An Evaluation Method of Temporal Change on Mental Model

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Abstract. The mental model of product, system and so on was constructed based on the main information, sub information and related information which were proposed and defined. An evaluation method of mental model can evaluate mental model quantitatively based on the difference between ex-post evaluation and pre-evaluation of mental model using the three information and evaluation items. Structural model and functional model of mental model were also examined from view point of temporal model. The pre-evaluation of mental model was changed into the ex-post evaluation of mental model from view point of temporal change. The effectiveness of the method was validated by four participants. The method was evaluated highly because of constructing mental model corresponding to their feeling or idea. If the structural model and functional model are known or unknown, the combination of two models can show how to design using cues, operation etc.

Keywords: Evaluation method · Mental model · Structural model
Functional model

1 Introduction

When we go to a high class restaurant or try to operate a new task of ATM, we will be really nervous. This means the first experience makes us strained. When the mental model is not constructed, users usually feel nervous. This study proposes a new evaluation method of mental model from viewpoint of the temporal change which means the difference between pre-evaluation and ex-post evaluation of mental model.

2 A Basic Consideration

The Mental model of product, system and so on has the main information, sub information and related information (Fig. 1). The mental model is affected by the information.

Main information
The main information is important information regarding main function of system. For examples, the main information is information of meal provided in case of restaurant and information of basic tasks such as depositing and taking money out in case of bank.
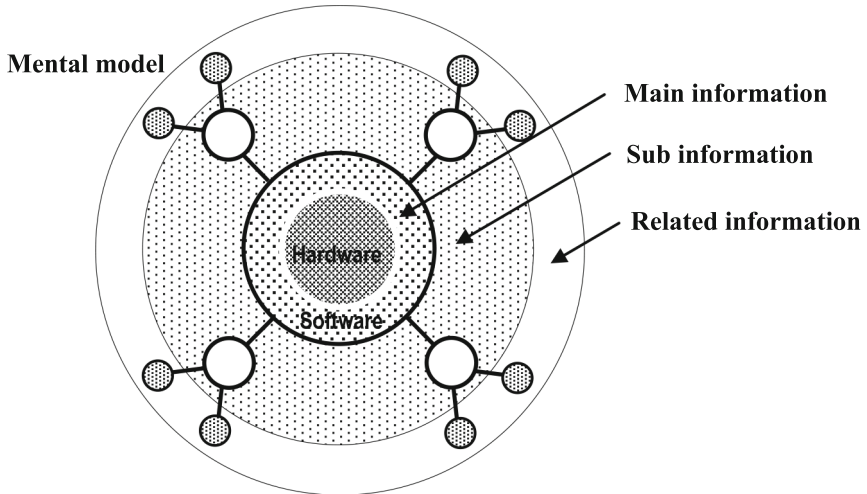
Fig. 1. The main, sub and related information of mental model.

Sub information

The sub information is related to the main information and information of sub function. For examples, the sub information is information such as interior, attitude of employee in case of restaurant and information of the less frequently used tasks such as remittance in case of bank.

Related information

The related information related indirectly to the function of product, system and so on is be remotely related to main and sub information. For examples, the related information is information of washroom in case of restaurant and information of account number in case of bank.

3   A New Evaluation Method of Mental Model

As user usually guess the function and operational image of product, system and so on before using them, they construct their mental model based on the information. The mental model is become clear by pre-evaluation of mental model, and modified mental model after using them is become clear by ex-post evaluation of mental model. The evaluation items of pre-evaluation and ex-post evaluation are follows.

The evaluation items of pre-evaluation

"Understand the system very well (4 points)"
"Understand the system (3 points)"
"so-so (2 points)",
"Don't understand the system very well (1 point)",
"Don't understand the system (0 point)".

The evaluation items of ex-post evaluation

"Understood the system very well (4 points)"
"Understood the system (3 points)"
"so-so (2 points)",
"Didn't understand the system very well (1 point)",
"Didn't understand the system (0 point)".

The main, sub, related information are weighted (%) according to the situation. The procedure of the method is as follows.

First, users estimate the usability of product, system and so on based on the mental model constructed before using. Secondly, the scores regarding main, sub and related information are calculated using the evaluation items from 3 points to 0 point. Thirdly, the difference between re-evaluation and ex-post evaluation of mental model is calculated.

4   Examination

Four students (undergraduate:3, master's course:1) of Kyoto Women's University were asked to grasp the change of their mental model for restaurants and cafe using the method.

