



# Hearing Method Considering Cognitive Aspects on Evidence Based Design

Fuko Ohura<sup>(✉)</sup>, Keiko Kasamatsu, and Takeo Ainoya

Tokyo Metropolitan University, 6-6 Asahigaoka, Hino, Tokyo, Japan  
fu.a7te@gmail.com

**Abstract.** It is commonly believed that user understanding is important in the development of products and system, including the concept of human-centered design. However, in order to utilize these results as evidence, it is necessary to construct the evidence itself by a research method appropriately designed for the purpose and object. In this research, first of all, we summarize the type and features of the interview in the user research. In order to understand the user's perception, how the interview was used. The following uses examples to analyze of relationship between the purpose of the investigation and the characteristics of the investigation method.

**Keywords:** Interview method · Evidence-based design  
Cognitive science approach

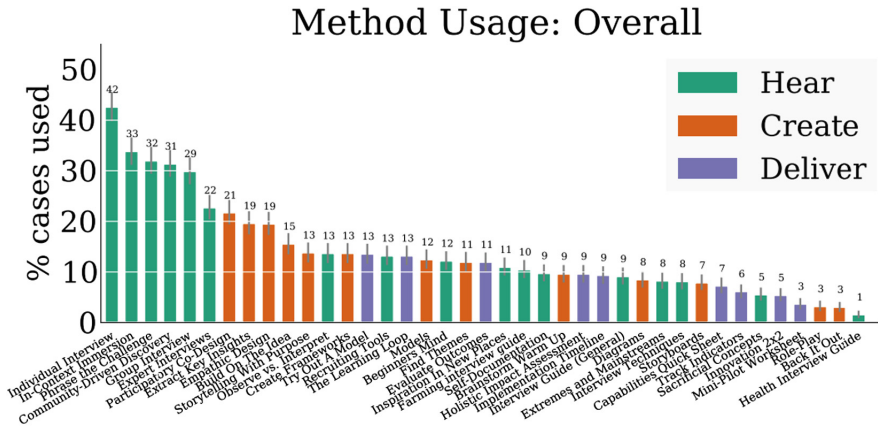
## 1 Introduce

### 1.1 Social Concern for User Research

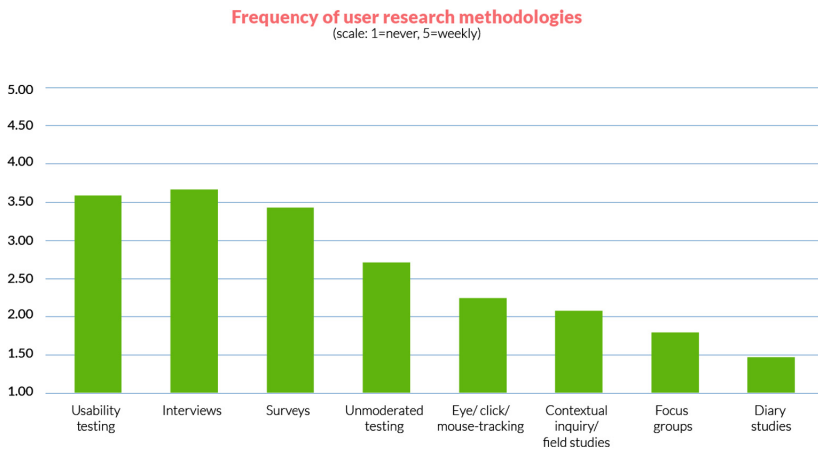
In recent years, user understanding has been considered important in the design process of products and services, and appreciation of user research is increasing. In addition to the user survey methods such as the web questionnaire, the user interviews are now also highly valued by design companies and consulting companies. The major manufacturing industries have also begun to actively adopt. The following are the content and frequencies included in the design activities of IDEO, which is famous as a design consulting company. It is mainly divided into three parts: hear, create, and deliver [1]. 7 of 17 items included in hear are interviews of some form, and it is conceivable that the interview research is also regarded as an important position in the design process (Fig. 1).

