Mobile Location-Based Services: Current Use and Future Prospects

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ABSTRACT

This study investigated three factors of self-determination theory (SDT) that influence the intrinsic and external motivation of mobile location-based services (M-LBS). This study was conducted on M-LBS users through an online survey, and a total of 308 response data were used for analysis. The results showed that the three factors of SDT significantly influenced the extrinsic motivation of M-LBS, and only perceived relatedness significantly affected intrinsic motivation. Intrinsic and external motivation had a great influence on attitudes and attitudes. Recognized competency influenced perceived usefulness more than pull type. A positive attitude influenced the intention to continue pulling rather than pushing. According to service type (i.e., push and pull), users are more likely to continue to use the service when users are satisfied with the service requested by M-LBS than when the operator provides the service on its own, so they need to understand how M-LBS affects perceived usefulness and intrinsic motivation.

KEYWORDS

Extrinsic Motivation, Intrinsic Motivation, Location-Based Services, Self-Determination Theory

INTRODUCTION

Mobile communication technologies has allowed consumers to access the services they want to use anywhere even on the move owing to the high-speed cellular network service along with the development of GPS technology (Elkhodr et al., 2021; Roopa et al., 2018). These services include many practical and fun services such as location- sensitive payment service, navigation, near-point information, store-guide, traffic updates, location-based advertising, mobile games, and discount coupons (Barnes, 2003; Luo et al., 2021). Providing applications using commercially sensitive geographic location information and value-added services is called location-based services (LBS) (Sørebø et al., 2009). LBS shows its potential by allowing suppliers and sellers to obtain confidential information such as the personal information of consumers in real time (Bellavista et al., 2008). Especially mobile location-based service(M-LBS) users are growing every year and getting more popular owing to various applications such as Yelp and Trip Advisor (Chen et al., 2018; Akel &

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Armağan, 2021). However, no matter how useful it is, a service distributed without the consent of a user can irritate the consumers and even be disregarded by the consumers (Teo & Zhou, 2014). Therefore, it is necessary to maximize the service satisfaction by motivating the user by providing a service that is in accordance with the service providing environment.

Self-determination theory (SDT) argues that autonomy, relatedness, and competence are three intrinsic values motivating people. Therefore, when these three factors are satisfied, more intrinsic motivation is given to using the service. It has been shown that intrinsic motivation enhances satisfaction and achievement and it is superior to extrinsic motivation. However, it is hard to say that intrinsic motivation is always more important than the extrinsic motivation in the IT system field. Depending on the IT system characteristics, extrinsic motivation can be more suitable. Although some studies have examined the three factors of SDT affecting the intrinsic and extrinsic motivation of users (Lin et al., 2007; Chen & Jang, 2010), their effects on M-LBS have not been evaluated. Furthermore, no study has examined the differences in the user motivation by distinguishing the push type and the pull type, which are the information delivery mechanisms of M-LBS. There are two common ways to reflect the new location: the push type provides contents with users and the pull type service needs a user to request location guidance service (Wakefield & Whitten, 2006; Fan et al., 2021). These two ways are study topics in the field of M-LBS because users experience different advantages and utilities depending on these two ways. The push type requires a little effort from a user but it does not control an unexpected situation well. On the other hand, the pull type allows a user to control services, but the user may receive a service that does not agree with the current situation. Due to the difference in the mechanism of the two M-LBS types, a user chooses push or pull type mechanisms depending on service convenience (Teo & Zhou, 2014; Nikou & Economides, 2017; Fan et al., 2021). The two mechanisms use different scopes and methods of receiving information depending on the level of users' personal information disclosure. The user may selectively choose one of the two service types to satisfy the service usage motivation.

Therefore, this study aimed to identify the usage motivation of users by service types, discover factors acting as intrinsic stimulator affecting it, and evaluate if the effects influencing the intrinsic motivation or extrinsic motivation differ by type. This study also aimed to confirm whether customized information such as a recommendation system could result in continuous use intention because a continuous use can be considered as a successful service (Bhattacharjee, 2001). The rest of the paper is organized as follows. Section 2 provides a theoretical background and hypothesis. Section 3 presents research method. Section 4 presents results. Section 5 presents general discussion and practical implication. Section 6 presents limitation and future research opportunities.

