A Proposal for Disaster Evacuation Manuals that Consider Spatial-Temporal Structure of Learner's Everyday Life

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Abstract. Current disaster evacuation manuals do not provide sufficient retrieval cues to recall appropriate rules when a disaster occurs. In order to resolve this, we propose a new manual with a spatial-temporal structure of the learner's everyday life based on the consideration that people recognize their own situations at all times and that the situation is embedded in a spatial-temporal structure. We expect that organizing knowledge by the spatial-temporal structure will enhance recallability of evacuation rules and help learners make appropriate survival decisions. This paper reports an implementation of a disaster evacuation manual for children that represents evacuation rules in the spatial-temporal structure of the learner's everyday life.

Keywords: manual, procedure learning, spatial-temporal structure, multimedia, cognitive science.

1 Introduction

The 2004 Indian Ocean earthquake that occurred on December 26 triggered a devastating tsunami along the coasts of Sumatra, Indonesia, killing tens of thousands of people. A number of people knew how to evacuate and survive from tsunami after learning such rules as "you must evacuate to high ground when an earthquake occurs because a tsunami may strike." However, the rule did not work properly when applied, presumably because the rule is not contextualized to the situation the people faced.

Self-made decision is the key to survival. We often suffer extensive damage from natural disasters. It is commonly believed that there are two factors involved in surviving disasters: social support and self-made decisions. Social support has played an important role in survival in many previous disasters. However, social support does not always address individual needs; self-made decisions are always necessary during a disaster evacuation period. Social support may also have a time lag. Self-made decisions are particularly important immediately after a disaster occurs.

Appropriate self-made decisions require people to have knowledge about behavioral procedures that specify what to do to survive. Without well-developed procedural knowledge, people may make bad decisions or fail to react to undesirable

situations. Disaster evacuation manuals are primary sources of knowledge for disaster preparedness. However, we claim that rules in currently available manuals are expressed in general terms and they are not specific enough for people to make the right decisions to survive during disasters. In this study, we will point out that people facing a disaster would have difficulty recalling general evacuation rules, typically provided by current disaster evacuation manuals, from the perspective of cognitive science. We call this the recallability problem. We propose a method for solving the recallability problem and apply the method for developing a "usable" disaster evacuation manual for children.

2 Designing Evacuation Manual Considering Spatial-Temporal Structure of Learner's Everyday Life

2.1 Solving the Recallability Problem

Evacuation rules in current evacuation manuals describe general procedures for evacuation. An example is "when an earthquake occurs, go to high ground because a tsunami may result." When one reads this rule, he/she would easily remember it as knowledge to be used when a disaster occurs that matches the description of the rule. However, the knowledge thus acquired has two recallability problems, as shown in

