가치 중심적 HCI를 위한 새로운 방법론의 개발 및 적용:

모바일 데이터 서비스의 사용자 경험 구조를 중심으로

Developing and Applying a New Methodology for Value-Centered HCI: Focusing on User Experience Structure of Mobile Data Service

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요약 지금까지 HCI분야의 많은 연구들은 사용성 (Usability)을 중요한 연구 주제로 인식하여 왔다. 그러나 연구의 범위를 사용성에 한정하는 것은 HCI 분야의 잠재성을 좁히고, 사용자 경험 (User Experience)의 개념도 좁은 범위로 한정시키게 된다. 따라서 향후 HCI 분야의 연구는 정보 기술의 사용성 측면의 뿐만 아니라, 정보 기술의 사용을 통한 다양한 사용자 경험을 구조적인 관점에서 살펴보아야 한다. 즉 사용성 중심의 연구가 아닌, 보다 전반적이고 구조적인 측면에서 사용자 경험을 살펴보는 새로운 방향의 HCI 연구가 필요할 것으로 보인다. 이와 같이 사용자 경험을 보다 전반적이고 구조적인 측정에서 이해하기 위해서는 사용자가 특정 정보 기술의 사용을 통해 추구하는 가치 (Value)와 그와 같은 가치를 실현 시킬 수 있는 정보 기술의 속성 (Attribute) 및 결과 (Consequence), 그리고 속성, 결과, 가치 간 연관 관계를 구조적인 측면에서 살펴보아야 한다. 이를 위하여 본 연구는 사용자 가치에 대한 대표적인 이론인 Means-End Chain Theory와 속성, 결과, 가치 간 연관 관계를 파악하기 위한 정성적 연구 방법론인 Laddering 기법을 기반으로 사용자 경험 구조 파악 및 가치 중심적 HCI (Value-Centered HCI)를 위한 새로운 연구 방법론을 제안하고자 한다. 또한 본 연구에서는 새롭게 제안된 방법론을 통해 모바일 인터넷 서비스에 대한 사용자 경험 구조를 도출하고, 모바일 인터넷 상황에서 도출된 결과 및 본 연구에서 새롭게 제안된 방법론의 이론적이고 실용적인 의의를 제시하고자 한다.

Abstract For many years, human-computer interaction (HCI) practitioners have focused on usability in order to enhance the user experience, and companies have seen it as an area where they can gain advantages over their competitors. However, a focus on usability limits the potential of HCI research because it restricts the concept of user experience to just an implemented functionality of the information technology (IT). Therefore, it is necessary to expand the boundary of user experience research into a holistic dimension. We suggest that one of the most powerful ways to broadly understand user experience with an IT is to investigate the attributes of an IT and users' perceived values and to construct a user experience structure, a hierarchical structure between the attributes of an IT and users' perceived values. This study thus undertakes two research tasks: to develop a specific methodology, which is the visual probing, for constructing a user experience structure with the attributes of an IT and users' perceived values, and then to build a user experience structure practically by conducting a case study to a specific IT: mobile data service.

핵심어: User Experience Structure, Visual Probing, Means-End Chain Theory, Laddering

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1. Introduction

Many researchers and developers in the field of HCI have focused on user experience since it is a crucial factor of an IT. User experience is how a product functions in the real world and how a product is perceived by users when employed by actual users. Developers interested in the design of user experience should pay attention to how users interact with it and how a product works on the outside rather than what a product does. Therefore, in the field of HCI, user experience with an IT should be studied in the broader perspective. However, many researchers in the field of HCI have considered the design of usable IT to be their own concern, and companies have seen usability as an area where they can gain advantages over their competitors. This focus on usability may limit the potential of HCI research and restrict the concept of user experience to an IT's implemented functionality [1], because it excludes or does not pay enough attention to users' values which interacting with an IT may bring. For example, according to Rondeau [2], good usability itself cannot guarantee quality of user experience with an IT if the IT is regarded as valueless, whereas problems with usability can be overlooked if an IT is considered valuable. In other words, the good usability of an IT is a necessary but not sufficient condition for ensuring high quality of user experience with the IT. Thus, it is necessary to expand the boundary of user experience research into a holistic dimension.

A number of recent studies have shown that understanding a user experience structure which connects the attributes of an IT and users' perceived values is important to enhance a good user experience and users' overall satisfaction (e.g., [3]). Because the values are induced by attributes of an IT and consequences of the attributes, simply listing the identified values is shallow [4]. We can understand how users interact with an IT by investigating the user experience structure because it provides the connection between the attributes and consequences as well as the consequences and values. In addition, the values which are the highest in a hierarchical user experience structure critically affect users' overall satisfaction. Vinson et al. [5] asserted that experienced values directly influence user's satisfaction which, in turn, impacts behavior. Thus, in order to design an IT that can maximize user satisfaction, HCI practitioners should focus on the hierarchical structure of user experience with the IT, as well as the users' perceived values of the IT.