THEORETICAL BACKGROUND AND HYPOTHESIS

Self-Determination Theory (SDT)

SDT proposes two most important motivations. Intrinsic motivation means that one does an activity because he or she enjoys the process, while extrinsic motivation refers to an activity for a result (e.g., reward and punishment avoidance) that can be separated from the activity (Ryan & Connell, 1989; Ryan & Deci, 2000; Ryan & Deci, 2020). Previous studies have shown that intrinsic motivation has higher persistence, performance, and satisfaction than extrinsic motivation in various domains (e.g., education, behavioral health, and organization) (Ryan & Connell, 1989; Ryan & Deci, 2000; Barnes & Scornavacca, 2004).

SDT also suggests that the adoption of intrinsic motivation over extrinsic motivation depends on the three basic psychological needs for autonomy, competence, and relatedness. Previous studies have shown that people are more likely to make a more consistent and better quality performance for activities satisfying these needs. Autonomy in STD is related to the desire of working freely and organizing own behaviors when doing so. The necessity of competence means that individuals have

an effective tendency in interacting with the environment and performing activities. The necessity of relatedness is to feel connected and supported by important people such as supervisors, parents, teachers, and team members. The satisfaction of the three basic psychological needs depends mainly on the context in which the activity occurs. Early studies led the development of the cognitive evaluation theory, which is a sub-theory of SDT. The results of these studies showed that external controls such as contingent rewards, deadline, surveillance, evaluation, and threats could reduce the intrinsic motivation of people (Ryan & Deci, 2006; Ryan & Deci, 2020). In the context of activities, the quality of interactions with other important people can also affect the motivation for this activity. Autonomy support is described as an interpersonal type that has an influential person offer choices or options, considers the perspective of a motivator, provides relevant information and rationality associated with the activities, and encourages initiatives. Therefore, when a parent, teacher, trainer, or supervisor uses a style characterized as autonomy-supportive, motivatees are more likely to be intrinsically motivated in their activities. On the other hand, when these influential people act in a controlling way, it is more likely to be extrinsic motivation because the motivation induces persistence, performance, and satisfaction. Other studies showed that autonomy support initially induced more involvement in boring activities and increase positive emotions for activities (Deci et al., 1994; Black & Deci, 2000; Joussemet et al., 2004). However, the most useful and innovative contribution of SDT is that it indicated that extrinsic motivation did not always have to be a controlled motivation form. The theory suggests that it is possible to internalize extrinsic motivation and regulate it autonomously. Internalization defines to regulate behaviors intrinsically by considering the values, goals, and structures as own belongings, contrary to be regulated by an external factor such as a reward or punishment (Deci et al., 1989).

Motivation of Using IT System

Information system research has received a wide range of intrinsic and extrinsic motivation as two major predictors of user technology acceptance behavior (Van der Heijden, 2004; Wakefield & Whitten, 2006; Sun & Gao, 2020). IS literature clearly shows that playfulness and usefulness have different effects on certain types of work. While usefulness has a stronger impact on uninteresting work, playfulness strongly influences fun. Davis et al. (1992) proposed extrinsic motivation (e.g., perceived usefulness) and intrinsic motivation (e.g., perceived enjoyment) as two major determinants of computer use intent at work. The perceived enjoyment plays a more important role than the perceived usefulness in a hedonic environment (Childers et al., 2001; Lee & Jeong, 2021). Internal motivation can be redefined as the TAM constructs of perceived pleasure, while autonomous external motivation can be redefined as perceived usefulness (Roca & Gagné, 2008).

The intrinsic motivation in technology adoption can be determined by the Internet, blog, online shopping, knowledge sharing system, instant messaging, Internet Protocol Television, social network systems, and online shopping systems. On the other hand, extrinsic motivations have a stronger impact than intrinsic motivation in the context of the utilitarian information system (e.g., ERP system, office automation applications, and web-based banking technologies).

Many previous studies argued that, if playfulness means intrinsic motivation and usefulness indicates extrinsic motivation, the interesting activity is a better predictor for intrinsic motivation and the behavioral engagement is a better predictor for extrinsic motivation (Gagné & Deci, 2005). On the other hand, Koestner et al. (1996) revealed that intrinsic motivation was a strong predictor for political participation through information seeking but extrinsic motivation was more related to pro-environmental behaviors and actually predicted voting behavior. These studies dealt with the mechanisms of intrinsic and extrinsic motivation that claimed the effects of, importantly, hedonic and utilitarian benefits, respectively (Xu et al., 2009; Hepola et al., 2020). That is, hedonism and pragmatic benefits can have different effects depending on information system types.