User research is not proactively conducted only by organizations specializing in design approaches such as design consulting firms. Figure 2 shows the results of a survey on the implementation of user researches for 100 high-tech companies in the United States [2]. It is shows that usability testing, interviewing, and surveying appear to be the three most commonly used user research methods practiced today.

Today it is more common, and perhaps even necessary, for companies to incorporate user research into design and development processes.



**Fig. 1.** Percent method usage by case in IDEO. Overall, users use methods from earlier design stages more frequently [1].



**Fig. 2.** Frequency user research methodologies in high tech companies. (Source: [2])

### 1.2 User Research

As mentioned in the previous clause, the interview for user’s understanding is often used in companies, and it is necessary to organize the Utilization methods of the interview in order to more effectively utilize the method in various ways. However, interviews are also various, including interviews with reporters. The interview dealing with this research is an interview as user research. Therefore, it is necessary to confirm once again the purpose of user research and its significance.

Robert Schumacher defines user research in “The Handbook of Global User Research” as follows:

*User research is the systematic study of the goals, needs, and capabilities of users so as to specify design, construction, or improvement of tools to benefit how users work and live [3].*

Jeff Sauro [4] describes the purpose of user research as follows:

*One of the primary goals of conducting user research is to establish some causal relationship between a design and a behavior [4].*

In addition, as a field that user research often uses, the following three are the main trends.

- Needs investigation for innovation
- Human-centered design to measure the relationship between system and user
- Marketing
- Consumer understanding marketing perspective.

This paper focuses on user research on a human-centered design perspective to measure the relationship between the system and users. Surveys focusing on cognitive parts of people are sufficiently considered in the other two, but this time, by organizing the research method based on the human-centered design, it is possible to apply the application in other fields later Also possible.

In the field of human-centered design, in order to explore what ease of use, comprehensibility, comfort for users, it has often been researched from the cognitive aspect the interaction when a person touches an object.

In this research, we aim to systematize the interview method in such surveys and work on the disassembly of investigation cases using interviews that considers the interview method and cognitive aspects.

## 2 User Research and Interviews

### 2.1 Types of Interviews

Interviews are often done with the aim of finding emotions, thoughts, intentions, past behaviors, etc. that are difficult to directly observe [5]. Generally classified into Structured interviews, Semi-structured interviews, and Unstructured interviews from the degree of their structure [6]. A summary of each feature is shown in the Table 1.

Semi-structured interviews can pursue parts of interest to the investigators during the interview. This type of interview is widely used in qualitative research. Structured interviews are a convenient way to compare how different subjects answered the same question, or when multiple investigators conduct interview surveys on teams.

The unstructured interview is characterized in that the content of the question is not decided in particular and it is a free conversation, often used in combination with participation observation. Because we have to think and develop questions in response to the subject's remarks, the result of the investigator's skill and experience broadly varies.

**Table 1.** Characteristic of each interview type

	Characteristic	Data	Space
Structured interviews	An interview managed so that there is no difference for each survey for multiple survey subjects by setting question contents and answer format	Qualitative, Quantitative	Telephone, controlled space
Semi-structured interviews	A question is made according to the interview guide which decided rough direction, the question can be changed according to the flow of the dialogue, and it is possible to hear the opinion flexibly	Qualitative	Controlled space, field
Unstructured interview	Question contents are not decided, and you can explore problems from natural conversation	Qualitative	Controlled space, field, visiting place, everywhere

## 2.2 Previous Research

In user research, the research method is not limited to a single research method, and it is possible to try user understanding more effectively by combining a plurality of investigation methods according to the purpose of the investigation. For interviews, it is also important to conduct multiple interview methods and to consider combinations with other user research methods as shown in the Table 2. In the table, Nielsen Norman Group performing Evidence-Based User Experience Research, Training, and Consulting on his website, It summarizes the user's investigation method focusing on the product development phase [7]. In this way, you also need to consider what kind of investigation is effective in each phase in the design process.