However, little research in the field of HCI has been empirically performed to understand user experience in the perspective of perceived values and hierarchical user experience structures. There is no established and accepted theory of value that can guide the design for good user experience. For these reasons, Cockton [1] argued that the most important goal of HCI research should be to provide users with good experience through delivering value and suggested a research agenda for value-centered design (VCD) or value-sensitive design. However, Cockton [1] did not focus on users' perceived values but on designers' or developers' intended values. Also, he did not investigate the user experiences in terms of hierarchical structure. Furthermore, his research did not provide HCI practitioners or researchers with any specific methodology for value-centered HCI.

This study therefore undertakes two research tasks: to develop a specific methodology, which is the visual probing, for constructing a user experience structure with the attributes of an IT and users' perceived values, and then to build a user experience structure practically by conducting a case study on a specific IT: mobile data service. In order to develop visual probing, we adapted laddering interview methodology which may serve as a useful technique to reveal the user experience structure. In the case study of mobile data service, we conducted a two-step research. The main objective of the first step research is to identify the important user experience attributes of mobile data service. In the second step, we construct a hierarchical structure of user experience with mobile data service. The interviews were conducted based on extracted attributes in the first step.

2. Research Background

In this section, after giving an overview of key theoretical foundation in the existing literature, we propose a research methodology to construct the hierarchical structure of user experience with an IT.

2.1 Value and Value-Centered HCI

The prior literatures have given an abundant number of definitions of values. In the field of marketing, it has often been viewed as a trade-off between customers' perceptions of benefits received and sacrifices incurred [6]. For example, Zeithaml [7, p.14] defined a value as "the consumer's overall assessment of the utility of a product based on perceptions of what is received and what is given." Many subsequent researchers have used Zeithaml's definition as the essence of their own definitions of customer values (e.g., [6; 8]).

Meanwhile, Woodruff [9] expanded the concept of value and described it as a source of competitive advantage. According to Woodruff [9, p.142], customer value is "a customers' perceived preference for and evaluation of those product attributes, attributes performance, and consequences arising from use that facilitate (or block) achieving the customer's goal and purposes in use situation." Furthermore, Woodruff [9] argued that customer value should be conceptualized as a means-end chain with attributes that exist in products leading to the achievement of desired consequences and then to the fulfillment of customer goals and purposes. Similarly, Vinson et al. [5, p.49] defined value as "centrally held cognitive elements that stimulate motivation for behavioral response", that exist in an interconnected hierarchical structure in which products attributes are related and connected to consequences, which are, in turn, associated with values. Many researchers have admitted this broader definition of value to provide conceptual richness (e.g., [10; 11]).

In the context of IT, users use an IT to satisfy needs of one sort or another; and when an IT satisfies a particular need, the users find value in that IT. Thus, value in this context is not inherent in ITs themselves; rather it is experienced by users as a consequence of using the ITs for their own purposes. As a result, a user's perceived values can be regarded as high level outcomes of certain kinds of good user experience with- or through- an IT. For these reasons, Cockton [1] argued that the most important goal of HCI research should be to provide users with good experience through delivering value.

In this study, we focus on value because it exerts a strong influence on individual users' behavior [10]. Value emerges as a key concept in various fields because it offers a theoretical and practical bridge between user behavior on the one hand and design or marketing strategy on the other. For example, prior research has found that value correlates with decision making, product evaluations, behavioral intention, and repeated usage [4]. Clearly, then, if an IT developers tend to deliver superior services to users, they must have a clear understanding of what exactly their users value in the IT. The alternative is to attempt to improve IT quality at the level of attribute. However, because value is the driving force behind user's behavioral responses [5], attribute-focused strategies that neglect the role of value will have a minimal effect on user motivation and behavioral response.

2.2 Means-End Chain Theory and User Experience Structure

Although HCI researchers recognize the importance of identifying values that users expect in an IT as a key step in value-centered, user-centered, user engineering, and goal-directed design, simply listing the values is shallow [4]. This is because users' perceived values are induced by attributes of an IT and consequences of the attributes. That is, in order to deliver superior values to users of an IT, developers should investigate attributes of the IT and consequences of the attributes that are related to the values. Thus, we should understand the concept of user experience from the perspective of a hierarchical structure in which attributes of an IT are connected to consequences, which are, in turn, associated with values.