Table 1. Pre-evaluation and ex-post evaluation of mental model

pre-evaluation of mental model	Main information (50%)	Sub information (30%)	Related information (20%)	Score
Understand the system very well (4 points)				
Understand the system (3 points)	1.5			1.5
so-so (2 points)		0.6	0.4	1.0
Don't understand the system very well (1 point)				
Don't understand the system (0 point)				
Total score				2.5
ex-post evaluation of mental model	Main Information (50%)	Sub Information (40%)	Related Information (10%)	Score
Understood the system very well (4 points)	2.0			2.0
Understood the system (3 points)		1.2	0.3	1.5
so-so (2 points)				
Didn't understand the system very well (1point)			Was	
Didn't understand the system (0 point)				
Total score				3.5

In case of visiting board game cafe (Table 1), a juior student reported as follows.

pre-evaluation

(1) Main information
     As she knew various information regarding the board game and imagined how to play it, "Understand the system very well (4 points) was decided.
(2) Sub information
     As information regarding foods and drinks were unknew, "so-so (2 points)" was decided.
(3) Related information
     As the order system and location of cafe were examined and she felt uncertain, "so-so (2 points)" was decided.

ex-post evaluation
As the nice cooking as sub information made the sub information increase the rate. So, 30% of sub information was changed into 40%.

The other students reported the evaluation results such as 1.8–>3.3, 1.4–>2.1, 1.8–>2.8. The difference between re-evaluation and ex-post evaluation of mental model was +1.0, +1.5, +0.7, +1.0. Shortly +numerical value means good design for constructing mental model, - numerical value means bad design for constructing mental model. According to the results, these restaurants and cafe are evaluated highly from view point of the mental model. For one example, a student reported "Although I couldn't know the situation of a new restaurants interior at first, I could understand the system according to various information such as cues. They reported mental model to be able to be grasped quantitatively (Fig. 2).
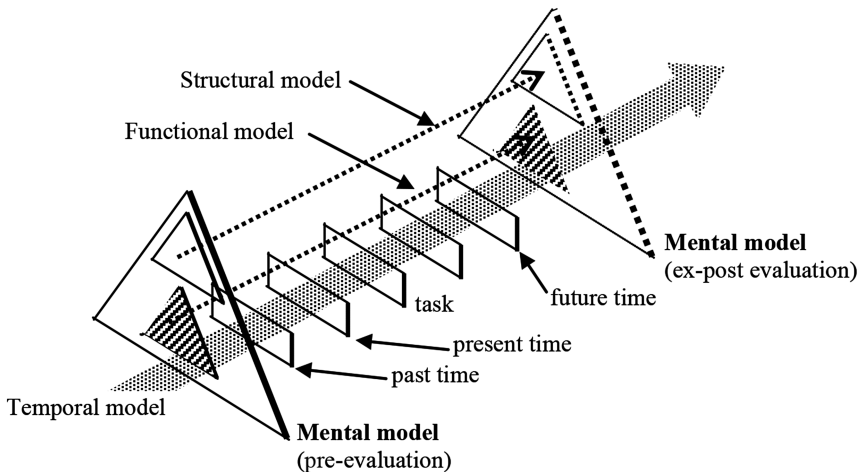

Fig. 2. The time transition of mental model.

5   Examining Structural Model and Functional Model of Mental Model Using Pre-evaluation and Ex-Post Evaluation of Mental Model

Structural model means "How it works" and functional model means "How to use it" [1]. Above mentioned, the following items can be made clearly (Table 2). When structural model is constructed and functional model is not constructed as pre-evaluation, cue is important for users. When structural model is not constructed and functional model is constructed as pre-evaluation, the procedure is known and so it seems to be easy to use. When structural model and functional model is not constructed as pre-evaluation, users can construct mal model using various cue after showing the structure.

Table 2. Pre-grasping and ex-post correspondence

Pre-grasping (evaluation)		Ex-post correspondence (evaluation)
Structural model (known)	Functional model (known)	No problem
		Example: Buying goods in super market
Structural model (known)	Functional model (unknown)	Understandable navigation using various cue
		Example: manner of tea ceremony
Structural model (unknown)	Functional model (known)	Structural model is constructed based on the operation.
		Example: operation of ATM
Structural model (unknown)	Functional model (unknown)	Making users construct mental model using various cue after showing the structure.
		Example: operation of game machines

6   Conclusion

The mental model of product, system and so on was constructed based on the main information, sub information and related information. The main information is important information regarding main function of system. The sub information is related to the main information and information of sub function. The related information related indirectly to the function of product, system and so on is be remotely related to main and sub information. The mental model is evaluated based on the difference between ex-post evaluation and pre-evaluation of mental model. If the structural model and functional model are known or unknown, the combination of two models can show how to design using cues, operation etc.

Reference

1. Preece, J., Rogers, Y., Sharp, H., Benyon, D., Holland, S., Carey, T.: Human-Computer Interaction, pp. 130–139, Addison-Wesley (1994)