SPECIFYING KANSEI REQUIREMENTS WITH THE APPLICATION OF ENVIRONMENTAL PSYCHOLOGY RESEARCH METHODS CASES OF INTERIOR DESIGN IN ARCHITECTURE

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ABSTRACT

To design and create architecture that serves the public, one of the foundations of architectural design is identifying and satisfying the demands placed on specific architecture. We constructed an observation model for identifying Kansei requirements applicable in the early stages of architectural design. For the observation model, we used a cognitive psychology based human model predicated on individual diversity. We also studied and referenced previous research on existing environmental psychology research methods, taking into account the features and limitations of each method. We then combined and developmentally applied them to a new observation model. We also focused on the potential of Kansei requirements, setting a requirement for a precise explanation that fit more closely with real conditions, and examined methods for prompting test subjects to think and speak subjectively. With this observation model for Kansei requirements specifications, we attempted observations and analyses. The test results confirmed that through freely chosen images with word prompts, the prompts encouraged speech and showed the potential for identifying Kansei requirements.

Keywords: *Kansei Requirements, Environmental Psychology, Architectural Design*

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1. RESEARCH BACKGROUND

Specifying and meeting the requirements placed on a particular building is a foundation of architecture: not only in order to design and create architecture that serves society; but it is also to design man-made objects. The specification of the requirements in design is one of the starting points for creating the value of man-made objects [1]. In architectural design, the designer thinks not only of the building's function and performance as an object to be the target of the design, but also of how the space and environment will be perceived by human beings [2]. People perceive designed and created objects through their minds, and the state of this design that has passed through the mind has been studied [3]. Human Kansei exist in a complex relationship; however, to make this topic meaningful for the future of design, we focus not on what has been designed and created, but on understanding the issue of what needs to be designed and created [4].

Requirements for design can be generally classified as non-functional and functional demands [5]. Kansei requirements that appear through Kansei of human, focused on in this study, are non-functional requirements. Non-functional requirements are usually requirements that are tacit, such as Kansei of human, and as such are not easily programmable. It is important to identify Kansei requirements. Previous research has shown that by observing human Kansei, through which each person perceives the space and environment, and including it in design and creation, we can improve our understanding of the design process [6].

Environmental psychology research methods are used as a way to systematically understand human cognitive structure [7]. These discuss how to explain human Kansei requirements, including individual differences, in a detailed way that is grounded in reality. Furthermore, in the history of architecture, designs often relied on the architect's personal intuition. However, according to the definition at the meta-level of the design, it is pointed out in the essence to be theoretical problem-solving [8].

2. OBJECTIVES AND METHODS

The objective of this study is to indicate methods for specifying Kansei requirements of architectural design in the early stages of its design. By indicating methods for identifying Kansei requirements, it will become possible to consider the architectural design process as logical problem-solving work, and to optimize the design process.

This study's methods are to first review existing environmental psychology research methods. Next, we propose an observation management model that makes it possible to understand and show human cognitive structure. In accordance with the proposed observation method model, we decided on a procedure of attempting observations and confirming the specification of Kansei requirements.

When we reviewed the human-based models that were the subject of existing environmental psychology research methods, we found that, while there are some differences in the human-based models used in psychology and sociology, there are no differences in their approach toward the "individual" and "personal." We thus thought that it would be appropriate to assume a human-based model along the lines of cognitive psychology [9]. After reviewing the existing environmental psychology research methods, we established the following three demands:

1) It must have the potential to specify Kansei requirements as functional demands.

2) In assuming that humans are diverse by nature, it must have the potential to explain in detail, and in a fashion that fits with actual circumstances, how and from what perspective the test subjects came up with their Kansei requirements.

3) It must operate scientifically from the point of view of reliability and practicality, to be adopted in the early stages of the design process, as a problem-solving system.

3. ANALYSIS AND REVIEW OF EXISTING ENVIRONMENTAL PSYCHOLOGY RESEARCH METHODS

3.1. Evaluation Grid Method

The "Evaluation Grid Method," or EGM, is a method for exploring individual cognitive structure, developed by Junichiro Sanui as an "advanced technique of the repertory grid method" (1986) and was later renamed the "Evaluation Grid Method" [9].

