Computers in Human Behavior 54 (2016) 326–340

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Full length article

Application of experiential locus of control to understand users' judgments toward useful experience

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ARTICLE INFO

Article history:
Received 1 June 2015
Received in revised form
12 August 2015
Accepted 14 August 2015
Available online 28 August 2015

Keywords:
Experiential locus of control
Judgmental
User experience
HCI
Determinants of judgment
Product and service design

ABSTRACT

Recently, innovative products and services have been changing the way people live their lives. Human–computer interaction (HCI) plays an important role in the development and design of such products and services. However, prior studies did not fully explain how people evaluate their experience when they use a product and service. The research goal of this study is to propose a conceptual model that explains the judgment of experience quality and the judgment criteria. This study suggested two research questions: First, how can we understand users' judgment of good experience? We will suggest a theoretical model that is based on the concept of locus of control (LoC) for explaining users' evaluation of their experience, including the use result and the use process. Second, what are the representative system factors to affect users' judgment? This study validates the representative system factors that affect the determinants through verifying the conceptual model. Through a pre-study, the representative system features affecting each determinant were derived and hypothesized for the main study. The results showed that experiential LoC was affected both internally and externally by the two determinants. In addition, each of the determinants was affected by the dimension or level of the system features.

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1. Introduction

Recently, innovative products and services have been changing the way people live their lives through pervasive digital technologies (Barnard, Bradley, Hodgson, & Lloyd, 2013; Powell, 2013). As an example of this change, traditional products such as radios, televisions, cars, and computers have been replaced with innovative products such as internet radios, smart TVs, driverless cars, and tablets. In addition, innovative products and services (e.g., social networking services, robot cleaners, drones, and wearable healthcare devices) are emerging in the 21st century (Danelek, 2010a, b).

Human–computer Interaction (HCI) has played a critical role in the above change. Closely related to the user experience, HCI has considered the human factors related to interactive design, system development, and evaluation of the user experience (Hewett et al., 1996). In particular, usefulness has been explained as one of the most important factors in terms of a good user experience in HCI (Finneran & Zhang, 2003; Kourouthanassis, Giaglis, & Vrechopoulos, 2007).

However, previous studies have had common limitations: First, as an evaluation factor of user experience (Wixon, 2003), it is difficult for usefulness to explain why users judge various products or services useful. Each person has markedly different criteria in usefulness evaluation because of their own subjectivity (Hertzum & Jacobsen, 2001). Some people feel usefulness in the process of using products or services, while others feel it through achieving a goal. These differences in evaluating usefulness may depend on the users' judgments of their use experience. Consequently, this has not only reduced the reliability of statistical results but also hindered our understanding of the conception of usefulness. Second, in terms of applicability to the design process of new digital products or services, many studies could not generalize the system factors affecting the judgment of usefulness. They have suggested different system factors for different research domains despite attempts to consider the common system factors for improving practical application, which has reduced the applicability to practical work (Gray & Salzman, 1998; Molich, Ede, Kaasgaard, & Karyukin, 2004).

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http://dx.doi.org/10.1016/j.chb.2015.08.010
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Though many studies on user experience exist, prior studies did not fully explain how a digital product and service affect users' attitude and behavior. Some people report their experience from the *result* of using products or services, while others report it from the *process* of using products or services. This subjectivity of users' report has confused our understanding of where a good user experience exists in using digital products or services (Hertzum & Jacobsen, 2001). In addition, this has caused the problem of explaining why users have positive/negative attitude through the judgment of use experience on products and services (Wixon, 2003).

This study suggested two research questions: First, how can we fully understand users' attitude and behavior through the user experience of product and service? We suggest a conceptual model that is based on locus of control (LoC) for explaining users' attitude and behavior, including two judgment factors of the use result and process. The LoC concept is effective because LoC explains human personality created from the experience including their use result and process (Milgram & Naaman, 1996; O'Donoghue & Rabin, 2000). This means that people are continually affected by experience in their lives, which can change them. Therefore, we particularly suggest *experiential* LoC, which is an extension from traditional LoC. Since various products and services are strongly linked to our everyday lives nowadays, they are affected by users' perceptions of their experiences. It may be closely related to judgments about users' experiences with things. Consequently, this study investigates the determinants that affect users' experiential LoC.

Second, what are the representative common system factors on useful products and services to affect users' attitude and behavior? This study validates the representative digital system factors that affect the determinants through verifying the conceptual model. To set up the relationships among them, this study takes a psychological approach, focusing on the cognitions of users during the experience, in order to identify the primary forces driving the use and influencing users' judgments of the experience.

In the following section, we first provide theoretical considerations as to how users judge the user experience of a product or service useful from the perspective of experiential LoC. We then briefly suggest the antecedent factors affecting the judgment. Subsequently, we draw the representative system factors that affect the antecedent factors from the results of a qualitative study based on eight case studies. Four of them are popular digital products such as robot vacuum clear, and the other four include popular digital services such as mobile simulation game. From this, we finally construct the causal model between the representative system factors and the judgment by the LoC, which is affected by two dimensions of antecedent factors.

2. Experiential LoC as research background

Theoretically, locus of control (LoC) is defined by Rotter (1954, 1966) as the perception of being able or unable to control what happens to an individual. Prior studies in personality psychology have been conducted to explain LoC with respect to human characteristics. LoC is described as having *two aspects*: internal and external. People who have the tendency of internal LoC in their experiences tend to judge what happens to them by their behavior and tend to have positive and progressive attitudes about their experiences. Accordingly, they think it is possible to control their experiences by themselves (April, Dharani, & Peters, 2012). On the other hand, people who have the tendency of external LoC in their experiences tend to judge what happens to them by external forces and tend to have negative and passive attitudes about their experiences. Accordingly, they think it is impossible to control their experiences by themselves (Jacobs-Lawson, Waddell, & Webb, 2011). Consequently, people can perceive their experiences differently because of their personal tendencies (Diamond & Shapiro, 1973; Layton, 1985).

However, scholars have inferred various meanings of "control" in Rotter's LoC definition (1966). In particular, there are two different views of internal–external LoC: the perspective of causal attribution explained by attribution theory (Heider, 1958; Kelley, 1967) and the perspective of perceived behavioral outcome contingency (Graybill, 1977; Palenzuela, 1984). The former perspective explains that internal–external LoC can be interpreted as the actual cause of an experience. According to previous studies (Weiner, 1972; Weiner & Kukla, 1970; Weiner, Nierenberg, & Goldstein, 1976), people who have internal or external LoC personalities create judgments of their experiential determinants through the attribution process. On the other hand, the latter perspective explains that internal–external LoC can be interpreted as the perceived cause of an experience. According to Wong and Sproule (1984), people with an internal LoC perceive their behavioral outcomes as contingent on their experiences even if there is no possibility of control. Therefore, they judge the internal–external LoC through the perception of controllability in the process of experience.

Both of these perspectives are important to the user experience in the HCI field, because people ascribe value to their experiences, which are judged by the *process* and *results* of the experience (Bruner & Bruner, 2009; McCarthy & Wright, 2004). Workman, Bommer, and Straub (2008) indicated that users usually have two considerations during judgments: causal attributions and self-efficacy. In a study on security threats, for example, the causal attribution explained that users judge the LoC of their experiences by whether they actually controlled the result of the security threat or not. In the self-efficacy, on the other hand, users judge the LoC of their experience by whether they perceived controllability from the process of the security threat (Bandura, 1991; Bandura & Walters, 1963; Workman et al., 2008). In this study, therefore, we define users' judgments of their experience of using a product or service as *experiential* LoC, integrating both traditional perspectives.

We divide determinants into two categories in the perspective of users' judgments of experiences during use: *goal achievement,* as the determinant of judgments on the result of use, and *autonomy,* as the determinant of judgments on the process of use. The reason why we assume the two determinants is explained as below.

First, people have various goals when using products or services (Hidi & Harackiewicz, 2000). When they achieve their goal, they think that the experience of using a product or service is valuable and useful (Ho, 2010; Li, Ji, & Li, 2006). These thoughts cause users to expect to achieve their goals when they use a product or service (Oliver, 2010). Therefore, *goal achievement* as the determinant of judgments is important to explain the effect on users' experiential LoC. In this study, based on Batra and Ahtola (1991) research, the goal achievement determinant of judgments on use was divided into two dimensions: hedonic goals and utilitarian goals.

