"Memes" UX-Design Methodology Based on Cognitive Science Regarding Instrumental Activities of Daily Living

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Abstract. "Memes" design methodology was developed by Mitsukazu Okuda as a practical UX-design method. In the original, it was developed to analyze our cognitive process on usability testing for electric appliances. This approach is based on several key assumptions, including: people understand things through mental models in their minds; the mental model is evoked based on the context; in the mind, information input multimodally and the mental model formed by them are related and the whole structured knowledge is called "schema"; the schema consists of associations evoked by sensing signals; after sensing, evoking, and structuring are processed sequentially, it comes to understanding; the design thinking for designers goes in the opposite direction of the stream line of cognitive process for users. This method will be applied to the improvement of IADLs for the elderly because as science and technology continue to advance, there will be elderly people left behind. In a sense, they will desire an old-style instrumental tool that they are familiar with. One of the solutions is to change the interface design to the old-style in appearance without changing the function of the tool. This design concept is for specific people to use a tool with appropriate way by old-time interface design in their old memories. It is not a universal design because it cannot work for younger people who do not know the old-style interface design. it is so-called "the retrospective design" since the previous interface design is used instead of new interface design. In that way, this design method is useful for the elderly.

Keywords: User experience design · Mental model · Instrumental activities of daily life · Retrospective experience design

1 "Memes" UX-Design Methodology

1.1 From UI-Design for Easy to Use to UX-Design for Comfortable Space-Time

UX-design stands for "User eXperience design" [1] based on user interface design (UI-design) [2]. The UI-designer has been focusing on making a good shape with easy to use. Their goal is to make a more efficient way to reduce waste time. On the other hand, UX-designer focuses on making user's good time by means of design. Therefore, the UX-designers make users to spend a comfortable time which might be regarded as wasted time on the UI-design side. In this paper, we will describe a user-experience design method for developing the retrospective experience design.

1.2 A Basic Concept of Analyzing a Cognitive Process

"Memes" design methodology was developed by Mitsukazu Okuda as a practical UX-design method. In the original, it was developed to analyze our cognitive process on usability testing for electric appliances. It was father sophisticated in the field and applied analyzing way of looking things in the diverse culture, as well as in the future vision creation. In this thesis, we focus on the cognitive process which is the origin of this method. This approach is based on several key assumptions, including:

(1) People understand things through mental models in their minds.
(2) The mental model is evoked based on the context.
(3) In the mind, information input multimodally and the mental model formed by them are related and the whole structured knowledge is called "schema."
(4) The schema consists of associations evoked by sensing signals.
(5) After sensing signals, evoking assumptions, and structuring schema are processed sequentially, it comes to understanding.
(6) The design thinking for designers goes in the opposite direction of the stream line of cognitive process for users.

For example, the Fig. 1 shows a cognitive process when a user looks at a Japanese teacup and understands the author's concept. This method separates a cognitive process into four steps which are sensing signals, evoking associations, structuring schema and understanding a concept. In the first step, he finds a small crack make by design. After recognizing it, he starts to search a semantic meaning. In the second step, he evokes various, nearly infinite associations from the crack. In the third step, he starts to search a message from the author by checking his memory of culture, protocol, or common sense. In the last step, if he gets some information regarding a love story such as this title, he can successfully reach the author's idea, "a lost love."

In general, a title works as the most powerful sign in fine art. Besides we must consider collective effect of multiple signs at the step of evoking. Since we have various association in the step of evoking, a designer needs to consider it to drive us to one concept. A good designer arranges multiple signs to work together efficiently.

