

Why Do Illustrations Promote Text Comprehension? Motivation Effect and Elaboration Effect

Hideaki Shimada (shimadahideaki@ni.aist.go.jp)

Muneo Kitajima (kitajima@ni.aist.go.jp)

Institute for Human Science and Biomedical Engineering,
National Institute of Advanced Industrial Science and Technology (AIST).
Central 6, Higashi 1-1-1, Tsukuba, Ibaraki 305-8566, Japan

Abstract

This paper proposes a model that explains the utility of illustrations in promoting text comprehension comprising two effects, increasing motivation and deepening elaboration. We conducted two experiments using an existing evacuation manual to test the model. The first experiment confirmed that illustrations did significantly increase the participants' motivation to read the manual text. The second revealed that the more the participants gazed at the illustrations, the better they recognized the ones they actually had seen, and that the better the participants recognized the illustrations, the higher they recalled the text associated with the illustrations, possibly due to deeper elaboration of the text with the illustrations.

Keywords: text comprehension; illustration; motivation effect; elaboration effect; web design

A Model of Utility of Illustrations in Promoting Text Comprehension

Illustrations are known to be effective for promoting comprehension of text. However, the underlying mechanism is still unknown. The purpose of this paper is to propose a model that explains the mechanism of how illustrations help readers comprehend textual information.

The model will be used to develop an *easy-to-understand evacuation manual* for cognitively disabled people, which is one of research activities carried out in an on-going Japanese national project, "Development of presentation method suiting cognitive abilities of persons with cognitive or intellectual disabilities." Manuals must teach evacuation procedures to the learners in such a way that the procedures can be recalled at the time of disaster and can be transformed for application in various disaster situations.

Figure 1 schematically illustrates the model. The model assumes that illustrations should promote comprehension of manual text through two effects: motivation and elaboration. In other words, the level of understanding of a manual should increase if its appearance *motivates* the learner to read, and if the manual text is *elaborated* more deeply.

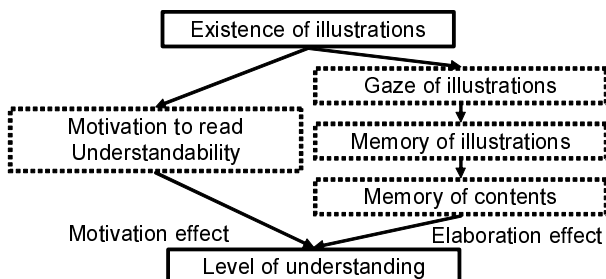


Figure 1: Schematic illustration of the model.

Motivation Effect

Motivation is derived from our daily experience. Suppose that you grab a newspaper and find an article on the front page whose heading looks interesting. You may read it carefully or skim through it. If an article includes an illustration, you may be tempted to read it. The illustration should help the reader to decide whether to read or not in a few seconds.

Elaboration Effect

Larkin and Simon (1987) reported why a diagram is so rich in information content, as many as 10,000 words, in their paper titled "Why a diagram is (sometimes) worth 10000 words." Though the purpose of illustrations is not exactly the same as that of diagrams, we assume that the learners should generate a representation of illustrations that helps them elaborate the text with which the illustrations are associated. As depicted in Figure 1, we assume the following steps to stimulate the elaboration effect. 1) The learner gazes at the illustrations. 2) He/she generates a representation of the illustrations. 3) He/she generates a representation of the text-illustration pair, which is regarded as an elaboration of the representation of the text that would have been created without the illustration.

Testing the Model

This section describes two experiments to test the model's assumptions.

Materials We created a set of experimental materials by revising an existing disaster evacuation manual provided on the Web by Kawagoe city, Saitama Prefecture, Japan, available at <http://www.city.kawagoe.saitama.jp/bousai/index.html>. The manual consists of eight web pages. Figure 2 presents one of the pages used in the experiments. Each page included two to seven headings with explanatory text. Each heading corresponds to some evacuation rule and has an associated illustration. We call these illustrated pages. In addition, we created unillustrated pages by removing illustrations from illustrated pages.