Second, many studies referred that user feels their experience by controlling the system (e.g., Lefcourt, 2014). According to self-determination theory, which is related to human motivation, autonomy is referred to as a human need involving willingness to engage in decision making on one's own behavior (Deci & Ryan, 1985, 2002). Related to this, various studies have regarded level of autonomy as related to control (Ryff, 1989) or independence of control (Ji et al., 2010). Therefore, *autonomy* as the determinant of judgments is important to explain the effect on users' experiential LoC. In this study, the autonomy determinant of judgments on use was considered as a level of autonomy, including system automation concept.

3. Two determinants of LoC and research hypotheses

3.1. Effect of goal achievement on experiential LoC

3.1.1. Hedonic goals

Hedonic goals refer to the internal motivation of people to obtain pleasure, leisure, enjoyment, or fun in the process of using a product or service (Boo & Mattila, 2003). Therefore, products or services related to the pursuit of hedonic goals allow users to enjoy the use process itself (Chernev, 2004). In addition, people using these products or services feel pleased when their cognitive absorption is high (Wakefield & Whitten, 2006). Related to this, according to Mano and Oliver (1993), the experience of use related to the pursuit of hedonic goals consists of internal satisfaction, such as interest, excitement, fascination, and agreement. In other words, the hedonic goal dimension is the internal determinant that is described by how helpful a product or service is in achieving users' internal goals.

Although hedonic goals have been mentioned in HCI, according to Nielson (1993), there has been a lack of discussion on the ability of hedonic attribution, including the essential common features for useful experience, to enhance users' internal LoC. Hedonic goals have the attribute of internal motivation, including users' symbolism, value expression, and affective consideration of the use of a product or service (Boo & Mattila, 2003). In respect to attributions, the hedonic goal dimension can be based on internal evaluations of how users achieve their goals in the process of experiencing products or services (Batra & Ahtola, 1991). Therefore, the hedonic goal dimension can be closely related to both determinants affecting *internal* experiential LoC positively, which consequently has negative effects on *external* experiential LoC.

H1. The hedonic goal dimension negatively affects *external* experiential LoC.

3.1.2. Utilitarian goal

Utilitarian goals refer to the external motivation of people to achieve attainment, fulfillment, and acquirement after using a product or service. If the use of a product or service provides users functional, complementary, and instrumental value, they feel the achievement of a utilitarian goal (Batra & Ahtola, 1991). Related to this, according to Boo and Mattila (2003), users with utilitarian goals are interested in the efficiency, cost-effectiveness, and pragmatic function of using a product or service to achieve their goals. In addition, they logically and rationally evaluate how a product or service is helpful in performing their tasks (Boo & Mattila; Childers, Carr, Peck, & Carson, 2002). In other words, the utilitarian goal dimension is the external determinant that is described by how helpful a product or service is in achieving users' external goals.

In HCI, utilitarian goals are referred to as performance factors providing useful experiences, including instrumental benefits, emotional consequences, and task completion (Batra & Ahtola, 1991; Mano & Oliver (1993); Overby & Lee, 2006). However, few studies have been conducted on the effect of utilitarian attribution for verifying the essential common features to achieve usefulness in terms of external LoC. The utilitarian goal has the attribute of external motivation, including endurability, functionality, and instrumentality in the use of a product or service (Batra & Ahtola, 1991; O'Brien, 2010; Overby & Lee, 2006). In respect to attributions, the dimension of utilitarian goals that leads to higher perceptions of utilitarian systems can be based on external evaluations of how users achieve their goals as a result of experiencing products or services (Chae, Kim, Kim, & Ryu, 2002). Therefore, the utilitarian goal dimension can be closely related to both determinants affecting *external* experiential LoC.

H2. The utilitarian goal dimension positively affects *external* experiential LoC.

3.2. Effect of autonomy on experiential LoC

In HCI, autonomy has been explained from the perspective of an autonomous system. Various researchers have considered autonomy as a system's capacity to operate without users' control (Beale & Wood, 1994; Brown, Santos, & Banks, 1998; Etzioni & Weld, 1995; Evans, Shapiro, & Lewis, 1993). The control system is called an autonomous agent, and this broader concept is referred to as having self-control and self-motivation (Castelfranchi, 1995; Covrigaru & Lindsay, 1991; Jennings, Sycara, & Wooldridge, 1998).

On the other hand, some studies have explained autonomy from the perspective of users. The level of autonomy is defined as the degree of self-perception in users' behavior, which is the result of free will without external interferences (Jung, 2011). In other words, users recognize the level of autonomy of a system through the use process of a product or service. If the system of a product or service intervenes with goal achievement automatically, users believe that they must give up their autonomy to the system (Jung, 2011; Müller, 2012). On the contrary, when users receive a control request from the system in the process of achieving a use purpose, they believe that they can control their experience by themselves even if they actually can not (De Charms, 2013; Müller, 2012; Wang, Schneider, & Valacich, 2015).

This perception of users' autonomy is closely related to experiential LoC, because experiential LoC can explain how systems affect users' judgments by affecting users' empowerment (Ji et al., 2010; Kay, 1990; Marsh & Richards, 1986). For example, if a product or service does not require users' empowerment, they recognize a low level of autonomy from the use experience. This affects their judgments that predict individuals' behavior on the system, depending on whether they see an outcome as controllable (internal) or controlled (external) (Marsh & Richards, 1986; Müller, 2012; Rotter, 1966).

Although many studies have explained users' perceptions of systems at the autonomy level, it is not yet fully understood how the perceived autonomy of the use experience affects users' judgments in their everyday lives. By focusing on users' judgments of use experiences in an actual use environment, we can more fully understand where they put their experiential LoC at the autonomy level.

H3. A high level of autonomy of a system (a low level of user autonomy) positively affects the perceptions of users' *external* experiential LoC.

In our research, therefore, we set up the theoretical framework on the impact on users' lives described by two determinants of judgment, including the result and process of the use experience (see Fig. 1.). In addition, other hypotheses are explained as a result of the pre-study.

4. Pre-study: contextual inquiry and interviews on eight cases

4.1. Research goal

In the pre-study, we explored the representative system features affecting the determinants of the use experience. For this purpose, we selected eight representative cases that have provided a good experience to users with key system features. The eight cases include four products and four services. It is important to select various products and services for exploring features to elaborate common factors affecting on determinants. Three

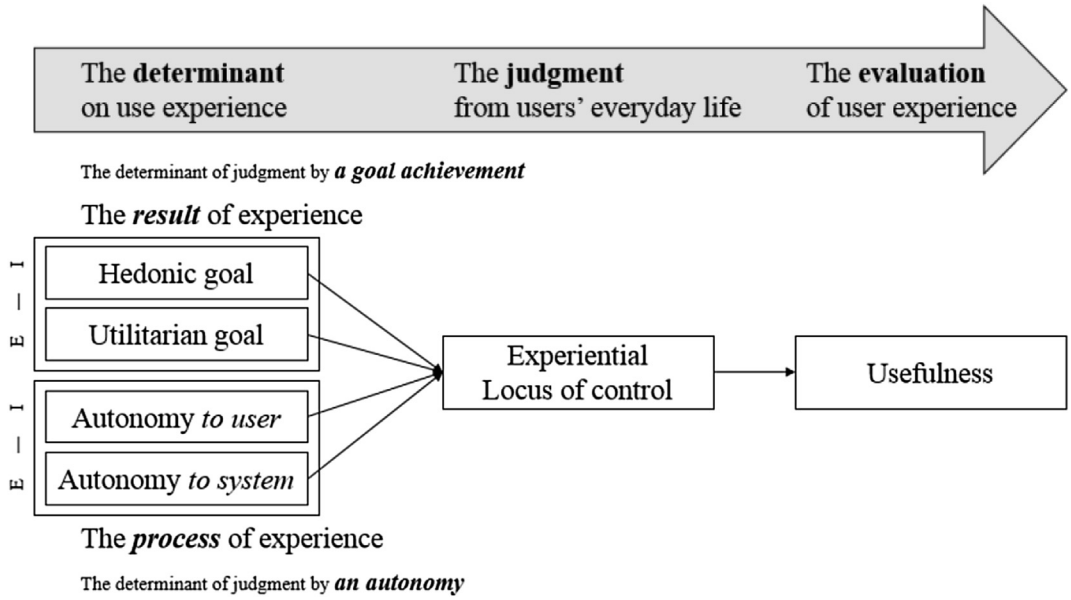

Fig. 1. The theoretical framework.

consecutive co-creation workshops with HCI experts have been conducted to select the products and services under three selection criteria. The selection criteria were as follows: 1) a product or service that is currently popular in each category, 2) a product or service that is representative in each category, 3) a product or service that is considered useful in each category. These criteria have been applied in terms of Korean market because the pre-study and main study was conducted in Korea. These products and services can be explained by the two determinants of users' judgments on a good experience. The results of the case selection are presented in Table 1.