Although this topic has already been extensively studied, this study aims to identify the user's motivation for use by service type, discover factors that act as intrinsic stimulating factors, and evaluate whether the effects affecting intrinsic or external motivation differ by type.

MOBILE LOCATION-BASED SERVICE (M-LBS)

M-LBS and SDT

The M-LBS provider can search the location of consumers. A mobile service provider can perform location-based marketing through it and provide promotional products based on the user's current geographical location. By combining the personalization and location search functions, it provides location-based entertainment services according to the preference of a user. Since a mobile device is a private property and it contains personal information of the individual, a mobile service provider can provide more personalized service with the mobile user based on the knowledge on the behavior and preference of users. The range of provided service can be controlled by a user.

The autonomy, relatedness, and competence of SDT are internal stimuli of human motivation. In other words, people want to interact with the environment effectively (competence), participate in activities according to own choice (autonomy), and feel connected (relatedness) (Sørenbø et al., 2009). M-LBS can be freely used under people's own discretion when it is needed, so it can satisfy the desire of organizing services by themselves. Alternatively, it is service automatically, appropriate to an environment. The M-LBS would affect both intrinsic and extrinsic motivation positively because it provides not only fun services but also practical service.

H1: Perceived autonomy has a positive effect on perceived usefulness.

H2: Perceived autonomy has a positive effect on intrinsic motivation.

H3: Perceived competence has a positive effect on perceived usefulness.

H4: Perceived competence has a positive effect on intrinsic motivation.

H5: Perceived relatedness has a positive effect perceived usefulness.

H6: Perceived relatedness has a positive effect intrinsic motivation.

M-LBS Motivation, Attitude, and Intention to Continue

Perceived usefulness and playfulness may be major factors influencing the use intention of IT devices (Lin et al., 2007; Liu et al., 2021). The perceived usefulness and playfulness of mobile users have a major impact on belief and maximize the use (Wakefield & Whitten, 2006).

Attitude was found to be the most powerful predictor of intention to use technology, along with perceived usefulness and perceived ease of use, consisting of a technology acceptance model (Ajzen & Fishbein, 1977; Teo & Zhou, 2014). It is a concept containing personal cognitive judgment and value which are felt generally and inclusively about an object, and it is a variable related to the belief of an individual. Particularly in information technology, it can be explained in the evaluation, judgment, acceptance, or perception regarding information technology.

Attitude and satisfaction can be used interchangeably in terms of emotion. However, attitude refers to a continuous emotional state after an experience, and satisfaction means an evaluation of temporary emotions (Bhattacharjee & Premkumar, 2004). Therefore, this study used the technology acceptance model attitude of Davis et al. (1989) instead of the existing satisfaction of post adoption model, because it was determined that attitude is more appropriate to evaluate a continuous emotional status than satisfaction.

H7: Perceived usefulness has a positive effect on attitude.

H8: Perceived intrinsic motivation has a positive effect on attitude.

Intention to continue means the degree of a consumer's desire to reuse a product or a service again. It is determined by the customer's subjective judgment about a product or a service. Bhattacharjee (2001) argued that the successful acceptance of information technology, which devised post adoption model, should be measured by the continuous use intention not the temporary acceptance intention, and, therefore, the one-time acceptance of an information system would not be suitable to measure the successful acceptance of an information system. Therefore, he suggested post adoption model for continuance intention after acceptance.

The technology acceptance model was studied on the basis of initial use, but the continuous use of users is essential for the technology system to be established successfully. It is difficult to evaluate it using use intention, a variable of the technology acceptance model. Therefore, this study utilized intention to continue instead of behavioral intention.

H9: Attitude has a positive effect on intention to continue.

Moderating Effects of Push or Pull Type

The information delivery mechanisms of M-LBS can be divided into two types (i.e., push and pull). The pull type sends a service to a wireless subscriber at once upon request. The pull type serves to the location of mobile device only when it is requested explicitly. In this type of M-LBS, a consumer begins to provide advertising or necessary services for the preferred product category near the location of a consumer. The push type is a way for advertisers and marketers to delivery service to wireless mobile devices, even if a subscriber does not request it (Unni & Harmon, 2007). The push type sends services to a mobile device of a consumer based on the location of the consumer and the previously specified product preference. Although the push type consumers have less control, marketers can control advertising and promotional flows better. Therefore, it provides a potentially effective way to trigger impulse buying (Unni & Harmon, 2007).

