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스마트 TV의 사용자 인터페이스 개념화 및 측정 : 사용자 경험, 상호작용성, 어포던스의 중첩작용

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Conceptualizing and Measuring the User Interfaces of Smart TVs: Roles of User Experiences, Interactivity, and Affordance

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[요 약]

사용자 인터페이스(UI)는 디지털 미디어에서 자주 사용되지만 개념 자체가 명쾌한 조작적 정의가 되어 있지 않았다. 본 연구는 미디어와 광고에서 유저 인터페이스의 중요성을 인식하고 인지 기반의 유저 인터페이스 측정 개념을 개발하였다. 연구 결과 유저 인터페이스를 구성하는 핵심 구조는 유저 경험(UX), 상호작용성(Interactivity), 어포던스(Affordance)로 나타났다. 지각된 유저 인터페이스를 탐색하기 위해 다차원 방법론이 사용되었다. 본 연구에서 발견한 17개의 항목은 개념적으로 분명한 가이드라인을 제공하고 다양한 스마트 기기에서 유저 인터페이스를 측정하는데 효과적인 도구로 사용될 수 있다. 더욱, 디지털 미디어 이용이 어포던스와 상호작용성에 영향을 미치는 선행요인으로 나타났으며 3가지 유저 인터페이스 차원은 스마트TV에 대한 태도에 영향을 미치는 것으로 나타났다. 또한 어포던스, 상호작용성, 유저 경험 간의 관계도 발견하였다.

[Abstract]

User interface (UI) is a frequently used—but rarely operationalized—concept associated with digital media. This study develops scales to operationalize the perception-based approach to UI, due to its importance in media and advertising research. Three overlapping constructs that are critical to UI are explored: user experience (UX), interactivity, and affordance. We used a multistage methodology to identify and refine the measure of perceived user interface. The 17 items developed in this study provided a clear conceptual guideline and an effective tool for measuring UI in various smart devices. Further, digital media uses influenced affordance and interactivity as antecedents; these three dimensions influenced attitudes toward smart TVs. Relationships among affordance, interactivity, and UX were also found.

색인어 : 스마트 티비, 사용자 인터페이스, 사용자 경험, 상호 작용성, 어포던스
Keyword : Smart TV, User Interface, User Experience, Interactivity, Affordance

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Ⅰ. Introduction

Smart devices are popular in our daily life. Smart phones have become essential media incorporating countless functions that have not been possible before. Some media have disappeared due to new functions that smart phones start to provide. Traditional media are also changed into digital formats and even smarter ones. From a media business perspective, smart TV shed light on current broadcasting and communication industries. With the interpenetration and mutual compatibility of telecommunication networks, radio and television networks and computer communication networks, these three network platforms are gradually integrated into a unified information and communication network all over the world, which brings great prospects for the development of Smart TV. Advances in human-computer interaction technology have resulted in major changes in the user interface (UI) and interaction mode of Smart TVs. Smart TV is the center of leisure and entertainment in family life and has a wide user group. The advantages and disadvantages of the UI systems of similar products at home and abroad are different, each with its own advantages and disadvantages, and there is a lot of room for development. Therefore, how to make the UI of smart TV achieve universal applicability is the core problem worth studying at present.

When we talk about smart media, the concept of user interface (UI) is frequently used as main variables explaining communication efficacy between users and digital devices. UI is a very complicated concept, but UI can be simply understood as a degree of usability. Acknowledging the importance of UI, companies that produce digital media devices try to realize affordable and easier UI environments. Apple and Samsung are representative companies that invest tremendous efforts to enhance usability of mobile media along with design, functions, and UI etc. The importance of UI is also applied to traditional media companies and even general product companies. However, UI has not been academically defined, and has not been quantitatively operationalized from a social science perspective.

Most of the research on Smart TV has focused on the period before 2017 and has mostly explored the development of Smart TVs as well as marketing strategies. The exploration of smart TV user interface (UI) has also been conducted from a limited perspective after the concept of human-computer interaction (HCI) came out in recent years, and the number of studies is insufficient. There are even fewer articles that use quantitative methods to measure the UI. This study could fill this academic gap, and would provide academic and managerial implications. This study aims to explore sub dimensions of UI, and tries to validate its usefulness through testing construct validity of the structural model. This model could enable researchers to do more specific and systematic analyses, and suggest various implications for future research.