Since a cognitive process goes through at a moment, we are not aware of each step. However, this method can analyze a brain activity in each step. That makes clear stream line of synergy process. Since we can easily find out which step makes a trouble on an interruption of cognitive process by using this method, we improve the interface design appropriately.
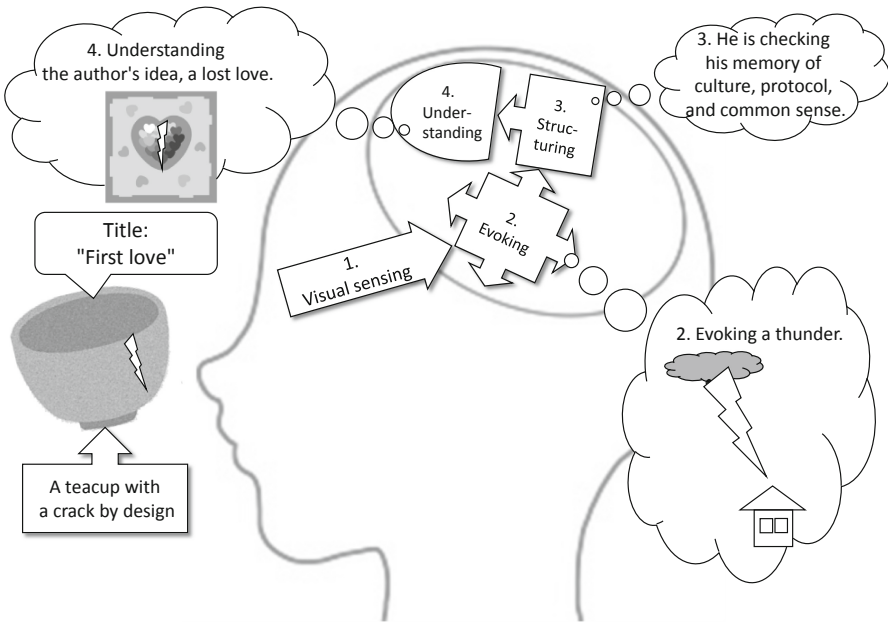

Fig. 1. Cognitive process

1.3 People Understand Things Through Mental Models

How do people feel and understand information? How is the understanding formed in the final step of the "Memes" UX-design method? In cognitive science, the mental representation is an image drawn in the mind and called a mental model. This mental model is a very important concept for designers. When people understand things, it is rare to directly grasp actual things. Instead, thoughts work through individual mental models drawn by individuals. The audience associates from the keyword, creates a mental model from his own experience, uses it to supplement the information, and finally understands the intention of the speaker. For example, from an apple as a keyword, a person thinks of eating it, another person thinks of an apple stuck with an arrow.

An excellent designer essentially understands the mechanism that transmits intended codes to recipients as analogies, generates their mental models, and leads them to the intended action. In other words, the designer creates empathy/ understanding by rebuilding the mental model of each user. The stream line of the

thinking process for designers goes in the opposite direction of the sequential cognitive process. It is so-called design thinking.