**Table 2.** The table below summarizes these goals and lists typical research approaches and methods associated with each. (Source: [7])

	Product development phase		
	Strategize	Execute	Assess
Goal	Inspire, explore and directions and opportunities	Inform and optimize designs in order to reduce risk and improve usability	Measure product performance against itself or its competition
Approach:	Qualitative and quantitative	Mainly qualitative (formative)	Mainly quantitative (summative)
Typical methods:	Field studies, diary studies, surveys, data mining, or analytics	Card sorting, filed studies, participatory design, paper prototype, and usability studies, desirability studies, customer emails	Usability benchmarking, online assessments, surveys, A/B testing

### 3 Hearing Method Considering Cognitive Aspects

From the characteristics of user research and user research in product development in the previous chapter, this chapter classifies interviews as patterns. In the next chapter, we will also try to model it in the actual research.

#### 3.1 Purpose of Interview in Consideration of Cognitive Aspects

As an aim of the interview that considers cognitive aspects, focusing on how the human side receives in human-system interaction, to understand its structure and characteristics. Furthermore, it is supposed to be a hint to a design that is beneficial and effective for people.

#### 3.2 Patternization of Interviews that Considers Cognitive Aspects

In an interview that takes cognitive aspects into consideration, contents related to human-system interaction are targeted. Therefore, the degree of reproducibility of the situation of interaction is a point to consider in investigation. We focused on “the temporal distance between interaction and interview” and “whether or not to consider factors involved in the environment at interaction” as factors influencing the reproducibility of the situation. Two axes of “immediate – retrospective – retrospective of self-experience” and “no presentation, system only, system + environment” were set, and each model corresponding to each of the biaxial matrix was taken as each model. We propose the five patterns shown in the Fig. 3. as a hypothetical model of interviews that considers cognitive aspects.

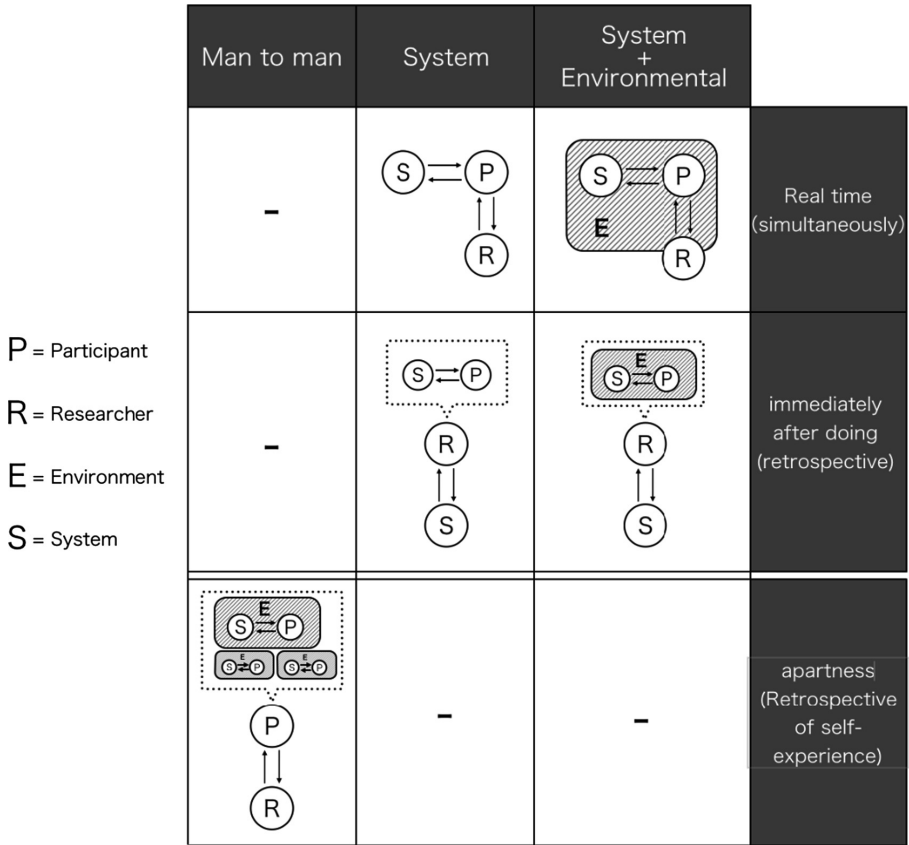
## 4 Case Analysis

In user research, the investigation method is rarely limited to one method, and it is possible to try user understanding more effectively by combining a plurality of investigation methods according to the purpose of the investigation.