Since mobile devices are privately owned, it is believed that consumers would have stronger intrinsic and extrinsic motivation for pull type, which they can control, than push type. The unconstrained service usage, in addition to the characteristics of mobile, would affect the usefulness and intrinsic motivation positively for the pull type.

H10: Perceived autonomy has a positive effect on perceived usefulness more strongly for pull type than for push type.

H11: Perceived autonomy has a positive effect on intrinsic motivation more strongly for pull type than for push type.

The push type can provide more detailed information or the part that a user did not know than the pull type by using the personalization service or the product recommendation system, being operated by a service provider. Push type users are likely more interested in products and services than pull type users. Therefore, they are expected to have higher intrinsic/extrinsic motivation than pull type users when they perceive that a service can be used easily and proficiently.

H12: Perceived competence has a positive effect on perceived usefulness more strongly for push type than for pull type.

H13: Perceived competence has a positive effect on intrinsic motivation more strongly for push type than for pull type.

The push type generally has a wider personal information disclosure range than the pull type. The information delivery mechanisms of the push and pull types of M-LBS can provide different control levels depending on each type according to the amount of personal

information exposed to a service provider. Moreover, it can affect the service perception of a user (Unni & Harmon, 2007). Consumers have interaction control in the pull type location-based service and they only provide location information to receive services. On the other hand, the push-type location-based service has less control over the interaction with the service provider because the service is delivered to the consumer based on the consumer's location-based information (Xu et al., 2009). Therefore, if a customer notices that the service exposure environment is protected by the service provider, he or she will be positively influenced by usage motivation.

H14: Perceived relatedness has a positive effect on perceived usefulness more strongly for push type than for pull type.

H15: Perceived relatedness has a positive effect on intrinsic motivation more strongly for push type than for pull type.

In the case of the push type, unhelpful advertising can annoy consumers. Useful information is believed to be beneficial and gives satisfaction, but otherwise they are irritated. Due to the difference in mechanisms, the advertisements that are unconsciously received in the pull type can receive different responses from consumers depending on their situations, unlike requesting information whenever needed. Perceived usefulness may have a greater impact on the attitude of the push type. On the other hand, intrinsic motivation can act strongly when it is determined by own needs, not by coercion or solicitation of the surrounding environment. The pull type may have stronger intrinsic motivation than the push type, because it is only serviced when a customer requests it at the desired time.

H16: Perceived usefulness has a positive effect on attitude more strongly for push type than for pull type.

H17: Perceived intrinsic motivation has a positive effect on attitude more strongly for pull type than for push type.

The push type is more likely to receive the advertisement information and a receiver may not use all provided information because users have less control in the push type than the pull type. On the other hand, since the pull type provides a service only when a consumer requests, positive experience will affect intention to continue.

H18: Attitude has a positive effect on intention to continue more strongly for pull type than for push type.

The hypothesized paths are depicted in Figure 1.

RESEARCH METHOD

Conceptual Definition of Variables

It constructed study items by revising the measurement items of previous studies. Table 1 defines the conceptual definitions and measurement variables for target variables. In detail, three items were applied to measure performance perceived autonomy and Intention to Continue, while two items were applied to measure perceived competence, perceived relatedness, perceived usefulness, intrinsic motivation and attitude.

Figure 1. Research model

Table 1. Measurement Constructs and Conceptual Definition

Construct	Conceptual Definition	Researcher
Perceived Autonomy	<ul style="list-style-type: none"> ● I was able to use the M-LBS the way I wanted to use it. ● I felt like I was free to decide for myself how to use the M-LBS. I was provided only essential services. 	Ryan & Deci (2000), Deci et al. (2001), Jeno et al. (2019)
Perceived Competence	<ul style="list-style-type: none"> ● I could understand easily the contents of the M-LBS. ● I could use the travel services easily. 	Ryan & Deci (2000), Levi-Orta et al. (2020)
Perceived Relatedness	<ul style="list-style-type: none"> ● M-LBS provider was considerate of me. ● I made good relationship with the M-LBS provider. 	Ryan & Deci (2000), Jeno et al. (2019)
Perceived Usefulness	<ul style="list-style-type: none"> ● Overall, M-LBS is useful. ● Using M-LBS saves me time. 	Baker-Eveleth & Stone (2020)
Intrinsic Motivation	<ul style="list-style-type: none"> ● I use the M-LBS because I enjoy it ● M-LBS are generally fun. 	Ryan & Connell (1989), Sun & Gao (2020)
Attitude	<ul style="list-style-type: none"> ● It is wise idea to use M-LBS. ● It is good idea to use M-LBS. 	Lee et al. (2005), Chawla & Joshi (2020)
Intention to Continue	<ul style="list-style-type: none"> ● I intend to continue using M-LBS. ● I will strongly recommend that others use M-LBS. ● I will use the M-LBS on a regular basis in the future. 	Bhattacharjee (2001), Chawla & Joshi (2020)