Experiment 1: Testing Motivation Effect

Method Thirty-four adults (6 females and 28 males; age 18 to 28) participated in the experiment. We presented participants with the illustrated pages and the unillustrated pages in two seconds in random order and collected subjective evaluations on their impressions. Each time a page was presented, the participants were allowed to glance at it for two seconds and were then asked to answer the following two questions. (a) Motivation to read "Does the page motivate you to read?" (b) Understandability "Does the page look easy to under-

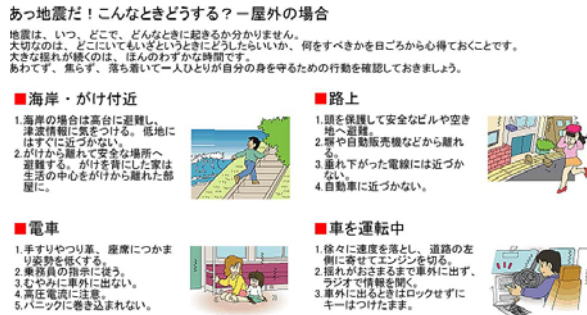


Figure 2: A page from a disaster evacuation manual. One section contains the text: *If you are along coastline or near a cliff and an earthquake occurs 1. You must evacuate to a high ground, and...*

Table 1: Mean scores (and standard deviations) of illustrated versus unillustrated pages.

	Illustrated	Unillustrated
Motivation to read	3.0 (.41)	1.8 (.46)
Understandability	3.3 (.33)	1.8 (.46)

stand?” They responded on a five-point rating scale from [0] “No, not at all” to [4] “Yes, definitely.”

Results Table 1 shows the results. Both the mean motivation-to-read score and the impression-of-understandability score for illustrated pages were significantly higher than those for unillustrated pages, as revealed by t-test ($p < .01$). This indicates that the illustrated pages did motivate the participants more to read them within the mere two-second glancing period than the unillustrated pages did, and this is related to the immediate impression of understandability.

Experiment 2: Testing Elaboration Effect

Method Twenty-three adults (11 females and 12 males; age 18 to 26) participated in the experiment. The illustrated pages were presented to the participants for ten minutes, long enough to comprehend the manual contents, and gaze data were collected. The participants were told at the beginning that they had to take an examination test concerning the contents they would see, and do the best to get high scores. After a distracter task (arithmetic for a minute), a recognition test for the illustrations and a recall test for the text were conducted.

In this experiment, we collected three measures using the model depicted in Figure 1. To measure gazing at illustrations, gaze points were collected with a Tobii x50 eye-tracker. To measure recall of illustrations, 60 illustration cards were prepared for recognition test; half of the cards were old and half were new. To measure recall of text, a recall test was conducted. The participants were asked to answer eight questions from their memory of the contents and to recall the evacuation rules that would match the cues the experimenter indicated.

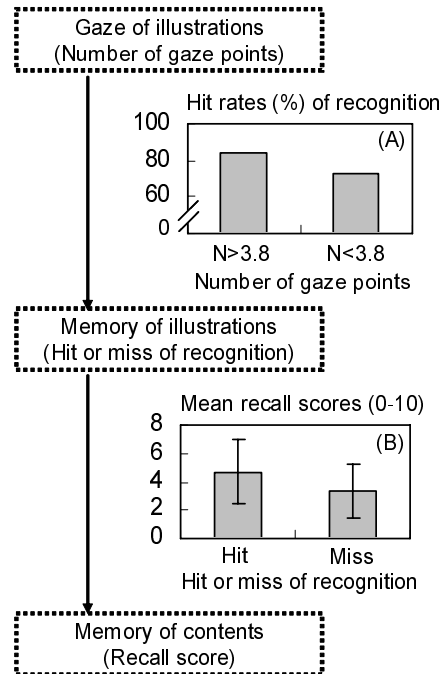


Figure 3: (A) Hit rates as a function of the number of gaze points for each illustration, N , and (B) mean recall scores (0-10) (and standard deviations) as a function of hit or miss of recognition of illustrations, overlaid on the processes for elaboration effect in Figure 1.

Results Participants gazed at each illustration 3.8 times on average ($SD = 4.5$). The more the participants gazed at the illustrations, the better they recognized the ones they actually had seen (Figure 3, A), as revealed by logistic regression analysis ($p < .01$). Then, the better recognition memory resulted in higher recall scores of the text (Figure 3, B), as revealed by t-test ($p < .05$). These results confirmed that readers utilized illustrations to increase their level of understanding by deeper elaboration.

Conclusion

We demonstrated that the utility of illustrations is derived from motivation and elaboration effects. However, the relationships between the attributes that define illustrations and these effects are not yet understood. A better understanding of the relationships would serve as a basis to create easy-to-understand materials.

Acknowledgments

This work was supported by “Assistive technologies to ensure safe and comfortable lifestyles of persons with disabilities,” Special Coordination Funds for Promoting Science and Technology, 2004, from the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan.

References

Larkin, J. H., & Simon, H. A. (1987). Why a diagram is (sometimes) worth ten thousand words. *Cognitive Science*, 11, 65–99.