1.4   Symbolization Strategy

As shown in Fig. 2, if a person sympathizes with a new design, it will be symbolized and that will make a shortcut in the brain. The recognition time will be shortened by symbolization. In other words, if a new design becomes a symbol, a person will reach the concept in a moment. A road sign is a good example. It is led that once a customer creates a mental model by symbolization, he accepts the message with no qualification [3]. That is applied to a branding strategy such as Apple logo on Mac OS. The logo design is not fixed, it retains its contour as an afterimage, changing from red to silver with the times. Keeping a sense of confidence in the brand, it stimulates our brain that tends to be bored comfortably.
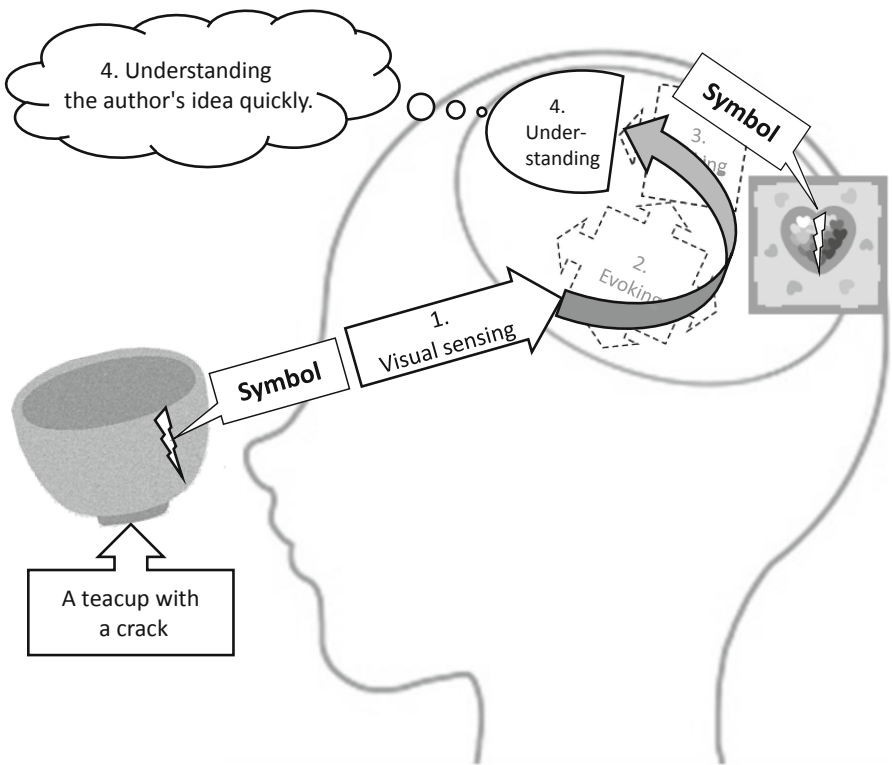

Fig. 2. Symbolization process

Another design strategy is found in a front grill design of Rolls-Royce motor cars as illustrated in Fig. 3. Originally, only the Parthenon's facade was a status symbol. In this case, the Parthenon's facade is called "Signifant" in French. The status of "Royalty" is

called "Signifie" in French. Once a user accepted the front grill design as the status symbol, the Rolls-Royce motor car itself was changed into the status symbol as shown in the dotted arrow. It is led that symbolization can be used for creating a new design.
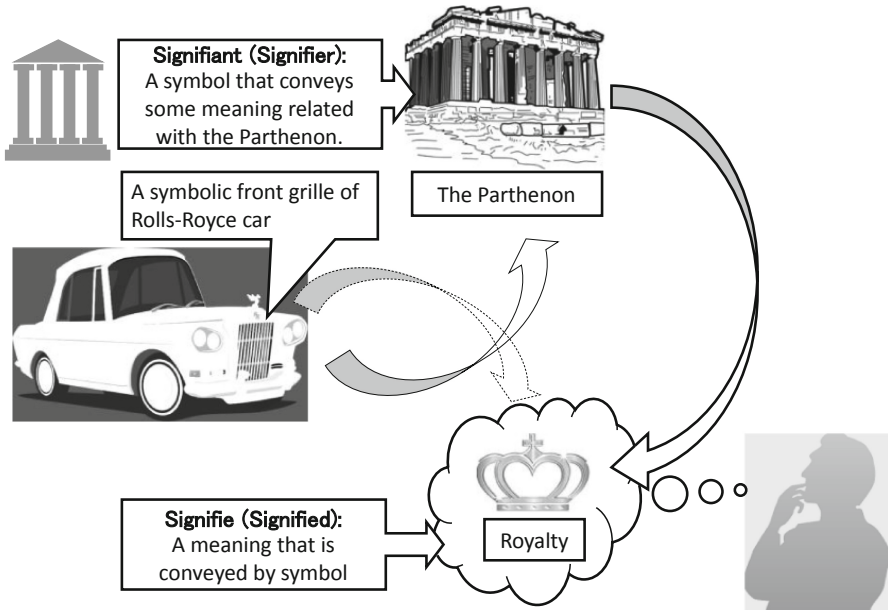

Fig. 3. Cognitive process on symbolization

1.5   A Pictogram Is a Symbol of a Standardized Mental Model

As shown in the Fig. 4, strategic design is to control the mental model for people to recognize things. For example, a mental model is an association that reminds us of "a Shinto shrine gate" by listening to the "Shinto shrine" and is cultivated through experience and learning. The structure composed of two vertical and two horizontal lines characterizing that "Shinto shrine gate" is called a key icon, or jewelry icon, and its mental model works in people's consciousness, reminding the "Shinto shrine" from the "Shinto shrine gate."

