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Effect of Motivational Factors on the Use of Integrated Mobility Applications: Behavioral Intentions and Customer Loyalty

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Abstract: The digital advancement of "as a service" models has led to the rapid emergence of mozbility as a service (MaaS) in transportation. This study aims to identify the motivational factors used among users of integrated mobility application services and empirically determine their attitudes regarding use and customer loyalty over the long term. To do this, four motivations for using integrated mobility mobile application services—social, habit-congruence, economic, and innovation acceptance—were identified. A total of 311 actual users of integrated mobility app services in South Korea were sampled and analyzed. Social motivation was found to have the greatest impact on positive attitudes and behavioral intentions to use integrated mobility apps. This is followed by habit-congruence motivation, which users perceived as essential for use determination. It was found that active users of integrated mobility apps, who have used them for years, have a positive attitude about them, viewing them as part of a regular transportation system of daily life rather than an innovative service. This study suggests practical implications for integrated mobility applications and service strategies for transportation-related governments and businesses.

Keywords: integrate mobility application; mobility as a service; motivation; attitude; behavioral intention; customer loyalty

Citation: Tae, I.J.; Broillet-Schlesinger, A.; Kim, B.Y. Effect of Motivational Factors on the Use of Integrated Mobility Applications: Behavioral Intentions and Customer Loyalty. *Information* **2024**, *15*, 536. https://doi.org/10.3390/info15090536

Academic Editors: Francis Cirianni and Antonio Comi

Received: 25 June 2024
Revised: 24 August 2024
Accepted: 2 September 2024
Published: 3 September 2024

1. Introduction

The as-a-service business model, traditionally provided by IT service providers—such as software or cloud and solution providers—is rapidly spreading. As these IT innovations change customers' lifestyles, the concept of consumption in the market is shifting from ownership to membership, possession to access, and product to relationship [1,2]. In such a changed environment, the mobility industry also significantly impacts individuals "as a service." With the expansion of information and communication technology (ICT) and the daily use of smartphones, the use of transportation services has also shifted from provider-centered to consumer-centered services, and in this process, mobility as a service (MaaS), which maximizes customer convenience by integrating various means of transportation, is emphasized [3,4].

MaaS is a service that incorporates multiple transportation services and provides them to users within a single app, providing seamless transportation options from origin to destination. The concept of MaaS first appeared in Sweden, where the business idea of MaaS spread worldwide through the thesis of Hietanen [5]. Since MaaS is a mobile app, customers understand it more as an integrated mobility application [6]. MaaS often refers to the user's use and accessibility of mixed-modal mobility solutions, and MaaS platforms act as mobility mediators [4]. According to the "MaaS Alliance," a European mobility service alliance, MaaS is defined as an integrated service that easily accesses various mobility forms according to customer needs, with Jittrapirom et al. [7] defining MaaS as an integrated solution that combines available transportation and mobility services. In recent years, transportation types such as buses, subways, public bicycles, kickboards, shared taxis,

electric shuttles, etc., have diversified, and transportation-based service businesses such as delivery and chauffeur services have been expanded. Amid these changes, service integrations and the creation of new businesses to maximize usage are intensifying, and integrated mobility app services are also attracting more attention [8].

European countries running Whim (Helsinki) and UbiGo (Sweden) are promoting the commercialization of MaaS led by cities and local governments to help solve human problems by inducing transportation to use eco-friendly energy such as electricity. The U.S. has been creating new markets and services due to the proliferation of ride-hailing forms such as Uber or Lift [9]. China is also researching effective solutions to urban transportation problems using shared service, low-carbon energy, and an Integrated Management tool, MaaS [10].

Korea has also enhanced integrated mobility services such as a public transportation transfer system [11]. As such, countries, local governments, and private sectors collaborate to develop integrated mobility systems [12,13]. As a result, the national and local governments trying to build the process of social transformation and desirable mobility support policies have been researched from the perspective of users and the marketability of integrated mobility apps. For example, Schilofsky et al. [3] revealed the mechanism of adopting integrated mobility apps in their study and suggested distribution strategies, government regulations, and the need for education for change. In addition, Tomaino et al. [14] introduced a study on the sustainable framework of MaaS. As such, technical, social, and policy research mainly focuses on integrated mobility application services.

However, Schilofsky et al. [3] argued that it is time for more practical research based on the actual utilization data of integrated mobility apps as integrated mobility app services spread and become more popular. From a market perspective, Caiati [13] argued that customer analysis is essential for the future development of integrated mobility apps because the need-oriented characteristics initiate the user's motivational factors. However, there is still a lack of research on the market influence, effectiveness, user attitude, and usability of integrated mobility apps. In the case of mobility services, where users have their own needs, market and consumer insights are crucial [15].