In order to understand hierarchical structure of user experience, we employ the means-end chain approach in this study. The central tenet of the means-end chain theory is that users' product meaning structures stored in memory consist of a chain of hierarchically-related elements. The chain starts with the product attributes and established a sequence of links with the personal values through the perceived consequences by the product. That is, the means-end

chain theory focuses on the connection between product attributes, user consequences, and personal values [11]. Attributes are relatively concrete and tangible aspects that represent the physical or observable characteristics of a product. Consequences are more abstract meanings that reflect the perceived benefits or cost associated with specific attributes. Finally, personal values are highly abstract meanings that refer to intangible, higher-order outcomes or end-states that users seek to achieve through usage of a product. Therefore, the personal values are the ultimate source of choice criteria that drive usage behavior. These concepts – attributes, consequences, and personal values – may constitute the content of user experience, whereas the linkages between the concepts form the hierarchical user experience structure. The means-end chain theory, thus, is in concern with the content and the structure of user experiences with an IT.

We believe that the means-end chain theory represents a useful theoretical framework for examining the hierarchical structure of user experience with an IT because it can explain how users organize the content and structure of the experience. Thus, the theory helps us to have a broadly understanding how users interact with an IT and how the IT works on the outside.

2.3 Laddering Interview

Reynolds and Gutman [11] offered a methodology for assessing the structure of customer experience in the field of marketing. The procedure, known as laddering, involves a series of one-on-one in-depth interview. The laddering interview was designed to understand how people translate the attributes of products into meaningful associations with respect to self [11]. In the laddering procedure, three steps are distinguished: (1) elicitation of salient attributes, (2) the in-depth interview, and (3) analysis of the results.

Laddering interview has served as a useful qualitative technique to reveal the hierarchical structure of user experience structure with an IT (e.g., [3]). However, it also has its limitations. First, when asked why a particular attribute of an IT (or consequence) is important to a participant, the participant may have difficulty articulating a reason which is based on their experiences with the IT. This may be because information about personal experiences is encoded in episodic memory, and it is quite difficult to retrieve such information from episodic memory without retrieval cues about the experiences [12]. Second, the laddering interview places a serious burden on participants, and participant fatigue may lead to omission of some information. This may be because most thinking is unconscious, and it is quite difficult to surface and report unconscious process.

2.4 Visual Probing

Due to those limitations of the laddering interview, we developed a new interview methodology, termed visual probing, which is a visual ethnography interview using video clips and photographs as interview stimuli. There are several reasons for inserting the visual stimuli into our interview methodology.

First, Barsalou [13] posited that retrieval of information from episodic memory is easy when a person is presented with cues about an event. Furthermore, Collier Jr. and Collier [14] suggested that visual stimuli, when used in interview, sharpen the episodic memory and give the interview an immediate character of realistic reconstruction. We thus thought that visual stimuli of an IT could play the role of retrieval cues about experiences with the IT. Second, visual stimuli are effective at surfacing participants' hidden thoughts. Prior research has found that use of visual stimuli helps people make unconscious experiences progressively more conscious and communicable [15]. This is because the parts of the brain that process visual information are evolutionarily older than the parts that process verbal information. Therefore, visual stimuli may be able to evoke deeper elements of user experiences with an IT and help participants overcome the fatigue of traditional laddering interviews. Third, Pink [16] argued that visual stimuli can be made meaningful through the gaze of researchers and that each participants can relate the stimuli to his/her existing personal experience and knowledge. In other words, researchers can use visual stimuli as objects through

which participants reference aspects of their experience and knowledge [16]. Thus, we thought that visual stimuli of an IT could be used as reference points in interview to examine participants' value structure of the IT. Fourth, in the field of HCI, video clips and photographs can be used as interview stimuli to examine hierarchical relationships among attributes, consequences, and values of an IT with which interviewees do not have experience. For example, because mobile date services can be accessed only through local communication networks, it is impossible to use other countries' services. Consequently, the perceived values and the experience structure of users in a country may be limited to the experiences with the country's mobile data services. Thus, visual stimuli of other countries' mobile data services can be utilized to broadly investigate the perceived values and the user experience structure for mobile data service.

For theses reasons, we believe that visual probing, which is an adaptation of the laddering interview method, is effective at examine users' perceived value and user experience structure for an IT. Further detailed explanations for the visual probing methodology are given in the case study on mobile data service.

3. Case Study: Mobile Data Service

We conducted the case study in which the developed visual probing methodology was used to investigate hierarchical structure of user experience with a specific IT: mobile data service. Mobile data service, which may be defined as wireless access via mobile devices to digitalized contents of the Internet, is an appropriate research domain for at least three reasons. First, mobile data services are used mostly for personal purposes by individual users in a personal context, making it a suitable domain in which to investigate their experience structure for mobile data service. Second, mobile data service can be accessed only through local communication networks. Thus, inserting visual stimuli of other countries'mobile data services into qualitative interview process can be effective to accurately investigate user experience structure for mobile data service. Finally, because of the high rate of discontinuation, mobile data service providers currently face serious problems in terms of low profits and shallow customer bases. Thus, understanding user experience structure for mobile data service might suggest ways of delivering superior services to users.