"Icon" and "pictogram" are similar words. However, these are clearly distinguished. For example, a representative of informatic design that transmits concise information in a short time is a pictogram in the traffic signs. Since an accurate code is defined, there is no ambiguity in expressions like "icon". Therefore, the explanation by text is necessary for the icon, but the explanation can be omitted in the pictogram.

In Japan, since the "Shinto shrine" is easily associated from "Shinto shrine gate", we understand "Shinto shrine gate" as one of the mental models of "Shinto shrine" and recognize that the key icon characterizing the frame of "Shinto shrine gate". Extracting this feature, pictogram of map symbol was designed.
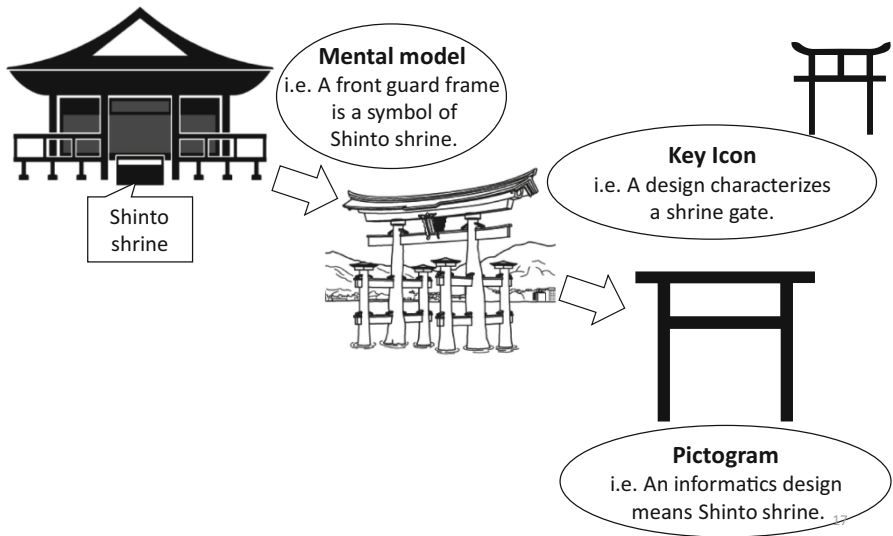
Fig. 4. A pictogram of shinto shrine

1.6 How the Schema Works to Help Understand

Schema in cognitive science refers to an abstract group of knowledge. For example, we use the schemas to determine to classify if a penguin belongs to a bird schema. In computer technology, it is also a term meaning a database structure. Based on this idea, it is easy to understand that various things in the world are classified by the schema. The level of understanding depends on the precision of the schema. If the schema in the brain has rich words, you can understand things more correctly.

For example, in Japan surrounded by the ocean, schemas related to fish are very developed. The number of words related to fish is extremely large compared to other countries. From a long time, Japanese people are interested in fish. In other words, the ontology, the hierarchical structure of the words, is substantial in terms of their interests. It is same reason why names of fry and adult fish are different in Japan, and why names of part of beef are enriched in Europe and the United States.

Schema of specialized field is called "domain". In the same expert group, since technical terms in the same domain are shared, they can easily obtain a consensus. On the contrary, it is common that groups with different domains cannot communicate at all. For example, even if a lecturer transmits "study", the audience who gathered at the conference understand this as "research", which is understood as "learning" at a high school. The meaning of a word is not determined by itself but by the audience domain.