In this method, elements are selected and evaluation items are extracted through comparing elements; the extracted evaluation items are then arranged for laddering, with the higher and lower items extracted, shown in a tree diagram, and evaluated. A qualitative assessment is made of the individual's cognitive structure and, through extracting components related to the evaluation, the links between those components can be understood. The interview technique used is a half-structured interview, and its psychological invasiveness is low.

Laddering (leading questions) is a technique for finding the contracts between upper and lower items, developed by D.N. Hinkel. The operation of this laddering process is characteristic to the evaluation grid method.

3.2. PAC Analysis

"PAC Analysis," or "Personal Attitude Construct" [10], is a method for exploring individual cognitive structure that was developed by Naito Tetsuo (1988).

It defines the cognitive structure of the subject being studied, and indicates this through an associative, prompting text. The subject extracts free association words from this text to expose important things about the subject's consciousness through the subject's free association. Paired comparisons of all the combinations with a degree of similarity from the extracted free association words are compared and recorded in random order. From the information recorded, a cluster analysis is conducted and the reciprocal links between free association words (phrases) are shown in a dendrogram (tree diagram) to be understood visually; these are grouped, understood, and appreciated as clusters. The individual's cognitive structure is qualitatively evaluated using the cluster and, by extracting factors related to the evaluation, the links between the components are understood. The interview technique used is a semi-structured interview, and its psychological invasiveness is low [13].

The biggest advantage to PAC analysis is that, even if the subject him or herself is not exactly aware of their own cognitive structure, it is possible for the researcher to deduce that cognitive structure. By having the researcher categorize the cluster analysis results together with the subject, it is possible to form an appropriate cluster, and it is easy to create a structured framework. It takes some practice to analyse these clusters, but the results are not influenced much by the skill of the researcher conducting the interview, and uniform analysis is possible [13].

3.3. Photo Projective Method

The photo projective method is as a method of observing human introspection through the visual medium of photographic images, developed by Masaaki Noda (1999) [11].

In this method, the subject is given a camera and some instructions, and is asked to take pictures. The things that the photos record are regarded as reflecting the relationship between the subject's self and the external world, and this method attempts to understand the perceived environment (outside) with the individual's psychological world (inside). The photo projective method is used in academic fields such as environmental studies, geography, and psychology. In studies using photos as a technique for moving an interview forward, it has been shown that content which a research subject was unable to verbalize or conceptualize could be more concretely expressed with the use of photos [12].

The photographer's cognitive structures is projected in their photos and, in this method the researcher evaluates externally, but it has been noted that it can be difficult to retrieve cognitive structures [13].

3.4. Caption Evaluation Method

The caption evaluation method combines the photo projective method and EGM, and was developed by Takaaki Koga et al (1999).

In the caption evaluation method, the research participant is given a camera and asked to walk freely around town taking photos of scenery that interests them, and write free descriptions of the scene's components, features, and impressions on a scene card. These cards are collected together with the photos and an EGM analysis is conducted; it is used in research such as environmental improvement proposals.

The goal of this method is to extract the free opinions of people with as few constraints as possible. It does not require the personal interviews or control seen in EGM and PAC analysis, and it is a method that can analyse a large amount of quantities of data [14]. It is clearly not a method for showing the cognitive structure of a person projected by the photos.

3.5. Consideration of demands for the Application of Existing Environmental Psychology Research Methods

Regarding the three demands set out, we summarized the considerations of each case with reference to past works and considered them as follows. Regarding demand 1, the operation of laddering used in EGM has the potential to draw out functions with lower evaluation items. Regarding demand 2, the network chart shown in the cluster analysis of EGM can statistically handle individual cognitive structures. Furthermore, the dendrograms shown in PAC analysis show as clusters of words (phrases), and can operate statistically. Regarding demand 3, the objective of sensory demand specification that can easily be made implicit by subjects, the photo projection method was considered and, through free selection of photo images and provision of speech prompts, it can be applied to a wide variety of people. Furthermore, free association was used to select evaluation items. We considered PAC analysis's unstructured interview method, which makes it possible to explore human subjectivity non-invasively and includes the potential for explaining in detail, and in a form that fits with actual circumstances.