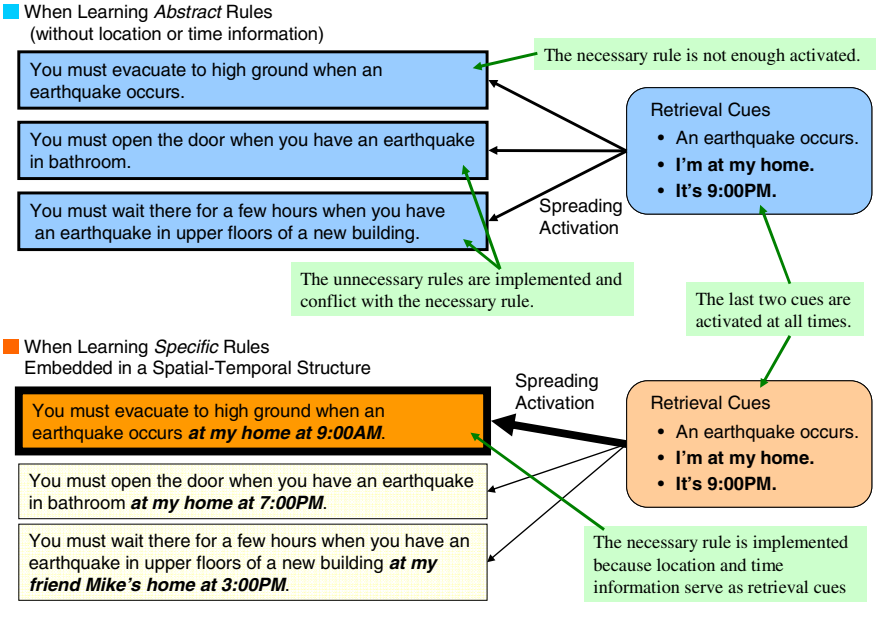

Fig. 1. Example of activation levels of individual evacuation rules. When people learn abstract rules without location or time information, they do not have the necessary information to act upon the rule. Also, unnecessary rules are implemented and conflict with the necessary rule. In contrast, when people learn specific rules embedded in a spatial-temporal structure, they implement only the necessary rule because location and time information serve as retrieval cues.

the top of Fig. 1. One is that the description of the rule is not specific enough to be actually used when necessary. Should we go to high ground wherever we are? The other is that the rules may conflict because the rules are too general and multiple rules may match the situation. There might be rules that describe actions other than "go to high ground" when an earthquake occurs, *e.g.* "open the door to prepare an evacuation route" or "wait there for a few hours because it is safe from tsunamis."

We assume that the source of the recallability problems is the lack of specificity of the rules in current manuals. The rules are too general to actually be applied when necessary. They describe the right things for a variety of situations using general terms, but they are not tightly connected to actual situations and become useless.

We are aware of our own situation such as "now, it is 6:00 o'clock, and I am at my friend's home" at all times in order to behave in the appropriate manner for a given situation. A promising way to solve the recallability problem is to describe the rules in specific terms that are closely associated with the situation. A situation typically consists of location and time information. In this paper, we propose a manual including a spatial-temporal structure of the learner's everyday life as retrieval cues of rules.

2.2 Prototype

We made a prototype that considered spatial-temporal structure for two children (6 and 8 years old). We investigated their field of activity in their everyday lives and embedded the rules in the spatial-temporal structure defined by the gathered information.

Spatial Information. The children are elementary school students, and thus, on weekdays, they spend almost all their time in their houses, in their schools, and on their walking routes from home to school. If a disaster occurs, the odds are high that the children will be in one of these areas. We investigate the room layout of the houses and schools, and the walking routes to determine the risk points when a disaster occurs.

These points are represented by a round yellow button on the *location page* depicted on the left of Fig. 2, for example, in the bathroom and in the bedroom in the house, at an intersection on the route, and in the toilet and in the classroom in the school. Learners access *rule pages*, in which evacuation rules are presented as shown in Fig. 3, after clicking the round yellow button. Therefore, they associate the rules with spatial information.

Temporal Information. We check their typical schedules with the location information from the time they get up to the time they go to bed. The schedules are organized as a list on the *time page* depicted on the right of Fig. 2, in which icons representing locations such as the bathroom or toilet are included. For example, waking up at 7:00AM with the bed icon and taking a bath at 8:00PM with the bath icon. Learners also access the rule pages by clicking the icons. Therefore, they also associate the rules with temporal information.

Integration of Spatial-Temporal Information and Evacuation Rules. In the prototype, learners MUST go through the location page or the time page to access the rule page. They can reinforce associations between rules and spatial-temporal