4.2. Products cases

4.2.1. Toy: Tamiya Porsche 934 Turbo RSR

The Tamiya Porsche 934 Turbo RSR is a remote control (RC) car. The process of assembling the car manually is enjoyable to many people, and users also feel enjoyment in the process of controlling the RC car. These experiences have hedonistic value, and this makes the result-oriented LoC *internal*. The Tamiya RC car also possesses a high *internal* process-oriented LoC. The user is able to meticulously control both the assembly and driving. Users are able to choose the interior and exterior parts they want to install in their car. They can choose customized engines and frames. This high level of user autonomy caused by being able to control all aspects of the building and driving processes makes both the result-oriented and process-oriented LoC *internal*.

4.2.2. Smart bulb: Phillips Hue

Hue is a smart light bulb that turns on and off automatically and can produce diverse lighting themes with colors. The Hue application for mobiles and tablets allows users to automatically search for a dedicated bridge that can control lighting and brightness. For example, Hue offers colors for certain themes, such as games or movies, and multiple Hue lamps can be used to express diverse color patterns, such as a rainbow. During this experience, people perceive hedonistic value, and this makes the result-oriented LoC *internal*. On the other hand, the Hue possesses a high *external* process-oriented LoC. No extra effort is needed after setting up relational conditions. Conventional light bulbs require the user to control the device for each use, but the Hue analyzes user movement and lifestyle patterns to control the lighting automatically.

4.2.3. Electric drill: Aimsak AD 418R

Rechargeable driver drills are often used in homes or offices for repair works, and they are frequently used by amateur users who make their own furniture or conduct their own repairs. The advantage of the rechargeable driver drill is that it is simple enough for amateurs to use. Tasks can be completed using the driver drill with little effort. Users consider the ease of use as an important value in using the driver drill. Therefore, users perceive more utilitarian value through the rechargeable driver drill, making the result-oriented LoC *external*. On the other hand, the Aimsak 418 series possesses a highly internal process-oriented LoC. Users can set the performance of the device according to their needs. The rotation direction and work/safety mode can be set using a single button, and the strength of the drill can be precisely set with over 20 levels. Since the process offers users many different aspects of control, the process-oriented LoC is *internal*.

4.2.4. Robot vacuum: LG Roboking

The LG Roboking reduces the effort required for cleaning, providing both vacuuming and mopping functions. It offers cleaning mode and auto-cleaning mode, and it has a rectangular design

Table 1
Eight selected cases.

Dimensions of each determinant	Hedonic (internal)	Utilitarian (external)
Autonomy to user (Internal)	**Product-Toy**: Tamiya Porsche 934 Turbo RSR **Service-Simulation game**: "I Love Coffee"	**Product-Electric drill**: Aimsak AD 418R **Service-Civil application service**: Minwon 24
Autonomy to system (External)	**Product-Smart bulb**: Philips Hue **Service-Music streaming**: BEAT	**Product-Robot vacuum**: LG Roboking **Service-Smart call taxi**: Easy Taxi

that makes it more efficient when cleaning corners. People perceive utilitarian value through the robot vacuum cleaner, resulting in a highly *external* result-oriented LoC. The Roboking also possesses a highly *external* process-oriented LoC. Users do not need to control many aspects of its tasks; they simply need to turn it on and off. The robot vacuum cleaner is highly automated, as it analyzes its context and cleans different parts of the house. The high system autonomy makes the process-oriented LoC *external*.

4.3. Services cases

4.3.1. Simulation game: "I Love Coffee"

"I Love Coffee" is a mobile game, released in 2012, that allows users to set up and manage a virtual coffee shop. Being able to decorate the coffee shop in several ways and playing with friends and other users makes it fun and enjoyable. People perceive hedonistic value through this experience, making the result-oriented LoC *internal*. "I Love Coffee" also possess a high *internal* process-oriented LoC. The user is able to control the details of the management, such as creating the coffee menu and choosing what to display in the shop. This high user autonomy determines the image of the coffee shop and its revenue; therefore, the process-oriented LoC is *internal* as well.

4.3.2. Streaming music service: BEAT

BEAT is a music player released in 2014 that recommends music based on context awareness. BEAT provides mix playlists, and users can select the type of music they would like to hear. Once a mix playlist is selected, BEAT starts playing music at random. When a user is listening to a mix that is popular in terms of the time of day or genre, BEAT enables the user to find other music and playlists randomly. Listening to music on BEAT itself can bring fun and enjoyment to users. Many users also feel enjoyment in selecting a mix. During this process, people perceive hedonistic value, making the result-oriented LoC *internal*. On the other hand, BEAT possesses a high *external* process-oriented LoC. BEAT automatically offers music to users based on their different preferences; therefore, users rely on BEAT to provide music recommendations while using the service.

4.3.3. Civil application service: Minwon 24

Minwon 24 is an e-government portal service that provides diverse administrative services, such as issuing certificates and searching for official documents. Users perceive utilitarian value in the service, because they can choose the service they want to receive for practical purposes. Therefore, Minwon 24 provides a highly *external* result-oriented LoC. Minwon 24 also possesses a highly *external* process-oriented LoC. It completes forms automatically by taking users' personal information from government databases. Thus, users have few steps to take to issue a certificate from start to finish. Users rely on the autonomy of the system, and the system automation is very high. Therefore, the process-oriented LoC is *external*.

4.3.4. Smart call taxi: Easy Taxi

Easy Taxi is a taxi reservation application that is available worldwide. When a user reserves a taxi through the application, his/her GPS location is utilized to request a pickup by the nearest taxi driver who is also using the application. Easy Taxi emphasizes safety as one of their most important values. All taxi information (e.g., the name of the driver, contact number, license plate number, and car type) is registered in the application, making it easy to deal with any safety and security problems that may arise. In this sense, users perceive utilitarian value in this service; therefore, the result-oriented LoC is *external*. On the other hand, Easy Taxi possesses a highly *internal* process-oriented LoC. For instance, taxi drivers and users can be connected one-on-one, so users can feel that they can make specific requests. Using the GPS location on a map is an effective way to help the user pinpoint the exact pickup location. Since users feel a greater sense of control during the pickup process, Easy Taxi possesses a highly *internal* process-oriented LoC.

Determinant of judgment for the eight cases are summarized in Table 2 below.

4.4. Method

Our pre-study consisted of two sessions. Session 1 was mainly based on a contextual inquiry. All of the data was analyzed considering useful system features for users. Session 2 was based on semi-structured in-depth interviews. The detailed process of the contextual inquiry and the interview protocol are presented in Table 3.

All of the contextual inquiry and interview content was recorded with the consent of participants. Every verbal and non-verbal expression, including the length of pauses, was transcribed into a text document. The script was then analyzed by four independent coders, and the content was classified according to the coding scheme based on experiential LoC. The coding scheme included four dimension (hedonic, utilitarian, autonomy to user, autonomy to system), and each coder manually coded user cue such as a gesture, sound, and other reactions. The detailed coding scheme is presented in Table 4.

For our interviews, we needed active users. Therefore, we controlled for the usage level. There were two criteria for screening appropriate participants. First, participants had to be active users of a product or service, because active users are more aware of the use experience in their daily lives. Second, we had to be able to check whether the participants actually used a product (or service) or not. When recruiting participants, we only included users who had used a product (or service) for more than two months. To improve the quality of data, we verified participants' actual levels of usage. Only the participants who met the two criteria were interviewed. Demographics and participants' usage information is presented in Table 5.

4.5. Results and hypotheses

By conducting the pre-study, we aimed to examine the representative system features affecting the two determinants of judgment of usefulness. Above all, we tried to determine the common features from each product and service in the same determinant condition. We also intended to investigate the possibility of a causal relationship between the system features and the determinants. Clarifying the expected causal relationship was one of the most crucial aspects of this pre-study. Based on the results of the pre-study, we hypothesized the causality and constructed the following survey.

4.5.1. Key features for achieving hedonic goals: serendipity and playability

By analyzing data following contextual inquiries and interviews, we discovered that four cases with hedonic goals have various features including common characteristics. For example, P10 indicated "randomly recommended music playlists" as the core feature of the BEAT user experience. P10 said that he had gained a pleasant experience due to that feature. P8 said that she was interested in building serendipitous relationships in "I Love Coffee" as a virtual environment. In addition, she noted that the unexpected rewards given when she achieved quests enhanced the hedonic value of the game experience.

Table 2
Determinants and levels of dimensions of each product and service.