Ⅱ. Literature Review

As information technologies and their interfaces become more complex, usability has become a key concept in user interface study[1]. It is a comprehensive concept that includes safety, utility, effectiveness, and efficiency. It is concerned with making systems easy to learn and easy to use. Usability is measurable in terms of accuracy, time, and satisfaction with the subjective workload. Even if computer system has a powerful capacity, users will avoid using it if it annoys or confuses them[2]. However, still the concept of usability has more focused on task oriented processes, dialogues, and actions by a system, rather than by users themselves.

Currently, it is an intriguing phenomenon that the notion of ‘user-centered’ has been widely disseminated and speedily accepted in the Human-Computer Interaction (HCI) community. Thus, currently HCI scholars have attempted to change the focus of attention to what users take using an interface (User Experience), which mechanism act for using it (Affordance), and how users do with it together (Interactivity).

2-1 User Experience

The traditional concept of usability has been considered the ability of the user to use the system to carry out a task successfully[3]. While usability has focused on a system, product or service itself used by users to achieve task related goals, user experience (UX) takes a broader view, emphasizing user's perceptions and responses resulting from the use

and/or anticipated use of a product, system or service[4]. Thus, according to reference[4], UX has instrumental, emotional and all the users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and accomplishments that occur before, during and after use the system.

UX is about beyond the technology itself or instrumental needs. It is about the pragmatic aspects of interactive products as well as about hedonic aspect, such as stimulation, identification and evocation. It is a consequence of a user's internal state (predispositions, expectations, needs, motivation, mood, etc.), the characteristics of the designed system (e.g. complexity, purpose, usability, functionality, etc.) and the context (or the environment) within which the interaction occurs (e.g. organizational/social setting, meaningfulness of the activity, voluntariness of use, etc.)[5].

An experience, a main factor on UX, is a unique combination of various elements, such as the product and internal states of the user, which extends overtime with a definitive beginning and end. In terms of UX, users could have experience with positive or good feeling and affection. Thus, UX could be determined by the extent to which a system, product or service can be used by specified users to have good experience in a specified context of using a system.

As traditional "features-and-benefits" paradigm have moved toward "creating experiences for users or customers," Reference[6] proposed that five modules of experience such as sensory experiences (SENSE); affective experiences (FEEL); creative cognitive experiences (THINK); physical experiences, behaviors and lifestyles (ACT); and social-identity experiences (RELATE). According to reference[6], 1) the sensory experiences through the senses, such as sight, sound, touch, taste and smell, could be used to differentiate products, to motivate customers and to add value to products; 2) the affective experiences are users' inner feelings and emotions that range from mildly positive moods to strong emotion of joy or pride. To make users have better affective experiences, the system should be built based on understanding of what stimuli can trigger certain emotions as well as the willingness of the user to engage in perspective-taking and empathy; 3) the creative cognitive experiences are related to the intellect with the objective of creating cognitive, problem-solving experiences that engage customers creatively. Those experiences, which come from users' convergent and divergent thinking process through surprise, intrigue and provocation, are considered meaningful for high-tech product design; 4) the physical experiences, behaviors and lifestyles, which are often more motivational, inspirational and emotional in nature, depend on the extent of ability of showing users alternative ways of doing things, alternative lifestyles and interactions; 5) the social-identity experiences are beyond the individual's personal, private feelings. These experiences are related the individual to something outside his/her private state in a social system such as a family, a subculture or a country. Although all experience modules have their own inherent structures and processes, they are connected and interact to each other.

2-2 Affordance

The concept of affordance was coined by reference[7]. According to reference[8], "affordance casts across the dichotomy of subjective-objective and helps us to understand its inadequacy. It is equally a fact of the environment and a fact of behavior. It is both physical and psychical, yet neither. An affordance points both ways, to the environment, and to the observer."

This ecological view refers to the actionable properties between environment and an organism (a person or animal)[9]. The relationship is not universal to all, but to a particular organism who have perceive or use it. Affordance perceptions vary depending on individual differences[10]. The direct perception by affordances is not based on prior synthesis or analysis from the actor's experience, knowledge, culture, or ability[11],[12], and, an affordance does not change as the needs and goals of the actor change[13].