3.1 Step 1

The main objective of the first step is to identify the important user experience attributes of mobile data service which would be used as starting point for the following visual probing procedure. To accomplish the objective, we interviewed 8 Korean users, using video clips of mobile data services.

3.1.1 Data Collection

For the first step, we accessed services provided by the major mobile data service provider in three countries: Korea, Japan, and Finland. We then recorded the actual processes of using them in the 4 use cases downloading a ring tone (Case 1), downloading a game (Case 2), reserving a movie ticket (Case 3), and reading sports news (Case 4). For the use cases, we observed that participants could not see the enough interaction in the movie clips if we chose the first or second menu item in the menu list. Therefore, in most of the use cases, we chose the fourth item in the menu list so that more interaction with the service would be shown to our study participants.

We videotaped the 4 use cases in each of the three countries, producing 12 video tapes in total. While recording these services, we read the labels of the menu items in native language first and then read it again in Korean for participants to understand the meaning. The movie clips ran around 10 minutes on average.

We conducted a pilot test with 4 mobile data service users. Details of the interview procedure were revised based on the pilot test results. Following the revised procedure, we conducted our main interview with 8 Korean users. These 8 people were selected based on Strauss and Corbin [17]'s technique of theoretical sampling. According to them, there is no magic number of sample size. The process of data collection

is controlled by the emerging theory, and additional samples are required only when the theory is expected to be elaborated substantially with the new data. Sampling new data stops as soon as the emerging theory hits the saturation point by which no substantial modification is made to the theory. In this study, we reached the theoretical saturation point with 8 participants. Theoretical sampling requires paying attention to theoretical relevance. To account for relevance, we conducted a pre-survey to learn what kinds of services the participants had used often before the interview. Based on these results, we selected for each participant a use case of mobile data service he or she had already used; 2 participants were allocated the same use case. Among the participants, the average age was 27.17, and gender was balanced at 50% male and 50% female.

Table 1. User Experience Attributes of Mobile Data Service

Code	Attribute	
A1	No Requiring Personal Information	
A2	Personalized Menu	
A3	Providing Search Facilities	
A4	Link of Related Items at the End of Contents Page	
A5	No Advertising Menu	
A6	High Graphic Quality	
A7	Font Color	Various Font Color
A8		Single Font Color
A9	Font Style	
A10	Font Size	
A11	Reliability of the Data Connection	
A12	Providing Progressive Bar	
A13	Service Classification	Unitary
A14		Aggregate
A15	Iconic Menu Style	
A16	Representation of Long Menu	Many Lines
A17		Moving
A18		"..."
A19	Logical Ordering of Menu items	
A20	Clear Menu Labeling	
A21	Meaningful Classification or Categorization of Contents	
A22	Providing Preview Function	
A23	Consistent Location of Buttons	
A24	Providing Secondary Information of Contents	
A25	Fast Reaction Speed for Operating Keys	
A26	Fast Page Loading Speed	
A27	Other Users' Contents Use Experience	
A28	High Sound Quality	
A29	Providing Option to Send Contents as Gift	
A30	Selecting Menu through Number Key	
A31	Various Options for Contents	
A32	Ordering of Contents List Based on Popularity Ranking	
A33	Space between Lines	
A34	Scroll by Line	
A35	Providing Bookmark Function	
A36	Short Menu List Length	
A37	Variety of Contents	
A38	Fast Contents Downloading Speed	
A39	Prompt Updates of Contents	
A40	Cue for the Present Location within a Page	
A41	Scroll by Page	
A42	Providing Cue of Page Numbers	
A43	Page Partitioning	Dividing over Pages
A44		All in One Page
A45	Large Amount of Information within a Screen	
A46	Hot Keys for Screen Up	
A47	Providing User's Navigation History	
A48	Providing the Home Button	
A49	Colorful Screen Design	
A50	Efficient Layout or Space Usage	
A51	Selecting Contents through CP List	
A52	Providing Information of CP	
A53	Direct Access through Keying URL	

Each participant saw the video clip of Korean mobile data service first, and then clips of the same use case in the other 2 countries. We asked participants to watch each video clip closely and to take as much time as they needed to verbalize what they thought or felt. Each time a participant had something to say, the interviewer paused the video clip. If the participant asked to see a previous screen, the interviewer rewound the clip and found that image.