Category	Product or service	Determinant of judgment			
		Goal achievement	Level	Autonomy	Level
Toy	Tamiya Porsche 934 Turbo RSR	Hedonic	Internal	Autonomy to user	Internal
Smart bulb	Phillips Hue	Hedonic	Internal	Autonomy to system	External
Electric drill	Aimsak AD 418R	Utilitarian	External	Autonomy to user	Internal
Robot vacuum	LG Roboking	Utilitarian	External	Autonomy to system	External
Simulation game	"I Love Coffee"	Hedonic	Internal	Autonomy to user	Internal
Music streaming	BEAT	Hedonic	Internal	Autonomy to system	External
Smart call taxi	Easy Taxi	Utilitarian	External	Autonomy to user	Internal
Civil application service	Minwon 24	Utilitarian	External	Autonomy to system	External

Table 3
The process of contextual inquiry and interview protocol.

Type	Contextual inquiry protocol	Interview protocol (semi-structured questions)
Products services	- Let's use [product or service] in daily life for 24 h. - When you use [product or service], record your data, such as use start time and end time, and capture the steps (with screen shots or photos) of your experience. - Describe your detailed situation during the experience.	1. What was your goal in using [product or service]? - Essay answer - From 1 to 7, how would you rate the level of [goal]? - What was your expectation of using [product or service]? - Before you used [product or service], what did you use or do to achieve your goal? 2. Where does the autonomy lie from the perspective of the experience being provided by [product or service]? With [product or service] or you? - Essay answer - From 1 to 7, how would you rate the level of [autonomy]? - How many controls are required when you use [product or service]? - If you need to control [product or service] many times, why? - What is your experience with a manually controlled [product or service]? - If you do not need to control [product or service] many times, why? - What is your experience with automatically controlled [product or service]? 3. Where is the value of the result of your experience? - Essay answer

Table 4
Coding scheme.

Construct (number of participants)	Code type	Code descript	Coding frequency (count)	Agreement rate (%)
Hedonic (6)	Verbal	Pleasure, unexpected good experience, fun, interest, happy, enjoyable	19	79.16
	Non-verbal	Laugh, burst out laughing, looks excited	22	91.67
Utilitarian (7)	Verbal	Usable, useful, helpful, need, satisfied, good, easy to use	25	89.28
	Non-verbal	Umm…, great tact, fluent, satisfied facial expression	25	89.28
Autonomy to user (7)	Verbal	My decision, my choice, my ability, my control	23	82.14
	Non-verbal	Control behavior, option adjustment, select	26	92.86
Autonomy to system (6)	Verbal	Automation, out of my control, believe this	17	70.83
	Non-verbal	No control, keep still	19	79.17

Table 5
Demographics and usage.

Participant	Case	Sex	Age	Job	Usage (when, how, where)
P1	Tamiya Porsche 934 Turbo RSR	M	36	Worker	Hobby, amateur contest
P2		M	32	Worker	Hobby
P3	Phillips Hue	F	27	Worker	Her room, connected with IFTTT
P4	Aimsak AD 418R	M	43	Worker	DIY
P5	LG Roboking	F	33	Housewife	Home
P6		F	32	Worker	Home
P7		F	35	Housewife	Home
P8	"I Love Coffee"	F	23	Student	Use in public transport
P9		M	26	Student	Use in home
P10	BEAT	M	27	DJ	Mixing work/listening to music
P11	Easy Taxi	M	26	Student	Call taxi in unfamiliar area
P12		F	29	Worker	Call taxi at late hour
P13	Minwon 24	F	36	Self-employed	Need to submit official documents

From this result, we inferred that users feel the sense of accomplishment on hedonic goal-oriented product or service by pleasure experiences. In particular, unexpected situation usually stimulated users' hedonic satisfaction.

Serendipity refers to an unexpected but positive experience while using a system (Hart, Ridley, Taher, Sas, & Dix, 2008). Serendipity is related to the unpredictability, creativity, and unexpected value facilitation of the user experience (André, Teevan, & Dumais, 2009; Lieberman, 1995). In particular, users who find serendipitous pleasure through unpredictable experiences are more likely to use the system (André et al., 2009). There are mainly two ways that people perceive serendipity (Erdelez, 1999). First, serendipity is determined based on past experiences (i.e., when users are exposed to non-encountered information or information they have not been exposed to previously). The second way that people perceive serendipity is when they judge that an experience provides a completely new contextual situation. This occurs when users feel enjoyment when they come upon information that is highly relevant in a new context.

H4. *Serendipity* positively influences the achievement of hedonic goals (internal) as a determinant of judgments.

By analyzing data following contextual inquiries and interviews, we discovered that four cases with hedonic goals provided various playability features. For example, P1 said that assembly was the core feature of playing with the RC car. In the contextual inquiry session, P2 noted that when he assembled the RC car, he felt self-satisfaction through that experience. P3 stated that she enjoyed using Hue to change the light color, making it appropriate to each situation. P9 indicated that "I Love Coffee" had hedonic value, as users are exposed to various enjoyable events involving social engagement.

Playability refers to how much a user enjoyed a certain object under a given context (Sánchez, Iranzo, & Vela, 2011, Sánchez, Vela, Simarro, & Padilla-Zea, 2012). High playability makes people feel positive feelings toward the corresponding product or service (Lazzaro, 2008; Norman, 2004). In particular, playability is one of the most significant features of achieving users' intrinsic motivation (Nacke, Kalyn, Lough, & Mandryk, 2011; Sánchez et al., 2011). For this experience, there are several ways in which people perceive playability. Fun enhances users' interest in the use environment (Sánchez, Zea, & Gutiérrez, 2009). Hedonic value is aroused through users' enjoyable internal experiences (Chernev, 2004).

H5. *Playability* positively influences the achievement of hedonic goals (internal) as a determinant of judgments.

After conducting the contextual inquiry, we found that users could achieve their hedonic goals of using products or services through serendipity and playability. Consequently, we propose that the two system features are important in daily use directly influencing the achievement of hedonic goals.

4.5.2. Key features for achieving utilitarian goals: compatibility and consistency

In our contextual inquiry and interviews, in four cases, users noted that utilitarian goals are achieved when there is compatibility in system features. For example, P11 said that the experience of using Easy Taxi was similar to prior experiences of using regular taxis. P5 indicated that Roboking's smartphone application provided a control system like on an RC car, making it useful for cleaning the home. In addition, Roboking's cleaning methods gave users a compatible experience, because it worked similar to a manual vacuum. P4 also said that electric drills should have battery compatibility for universal use and that Aimsak's battery compatibility was useful.

Previous studies define *compatibility* as the degree to which technology fits with potential existing values and experiences (Rogers, 2003). Its effects occur whenever external relationships exist among systems and among experiences (Proctor & Van Zandt, 2008). In particular, when compatibility with prior experience is high in the perspective of the relationships (Agarwal & Prasad, 1998), users perceive a product or service as useful. This enhances effectiveness and reduces perceived risk of use (Mitchell & Boustani, 1993).

H6. *Compatibility* positively influences the achievement of utilitarian goals (external) as a determinant of judgments.

In the contextual inquiry and interviews, in four cases, people easily used their product or service, including through skilled means. P13 explained that the online civil service had the consistency of the experience of visiting public offices. Since he used Minwon 24 to issue his resident certificate, he was able to predict that issuing a land register would be a similar experience, and he was able to issue the document with ease. P12 said that Easy Taxi used the star icon to indicate "Favorites," which let him know that this was where his favorite content was stored. Such consistent graphic user interfaces help users navigate through a product or service more efficiently.

Consistency provides the effects of transfer of skill and credibility (Monk, 2000). A highly consistent experience enables users to learn from the experience and apply it in another situation (Alonso-Ríos, Vázquez-García, Mosqueira-Rey, & Moret-Bonillo, 2009). Through such consistency, it is easier to ensure utilitarian value, since users will not be prevented from performing new tasks quickly and efficiently (Nielsen, 1989). Furthermore, consistency increases users' trust in the corresponding product or service (Clark & Montgomery, 1998). Trust is a very important concept in ensuring utilitarian value, because users need to first trust that the system will bring the desired results before they can place utilitarian value on a system (Lee, Lee, Moon, & Park, 2013). Therefore, while using a system, consistency ensures representability (Lin, Choong, & Salvendy, 1997) and the achievement of utilitarian goals as an external attribute.

H7. *Consistency* positively influences the achievement of utilitarian goals (external) as a determinant of judgments.

Overall, we found that users could achieve their utilitarian goal of using a product or service through the features of compatibility and consistency. After conducting the contextual inquiry, we propose that the two system features that are important in daily use directly influence the achievement of utilitarian goals.