DATA COLLECTION AND SAMPLE CHARACTERISTICS

This study collected data from adults (≥ 20 years old) who used M-LBS. The online survey was conducted by Dooit survey, a Korean online survey company. A total of 318 people attended the online panel, and it was divided into two groups: push type and pull type. The questionnaire consisted of general items for personal information and items related to 7 measurement variables. Each variable was measured in 2-3 items to verify the reliability and validity of the questionnaire. Each item was measured on a 7-point Likert scale, and out of 318 survey responses, 308 response data were used for the analysis, excluding 10 inappropriate respondents. The demographical characteristics of the subjects are summarized in Table 2.

Respondents were composed of 138 males (44.8%) and 170 females (55.2%). The majority of respondents were in their 30s (41.6%) and college students or graduate school graduates (73.1%).

Table 2. Sample Description (n=308)

Measure	Items	Frequency	Percent
Gender	Male	138	44.8
	Female	170	55.2
Age	20~29	51	16.6
	30~39	128	41.6
	40~49	93	30.2
	50~59	36	11.7
Education	High school graduation	59	19.2
	College student or college graduate	225	73.1
	Above graduate school graduation	24	7.8
Occupation	Office job	143	46.4
	Technician	34	11
	Researcher	6	1.9
	Professional occupation	35	11.4
	Student	18	5.8
	Other	72	23.4
Frequency of using M- LBS	Use 1-2 times per day	50	16.2
	Use 1-2 times per week	116	37.7
	Use 3-4 times per week	24	7.8
	Use 5-6 times per week	9	2.9
	Use 1-2 times per month	109	35.4
type	Push	155	50.3
	Pull	153	49.7

An office job was the main occupation (46.4%). The most common use frequency was 1-2 times per week (37.7%), followed by 1-2 times per month (35.4%).

DATA ANALYSIS

This study aimed to evaluate if the three variables of SDT (i.e., competence, autonomy, and relatedness) affected intrinsic and extrinsic motivation, and if there was a causal relationship between attitude and intention to continue. This study used SPSS 21.0 and AMOS 21.0 for statistical analyses. The development of a measurement model was performed by using confirmatory factor analysis. The convergent validity and discriminant validity of factors were verified by developing this measurement model. Lastly, structural equation modeling(SEM) analysis was conducted to verify the hypotheses of this model.

RESULTS

Measurement Assessment

This study conducted confirmatory factor analysis to verify validity. Moreover, convergent validity and discriminant validity were tested through it. First, in order to test convergent validity, this study

examined the standard factor load ($FL > 0.7$). Secondly, squared multiple correlation value ($SMC > 0.5$) was verified (Fotopoulos & Psomas, 2009). Thirdly, this study tested if the standard residual matrix met the criterion ($SRC < \pm 2.58$). The results are shown in Table 3.

After verifying convergent validity, this study examined discriminant validity. For discriminant validity, when different concepts were measured, the correlation of the two sets of results should have a low coefficient. The discriminant validity was tested by comparing the square root of of average variance extracted(AVE) for each variable and the correlation coefficient between variables. Lastly, a reliability analysis was conducted for the factors of variables. This study evaluated construct reliability ($CR > 0.7$) and average variance extracted ($AVE > 0.5$). The results of CR and AVE showed that all factors were above the thresholds. The results are shown in Table 4.

HYPOTHESES TESTING

Since the validity of factors was verified through the measurement model, the causal relationship between the factors was examined. A structural model was established to evaluate the causal relationship of entire factors ($\chi^2=253.982$, $p=0.000$, $\chi^2/d.f=2.761$, $GFI=0.900$, $NFI=0.908$, $CFI=0.939$, $RMSEA=0.076$, $TLI=0.920$).