Each session consisted of both an unstructured and a structured interview. The unstructured interview took place during the viewing as participant expressed what they thought or felt and also after the end of each clip; this time, the interviewer asked questions about the participant's impressions. To learn the users' thoughts, feelings, and experiences without filtration through the interviewers' perceptions, all interview questions in the unstructured interviews were open-ended such as "What do you think of the overall process in the Japanese mobile data service?" or "Was there anything about the Korean mobile data service you didn't like?"

In the structured interview, we asked participants what attributes they felt made each country's mobile data services unique, how willing they would be to use each service, and what aspects of each could be improved. When they were vague or ambiguous in expressing an opinion about a user-experience attribute, we asked about their preferences once again, in order to clarify their response. Each interview took around 3 hours, and the entire

interview was videotaped. Each of the 8 recordings was then transcribed word-for-word.

3.1.2 Data Analysis and Results

To analyze the raw data, we applied the open coding method of the grounded theory approach [17]. Raw data in the transcripts was broken down, examined, compared, conceptualized, and categorized in terms of user experience attributes of mobile data service. As shown in [Table 1], a total of 53 user experience attributes of mobile data service were elicited. For example, a participant stated that 'I like the function that lets you send content as a gift. If there is content I like, I am used to sending it to a friend.' Based on the open coding method, the statement was coded as 'Providing option to send contents as gift' (A29).

3.2 Step 2

In the second step, based the attributes elicited by the first step, we intend to understand users' perceived values through using mobile data service and construct their experience structure. 20 Korean users were visually probed in this step through photographs of mobile data services as interview materials.

3.2.1 Data Collection

For the second step, we took 53 photographs of mobile data services in three countries; Korea, Japan, and Finland. The photographs reflected the important 53 attributes of mobile data service elicited by the first step. We then made PowerPoint slides in which the photographs and detailed explanation of them were included. We intended to use the PowerPoint slides as a tool of facilitating visual probing in step 2.

With the PowerPoint slides, we conducted a pilot test with 5 mobile data service users. Details of the interview procedure were revised based on the pilot test results. Following the revised procedure, we conducted our main interview with 20 Korean users who have at least one year of experience with mobile data services. Like the first step, the sample size of this step was determined by the results of the visual probing based on the principle of the theoretical sampling [17]. Among the participants, the average age was 22.75, and gender was balanced at 50% male and 50% female.

After collecting basic demographic information, 20 participants were each presented with the PowerPoint slides of 53 attributes of mobile data service elicited by the first step. Seeing those attributes, the participants were asked to indicate how important each attribute is for them to satisfy their expectation and desire for mobile data services on a 11-point scale ranging from "not important (-5)" to "very important (5)". This scale was used successfully in previous laddering research (e.g., [18]). Completion of the evaluation took 30 minutes on average.

After participants' evaluating, about top 20 attributes that each participant had evaluated to be important were chosen by the interviewer as starting point for the visual probing procedure. We then asked them the reason why they thought those attributes were important. For each reason given, participants were asked why it was important to them; and if they provided an answer, they were again asked why that reason was important. Repeated applications of this procedure led to higher-level values until participants could no longer answer the "why" question. For instance, participants rephrasing the same answer or saying "I don't know" or "it is important because it is just important" meant the high level of user experience structure had been reached [4]. When a participant struggled to articulate an answer, we asked them alternative questions, for example, "If this attribute or consequence is not that good, what kinds of problems might happen to you?", "Could you recall your memory of seeing this attribute when you used mobile data service recently? What was good or bad?" or "Do you have any friends or family who were satisfied or not satisfied with this? If you have, why do you think they were satisfied or were not satisfied with this attribute?" [11]. Consequently, we interviewed with the 20 participants about the 32 attributes among the 53 user experience attributes extracted by the first step. Each visual probing took around one and half hours and the entire interview was videotaped for later verbatim transcription that was used in the data analysis.

3.2.2 Data Analysis and Results

Because the responses obtained in a visual probing are typically rather idiosyncratic, it is necessary to perform a content analysis and classify the raw data

into a limited number of response categories. Like the data analysis in the first step, the grounded theory approach was adopted in the content analysis and the classification of the raw data, following the work of Strauss and Corbin [17]. The codes arose naturally during the coding of the data rather than being pre-specified [17].

As shown in [Table 2], a total of 33 consequences or values of mobile data service were elicited. For example, in the interview about 'Clear menu labeling (A20)' in [Table 2], a participant stated that'If a menu labeling is obscure, I have to stay on the net longer which will cost more money.' Based on the open coding method, the statement was coded as 'Saving time' (C19) and 'Saving money' (C20).