Reference[14] proposed the concept of perceived affordance, which has been popularized in the HCI, especially a design filed. He addressed the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used. Affordances provide strong clues to the operations of things. For example, knobs are for turning; slots are for inserting things into; balls are for throwing or bouncing. When

affordances are taken advantage of, the user knows what to do just by looking without picture, label, or instruction although complex things may require explanation[14].

In his view, for product design, where one deals with real, physical objects, there can be both real and perceived affordances, and the two need not be the same[15]. In smart TV environment, already existing affordances (e.g. looking at TV screen; pointing, clicking and touching with remote) have little value. However, if the display does not have a touch-sensitive screen, the screen still affords touching, but it has no result on the smart TV system. All screens afford touching: only some detect the touch and are capable of responding. But the affordance of touchability is the same in all cases.

Although the notion of affordance has attracted huge attention in UI fields and has been a key principle for designing interfaces, the existing related studies have remained at the conceptual building level. A few studies have developed it for facilitating to apply to current new media. For example, reference[12], attempted to construct a conceptual framework to show how perceived affordances can facilitate the interaction design of social media. Reference[16] proposed a new prospective and methodology to explore how design affordance affected smartphone usage with a contextual approach to investigating the relationship among design features, functional affordance, descriptive beliefs, and inferential beliefs.

2-3 Interactivity

Smart TV is an interactive device. Interactivity can be classified into actual interactivity and perceived interactivity. Actual interactivity values on a process and a function, whereas perceived interactivity focuses on a perception. Even though different scholars define interactivity differently, there are three dominant ways of defining the concept: 1) interactivity between human and human, 2) interactivity between human and message, and 3) interactivity between human and machine[17]. First, interactivity between human and human means the two-way flow of messages from sender to receiver, and vice-versa, interaction between senders and receivers of the messages; while in contrast there is usually only a one-way message flow from sender to receiver in traditional mass media. Second, in the human-message interaction perspective, interactivity between human and message is defined as the ability of the user to control and modify messages[18]. In traditional media, users have many choices, but no control over the messages[17]. The only thing they can do, for example, is to flip the channels, looking for the messages that match with their own existing attitudes and interests[19]. However, the new media technology like Smart TV gives users much more freedom in controlling the messages they receive and allows them to customize messages according to their own needs. The human-message interaction plays both positive and negative roles in consumers' decision-making[20]. The high interactivity may yield better recall, better knowledge, and more confidence in consumers' judgments, while it may harm utilization of information by creating "demands on processing resources," especially when tasks were difficult. Lastly, interactivity between human and machine was the focus of early definitions of interactivity, in which the emphasis was on human computer interaction (HCI). Currently, HCI is an interdisciplinary subject, relating computer science to many other fields of study and research, including communication study[21].

In addition, interactivity can be specified operationally by three dimensions in the new media environment: (1) active control, which describes a user's ability to voluntarily participate in, and instrumentally influence, a communication; (2) two-way communication (reciprocity), which captures the bi-directional flow of information; and (3) synchronicity, which corresponds to the speed of the interaction[21]. Empirically, it is suggested that interactivity has three dimensions of real-time conversation, no delay, and engaging[22]. Reference[23] proposed perceived control, perceived responsiveness, and perceived personalization. More recently, other scholars found that interactivity has sub-dimensions of two-way communication, synchronicity, and active control[24].

Interactivity is not always a good thing, and is a function of persons and situations[21]. In another perspective, a dual-process model of interactivity effects is proposed utilizing the moderating role of involvement[25]. In addition, Interactivity perceptions can be different according to cultural orientations. Through investigating Internet websites, it is found

that Western web sites use more consumer-message and consumer-marketer interactivity, but Eastern Web sites emphasize consumer-consumer interactivity due to the collectivistic cultural characteristics of Eastern users[26]. Another cross cultural research showed that low context culture uses more human-massage interaction, and high context culture uses more human-human interaction[27]. It is also effects of culture on interactivity perceptions of international users.