In this chapter, we going to discuss two cases of the interview research actually conducted by the authors and the interview research used in the same laboratory project. Collect the findings in research design for user understanding by organizing and analyzing the investigation cases by combining the classified interview pattern with the user research method as shown in the Table 2 in the previous chapter. In order to understand the user’s perception, how the interview was used. The following uses examples to introduce the purpose of the investigation and the characteristics of the investigation method.

#### 4.1 Case Study Using Interview Method Considering Cognitive Aspects - 1

- Investigation of walking in an indoor space for low-vision people to investigate spatial recognition during walking



**Fig. 3.** Hypothetical models of interviews that considers cognitive aspects focused on “the temporal distance between interaction and interview” and “whether or not to consider factors involved in the environment at interaction”

### 4.2 Investigation Outline

In order to find out what requirements the low-vision people has in the space that easy to walk, we conducted an interview while walking and a retrospective interview after the behavior on the recognition of the space during indoor walking.

#### 4.2.1 Investigation Procedure

First of all, we interviewed the viewing function status and the visual experience in everyday life in a given interview room, and then asked for a predetermined route in the facility to walk. Interview on how to see the space and behaviors that I was concerned while walking (Fig. 4). After walking, return to the predetermined interview room and interview again while looking back on the walking contents.

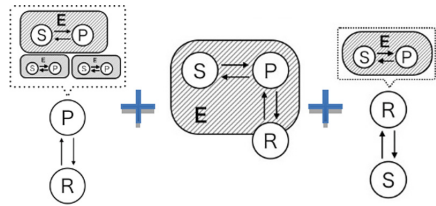
**4.2.2 Result**

Figure 5 shows the model of this investigation. The interview was divided into three phases, each of which was combined with a different model. In an interview on the appearance in his own experience, since the low vision has a property that each person looks different, I went to the beginning of the research in order to grasp the fundamental characteristics of its appearance. A major feature of this investigation is an interview accompanied by walking in real space that was conducted in the second phase. When walking, I encounter multiple pattern spaces. I asked in real time what kind of appearance and how I perceived it at that. Some participants, together with the investigators, re-exploring the unconscious cognitive part of the physical sense in the real space to find out what factors influence the formation of spatial cognition.

In the retrospective interview after walking, we did deep digging of parts that we could not hear during walking and looked back the whole.



**Fig. 4.** Research scene



**Fig. 5.** Investigation model

**4.2.3 Discussion**

Although the participants of the research were spatial recognition of low vision people this time, it is difficult to grasp the characteristic behavior and cognition on how to recognize spaces themselves and speak themselves. Therefore, as a research method, we adopted a form of interviewing with walking.

The walking interview was done in the form of an almost unstructured interview. For that reason, the characteristics of investigators' skills, conversation on the spot, information obtained depending on the circumstances could change dramatically as seen in the characteristics of the unstructured interview given in Sect. 2. It is a way to gather information well by presetting some hypothesis and research theme and interviewing as much as possible on that axis.

The use of an interview accompanied by such behavior is thought to be effective when the influence of the environment is greatly influenced when using the system or the system can not be presented unless a person is enclosed in the environment (Such as space and traffic etc.).