The results showed that it was valid because the fitness of the model was very close to 0.9. This satisfies all of the general fitness indices, indicating that there is no issue in interpreting the model of this study. The analysis results are shown in (Table5).

Table 3. Confirmatory Factor Analysis Results

Construct	Factor loading	α	Composite reliability	Variance extracted
perceived autonomy 1	0.77	0.77	0.75	0.50
perceived autonomy 2	0.72			
perceived autonomy 3	0.68			
perceived competence 1	0.81	0.80	0.79	0.65
perceived competence 2	0.82			
perceived relatedness 1	0.78	0.74	0.71	0.55
perceived relatedness 2	0.75			
intrinsic motivation 1	0.87	0.82	0.75	0.60
intrinsic motivation 2	0.81			
perceived usefulness 1	0.76	0.74	0.70	0.54
perceived usefulness 2	0.78			
Attitude 1	0.80	0.78	0.76	0.62
Attitude 2	0.80			
intention to continue 1	0.79	0.86	0.82	0.60
intention to continue 2	0.83			
intention to continue 3	0.83			
Recommended value	>0.70	>0.70	>0.70	>0.50

Note: α = cronbach's alpha

Table 4. Discriminant validity

	1	2	3	4	5	6	7
1. Perceived autonomy	0.70						
2. Perceived competence	0.60	0.81					
3. Perceived relatedness	0.13	0.45	0.74				
4. Intrinsic motivation	0.03	0.37	0.73	0.78			
5. Perceived usefulness	0.66	0.69	0.47	0.58	0.73		
6. Attitude	0.56	0.63	0.48	0.51	0.97	0.79	
7. Intention to continue	0.48	0.60	0.59	0.59	0.89	0.98	0.78

Note: Diagonal elements in bold are the square root of average variance extracted (AVE) between the constructs and their indicators. Off-diagonal elements are correlations between the constructs.

Table 5. Results of hypothesis testing of hypotheses 1 to 9

Hypotheses	N=308			
	Standardized Coefficients	Standard errors	Critical Ratio	P
H1: PA-PU	0.429	0.082	5.243	***
H2: PA-IM	-0.113	0.116	-0.973	0.331
H3: PC-PU	0.236	0.093	2.53	0.011*
H4: PC-IM	0.118	0.146	0.807	0.42
H5: PR-PU	0.407	0.077	5.299	***
H6: PR-IM	1.088	0.135	8.052	***
H7: PU-AT	0.827	0.072	11.491	***
H8: IM-AT	0.091	0.035	2.583	0.01**
H9: AT-ITC	1.125	0.076	14.886	***

*p < 0.05, **p < 0.01, ***p < 0.001

(perceived autonomy: PA, perceived competence: PC, perceived relatedness: PR, perceived usefulness: PU, intrinsic motivation: IM, Attitude: AT, intention to continue: ITC)

H1-H9

Perceived autonomy significantly affected perceived usefulness (0.429), and H1 was accepted. The effects of intrinsic motivation were not significant (-0.113), and H2 was rejected. Perceived competence significantly influenced perceived usefulness (0.236), and H3 was accepted. Intrinsic motivation was not significant, so H4 was rejected. Perceived relatedness significantly affected perceived usefulness (0.407) and intrinsic motivation (1.088), so H5 and H6 were accepted. Perceived usefulness (0.827) and intrinsic motivation (0.091) significantly affected attitude, so H7 and H8 were accepted. Attitude significantly influenced intention to continue (1.125) so H9 was accepted.

H10-H18

Individual estimation was performed for push and pull to test Hypotheses 10-18. The results are shown in Table 6. Multigroup analysis was carried out to determine the regulation effects by M-LBS type. The analysis results showed that the strengths of the path were different by type. The results are shown in Table 7. It was found that the effects of perceived autonomy on perceived usefulness were

Table 6. Results of moderating effect of M-LBS types

Hypotheses	Push		Pull	
	Standard Estimate	Critical Ratio	Standard Estimate	Critical Ratio
H10: PA-PU (pull > push)	0.299	2.385*	0.380	3.330***
H11: PA-IM (pull > push)	-0.396	-2.118*	-0.020	-0.123
H12: PC-PU (pull < push)	0.471	3.521***	0.250	1.957*
H13: PC-IM (pull < push)	0.199	1.096	0.217	1.143
H14: PR-PU (pull < push)	0.278	2.870**	0.221	2.319*
H15: PR-IM (pull < push)	1.093	6.354***	0.734	4.630***
H16: PU-AT (pull < push)	0.964	7.897***	0.576	4.651***
H17: IM-AT (pull > push)	-0.011	-.167	0.274	3.109**
H18: AT-ITC (pull > push)	1.037	10.179***	1.298	10.041***