Smart TV should be an interactive device for the following reasons: 1) In the human-message interaction perspective, Smart TV provides the audience with the ability to control and modify their own time schedule without TV programmers and skip commercials while, in traditional TV environments, audiences have many choices at a time, but no control over the scheduling. 2) In the interactivity between human and machine prospective, Smart TV systems are responsive to audiences' actions. Through an electronic program guide (EPG) as a user interface, audiences can select, search, edit, and modify their TV schedule. 3) Overall, Smart TV provides three dimensions in the new media environment. Active control enables audiences to voluntarily participate in TV viewing scheduling. With Smart TV audiences are able to customize the information flow and jump from one located program to another, while the linearity of a medium such as traditional television makes it possible for a person to watch television without taking any action except to switch channels once in a while. Furthermore, two-way communication (reciprocity) and synchronicity through a Smart TV device and an electronic program guide (EPG) enable audiences to perform human-machine interaction.

2-4 Research Question and Hypotheses

As existing literature suggested, UI has complicated conceptual backgrounds. Among them, representative elements are said to be user experience, interactivity, and affordance. However, quantifiable measurement items are not developed or even suggested. In this regard, this study suggested the research question that tries to figure out reliable dimensions of UI empirically. As discussed earlier, we can capture overall pictures of overlapping three dimensions, but we need to get a better understanding and need to develop specific measurement scales constituting each dimension.

RQ: What are the constituent dimensions of smart TV user interface?

Next, this study proposed the research model incorporating antecedents and consequences of UI. The main antecedent is the prior use experiences of digital media. Experience is important antecedents on consumer satisfaction, stated loyalty, and consumer/brand relationship[28],[29]. Experiences can be divided into intellectual experience and affective experience, influences are different between them[30]. Digital media experiences could make users familiar to other digital media. Given that digital signage is our-door digital media, it can be proposed that experience of digital media uses could enhance consumer perceptions.

H1: Digital media uses will influence affordance.
H2: Digital media uses will influence interactivity.
H3: Digital media uses will influence user experiences.

Hierarchical relationships could exist among three concepts. First of all, we can postulate the relationship between affordance and interactivity.

H4: Affordance will influence interactivity

Affordance and interactivity can be antecedents of user experiences.

H5: Affordance will influence user experience.
H6: Interactivity will influence user experience.

Finally, this study aims to explore the relationship between dimensions of UI and smart media attitudes. Attitudes toward digital signage are included as the consequence of digital signage user interface. This process aims to test construct validity exploring relationships between UI dimensions and attitudes toward smart TV. If those three dimensions have theoretical congruence one another, the direct relationships between UI dimensions and attitudes toward media devices should be proved. In this regard, three hypotheses can be postulated.

H7: Affordance will be linked to attitudes toward smart TV.
H8: Interactivity will be linked to attitudes toward smart TV.
H9: User experience will be linked to attitudes toward smart TV.

Figure1 illustrates visual descriptions of the suggested research model incorporating all hypothesized relationships among constructs of UX, interactivity, affordance, attitudes toward smart TV, and digital media uses.

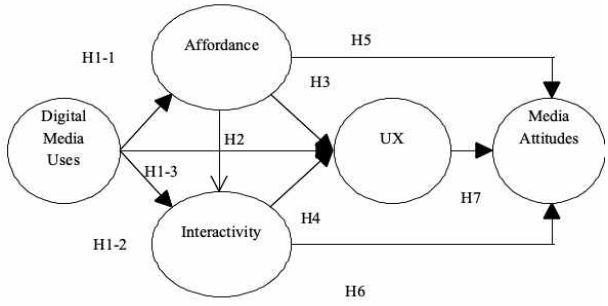

Fig. 1. Proposed model

III. Methodology

3-1 Research Methods

To find main constituents of UI and verify the proposed model, this study used a survey research method. Korea was selected as a target country. Korea is regarded as one of the developed countries in terms of IT industry with a 97.5% broadband household penetration rate[31], and served as a test market for global IT companies. Smart TV sells well in Korea because headquarters of representative smart TV makers, Samsung and LG are located in Korea. Survey was executed by a professional research company that has pooled data. Collected data were analyzed using SPSS16 and AMOS16.

3-2 Survey Samples

The research company has a total of 980,000 research panels. Survey questionnaire was emailed targeting 850,000 research panels whose ages range from twenties to fifties, and the number of total sent email is 6,101. Among them 1,476 panels visited the survey site, and 363 finished their entire survey questions. 44 samples that have response problems were eliminated from the final sample. Basically, survey population is general media users, but research samples are limited to only smart media users such as smart TV, smart phones, tablet PC, IPTV etc. Non-users are not included in this survey though screening questions. Among 1,476 connectors to the survey site, 1,101 respondents were excluded due to this reason.