### 4.3 Case Study Using Interview Method Considering Cognitive Aspects - 2

- Influence of visual and sound feedback of the feeling of sucking in the cleaner

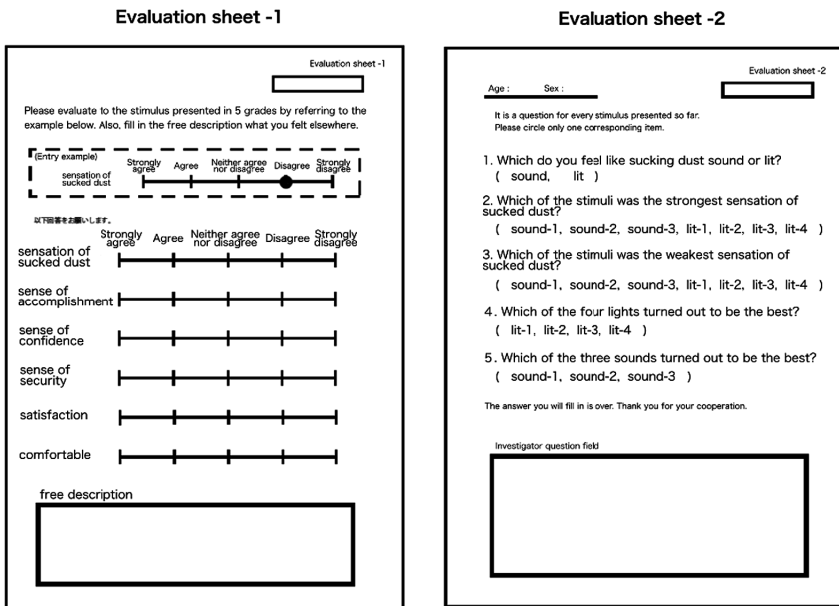
#### 4.3.1 Investigation Outline

It is an investigation of interfaces and sounds for the feeling that the cleaner is sucking. In this investigation, we aimed to explore changes in the cognition of functional functionality of products, such as how changes in visual stimuli and sound stimuli affect sucking sensation.

As an interview method, we conducted a retrospective interview after presenting the system.

#### 4.4 Investigation Procedure

First of all, three stimuli stimulus patterns and three visual stimulus patterns are presented to the investigate participants and then they are completed on the two evaluation sheets shown in the Fig. 6. After that, the researcher inquires the participants about the reason for the evaluation value, how to receive the stimulus, etc. with reference to the evaluation sheet.



In response to a single stimulus, we asked them to evaluate "sensation of sucked dust", "sense of accomplishment", "sense of confidence", "sense of security", "satisfaction" and "comfortable" in 5 stages.

Interview with the responses of good stimulus for all 7 stimuli and their reasons

Fig. 6. Questionnaires



**4.4.1 Result**

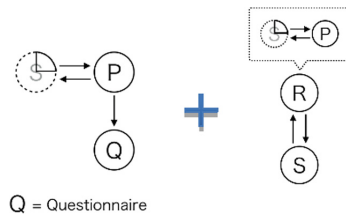
The investigation model in this research is shown in the Fig. 8. The participant received stimulus of one element constituting the system in the laboratory (managed space) and asked the questionnaire to write the evaluation by SD method.

Therefore, it becomes a model as shown on the left side of the Fig. 7. Thereafter, the investigators interview the reasons for the evaluation and the contents of the interaction. At this time, the participants will reply while looking back at the time of interaction, so it becomes a model of “system × retrospective interview”.

Since this time the questionnaire was filled out by the researcher, it is a questionnaire survey + “system × retrospective interview” The structure degree of the interview is based on the questionnaire, so it seems that it is close to semi-structured interview. As a result, in addition to the quantitative evaluation in the questionnaire, qualitative feedback of the number of investigators (10) × the number of items (5) regarding the reasons of each evaluation of the sheet 2 was obtained.