4. KANSEI REQUIREMENTS SPECIFICATION THROUGH THE APPLICATION OF ENVIRONMENTAL PSYCHOLOGY RESEARCH METHODS

4.1. Observation Model Proposal

From our study of environmental psychology research methods, we constructed an observation model for Kansei requirements specification as follows.

Activity 1. Selection of Images for Association Prompting

To prompt participant's internal observation, we choose images through free selection. Referencing the photo projective method, the subject freely chooses as many cards as they wish, based on their intuition for which images they prefer, from a set of images prepared by an architectural design professional. We also make it possible for participants to freely choose from images published in magazines or on the Internet. We give the subject the following instructions: "We are going to conduct an interview to understand people's Kansei on Interior

image of architecture. First, please select the images you prefer from among these prepared images. You may choose as many as you like. Please tell us if you do not like any of the images. "When participant has finished selecting images, we give the following instructions: "Next, please search for images you like on the Internet. Perform the search yourself by entering keywords for images in an image search engine or similar. You may also search by any other methods that occur to you." We have participant choose images using the above procedure. We also record the search keywords participant used.

Activity 2. Selection of free association words (phrases)

While looking at the selected images combined with themes (association prompt phrases), we conduct a non-structured interview along the lines of a PAC analysis procedure and, through free association, and we select free association words (phrases).

Figure 1: Diagram of Kansei extraction

Because our aim is to specify Kansei requirements by using images to find things that can become latent demands, we give participants a theme (association prompt phrases) by saying "Look at these images and tell us any words or images that come to mind on the topic of _____ that fits your Kansei. Use as many words or images as you like." If the participant falls behind in free association, we encourage the free association with the following instructions: "Is there anything else?" "Please recall it again." We continue this process until participant can no longer easily come up with new free association words (phrases). Next, we focus on the potential of speech, give a simplified explanation of the human senses, show Kansei words selected by experts on several printed cards, and dig deeper to find more free association words (phrases). We continue this process until participant can no longer easily come up with new free association words (phrases).

Activity 3. Similarity Comparison

Through free association made with non-logical thinking, and by calculating the dissimilarity of evaluation items in a cluster analysis, PAC analysis allows for the advance of indicating cognitive structure. We randomize paired comparisons of all items and ask the subject to conduct a similarity comparison. We judge participant's intuitive similarity selection while checking that they did not grow weary and let their similarity comparisons become lazy.

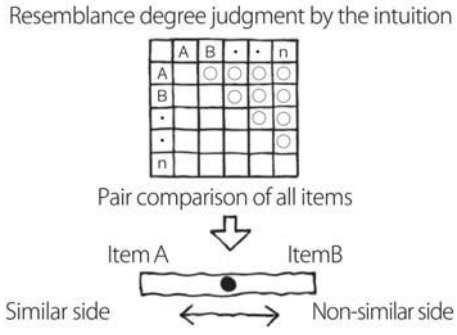

Figure 2: Diagram of similarity

Activity 4. Laddering

Laddering is conducted, using each of the following instructions to discuss the evaluation items selected in Activity 2. For selecting higher-level free association words (phrases) (laddering up): "You said that it is ____and it fits Kansei, why do you suit your sensibility when it is ____for you? How do you feel if it is____? Please explain your reasons and senses?" For selecting lower-level free association words (phrases) (laddering down): "You said it would be good if ____. To you, specifically what and how is ____? Please explain your reasoning."

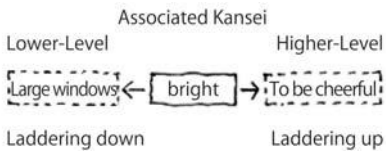

Figure 3: Diagram of Laddering

4.2. Analysis and Comprehension

With the data collected in Activity 3, we conducted a cluster analysis, expressed it in a dendrogram, indicating the subject's cognitive structure, and read the connections and grouping of Kansei requirements. With the data collected in Activity 4, we expressed it in a network diagram, indicating the subject's cognitive structure, and I determined the whole of the lower free association words (phrases) and language of higher free association words (phrases) tied to free association words (phrases) picked up by free association words (phrases).We can scientifically understand the subject's Kansei requirements by combining the dendrogram that showed relationships and groups of free association words (phrases) and the network diagram that is indicated by laddering

5. OBSERVATION MODEL TESTS

5.1. Test Summary

We conducted tests of the observation model using four subjects. These tests had the objective of confirming the following: that the proposed observation model could be smoothly conducted, that potential Kansei requirements could be specified easily in the early stages of design, and that if the requirements were non-functional, most Kansei requirements could be understood as functional requirements through identification. We did an online image search of architectural interiors, we then chose and printed 50 photo images from the web. We gave information about Kansei and showed Kansei words on printed cards ahead of time.