4.5.3. Key features of autonomy: customizability and adaptivity

In the contextual inquiry, P11 said that Easy Taxi had various options for calling taxis. When she called the taxi, she could indicate her location precisely on a visual map, select the type of taxi, and choose the payment method (cash, debit card, credit card). P4 said that he could control the drill's power fittings depending on the characteristics of the task. Unlike manual drills that depend on users' power, users can control the power transferred using the torque level on the electric drill. P1 explained that he usually tuned his RC car to satisfy his preferences or improve the car's performance when driven on certain race tracks.

Customizability refers to users' perceptions of how they can change the system based on preference and circumstance (Nidumolu & Knotts, 1998; Orehovacki, 2010; Teng, 2010). In the sense that the system changes based on circumstance, customizability is often compared to personalization. However, while personalization enables changes to the system without the user

knowing, customization provides users with direct autonomy and options to create the circumstances they want. In previous studies, customizability was seen as a user-initiated process that increased process flexibility (Nidumolu & Knotts, 1998; Nurkka, 2013). An experience with high customizability provides users with the authority to control or change a product or service according to specific circumstances. In addition, users who control the system also know the result of their required resources, time, and actions and are able to control the system autonomously. Therefore, customizability positively influences users' perceived autonomy, which consequently lower the systems' perceived autonomy.

H8. *Customizability* negatively influences perceived system's autonomy (external) as a determinant of judgments.

In the contextual inquiry, P7 showed us her Roboking and how it worked in her home. She said that Roboking was useful, as it detected her home environment using sensors and set up the path to clean. P6 referred BEAT as a surprising jukebox that enabled him to listen to unpredictable new music without his control. In particular, as a DJ, BEAT filled his need to listen to and mix new music. P13 said that automatic security is important when using civil services. In Minwon 24, he simply managed his certification file to control the secure programs. This experience led him to perceive the online civil service as safe.

Adaptivity refers to how the system adapts to users' desires (Heerink, Kröse, Evers, & Wielinga, 2010). In the field of robot interfaces, especially, perceived adaptivity is defined as the user's perception of a robot that can alter its responses according to the user's conditions and changes in the environment and make its own adaptations (Shin & Choo, 2011). From the perspective of the user experience, adaptivity is considered the key attribute of the perceived usefulness of a system when users judge its importance and value using collected information. For example, Heerink et al. (2000) found that users' perceptions of adaptivity positively affect attitudes and that users' perceptions of usefulness depend on how much robots can adapt to changing environments. In addition, many studies suggest that adaptivity reduces users' cognitive workload when using a system (Rothrock, Koubek, Fuchs, Haas, & Salvendy, 2002).

H9. *Adaptivity* positively influences the system's autonomy (external) as a determinant of judgments.

Accordingly, we found that users could perceive their autonomy in using a product or service through features such as customizability and adaptivity. After conducting the contextual inquiry and interviews, we propose that the two system features are important in daily use directly influencing users' perceived autonomy.

5. Main study: survey

5.1. Method

Based on the theoretical background and pre-study, we set up the research model and conducted the survey to verify the nine hypotheses empirically. We reviewed previous studies and theoretical conception for extracting the items to verify our research model. All of items were converted to adjust a tone and manner on eight cases, respectively. Also, we conducted a pilot test for each of the eight cases with four to six participants to identify any mistakes during the conversion process. The research model for this study is presented in Fig. 2 below. A total of 242 participants were recruited through advertisements on Facebook, Hangout, and by email. We recruited participants who had experienced each case more than two months prior to the study (see Table 6). The questionnaire has been constructed based on prior studies using the same constructs in our study. The questionnaire is presented in the Appendix.

5.2. Results

To test the measurement model, the Partial Least Squares (PLS) method of structural equation modeling was utilized (Smart PLS 2.0). Based on the valid data from 183 respondents, we conducted a confirmatory factor analysis of the measurement and the structural model.

5.2.1. Measurement model

Reliability was measured with Cronbach's alpha and composite reliability, which must both exceed 0.70 (Fornell & Larcker, 1981). Table 7 indicates that all Cronbach's alphas exceeded the required minimum of 0.70. All composite reliabilities also exceeded the required minimum of 0.70 (Chin, 1998; Kline, 2005). Convergent validity is verified when the standardized factor loading of each construct exceeds 0.70 with a t-value greater than 1.96 as well as an Average Variance Extracted (AVE) greater than 0.50 (Arnold & Reynolds, 2003). Table 7 indicates that all standardized factor loadings exceeded the required minimum of 0.70. In addition, all AVE values exceeded the required minimum of 0.50.

As noted, all figures exceeded the recommended standards of the measurement model (Fornell & Larcker, 1981). Consequently, all 35 questionnaires had remarkable convergence validity for

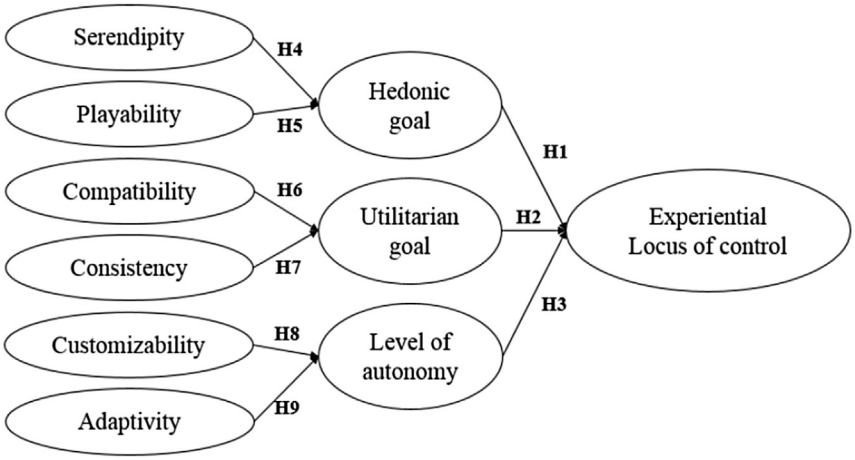

Fig. 2. Research model.

Table 6
Main study respondent characteristics.

Measure	Value	Number of participants	Percentage
Cases	Tamiya Porsche	18	9.23
	Phillips Hue	21	10.77
	Aimsak AD 418R	18	9.23
	LG Roboking	26	13.33
	"I Love Coffee"	38	19.49
	BEAT	21	10.77
	Easy Taxi	20	10.26
	Minwon 24	33	16.92
Age	<20	20	10.93
	21–30	112	61.20
	31–40	33	18.03
	>41	18	9.84
Gender	Male	66	36.07
	Female	117	63.93

measuring the ten concepts presented in this study (Bagozzi & Yi, 1988).

Discriminant validity was measured with the criterion that the square root of AVE for each construct should be greater than the corresponding correlation coefficients (Fornell & Larcker, 1981). All square roots of each corresponding AVE exceeded the corresponding correlation coefficients, as shown in Table 8. In addition, cross-loadings between constructs are shown in Table 9. The results indicate that the factor loadings of the items of each construct show correlation, meaning that the items of each construct explain their corresponding constructs in a statistically significant manner. Moreover, the factor loadings of each item on its construct were higher than the factor loadings on the other constructs, which indicates that items statistically support being part of their corresponding constructs.

5.2.2. Structural model

Structural equation modeling was used to analyze all hypotheses using PLS with Smart PLS 2.0. We have identified the six constructs (serendipity, playability, compatibility, consistency, customizability, and adaptivity) and constructed the six hypotheses (H4–H9) mostly based on the results from our pre-study of contextual inquiry and interviews on the eight cases. Therefore, our conceptual model has strong exploratory flavor, and we decided to use PLS instead of a covariance-based approach (Chin, 1998). The structural model is shown in Fig 3.

According to the results, approximately 48.8% of the variability in the achievement of hedonic goals is explained by serendipity and playability, and 23.9% of the variability in the achievement of utilitarian goals is explained by compatibility and consistency. As for level of autonomy, 41% of the variability is explained by customizability and adaptivity. Finally, 40.8% of the variability in experiential LoC is explained by the determinant of goal achievement, including hedonic and utilitarian goals, and the determinant of autonomy. These values exceed the minimum requirement of 10% variance (Falk & Miller, 1992) and are thus deemed acceptable.

In order to find support for the hypotheses, path coefficients and t-statistics (N = 183) were examined. The influence of serendipity on the achievement of hedonic goals was 0.171 (**H4**), and the influence of playability on the achievement of hedonic goals was 0.583 (**H5**). The t-values for each respective path were 2.002 and

Table 7
Convergent validity and reliability.