**Fig. 7.** Research scene



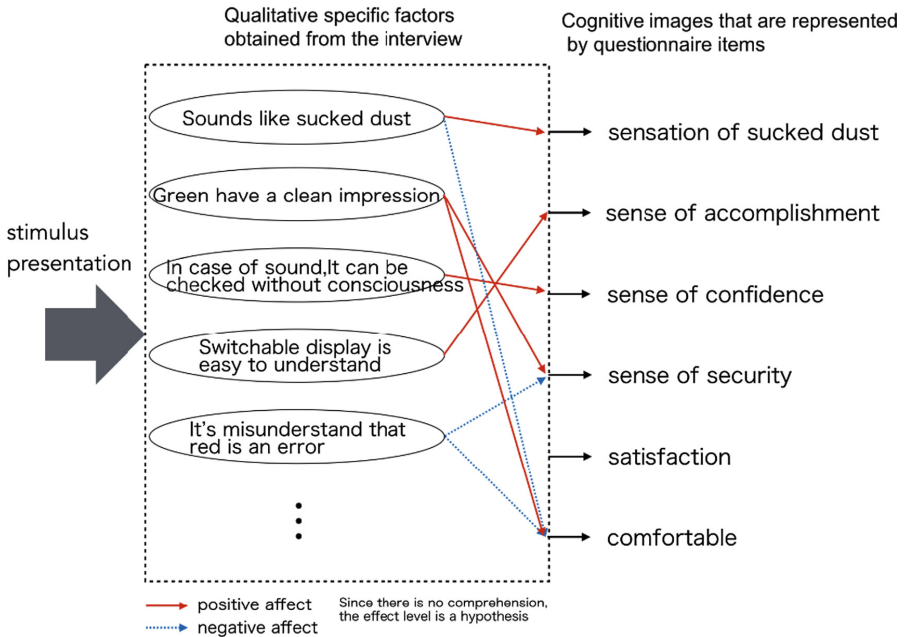
**Fig. 8.** Investigation model

**4.4.2 Discussion**

The researcher conducted an interview while looking at the characteristics of the evaluated value by asking the evaluation value beforehand by questionnaire. The feature of this research form is that we can quantitatively extract the features of impressions and then qualitatively draw out what has been decided after this assessment result.

In addition, through the qualitative feedback which stimuli received, can get not only stay in the comparative evaluation like A or B or C, but also more detailed insights which is similar to this part of A will give the impression likes this, this part of B will give the impression likes that.

From the perspective of cognition, the graph is made from the quantitative evaluation obtained from the questionnaire and the qualitative evaluation obtained from the interview. During model, I referenced the system diagram of multi sensory information processing and functional evaluation of Mr. Jingu [8] (Fig. 9).



**Fig. 9.** Relationship diagram of interview and questionnaire considering cognitive aspect in this investigation

I use 6 kinds of words of impression to express the impressions which are prompted about the stimuli in this experiment, A square which made up of a dotted line is the processing activities performed by a unconscious person in the brain, the left arrow is stimulated, the investigators after consciously accept the stimulation, then consciously to evaluate 6 kinds of evaluation project.

In general, when a questionnaire is used to evaluate the impression, the result is usually not seen in the square of the dotted line. But when developing systems and products, it is very important to understand which elements are based on what kind of value judgments, or how emotionally affect the formation of impressions. This is not only an understanding of the user's cognitive benchmarks, but also helps to reduce the differences between the designers and the recipients.

The red and blue arrows in the figure from the qualitative data combine what kind of factors positively or negatively influence the evaluation as output.

For example, in this case, "sounds like inhaling garbage" play a role in the inhalation sense of vacuum, but on the other hand, it brings unpleasant feelings. Therefore, the design is carried out from the perspective of "avoiding the sound that can be directly associated with the garbage, while giving feedback to the inhalation".

## 5 Future Works

This paper focused on interviews that considered cognitive aspects, described the significance in user research, and modeled interviews and investigated case examples for their use. We picked up two cases and categorized them as an interview model and examined how the combinations and the features of the interview form worked in the research.

Through this study, future tasks will be shown below.

Issues for improving the accuracy of systematization: Analysis in more cases, Review of the model by it.

Other developments: Relationship with design process, How the research system changes due to differences such as objects, systems, and services.

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