As a result, a total of 319 Koreans participated in this survey. Among respondents, 159 (49.8%) were male and 160 (50.2%) were female. Ages are ranged from 20 to 59, and the mean age was 39.9. For their occupations, 163 (50.8%) are office workers, 47 (14.7%) are professionals, 45 (14.1%) are home makers, 27 (8.5%) are self-employed, and 20 (6.3%) are students etc.

3-3 Measurements

UI can be classified into three different concepts, UX, interactivity, and affordance. UX is measured based on five dimensions that reference[6] developed. 15 items, three for each dimension, are used to measure UX. To assess the extent of the user experience, this study designed the following metrics 'TV stimulated various sense such as visual sense, auditory sense, and sense of touch', 'Smart TV stimulated special emotion for me', 'Smart TV is an emotional medium for me', 'Smart TV makes me feel special feeling', 'Smart TV let me know something new', 'I get interested and exited in new information through smart TV', 'I became active to search information','I feel that smart TV users are similar to my lifestyle' to measure this variable. Interactivity was measured by three dimensions of two-way communication, synchronicity, and active control[24]. In order to evaluate the effect of interactivity in a comprehensive way, the study used the four dimensions : 'While I was using smart TV, I could choose freely what I wanted to see', 'While I was using smart TV, I was always aware where I was', 'While I was using smart TV, I always knew where I was going', 'I feel that I have a great deal of control over my visiting experience at the smart TV' to ask the questions. For affordance measurement scales, we modified pre-existing items, and used them for this

study[32],[33]. This research selected five topics:'Smart TV is natural to use according to my thoughts', 'Menu of smart TV is easy to use', 'Smart TV make me do what I want at the minimal manipulation', 'I can easily expect where the functions that I want to use lie', 'Smart TV seems to provides proper feedbacks to expect the next situation ' to measure affordance. Attitudes toward smart TV were measured by four attitude scales that reference[34] developed. They are favorable/unfavorable, good/bad, positive/negative, and likable/unlikable. Digital media uses are measured by the degree of perceived uses of smart phones, tablet PC, games, SNS using the sentence of "I use ( ) a lot." All the measurements in this study used the Likert Level 7 Scale, which was divided into 7 levels from very disagree to very agree to collecting data collection. Using the Likert scale to make a questionnaire, respondents can more accurately feedback the comprehensive attitude to the question, and thus collect more accurate data.

Since we constructed or modified measurement items used in this study, it is needed to perform a four-step measurement purification process: 1) exploratory factor analysis to discover the items that deviate from the common core of items and to produce additional dimensions, 2) confirmatory factor analysis for the final verification of unidimensionality, 3) reliability test of the final scales, and 4) calculation of construct validity.

IV. Results

4-1 Factor Analysis

First, a factor analysis is done to identify initial elements of UI constituents. We conducted exploratory factor analyses and decided to keep only one factor for each construct due to either a small eigenvalue (slightly higher than 1) of the second factor or only one item belonging to the second factor. A series of exploratory factor analyses was executed to refine factors, and three factors are clearly emerged finally: user experiences, interactivity, and affordance.

Next, confirmatory factor analysis is executed, and deleted nonsensical or theoretically inconsistent items that had large standard errors, standardized coefficients exceeding or very close to 1.0, or negative error variance. The results show that the ratio of Chi-squares and degree of freedom is 3.39, Comparative Fit Index (CFI) is .95, Normed Fit Index (NFI) is .93, and Root Mean Square Error of Approximation (RMSEA) is .087 respectively. The result of model fit index by the confirmatory factor analysis shows that the proposed CFA model is acceptable. Finally, it is concluded that UI is constituted by UX, interactivity, and affordance. After that, scale reliability was tested, and all constructs show reliability results of above .90: the cronbach alpha of UX is .95, that of interactivity is .92, and that of affordance is .94.

4-2 Model Testing

This research tested nine research hypotheses, using structural equation modeling, by the method of maximum likelihood. AMOS16 was used to perform data analyses. As figure1 shows, exogenous variables included three UI factors such as UX, interactivity, and affordance. Two endogenous variables are attitudes toward smart TV and digital media uses.