Figure 4: Example of prepared photo image

5.2. Use of Support Tools in the Observations

During testing of the proposed model, we used the PAC analysis support tool "PAC-assist" [15]. For cluster analysis, we used "R." For the laddering activity, we used "EGM-assist" [16].

5.3. Results and Analysis

Figure 5 shows the dendrogram of test participant-3 created by Similarity Comparison of subjects in free association words (phrases).The cluster derived by the subject's subjectivity between free association words (phrases), and words (phrases) are given to the group by participant 's own words (phrases), are indicated by a dendrogram as shown in Figure 5. Looking at the cluster of participant-3, it is Feeling of external environment, and it is understandable that Kansei to the coming in of Natural soft light comes from the fact that it is Not overly visually stimulating is low. It is possible to quantitatively capture relationships and groups of free association words (phrases) derived by the subject's subjectivity.

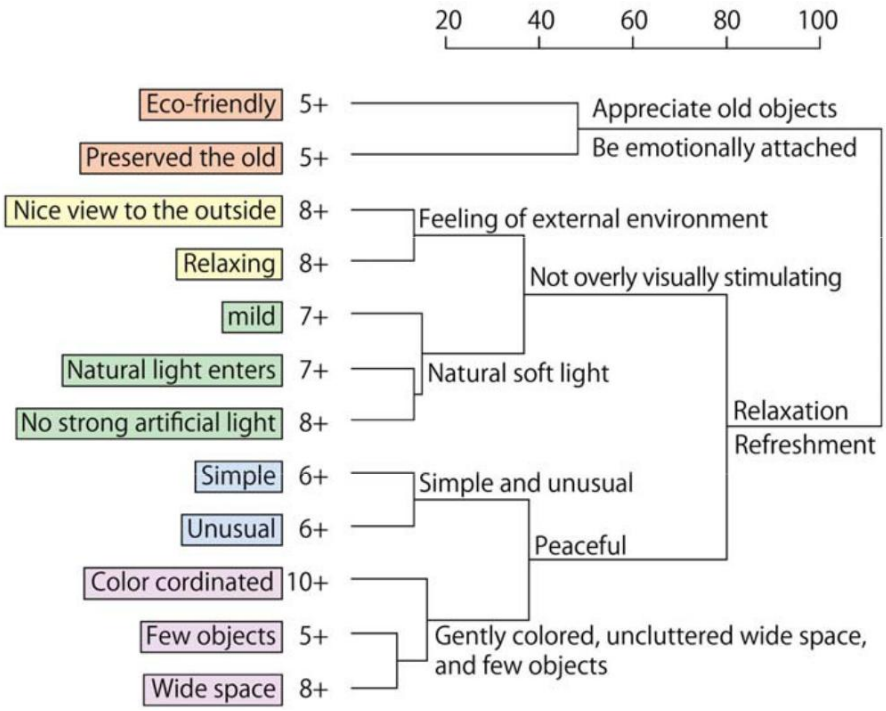

Figure 5: The dendrogram indicated by cluster analysis (participant-3 47 year old female)

Figure 6 is a network diagram created by laddering. From the free association words (phrases), it is possible to understand the condition and state the Kansei requirements is specifically lower free association words (phrases) indicated by laddering. In addition, it is possible to understand which upper level conceptual free association words (phrases) are linked to specific conditions and states.