Factor type	Construct	Item	Factor loading	AVE	CR	t-value
Key features affecting the determinants	**SER**	SER1	0.807	0.686	0.868	19.134
		SER2	0.840			20.927
		SER3	0.838			14.891
	PLA	PLA1	0.844	0.757	0.926	23.36
		PLA2	0.920			57.05
		PLA3	0.868			24.433
		PLA4	0.846			16.862
	COM	COM1	0.909	0.754	0.902	35.384
		COM2	0.875			14.32
		COM3	0.817			9.198
	CON	CON1	0.844	0.643	0.843	17.814
		CON2	0.829			15.028
		CON3	0.727			6.486
	CUS	CUS1	0.877	0.820	0.948	31.08
		CUS2	0.906			32.118
		CUS3	0.926			55.442
		CUS4	0.911			38.565
	ADA	ADA1	0.878	0.844	0.942	18.956
		ADA2	0.948			83.037
		ADA3	0.929			58.528
Determinants affecting experiential LoC	**HED**	HED1	0.964	0.908	0.975	59.726
		HED2	0.969			110.685
		HED3	0.963			67.036
		HED5	0.916			30.332
	UTI	UTI1	0.925	0.861	0.969	45.754
		UTI2	0.951			77.392
		UTI3	0.933			62.554
		UTI4	0.932			59.505
		UTI5	0.899			34.289
	LOA	LOA1	0.857	0.727	0.889	22.558
		LOA2	0.843			16.593
		LOA3	0.858			19.353
Experiential LoC	**LOC**	LOC1	0.791	0.669	0.858	11.662
		LOC2	0.801			11.541
		LOC3	0.860			20.931

SER: Serendipity, **PLA**: Playability, **COM**: Compatibility, **CON**: Consistency, **CUS**: Customizability, **ADA**: Adaptivity, **HED**: Hedonic, **UTI**: Utilitarian, **LOA**: Level of autonomy, **LOC**: Locus of control.

Table 8
Discriminant validity.

	SER	PLA	COM	CON	CUS	ADA	HED	UTI	LOA	LOC
SER	***0.828***									
PLA	0.596	***0.870***								
COM	−0.284	−0.284	***0.868***							
CON	−0.225	−0.244	0.447	***0.802***						
CUS	0.211	0.177	−0.088	−0.157	***0.906***					
ADA	−0.174	−0.238	0.215	0.337	−0.594	***0.919***				
HED	0.528	0.685	−0.327	−0.369	0.332	−0.330	***0.953***			
UTI	−0.490	−0.514	0.401	0.429	−0.184	0.219	−0.582	***0.928***		
LOA	−0.097	−0.095	0.091	0.080	−0.541	0.597	−0.100	0.057	***0.853***	
LOC	−0.213	−0.250	0.250	0.237	−0.408	0.402	−0.363	0.353	0.529	***0.818***

Bold italic figures indicate statistically significant values. SER: Serendipity, **PLA**: Playability, **COM**: Compatibility, **CON**: Consistency, **CUS**: Customizability, **ADA**: Adaptivity, **HED**: Hedonic, **UTI**: Utilitarian, **LOA**: Level of autonomy, **LOC**: Locus of control.

6.206. The influence of compatibility on the achievement of utilitarian goals was 0.261 (**H6**), and the influence of consistency on the achievement of utilitarian goals was 0.312 (**H7**). Their respective t-values were 2.707 and 3.116. Additionally, the influence of customizability on the level of autonomy was −0.288 (**H8**), and the influence of adaptivity on the level of autonomy was 0.426 (**H9**), with respective t-values of 3.022 and 4.048. In addition, the influence of hedonic goal achievement level on experiential LoC was −0.187 (**H1**), the influence of utilitarian goal achievement level on experiential LoC was 0.216 (**H2**), and the influence of autonomy level on experiential LoC was 0.498 (**H3**). The respective t-values were 2.043, 2.084, and 5.503. In sum, all hypotheses were supported (See Table 10).

6. Conclusion and discussion

The purpose of our study was to examine commonly important factors of User Experience on innovative products and services. We assumed that the UX factors affect not only users' experience of digital product or service, but also users' judgment of their experience as useful. Therefore, we developed a theoretical model explaining how users judge their experiences as useful because of the factors of HCI. We focused on LoC as an important dependent variable in the judgment of usefulness. In addition, we extended and applied the experiential LoC to the aspect of the user experience that it is affected by two determinants. The determinant of goal achievement, including hedonic and utilitarian goals, was closely

Table 9
Cross-loadings.

	SER	PLA	COM	CON	CUS	ADA	HED	UTI	LOA	LOC
SER1	***0.807***	0.478	−0.219	−0.143	0.109	−0.144	0.455	−0.402	−0.024	−0.148
SER2	***0.84***	0.487	−0.241	−0.236	0.223	−0.178	0.431	−0.445	−0.105	−0.252
SER3	***0.838***	0.519	−0.247	−0.181	0.196	−0.106	0.397	−0.368	−0.119	−0.127
PLA1	0.506	***0.844***	−0.242	−0.251	0.156	−0.176	0.525	−0.441	−0.108	−0.186
PLA2	0.577	***0.92***	−0.285	−0.248	0.15	−0.214	0.669	−0.499	−0.061	−0.229
PLA3	0.526	***0.868***	−0.193	−0.166	0.118	−0.174	0.56	−0.402	−0.053	−0.229
PLA4	0.463	***0.846***	−0.261	−0.183	0.191	−0.259	0.613	−0.439	−0.113	−0.223
COM1	−0.236	−0.223	***0.909***	0.45	−0.077	0.202	−0.293	0.451	0.079	0.306
COM2	−0.278	−0.289	***0.875***	0.374	−0.044	0.146	−0.283	0.29	0.057	0.145
COM3	−0.24	−0.25	***0.817***	0.305	−0.12	0.216	−0.28	0.239	0.11	0.144
CON1	−0.258	−0.307	0.346	***0.844***	−0.211	0.277	−0.398	0.378	0.091	0.211
CON2	−0.142	−0.14	0.474	***0.829***	−0.098	0.281	−0.222	0.374	0.1	0.199
CON3	−0.128	−0.119	0.225	***0.727***	−0.048	0.255	−0.264	0.263	−0.025	0.154
CUS1	0.262	0.145	−0.075	−0.136	***0.877***	−0.523	0.261	−0.139	−0.453	−0.31
CUS2	0.185	0.171	−0.043	−0.037	***0.906***	−0.493	0.291	−0.123	−0.507	−0.359
CUS3	0.147	0.137	−0.076	−0.154	***0.926***	−0.578	0.291	−0.15	−0.529	−0.394
CUS4	0.177	0.192	−0.132	−0.252	***0.911***	−0.555	0.362	−0.261	−0.463	−0.413
ADA1	−0.052	−0.131	0.146	0.277	−0.513	***0.878***	−0.23	0.094	0.487	0.294
ADA2	−0.205	−0.225	0.269	0.338	−0.57	***0.948***	−0.347	0.263	0.556	0.39
ADA3	−0.206	−0.286	0.175	0.312	−0.552	***0.929***	−0.323	0.233	0.595	0.413
HED1	0.514	0.664	−0.329	−0.357	0.325	−0.327	***0.964***	−0.562	−0.121	−0.376
HED2	0.508	0.676	−0.321	−0.358	0.319	−0.349	***0.969***	−0.549	−0.114	−0.336
HED3	0.479	0.682	−0.332	−0.364	0.323	−0.317	***0.963***	−0.562	−0.07	−0.326
HED4	0.474	0.583	−0.262	−0.326	0.297	−0.26	***0.915***	−0.547	−0.075	−0.346
UTI1	−0.437	−0.469	0.397	0.432	−0.205	0.215	−0.502	***0.925***	0.075	0.344
UTI2	−0.483	−0.489	0.373	0.433	−0.167	0.225	−0.564	***0.951***	0.071	0.34
UTI3	−0.455	−0.488	0.393	0.425	−0.191	0.219	−0.549	***0.933***	0.081	0.346
UTI4	−0.474	−0.476	0.372	0.368	−0.194	0.198	−0.565	***0.932***	0.021	0.333
UTI5	−0.424	−0.461	0.314	0.311	−0.078	0.149	−0.524	***0.899***	0.001	0.263
LOA1	−0.081	−0.093	0.042	0.069	−0.456	0.508	−0.1	0.045	***0.857***	0.465
LOA2	−0.105	−0.069	0.129	0.077	−0.48	0.494	−0.083	0.057	***0.843***	0.435
LOA3	−0.065	−0.082	0.063	0.059	−0.449	0.526	−0.073	0.044	***0.858***	0.453
LOC1	−0.135	−0.217	0.139	0.198	−0.289	0.289	−0.308	0.242	0.367	***0.791***
LOC2	−0.152	−0.159	0.25	0.192	−0.386	0.322	−0.275	0.247	0.417	***0.801***
LOC3	−0.224	−0.233	0.219	0.194	−0.329	0.367	−0.309	0.362	0.499	***0.860***

Bold italic figures indicate statistically significant values. SER: Serendipity, **PLA**: Playability, **COM**: Compatibility, **CON**: Consistency, **CUS**: Customizability, **ADA**: Adaptivity, **HED**: Hedonic, **UTI**: Utilitarian, **LOA**: Level of autonomy, **LOC**: Locus of control.