1.7 Movement of One's Mind Creates Action

In order to increase sales of a restaurant, it is not enough to have delicious menus side by side. As a matter of course, a design consultant regards that the concept and menu of

the restaurant are consistent, but also emphasizes that all the customer service processes are designed in a unified manner.

In a family restaurant, in addition to the convenience of children's menu, children's chair, fork knife, cup, lighting, BGM, interior design needs to be coordinated in total. Comparing the restaurant's service to a play, the designer is to be a director, to listen to messages released by decorations, to harmonize them with the space for the targeted customers. From the floral language of flowers decorated in the room, unraveling the secret message of the owner and reaching the hidden theme is the real pleasure of the customers; the impression gives empathy; both the owner and the customers are increase value of the restaurant [4].

Regardless of targets, designing the mind is the essence of designers, and moving customers' hearts results in their actions. Therefore, the designer succeeds as a business consultant. In this way, excellent designers can control the context freely. As superior military breaks the tight situation strategically by manipulating the context, the designer changes behavior of the audience by manipulating their mental models. There is the essence of the "Memes" design method in strategically designing the flow of information, encouraging the mental model of the audience, and inducing changes in the internal aspects of the audience.

2 Retrospective Experience Design

2.1 Elderly People Cannot Catch up with Rapid Advanced Social Systems

The United Nations shares a prediction that 18% of the world's population will be over 65 years old in 2050. In particular, Japan is the first aging society in the world in terms of average lifespan, number of elderly people, and speed of aging. Currently, the population over 65 years of age exceeds 35 million, the proportion of elderly people is about 28% of the total population, one in every four people is elderly. One of the problems of aging society is that sophisticated social system is not friendly to the elderly. Elderly people cannot catch up with rapidly advanced social systems because of technological progress. The usability is improved, and the new user interface system is implemented, so people who cannot use it are left behind from the new social system. It is more difficult for people with dementia to memorize new things. New memories will disappear, only old memories will remain.

2.2 A Testing Tool for People with Psychological Problems

Activities of daily living (ADLs) are tasks of everyday life. These include basic survival tasks such as eating, dressing, getting into or out of a bed or chair, taking a bath or shower, and using the toilet. Especially, instrumental activities of daily living (IADLs) are defined as activities related to independent living and include driving cars, paying bills with cards, using telephones or other machines. Originally, they are tasks, but they are also used to measure self-performance in elderly people's quality of life (QOL).

For example, one elderly woman may be able to dress herself except for managing difficult fasteners that close in the back. If that is the case, her daily living can be improved simply by changing the kinds of clothes. One elderly man no longer wanted to drive by himself because of the recent unfamiliar driving system. The former is a problem of ADLs, the latter is one of IADLs.

Generally, elderly people need to be able to manage IADLs in order to live independently without the assistance of another person, such as caregivers. Problems with IADLs usually reflect problems with physical health and cognitive health. Often problems in ADLs arise gradually and may not even be considered a problem for some time. Instead, in IADLs, a problem is clearly found by event of not using instruments. In that sense, IADLs may be more detectable than ADLs within a testing tool for people with psychological problems.

2.3   A Symbol Reminds a Same Mental Model Among Audiences

Many elderly people experience problems in daily living because of declining cognitive and physical activities by aging or health-related disabilities. Those difficulties restrict their ability to perform self-care. Most reasons of inability for self-care are classified into four types which are related to signal detection, information processing, decision making and action. However, they are not independent. Since they are sequential causalities, each or combinations make a self-care failure. And we are only witnessing activities as a result of causality.

In this way, cognitive psychology regards an individual as a processor of information, in much the same way that a computer captures information, eliminates unnecessary data, and generates a view for judgment. In addition, since the human brain is a slower processor that cannot handle such large data at high speed as a computer, we focus on only important information to save our energies.

This corresponds to differential data on the computer. Saving movie data, a large capacity is required to save all frames. However, for example, at a press conference, since there is motion only in the person at the center of the frame and the background is fixed, it is waste that a large amount of redundant data of the background is saved as common information.