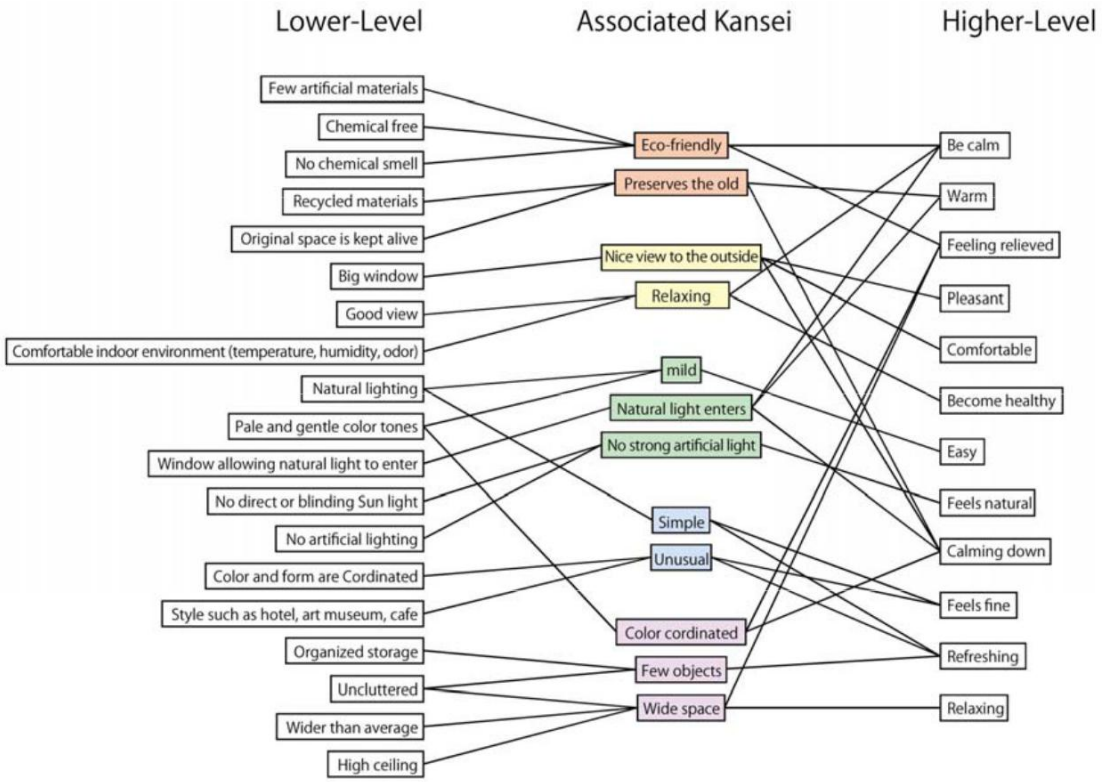

Figure6：Network diagram indicated by laddering (participant-3 47 year old female)

In this way, we could show the dendrogram by similarity comparison and cluster analysis. While the network diagram could be shown by laddering. I would like to focus on the work of integration in the design process of the designer. The designer will capture multiple Kansei requirements and will do the integration work to satisfy the client's desires and requirements. Regarding this integration work, while it is impossible to satisfy the lower specific Kansei requirements shown in the network diagram, we can quantitatively understand the subjective Kansei requirements as clusters by using a dendrogram, and possibly make the design creation process more efficient.

6. CONSIDERATIONS ON SPECIFYING SENSORY DEMANDS THROUGH THE APPLICATION OF ENVIRONMENTAL PSYCHOLOGY RESEARCH METHODS

Using images to prompt associative words, we confirmed that these were connected to subjective speech by testing the observation model. Through the test subjects, and through methods proposed ahead of time involving the cognitive psychology human model used in this study, potential was indicated for explaining how, and from what perspective, people come up with sensory demands, in detail, and in a way that fits real conditions. We also confirmed through the observation model tests that this method is able to grasp statistical meanings with reliability and practicality, which in turn aids as problem-solving system in the early stages of the design process.

7. CONCLUSION

We used existing environmental psychology research methods to propose a new observation model for specifying Kansei requirements through the application of such research methods, and tested this model. The result of the test was that this method has the potential for specifying Kansei requirements in this study. Regarding the data obtained from testing the observation model, we have only gone so far as to discuss the potential for using this in the process of drawing up designs. However, regarding Kansei requirements that can easily become potential requirements, the question of how the subject perceives the indicated data is a topic to be pursued in future research. In the study of design, research focusing on human senses can make its approach from myriad angles for the future of design, and the present study shows one possibility.

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