Estimating goodness-of-fit for the hypothesized research model is the first step in model testing. In our study the X2/degrees of freedom ratio was estimated as 2.81, and Comparative Fit Index (CFI) is .93, Normed Fit Index (NFI) is .93, Tucker-Lewis index (TLI) is .93. and RMSEA is .075. These index shows that the proposed model has a good model fit within acceptable criteria, and we confirmed the model as the final one.

Then, the significance of regression weights was examined for all constructs. Their associated measures and four relationships were significant at $p < .001$. The final model provides (figure2) support for all four hypotheses. In support of the first set of hypotheses, digital media uses influence affordance (H1: $\gamma = .62$, $p < .001$) and interactivity (H2: $\gamma = .18$, $p < .05$). The relationship between digital media uses and UX (H3: $p > .05$) is not supported. Affordance has positive related to interactivity (H4: $\beta = .62$, $p < .001$). Affordance (H5: $\beta = .21$, $p < .01$) and interactivity (H6: $\beta = .65$, $p < .001$) are linked to UX. Affordance (H7: $\beta = .11$, $p < .05$), interactivity (H8: $\beta = .29$, $p < .001$), and UX (H9: $\beta = .51$, $p < .001$) lead to positive attitudes toward smart TV. In conclusion, we confirmed eight out of nine hypotheses suggested in this study.

Table 1. Key statistics of variables

Variables	Dimensions or Indicators	M	SD	CFA Loadings
User Experience	Smart TV stimulated various sense such as visual sense, auditory sense, and sense of touch	4.65	1.30	.84
	Smart TV stimulated special emotion for me	4.52	1.26	.87
	Smart TV is an emotional medium for me	4.39	1.38	.85
	Smart TV makes me feel special feeling	4.44	1.40	.86
	Smart TV let me know something new	4.73	1.35	.84
	I get interested and exited in new information through smart TV	4.66	1.32	.86
	I became active to search information	4.37	1.34	.85
	I feel that smart TV users are similar to my lifestyle	4.39	1.31	.81
	Index	4.52	1.16	Cronbach α =.95
Interactivity (control)	While I was using smart TV, I could choose freely what I wanted to see	4.82	1.29	.79
	While I was using smart TV, I was always aware where I was	4.46	1.26	.91
	While I was using smart TV, I always knew where I was going	4.52	1.28	.91
	I feel that I have a great deal of control over my visiting experience at the smart TV	4.49	1.29	.86
	Index	4.57	1.15	Cronbach α =.92
Affordance	Smart TV is natural to use according to my thoughts	4.89	1.28	.79
	Menu of smart TV is easy to use	4.63	1.28	.87
	Smart TV make me do what I want at the minimal manipulation	4.66	1.28	.91
	I can easily expect where the functions that I want to use lie	4.64	1.33	.92
	Smart TV seems to provides proper feedbacks to expect the next situation	4.46	1.32	.87
	Index	4.66	1.17	Cronbach α =.94

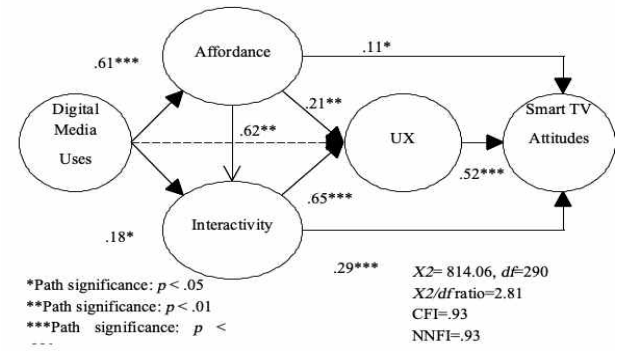

Fig. 2. Final model

V. Discussions and Conclusion

Smart TV is a rising new media device. This study explores constituting dimensions of UI, and then investigates hypothesized relationships of the suggested research model. The findings of this study illustrated that the three dimensions of UX, interactivity, and affordance are proved to be main constituents of smart TV UI (RQ). Modeling subsequent relationships, it is found that digital media uses influenced affordance (H1) and interactivity (H2). Affordance is linked to interactivity (H4), and both affordance (H5) and interactivity (6) have positive relationships with UX. Finally affordance (H7), interactivity (H8), and UX (H9) influenced attitudes toward smart TV.