Meanwhile, the 20 participants listed a total number of 928 ladders, for an average of 46.4 ladders per participant (range of 17 to 79). The average length of a ladder was 3.5 (range 2 to 8). For example, the ladder for the above statement was coded as 'Clear menu labeling (A20) → Saving time (C19) → Saving money (C20)'

With the coding process complete, individual ladders were aggregated across participants. This aggregation involved the development of an implication matrix, which bridges the gap between the qualitative and quantitative aspects of the visual probing method by displaying the number of times each code leads to another code [11]. The implication matrix reveals both direct and indirect relationships, facilitating identification of the levels of significance of the various connections in the ladder. For instance, the ladder A20 (Clear menu labeling) → C22 (Maximizing understandability) → C23 (Less cognitive load) represents relations between adjacent elements. The A20 to C22 relation is direct, as is C22 to C23. However, there are also indirect relations such as A20 to C23. Elements with a high incidence of indirect relations should not be ignored so both types of relations were considered in determining which paths were dominant [11].

Table 2. Consequences or Values of Mobile Data Service

Code	Consequence or Value
C1	Preventing Lostness
C2	Minimal Step
C3	Fast Searching for Information and Contents
C4	Minimizing Keystroke or Input Activity
C5	Avoiding Unwanted Efforts
C6	Easy to Find Information and Contents
C7	Error Prevention
C8	Maximizing Predictability or Observability
C9	Preventing Exposure of Personal Information
C10	Feeling Comfortable
C11	Variety of Choice
C12	Familiarity
C13	Maximizing Legibility
C14	Fast Attainment of User Goal
C15	Acquiring More Knowledge
C16	Fast Decision Making
C17	Not Downloading Needless or Unwanted Contents
C18	Fun and Enjoyment
C19	Saving Time

A part of the matrix generated for this study can be seen in [Table 3]. Cells contain the frequency that a row element leads to a column element. Within the matrix, numbers in parentheses represent the total number of direct plus indirect relations between two elements, whereas numbers out of parentheses represent the number of direct relations between the two elements. Consider, for example, the relationship between A3 (Providing Search Facilities) and C3 (Fast Searching for Information and Contents). The value in the implication matrix for these two elements is 3(11), indicating 3 direct relationships and 8 (= 11-3) indirect relationships.

Table 3. Implication Matrix

	C1	C2	C3	C4	C5	C6	C7	C8	...
A1				1(1)	1(1)	(1)			
A2		1(1)	2(6)	6(7)		2(5)	(1)		
A3		11(11)	3(11)			1(3)			
A4		2(2)	1(2)			(1)			
A6									
A10	(1)	(2)		(5)	(2)	(2)	(1)		
A11					13(13)	(1)			
A12						(1)		15(15)	
...									

The implication matrix was then used to produce hierarchical experience map (HEM), a visual representation of user experience structure for an IT. As Arnheim [19]'s suggestion, vision is the primary medium of thinking, and a well designed graphic takes advantage of this and facilitates the processing of large amount of information. Thus, the HEM may be

very effective at representing the relationships between attributes, consequences, and values, that is, user experience structure for an IT.

Usually, the HEM do not display all the linkages between active cells in the implication matrix [11]. The objective of representing the key relationships in user experience structure for an IT can be achieved considering only the connections between elements that reach a predetermined cut-off value. In this study, we defined our cut-off level comparing the proportion of active cell in the implication matrix with the proportion of all connections between elements accounted for at a given level. According to the previous means-end chain research (e.g., [20]), this entails a trade-off between parsimony and goodness of fit. The higher the chosen cut-off level, the more parsimonious the representation of the user experience structure for an IT. However, increasing parsimony means that a smaller percentage of all connections between connections actually made by participants is accounted for. Given the above criteria, a cut-off was chosen based on linkages occurring 7 or more times in this study. At the cut-off level of 7, we can account for 63.1% of all connection between variables made by participants using only 3.4% of all possible cells in the implication matrix and only 24.9% of all cells that contain a non-zero entry. Once an appropriate cut-off level has been chosen, the HEM for an IT can be represented graphically. In this study, the HEM for mobile data service was constructed from the implication matrix in [Table 3] by drawing all linkages that met or exceeded the chosen cut-off level of 7. As shown in [Figure 1], the line segments connecting the variables are of varying degrees of thickness, representing the number of times a connection was made by participants.

