language, a subject is supposed to compensate an understanding with reference to a text. Since the information acquisition by glance is possible by text reading, they can read alternatively only the portion which was hard to understand by JSL.
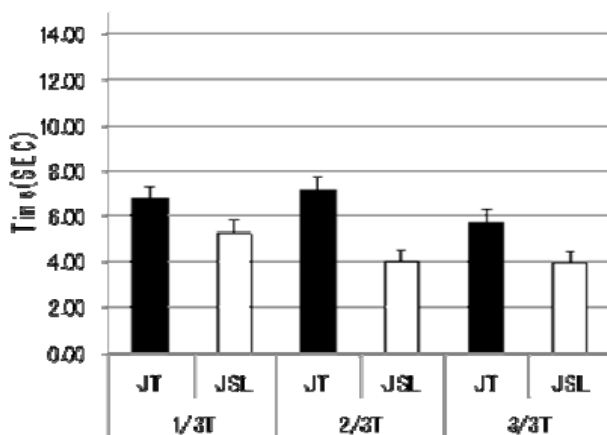

Fig. 6. Average gaze duration in message reading

5   Conclusion

An experiment was conducted on the effect of adding text to emergency messages displayed in sign language. The transmission efficiency of information and the understanding of information are quantitatively measured. The situation assumed is that information about a vehicle accident is to be displayed in a railroad carriage to deaf

people. Three information methods are examined JT, JSL, and JT+JSL. We show that JT and JT+JSL yield high correct answer rates; JSL yields low rates. Furthermore, the subjects' impressions of the three methods show that they responded favorably to JT. The results confirm that adding the text equivalent of the emergency message is very effective in decreasing the time taken to capture the message and raising the level of understanding.

The text display was effective as a result of carrying out measurement of information reading performance, and impression evaluation. However, as a result of conducting gaze analysis of the information reading process by a subject, the subject's information reading strategy was proved to be a continued comparison of both sign language and a text. This result may have been influenced by that the message expression was restrictive and that the lexical level was controlled by presentation of the word list. Although there may be individual difference, comparison of sign language and a text certainly occurs in bilingual presentation of urgent information. Therefore, in presentation of the urgent information to deaf people, just presentation of text messages is insufficient, and it is required to use presentation of sign language together. Smooth cooperation of the awareness to information and information reading is the most important at the information presentation in an emergency. The navigation in an emergency by the cooperation of attention in a tactile sense and information reading should be improved by the further research.

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