Therefore, this study aims to derive the motives of integrated mobility app users to use the service and empirically determine whether these motivational factors affect behavioral intention to use integrated mobility apps and customer loyalty over the long term. Through this, we will identify the determinants of users' apparent attitudes toward integrated mobility apps and discuss a marketing strategy considering the needs of consumers. As integrated mobility apps are an area where the user experience of various means of transportation has much influence, unlike other mobile apps, it is now necessary to go beyond the environmental and policy discussions of technology and social infrastructure to seek development directions for maximizing use and experience services. This study is a market-accessible study on integrated mobility app users and will provide meaningful implications for companies and government policymakers.

2. Literature Review and Hypothesis Development

2.1. Integrated Transportation and Mobility Application

Through information technology and intelligent transportation information systems currently introduced in various public transportation methods, public transportation users have become more convenient to use. Recently, real-time prediction information on buses scheduled to reach stops, such as bus information systems, has been visually provided, enabling more convenient use of public transportation information [16]. Integrated transportation information is provided for each transportation means, which is becoming useful for search uses such as transfer considering various transportation means [17]. In addition, cloud computing is emerging as a new IT technology that increases resource efficiency by integrating and effectively managing resources [18].

The transportation integration system proposed in this way provides results by comparing and searching various conditions centered on transportation users, such as departure

and arrival times, time required, and amount required, and recommends transportation according to the user's preference among the results. By searching for multiple public transportation methods at once, transportation users can use the transportation they prefer more conveniently [19]. Additionally, if the system is applied to a cloud computing environment, transportation users can access it from anywhere through a variety of equipment, and service providers can manage resources more efficiently, reduce management and maintenance costs, and handle billing according to usage. The most important platform used to use this integrated system is the mobile application (also known as an "app").

A mobile application is a type of application software designed to run on mobile devices such as smartphones or tablet computers [20,21]. Since the launch of Apple's App Store in July 2008, mobile phone apps have become innovative and convenient channels to access online and offline [22,23]. Users are beginning to adapt to a system that utilizes only influential mediums that are useful to them [24–26]. The personal functions that people want in their daily lives through mobile apps satisfy users' requirements: cameras, games, translation, maps and navigation, calendaring, commerce, and even financial transactions like payments [27,28].

These mobile applications also influence transportation services and spread beyond simple transportation to services that provide an integrated platform by combining privately owned means of transportation, taxis, public transportation, and shared cars [29]. In terms of demand, mobile apps allow mobility service users to use various mobility forms safely and efficiently [30] and provide services suitable for each individual's context with data accumulated on the platform as they use it [31,32].

Eventually, users will recognize the integrated mobility service app as a system while using various mobility services. To the end-users, the app is the single point of contact for the service and is perceived as a feasible MaaS service. Moreover, unlike other app services, the value of utilization of integrated mobility apps varies depending on the mobility capability and location characteristics. Therefore, users seek a service that can maximize utilization by guaranteeing actual mobility. Accordingly, integrated mobility apps have the main characteristics of a customer-centric paradigm, integration, and multimodal support [33,34].

First, in the case of the customer-centric paradigm, integrated mobility apps enable users to obtain mobility services based on their personal needs, preference-based configurations, and transportation selections. The selection covers personal mobility, such as bicycles and kickboards, and public transportation, such as taxis, buses, subways, and trains. It expands to delivery, car rental, tour buses, and parking and valet services. Second, "integration" refers to a single, integrated application that provides a single account and payment system, as well as continuously integrated mobility services, from a single point of contact. Third, "multi-means support" refers to connecting multiple modes of transport. It has the characteristic of combining different modes of transportation between journeys or changing them over time [35].

2.2. Individual Motivations

Motivation is an intrinsic or extrinsic force that leads an actor to act to achieve a certain goal, selectively causing some selective behavior toward an end and actively maintaining the behavior [36]. Therefore, motivation can find its essence in the process of inducing and continuing goal-oriented activities [37]. Motivation becomes the source that makes the actor start something, pursue it continuously, and complete the task he or she started. These motivations affect learning and performance and learning and performance form a feedback interrelationship that influences motivation again [38].

These motivations can be divided into intrinsic motivation and extrinsic motivation, depending on where the motivation originated. Intrinsic motivation refers to the case where the fundamental reason for acting exists inside the actor, and participates in the action as desired by interest, satisfaction, or curiosity, without external coercion. External motivation is when there is an external reason for acting, such as external compensation

or external pressure. Behaviorist motivational theory posits that motivation is driven by external factors such as external compensation or external pressure rather than the intrinsic factors of the actor [39,40].