*p < 0.05, **p < 0.01, ***p < 0.001

(perceived autonomy: PA, perceived competence: PC, perceived relatedness: PR, perceived usefulness: PU, intrinsic motivation: IM, Attitude: AT, intention to continue: ITC)

Table 7. Multigroup analysis

	Unconstrained model	Constrained model
Goodness of fit Index		
χ^2	234.447	251.509
Df	154	163
P	0.000	0.000
Comparative Fit Index	0.970	0.967
Root Mean Square Error of Approximation	0.041	0.042
Model Comparison		
χ^2	17.062	
Df	9	
P	0.048	

stronger for pull than push. The difference between the types was significantly different and H10 was supported. It was also found that the effects of perceived autonomy on intrinsic motivation were stronger for pull than push. The difference between the types was not significantly different and H11 was rejected. The results revealed that the effects of perceived competence on perceived usefulness were stronger for push than pull. The difference between the types was significantly different and H12 was supported. The results showed that the effects of perceived competence on intrinsic motivation were stronger for pull than push. The difference between the types was not significantly different and H13 was rejected. The results indicated that the effects of perceived relatedness on perceived relatedness were stronger for pull than push. The difference between the types was not significantly different and H14 was supported. It was found that the effects of perceived relatedness on intrinsic motivation were stronger for push than pull. The difference between the types was significantly different and H15 was supported. It was also found that the effects of perceived usefulness on attitude

were stronger for push than pull. The difference between the types was significantly different and H16 was supported.

The results revealed that the effects of intrinsic motivation on attitude were stronger for pull than push. The difference between the types was not significantly different and H17 was supported. The results showed that the effects of attitude on intention to continue were stronger for pull than push. The difference between the types was significantly different and H18 was supported.

Table 8 summarizes the results of hypotheses.

GENERAL DISCUSSION AND PRACTICAL IMPLICATION

M-LBS are being used in user's daily life. Moreover, as service providers have been applied to various environments, the width of application has been widened. They provide not only useful services for living but also fun services. Since they ask different levels of compensation depending on the degree of personal information disclosure, it is important to understand the characteristics of information delivery mechanisms and to recognize the service value accurately. This study evaluated how M-LBS

Table 8. Summary of hypotheses testing

Hypotheses		Results
H1:	Perceived autonomy has a positive effect on perceived usefulness.	supported
H2:	Perceived autonomy has a positive effect on intrinsic motivation.	not supported
H3:	Perceived competence has a positive effect on perceived usefulness.	supported
H4:	Perceived competence has a positive effect on intrinsic motivation.	not supported
H5:	Perceived relatedness has a positive effect perceived usefulness.	supported
H6:	Perceived relatedness has a positive effect intrinsic motivation.	supported
H7:	Perceived usefulness has a positive effect on attitude.	supported
H8:	Perceived intrinsic motivation has a positive effect on attitude.	supported
H9:	Attitude has a positive effect on intention to continue.	supported
H10:	perceived autonomy has a positive effect on perceived usefulness more strongly for pull type than for push type.	supported
H11:	perceived autonomy has a positive effect on intrinsic motivation more strongly for pull type than for push type.	not supported
H12:	perceived competence has a positive effect on perceived usefulness more strongly for push type than for pull type.	supported
H13:	perceived competence has a positive effect on intrinsic motivation more strongly for push type than for pull type.	not supported
H14:	perceived relatedness has a positive effect on perceived usefulness more strongly for push type than for pull type.	supported
H15:	perceived relatedness has a positive effect on perceived usefulness more strongly for push type than for pull type.	Supported
H16:	perceived usefulness has a positive effect on attitude more strongly for push type than for pull type.	supported
H17:	perceived intrinsic motivation has a positive effect on attitude more strongly for pull type than for push type.	supported
H18:	attitude has a positive effect on intention to continue more strongly for pull type than for push type.	supported

affected perceived usefulness and intrinsic motivation by applying SDT and examined the regulation effects of the information delivery mechanisms.