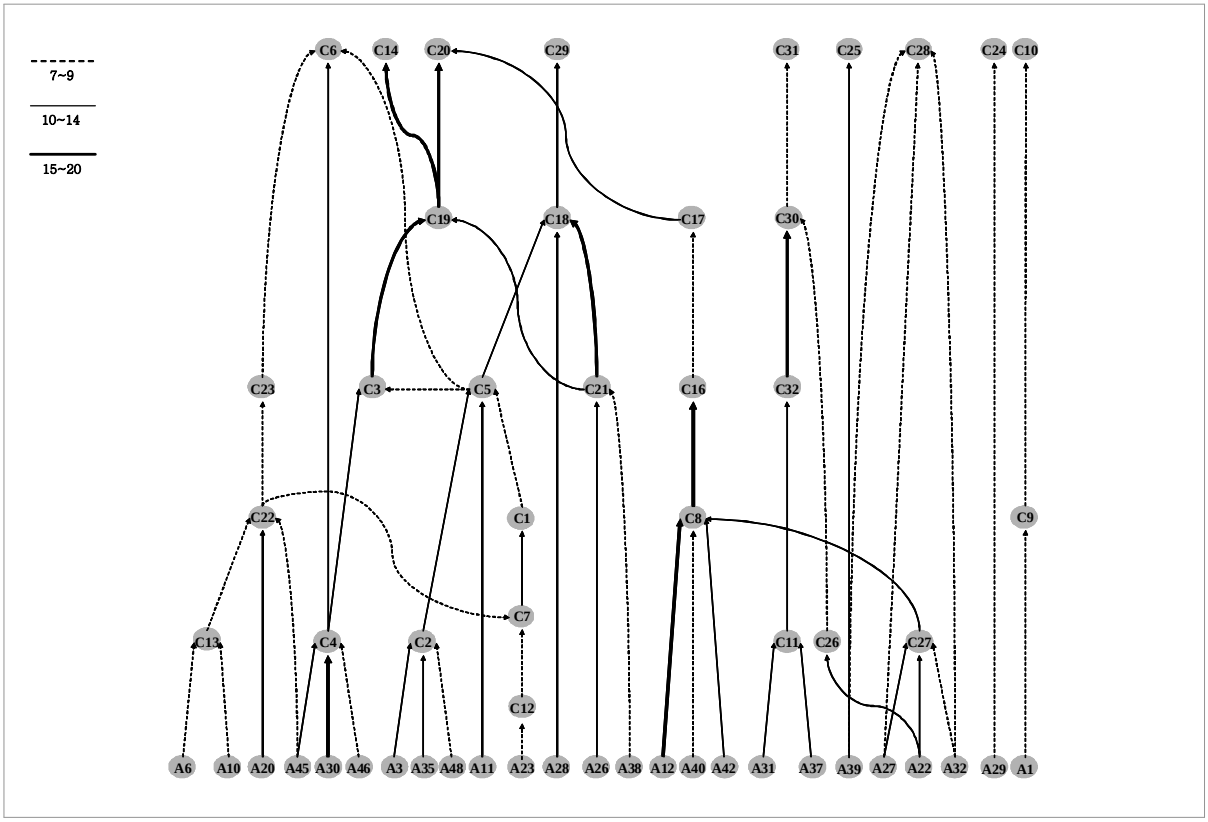

Figure 1. User Experience Structure for Mobile Data Service (Cut-off Point = 7)

[Figure 1] reveals 9 major values that are experienced by mobile data service users: C6 (Easy to find information and contents), C10 (Feeling comfortable), C14 (Fast Attainment of user goal), C20 (Saving money), C24 (Social interaction), C25 (Up-to-dateness), C28 (Trust), C29 (Playfulness), and C31 (Self-satisfaction). Also, [Figure 1] represents the user experience structure for mobile data service. For example, according to [Figure 1], mobile data service users think that selecting menu through number key

(A30) can minimize keystroke or input activity (C4), which is in turn positively related to fast searching for information and contents(C3). Furthermore, they perceive that the fast searching (C3) leads to saving time (C19), which in turn saves connection fees (C20).

The HEM for an IT will facilitate inferences. The graphic representation of data from visual probing in the HEM may allow the researchers or practitioners to identify patterns of user experience structure for an IT. By examining HEM, the researchers or practitioners may also find ways of delivering a superior value to the IT users. For example, in order to deliver the 'Self-satisfaction' (C31) value to their users, mobile data service providers can provide their users with 'Preview function' (A22), 'Various options for contents' (A31), and 'Various contents' (A37), as shown in [Figure 1]. As a result, we think that the HEM for an IT helps us understand the hierarchical structure of user experience with the IT.

4. Conclusions and Implications

The purpose of this study was to offer both the concept of hierarchical user experience structure and methodological framework for constructing the structure. Based on means-end chain theory in the field of marketing, we suggested the concept of hierarchical user experience structure for an IT. Furthermore, based on psychological and anthropological theories, we developed the visual probing methodology for constructing a user experience structure and then built the user experience structure for mobile data service. The results suggest that the visual probing methodology in the field of HCI may be efficient at identifying the users' perceived values and constructing the hierarchical structure of user experiences with an IT.