The main academic implication is that reliable dimensions of UI are found in this study. Even though the concept of UI is frequently mentioned and used in various academic fields, it is not adequately operationalized and quantitatively defined. It is because UI is primarily studied from conceptual perspectives. This study fills this academic gap, and provides empirical explanations for the UI. It means that this study extend the usability of UI to social science areas like advertising and communication. The 17 items measuring UI could be quite useful for future researchers that might want to measure UI empirically.

More specifically, it is also found that user experiences mainly include affective and cognitive experiences. This study used reference[6]'s five dimensions for consumers' experiences, and affective and cognitive experiences are emerged as dominant elements in smart TV uses. Given the characteristics of smart TV, it is understandable for users to feel smart TV experiences, and search information. We found one item of sensory experience and another social experience item, but any item from act experience is not found in this study.

Interactivity mainly includes the dimension of active control. This study used three dimensions of interactivity such as two-way communication, synchronicity, and active control[24]. Among them, active control is the sole constituent of smart TV UI. It is because other two dimensions might share variance with affordance. We actually deleted items other than active control due to cross loadings on both the

interactivity factor and the affordance factor. It means that the concept of affordance could explain two-way communication and synchronicity in uses of smart TV. Interactivity of UI should be understood as the concept of user control-oriented.

It is also insightful to refine specific scales of affordance. As a sub-dimension of UI, affordance can play significant roles explaining the conceptual construct of UI. As N screen service becomes popular, UI is regarded important because standardized UI is essential to integrate all devices technically. In that case, complex problems need to be solved, and so affordance can be an effective guideline for N screen service design to solve compatibility problems among digital devices.

Prior experiences are important antecedents of user interface. As previous literature illustrates, experiences influence consumer satisfaction, loyalty, and brand-consumer relationship[25],[29]. This study adapted those relationships to digital media based on the concept of user interface, and confirmed the research model.

These three dimensions of UI are associated to attitudes toward smart TV. It confirms that sub-dimensions of UI are theoretically related to attitudes toward smart TV directly. As literature suggested, UI is a major antecedent of user evaluations of smart media[35]. This results show the acceptable construct validity of the UI.

This study also provides managerial implications. It is true that UI itself is a creative solution for digital media. Smart device designers should consider the results of this study. Specifically, UI need to be designed to enhance UX. It is said that experiences are important factors enhancing consumer satisfactions. This study also confirmed this belief, and could provide guidelines for designing smart media devices. UX will serve as a basic benefit of smart media because users of smart media experience media through getting information, playing games, and even living with it.

Interactivity is also an important factor. Interactivity is a critical element of digital media. Almost all media converted into digital, and even traditional media cannot avoid this interactive trend. TV is not a passive medium anymore due to digital set top boxes. TV provides novel experiences, and communicates with users. Interactive services like VOD and are already common service and even T-commerce draws attentions from innovative consumers. TV itself became smarter than ever before enough to notice what users want to watch or buy. Accordingly, interactivity is important when developing or inventing new media devices that might provide innovative functions. Another thing is that interactive advertising is made based on creative UI design. UI is a creative source in interactive advertising and it can enhance advertising experiences through realizing consumer-oriented interactivity. This can be called truly effective advertising in the era of digital advertising.

In addition, affordable design is essential for media interface. As new media devices enter into markets, it is hard to understand individual functions at one sight. It is essential for users to catch easily how to use. That is called affordable design that is the key factor to become the standard in competitive industry environments. Technological developments do not always provide functions that users really want. The same problems happen in interface design processes. Design of smart media need to be predictable to users. It is not about just easiness of design. Complex functions can be easily understood when user interface hold the principle of affordance.

This study has a couple of limitations. First, this study used only Korean samples to answer the research question and to validate the hypotheses. It might provide somewhat different research outputs if Western county consumers are used as samples. In this regard, future research using more diverse samples is required to ensure external validity of UI dimensions. Given that old media become smart, and smart device keep being developed and coming to markets, other upcoming smart devices are also need to be explored in terms of UI and usability of those media.

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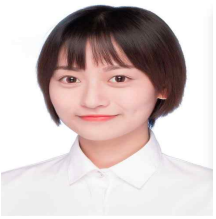

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