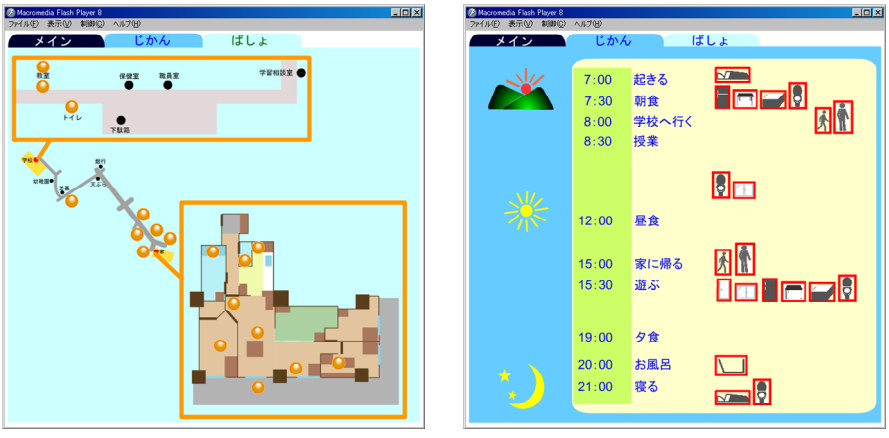

Fig. 2. Illustration of the prototype. The location page is on the left, and the time page is on the right. The rules can be accessed either from the location or time page by clicking the round yellow buttons on the location page or icons on the time page.

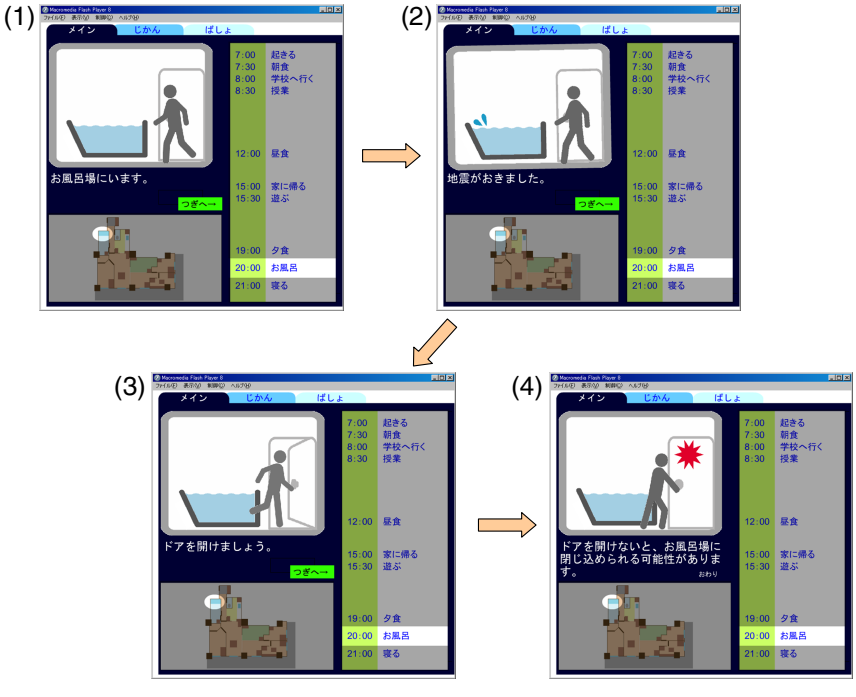

Fig. 3. Illustration of rule pages that explain how to evacuate from a bathroom when an earthquake occurs. It explains, “You must open the door if in the bathroom when an earthquake occurs” in four scenes. On each page, the upper left area depicts the evacuation rules using animated illustrations and captions in the form of SMMAPS [1]. The lower-left area indicates the location, and the lower-right, the time. Related locations and times are highlighted so they can be associated with the corresponding evacuation rule.

information by repeating such access, so that the evacuation rules are embedded in a spatial-temporal structure. In addition, the related location and time on rule pages are highlighted to organize this information (Fig. 3). Thus, the children began to use location and time information as retrieval cues to recall an appropriate rule for a situation when disaster occurs.

Evaluation. As an informal evaluation, we presented the manual to the children. They seemed to favor the prototype. We will continue improvements and evaluations in further research.

3 Conclusion

People need knowledge about how to survive crises. We demonstrated that the combined approach of cognitive science and multimedia greatly facilitate organizing such knowledge. We hope, beyond disaster evacuation, that the approach will be utilized to solve various educational problems.

Reference

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