For this reason, compressing data, only the data of the first frame with background is saved as common data, and only difference is saved in the later frame. By this compression technology, movie data can be displayed at high speed.

Similarly, human being makes judgments using only differential information comparing with common sense. For example, when being said "a black swan" for the first time, you think of a swan at first and presume that it is a bird with white changed to black. Since we know what kind of animal a swan is, we can imagine even "a black swan" we have never seen before. In cognitive psychology, the swan in each mind is called a mental model. Based on this as common recognition, we can understand the black swan by the attribute difference.

Similarly, in communication, mental models work to understand each other's idea. On the contrary, unless thinking of same mental model in each mind, we will make a miscommunication on it. Since mental models vary from person to person, it is necessary to keep same mental models in each mind for good communication.

For example, when telling a new concept to others, telling all the attributes one by one is not efficient and may not be understood at all. Explaining a new concept, it is best to use analogy as a mental model. Compared with the analogy, you can communicate efficiently by telling only the difference. It leads managing others' mental models is important for good communication.

An excellent designer is a psychological magician who uses symbols to remind the same mental model among audiences and leads them towards own intention. It is clearly different from art, design aims to solve problems [5]. A design has a purpose of solving problems essentially. This point is quite different from art. A good design makes a lot of people happy. A good designer solves it by manipulating mental models of others by using the design.

2.4   Retrospective Experience Design for Elderly People

For example, currently, a key less entry system is common in automobile. Similarly, it is also implemented in the home entrance system. That makes a big problem for elders with the symptom of dementia or MCI (Mild Cognitive Impairment), to enter their renovated houses. They were confused about how to open the entrance doors. They could not go through the doors by themselves and keep their memories about how to open the door.

One of the solutions is to put back to the previous entrance system with a metal door key. However, it is not actual or reasonable. Another solution is to change the interface design for us to reach the right understanding. If we cannot do the right action, there may be some troubles to interrupt our cognitive process. On the contrary, we can solve an interruption of cognitive process by changing the interface design. That means, in order to improve the above-mentioned daily life for people with dementia, we should change the interface design of their tools. For example, changing a shape of card in key less entry system into a metal door key which was used in the previous, some people with dementia may go through the entrance door. And a key hole on the door is needed for elders to reach the goal of understanding even if it is meaningless. That makes they can feel relived and enter their house through the door in the key less entry system.

This design concept is for specific people to use a tool with appropriate way by time interface design in their old memories. It is not a universal design because it cannot work for young people who do not know the old-style interface design. At least, it should be called "the retrospective design" since the previous interface design is used instead of new interface design.

In addition, strictly, this design concept is not user interface design (UI-design) because it is not aimed at realizing efficient operation [2]. However, this design concept is aimed at improving the interface, but it is not a purpose for efficient operation. This design concept is rebuilding the design of time space. This is not to improve only operability but to design the user experience. It should be called "retrospective experience design" because it is meaningless for younger generation with different experience to the elderly.

3 Summary

"Memes" design methodology was developed as a practical UX-design method. This method can create a design strategy based on cognitive science. In this method, a cognitive process is divided into four steps which are sensing signals, evoking assumptions, structuring schema and understanding a concept. Since a cognitive process goes through at a moment, we are not aware of each step. However, this method will check a brain activity through each step. Besides, this method will be applied to the improvement of IADLs for the elderly because as science and technology continue to advance, there will be elderly people left behind. In a sense, they will desire an old-style instrumental tool that they are familiar with. One of the solutions is to change the interface design to the old-style in appearance without changing the function of the tool. This design concept is for specific people to use a tool with appropriate way by old-time interface design in their old memories. It is not a universal design because it cannot work for young people who do not know the old-style interface design. it is so-called "the retrospective design" since the previous interface design is used instead of new interface design. In that way, we can conclude that this design method is useful for retrospective experience design for the elderly.

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