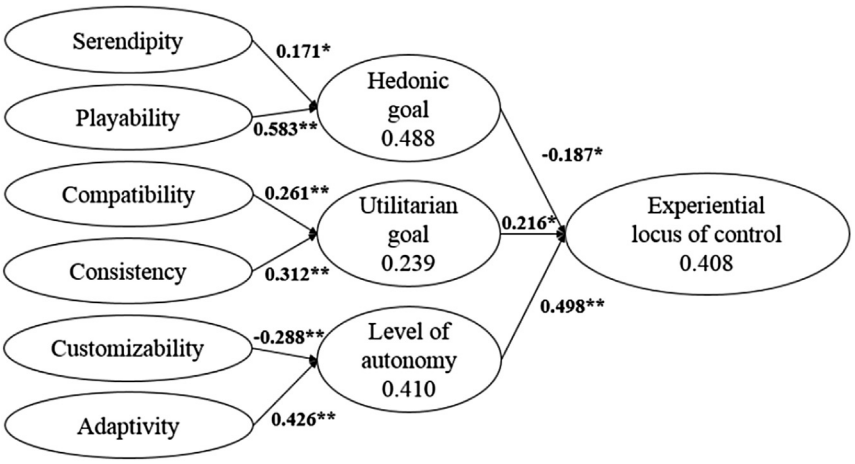

Fig. 3. Structural model analysis.

Table 10
Hypothesis testing.

Hypothesis	t-value	Result
H1. The hedonic goal dimension negatively affects *external* experiential LoC.	>1.96	Supported
H2. The utilitarian goal dimension positively affects *external* experiential LoC.	>1.96	Supported
H3. A high level of autonomy of a system (a low level of user autonomy) positively affects the perceptions of users' *external* experiential LoC.	>2.58	Supported
H4: *Serendipity* positively influences the achievement of hedonic goals (internal) as a determinant of judgments.	>1.96	Supported
H5: *Playability* positively influences the achievement of hedonic goals (internal) as a determinant of judgments.	>2.58	Supported
H6: *Compatibility* positively influences the achievement of utilitarian goals (external) as a determinant of judgments.	>2.58	Supported
H7: *Consistency* positively influences the achievement of utilitarian goals (external) as a determinant of judgments.	>2.58	Supported
H8: *Customizability* negatively influences perceived system's autonomy (external) as a determinant of judgments.	>2.58	Supported
H9: *Adaptivity* positively influences the system's autonomy (external) as a determinant of judgments.	>2.58	Supported

related to the *result* of the user experience. On the other hand, the determinant of autonomy was closely related to the *process* of the user experience. The system features from our pre-study were proposed as core determinants. It was found that the determinant of goal achievement, including hedonic and utilitarian goals, affected experiential LoC. In addition, the determinant of autonomy, measured by level of autonomy, affected experiential LoC. Furthermore, all of the representative features included in products and services affected the two determinants. Based on the study results, two interesting issues are worth discussing in more detail.

First, the users' experience dimension of goal achievement affected experiential LoC, whether internal or external. The hedonic goal dimension gave users pleasure when using a product or service through the serendipitous system interface/information and playable system interaction. On the other hand, the utilitarian goal dimension gave users practicality when using a product or service through the compatible system interface and consistent system interaction. It is important to note that people perceive the user experience differently depending on how the system provides them a useful experience through the key features of the product or service. Furthermore, the achievement of hedonic goals ascribes users' experience to internal-experiential LoC. Therefore, if people want to gain internal satisfaction through the experience of using a product or service, they might choose a product or service providing a serendipitous or playable experience. On the other hand, the achievement of utilitarian goals ascribes users' experience to external-experiential LoC. Therefore, if people want to gain external satisfaction through the experience of using a product or service, they might choose a product or service providing a compatible or consistent experience.

Second, the users' experience dimension of autonomy affected experiential LoC, whether internal or external. A high level of system autonomy gave users a sense of automation when using a product or service through adaptive system interaction or interfaces. On the other hand, a low level of system autonomy, explained as a high level of user autonomy, gave users an autonomous experience when using a product or service through customizable system interaction, interfaces, or information. All of these results indicate that users perceive the user experience differently depending on how the system provides them autonomy through the key features of a product or service. A high level of user autonomy ascribes users' experience to internal-experiential LoC. Therefore, if people want to gain internal satisfaction through the experience of using a product or service, they might choose a product or service providing a customizable experience. On the other hand, a high level of system autonomy ascribes users' experience to external-experiential LoC. Therefore, if people want to gain external satisfaction through the experience of using a product or service, they might choose a product or service providing an adaptable experience.

7. Limitations and implications

7.1. Limitations and further study

In our study, we adopted the determinants of judgments on the *result* of use (hedonic goal dimension and utilitarian goal dimension) and the *process* of use (level of autonomy), which had positive effects with respect to experiential LoC. However, the key features of the system for the determinants used in our study were simple and short pieces of factual information. Although we suggested the features according to the results of the pre-study and various previous studies, this limited examination caused some problems in the main study. For example, some survey participants suggested other key features. The study took the first step to explain and verify the effect of determinants through key features with respect

to experiential LoC. Future studies may focus on various key features to verify experiential LoC with respect to users in various cases. In addition, future studies may use an experimental methodology for verifying the key features affecting the determinants of judgment. Moreover, our study used the same products and services both for the pre-study where we identified key constructs and for the main survey study. However, using the same products might limit the generalizability of the study results. Future studies should be conducted to investigate whether the conceptual model applies to diverse products and services.

Nevertheless, this study has various theoretical and practical implications.

7.2. Theoretical implications

Theoretically, this study proposed a theoretical framework of judgment of users' experiences using products or services and verified it with empirical data. Furthermore, this study utilized eight cases to empirically verify a theoretical model where two determinants led to experiential LoC internally or externally. Prior studies focused on usefulness from the perspective of evaluation or technology acceptance. However, these studies did not explain how the users judge their user experience in terms of the human experience. We expanded upon prior studies by explaining how users perceive the system features influencing the determinants of judgment and judge their user experience through experiential LoC.

In particular, we set up the experiential LoC by summarizing the debates on LoC. From the perspective of personality psychology, two different views on LoC exist, as mentioned earlier. From the perspective of the human experience, we logically understand and apply two views to explain users' judgments of their experiences as a result of use and during the process of use. This means that people are continually affected by using a product or service, and they immediately change their psychological modes and attitudes, which are explained by the experiential LoC in their lives.

7.3. Practical implications

Practically, this research points to the effects of two determinants on experiential LoC. In order to increase *internal* experiential LoC, we believe that the achievement of hedonic goals and a high level of user autonomy should be considered. We know that creating serendipitous and playable experiences when using a product or service has a high impact on hedonic goal achievement. For example, developers and designers who want to create a high level of hedonic goal achievement can focus on pop-up interfaces or context-based contingent information to provide a serendipitous experience. Pop-up interfaces can provide serendipitous experiences to users without users having to interact with the system first. In our study, "I Love Coffee" induced users, even those who did not participate frequently, to experience serendipity in its world through continual pop-ups. When a regular guest would come near a user's coffee shop, the system would launch a pop-up to persuade the user to sell coffee to the guest. At times, the system also provided appropriate compensation to provide a sense of serendipity. In addition, recent trends reveal that services that provide interaction based on usage context are popular. Analyses of usage contexts can help provide unexpected content. A wide variety of content can be tailored to users based on algorithms that understand the connections between user preferences and usage context information. In our study, BEAT did not simply recommend similar genres or popular songs in a mix. It induced a serendipitous experience by recommending music based on how many users listened to a certain song under similar contexts.