However, the study has several limitations. First, while we reached the theoretical saturation point with 8 participants in step 1 and 20 participants in step 2, the number of participants in this study was small. Thus we are planning to conduct additional interviews with more people, as well as with mobile data service users in other countries. Second, because data were collected concerning mobile data service users, usefulness of our visual probing methodology may be questionable in the context of other ITs. A future study should take up other ITs with different features and use context. Third, in our visual probing study, the interviews were conducted without any real use of an IT. Users' opinions and preferences might be different when they actually use the IT themselves, rather than watching somebody else using the IT. Therefore, our visual probing methodology may be modified for future research.

Despite these limitations, this study has valuable theoretical and practical implications. On the theoretical side, the study extends our knowledge in the field of HCI by incorporating the concept of hierarchical user experience structure. Also, the study presents the researchers with a useful methodology, visual probing, for constructing a user experience structure. The visual probing can be successfully applied in the context of HCI research.

The main practical strengths of the visual probing developed in this study can be summarized as follows. First, because the visual probing methodology uses visual stimuli of an IT, users' episodic memory or hidden thoughts about their experiences can be effectively surfaced; and the fatigue of traditional laddering interviews can be overcome. Second, while many techniques for eliciting user requirements deal with functional and interface features of an IT, the visual probing helps HCI practitioners understand deeper elements of user experiences with an IT. Third, the visual probing can be practically used as a substitute of actual usage, when actually using an IT is impossible for technical or economic reasons.

Also, in terms of practice, the concept of hierarchical user experience structure suggests that HCI practitioners should understand and measure the entire structure of user experience. Understanding the relationships among attributes, consequences, and values can help HCI practitioners to identify high impact attributes that provide multiple values for users. Therefore, the construction of hierarchical user experience structure can provide HCI practitioners with various new opportunities for IT development and design. Also, although many IT developers or designers that are usability-driven start at the bottom of the structure, the concept of hierarchical user

experience structure suggests a top-down approach. By adopting the top-down approach, the developers or designers begins with an in-depth understanding of the values that are important to users and then works backward to try to develop or design a bundle of attributes to deliver those values.

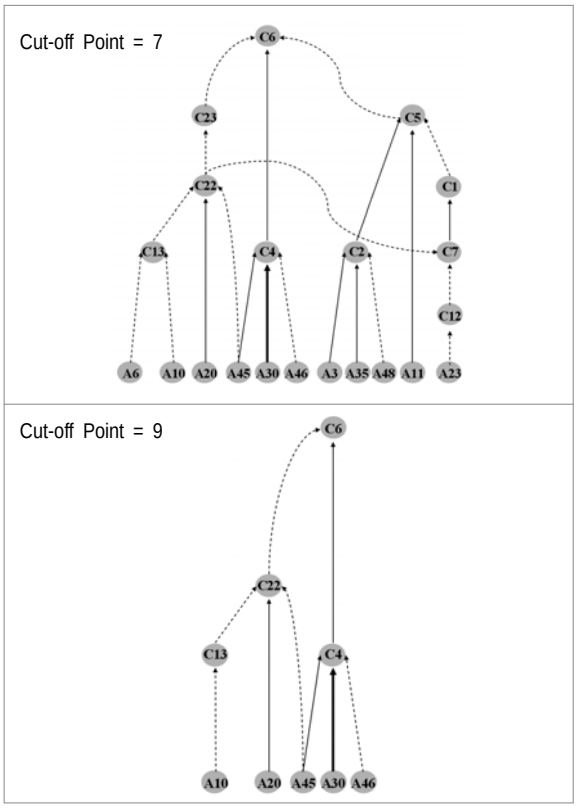

Figure 2. Adjustment of Cut-Off Point

As seen in [Figure 2], if mobile data service developers or designers intend to help users easily find information or contents (C6), their efforts can be focused on A3 (Providing search facilities), A6 (High graphic quality), A10 (Font size), A11 (Reliability of the data connection), A20 (Clear menu labeling), A23 (Consistent Location of Buttons), A30 (Selecting menu through number key), A35 (Providing bookmark function), A45 (Large amount of information within a screen), A46 (Hot keys for screen up), and A48 (providing the home button) at the cut-off level of 7. However, if their resources (e.g., time, budget) are insufficient, a lower cut-off point can be chosen. For example, at the cut-off level of 9, their efforts to help users easily find information or contents (C6) may be focused just on A10 (Font size), A11 (Reliability of the data connection), A20 (Clear menu labeling), A30 (Selecting menu through number key), A45 (Large amount of information within a screen), and A46 (Hot keys for screen up). Thus, the hierarchical experience map (HEM) can be used as s criterion of decision-making for efficient IT development and design.

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