The results of this study showed that the three factors of SDT influenced both intrinsic and extrinsic motivation of M-LBS and it affected intention to continue. Since positive attitude strongly influences intention to continue, it would be desirable to offer services that can be used practically and are clearly fun to users according to an environment rather than provides a lot of services unconditionally. Also, the analysis results revealed that the utilitarian motivation of usefulness affected attitude more than the intrinsic motivation. It is needed to segment the requests of users further, accept these requests, and apply them to services. The practical value derived from the economic concept of the information processing paradigm is the result of useful, economic, and productive experiences, and the hedonic value is the result of fun experiences. The empirically perceived playfulness and the ease of perceived use determine the intention to use a hedonic information system (Van der Heijden, 2004). Currently, M-LBS is in a growth stage, a preceding stage for having enjoyment. It was implied that it is important to increase the utilitarian value and lead to a positive attitude. Moreover, it was suggested that it could be led to continuous use when a positive attitude was increased by having users experience high-quality services that they could be satisfied, even though the initial service motivation was not sufficient at first.

The service type (i.e., push and pull) can be determined by the level of practicality and the degree of fun as well as the degree of user's personal information disclosure. It can be seen that both push and pull strategies increase the disclosure of actual location information through two distinct coordination paths, and in particular, pull delivers information to alleviate user privacy issues. (Fan et al., 2021). Previous studies have shown that financial compensation is more important for the push type than pull type (Xu et al., 2009). Users wants to get enough compensation form the cost. Since the push type exposes the personal information of users more than the pull type, it should provide services that make users feel that they receive equivalent benefits. The results of the study indicated that the current relatedness influenced intrinsic and extrinsic motivation, and the influence was stronger in the push type than the pull type. Considering that the service control power of the push type is weaker than that of the pull type, the results of this study implied that it is important for the push type to maintain a close relationship with a service provider in order to identify the needs of a user and provide services accordingly even in unexpected situations.

An advanced service will be provided in the future, and it will provide services automatically even before a user requests the services without irritating or annoying the user. Therefore, the push type services will also appeal to users. A user is highly likely to continuously use a service that the user can control freely and works well in a desired environment. Although a service stimulated by an external environment can affect attitude by increasing intrinsic motivation than extrinsic motivation at the moment, intrinsic motivation will be increased when a service is highly advanced and technologies are very closely linked to the life. Since a positive attitude influences intention to continue and perceived usefulness affects attitude more than playfulness, it is most important to consider users, maintain a good relationship, and offer practical services that are suitable for user's preference than to provide advertisement giving pleasure or an unwanted event.

The practical implications of this study are as follows. The results of this study showed that the user is more likely to use the service continuously when a user is satisfied with the service requested by the user in M-LBS than when a service provider offers a service of its own accord. The results implied that it is important to understand what values consumes perceive about a product or a service. Since value cognition can vary by the environment it is necessary to graft technology to it according to the current of the times and to provide an environment that can enhance the user experience.

Moreover, the results of this study showed that relatedness among the three factors of SDT had the strongest impact on motivation. The results suggested that it is most important for a service provider to give an impression to a consumer that it provides a service considering the circumstance of a consumer, and a good relationship can induce intrinsic and extrinsic motivation greatly. Consumers

negatively perceived and evaluated mobile advertising services that they did not authorize in advance when they are not satisfied with them (Barnes, 2003; Leppaniemi & Karjaluto, 2005). It is necessary not to give an impression that it solely focuses on the profit of service providers due to loss leader events or unnecessary advertising.

LIMITATION AND FUTURE RESEARCH OPPORTUNITIES

This study applied SDT to M-LBS with focusing on the three factors of SDT. Although this study identified the impact of the three factors on intrinsic and extrinsic motivation, it is necessary for future studies to evaluate which specific factors of M-LBS make these three factors directly associated with it. It will help establish a service delivery strategy based on the two information delivery mechanisms.

Although this study discovered the moderating effect of the information delivery mechanism, this study could not categorize diverse M-LBS services and evaluate the difference between them. Since push and pull types depend on the user's decision making, it will be possible to understand the three factors stimulating usage motivation by specifying the frequently used services and the reason of usage.

Lastly, the use frequency of M-LBS may influence motivation. The results showed that it was closely related to the perceived relatedness of M-LBS. It would be an interesting to evaluate if "mere exposure effect theory", which argues that people have a positive attitude for frequently exposed stimulus, is applicable to this case: how frequent service usage with maintaining a close relationship with a service provider would affect the attitude of consumers.

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