In addition, developers and designers who want to create a high level of hedonic goal achievement can focus on tangible or share-based interactions to provide a playable experience. Tangible interactions utilize physical objects to interact with digital information (Hornecker, 2005; Ishii & Ullmer, 1997). In our study, "I Love Coffee" users had to physically tilt the smartphone in order to pour milk into coffee during a barista test. The intensity of the tilt determined how fast the milk was poured. As this type of interaction has physical properties, it is more enjoyable than interacting by tapping or swiping the screen. In addition, interaction methods of sharing information with other users, such as the "share" button or a button that moves a user to another person's profile, help enhance playability. The Philips Hue is merely a light bulb, but people have different ways of utilizing it to share themes and usage methods through meethue.com, and they discovered new ways provided by other users, which, according to our study, enhanced playability.

Furthermore, we know that creating a customizable experience when using a product or service has a high impact on the level of user autonomy. For example, developers and designers who want to create a high level of perceived user autonomy can focus on preview interfaces or detailed task manager information. Preview interfaces show the results of actions before they actually take place so that users can check and revise the actions (Create a Sim, 2014). In our study, a driver drill indicated the direction in which the drill would rotate and what the speed would be even when not in use. The preview process, as well as revisions based on the preview results, enables users to conduct their tasks with precision and helps them perceive that they are directly in control of the system. In addition, a task manager shows users information that helps them understand the mechanisms of the system (Windows Task Manager, 2014). This can be explained through the process monitoring a system. In our study, users needed to know exactly how each part functioned, whether the parts were replaceable, and whether they were compatible with other products to predict how to tune the RC car according to their needs. Thus, information about the RC car's mechanisms should be shown to users in an understandable manner.

In order to increase *external* experiential LoC, we believe that utilitarian goal achievement and a high level of system autonomy should be considered. We know that creating compatible and consistent experiences when using a product or service has a high impact on utilitarian goal achievement. For example, developers and designers who want to create a high level of utilitarian goal achievement can focus on standardized interfaces or human-like interaction to provide compatible experiences. Standardized interfaces have greater compatibility when they follow a common standard (Collins, 2013). It is important to design a product or service so that its functions are not just specialized for itself but shareable with other products and services. In our study, good examples of standardization were the rechargeable driver drill compatible with batteries between 10.8 V and 18 V as long as the size fit and the Android smartphone charger that could charge any Android phone regardless of manufacturer. In addition, human-like interaction refers to interactions between humans and systems that are similar to human-to-human interactions, such as conversation or gestures (SIRI, 2014). In our study, the LG Roboking understood and followed the commands "Come here," "Start cleaning," "Stop now," and "Recharge." When the user said, "Come here, Roboking," the robot located the direction of the voice and moved toward the user. The product was designed to use natural commands rather than unnatural ones (e.g., "Activate," "Stop," and "Clean") in order for the robot to perform its tasks.

In addition, developers and designers who want to create a high level of utilitarian goal achievement can focus on consistent graphic

user interfaces or "action–results" interaction to provide consistent experiences. Screens of a single system should be designed with consistent themes and colors. Icons must also possess a consistent look, feel, and concept. In terms of services, one way to provide consistency is to provide buttons at the same location on every page. In our study, Easy Taxi used the star icon to indicate "Favorites," which let users know that this was where their favorite content was stored. Such consistent graphic user interfaces help users navigate through a product or service more efficiently. In addition, when a user performs a certain action, a system should provide consistent results relevant to the action (i.e., "action–results" interaction). In our study, Roboking, the robot vacuum cleaner, could be controlled through an RC or a smartphone application. Each method of control provided consistent actions that led to consistent results. For instance, using the arrows of the RC moved the Roboking in the same way as using the arrow icons on the smartphone application. This design feature is similar to what design style guidelines require in general.

Furthermore, we know that creating adaptable experiences when using a product or service has a high impact on the level of system autonomy. For example, developers and designers who want to create a high level of system autonomy can focus on situation-based system-initiated interaction or responsive interfaces. Situation-based system-initiated interaction technology predicts the objective of a user and provides an appropriate situational interaction to fulfill that objective. Such interaction does not require human intervention; it requires users to give up their control of the experience to the system. Through the experience, the robot provides users with the perception that it is not merely a cleaning device; it is a product that helps users feel the experience of cleaning. The development of interaction technology utilizing cameras and sensors has helped products such as the robot vacuum cleaner to become smart products that understand their context and perform actions that are appropriate to those environments. In our study, the Roboking used cameras and sensors to avoid obstacles and sensed the texture of the floor in order to select the appropriate method of cleaning. In addition, a responsive interface refers to a type of interface that organically interacts with people based on the situation and context rather than functioning in a mechanical and static manner. In our study, the BEAT music service used a responsive interface to provide users with mixes appropriate for the situation and context; this led users to perceive the presence of a system agent. More specifically, BEAT uses data such as the day's weather, temperature, genre, and other information to help users select an appropriate mix name. Related to this, Ochoa, González, Esquivel, Matozzi, and Maffucci (2009)'s study is a good example of explaining how contextual information is provided by recommendation system to users. There are three methods of recommendation system including content-based, collaborative filtering and hybrid approach. BEAT provides feedback to users using hybrid approach, which is the way of analyzing users' static data and others' dynamic data. This helps users experience BEAT as an aware agent that helps recommend music.

Acknowledgements

This work was supported by the National Research Foundation of Korea Grant funded by the Korean Government (NRF-2013R1A1A2A10012594). The authors thank Yunjin Jang who kindly proofread the entire draft and all of our research team members. Thanks to anonymous experience designers who provide users with the real experience.

Appendix

Table 11
Measurements.

Construct	Item	Measurement	Reference
Serendipity	SER1	I found something interesting in [product or service] that had unexpected [things].	McCay-Peet & Toms, 2011
	SER2	I explored something I normally would not have while using [product or service].	
	SER3	I was able to gain unexpected information through [product or service].	
Playability	PLA1	This [product or service] provides me with an impressive experience, so I want to experience [product or service] more.	Sánchez et al., 2012
	PLA2	Using this [product or service] is fun.	
	PLA3	The process of using [product or service] catches my attention.	
Compatibility	COM1	I think the method of using [product or service] fits well with the way that I use other [product or service].	Carter & Bélanger, 2005
	COM2	I think this [product or service] fits well with the way that I interact with other [product or service].	
	COM3	Using this [product or service] to do [something] is similar to the way I use other [product or service].	
Consistency	CON1	I perceive a consistent experience on [product or service]	Lin et al., 1997
	CON2	I think the information of [product or service] is displayed consistently with [something].	
	CON3	I have been required to produce consistent actions regardless of circumstances.	
Customizability	CUS1	I can change [product or service] effectively.	Nidumolu & Knotts, 1998
	CUS2	I can choose the [feature] of [product or service] to fit my preferences or circumstances.	
	CUS3	I can coordinate the [feature] of [product or service] to fit my purpose.	
Adaptivity	ADA1	I think that the [product or service] system can fit the necessary parts automatically.	Heerink et al., 2000
	ADA2	I think that the [product or service] system can work when necessary.	
	ADA3	I think that the [product or service] system helps me by itself.	
Hedonic	HED1	I think [product or service] is fun.	Voss, Spangenberg, & Grohmann, 2003
	HED2	I think [product or service] is exciting.	
	HED3	I think [product or service] is delightful.	
	HED4	I think [product or service] is thrilling.	

Table 11 (*continued*)

Construct	Item	Measurement	Reference
Utilitarian	UTI1	I think [product or service] is effective.	Voss et al., 2003
	UTI2	I think [product or service] is helpful for me.	
	UTI3	I think [product or service] is functional.	
	UTI4	I think [product or service] is necessary.	
	UTI5	I think [product or service] is practical.	
Level of autonomy	LOA1	*In general, [product or service] offers*…no assistance; I have to control my experience (1). …full assistance; There is no need for me to control the experience (7).	Goodrich & Schultz, 2007
	LOA2	*In general, [product or service] offers*…maximum choice selection; I have to pay attention to control. (1) …minimum choice selection; There is no need for me to pay attention. (7)	
	LOA3	*In general, [product or service] offers*…the decisions on everything and acts only on my orders. (1) …the decisions on everything and acts autonomously without me. (7)	
Experiential locus of control (External-side)	LOC1	*The benefit of using [product or service] is*…my ability. (1) …[product or service]'s ability. (7)	Rotter, 2011
	LOC2	*The key to benefiting from using [product or service] is*…pursuing the experience myself. (1) …having the experience provided by [product or service]. (7)	
	LOC3	*My experiences through [product or service] are*…almost entirely dependent on [product or service]. (1) …almost entirely dependent on me. (7)	

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