However, humanism and cognitive motivation theory assume that an individual's inner needs and tendency to achieve self-fulfillment play a more important role in motivation than external factors. While the former focuses on the overt behavior of observable actors, the latter involves internal cognition. It focuses on structural changes. It is believed that these intrinsic and extrinsic motivations may not only work mutually but may work at the same time. It is said that synergistic motivation, in which the two motives are in harmony, can work [41].

In the marketing perspective, consumer choice is driven by motivation, perception, learning, and beliefs [42]. Motivation, customer satisfaction, and loyalty are closely related, so motivation is an important factor in determining a company's business performance. In particular, the user's motivations for purchasing and using the product affect the outcome [43]. Motivation involves using a particular product or service to satisfy a need. A consumer's firm belief in an attitude leads to a positive intent to use [44]. Lee and Na [45] explained that users may purchase not only based on the need for the service or the utility they derive from the action but also for personal and social reasons unrelated to purchasing behavior. In previous studies, motivational factors that consider emotional and empirical values, such as practical and hedonistic values and economic, convenient, and hedonistic for use, were presented [46–48].

In particular, with the rise of mobile and digital platform channels, factors such as convenience, price, variety of choices, and ease of access have become principal variables in users' motivations [49]. Papacharissi and Rubin [50] categorized the motivations for using digital platform services into the following: interpersonal utility, time-killing diversion, information-seeking medium, convenience channel, and entertainment outlet. In addition, utilitarian motivation and hedonic motivation were suggested as motivations for using location-based app services [51], and eight motivations were extracted for the use of smartphone apps: information acquisition, social relationships, service integration, trend and show-off, information utilization at all times, response promptness, habituation, and convenience of use [52]. Because the use of mobile apps varies, motivations for using smartphone apps were also categorized into five categories: broad functionality, relationality, ease of mobility, informativity, and trend-forwardness [53].

2.3. Motivations to Mobile Application Service Use

On the motivational factors for these mobile app services, the literature reviews are divided into social, habitual, economic, and innovative motivators. First, social motivation refers to the influence of a consumer's social environment, perceived norms, family and friends, etc., on utilizing decisions [54]. Environmental research, such as electric vehicle utilization, shows that social aspects can play an important role in understanding the acceptance of innovation [55].

Pangbourne et al. [56] insisted that MaaS provides positive feelings and attitudes to connect with peer groups with similar lifestyles. MaaS can also be applied to public transportation system upgrades or traffic regulation planning in specific urban areas. In other words, various government support programs and social regulations such as mobile payments, related laws, and roads, and stations can influence the use of integrated mobility apps [15]. Ultimately, these social systems supply integrated mobility apps with traffic status and functions such as maps, addresses, place information, predicted travel time, route planning, traffic dispersion in rush hour, and public transportation arrival times. This study examined social motivation because social factors are critical motivating factors for users of integrated mobility apps. After all, mobility apps significantly impact individual mobility and quality of life [57].

Second, this study looks at habit-congruence motivation. Habits can have a self-energizing effect on the mode of movement choices [58] and behavioral intentions as

humans strive for self-continuity and inner coherence [59]. This self-energy effect explains the repetition or continuance of specific traveling behaviors. Suppose that the potential traffic behavior of the user has a specific influence on the choice of transportation, and this is not reflected in the research. In this case, the reliability of the research model is undermined [60]. Therefore, if research considers the traffic behavior of end-users as habit-congruence motivation, the error caused by non-observational factors can be significantly reduced, and a more rational interpretation of the traffic behavior can be made [61]. Habit-matching motivation refers to the appropriateness of the user's habitual behavior pattern and the use of the transportation services provided [62]. With a high congruence with habits, individuals can better transfer their knowledge and learned patterns to new areas of consumption, which can also affect the expected ease of use of new service solutions.

Third, economic motivation is explained as one of the factors that not only determines service selection but also influences the utility of services through subscribing behavior [63]. Ben-Bassat et al. [64] explained that when a user utilizes a service, it refers to the perceived value to the user at a relatively low cost compared to other alternatives. Economic motivation involves choosing services that are cheaper than others or at a reasonable service value [65]. In particular, the economic motivation to pursue relatively low costs through subscriptions has led to continued use of the internet and mobile apps [66]. Time-economic factors (such as travel time and securing advance information) as well as subscription costs promote users' positive attitudes [67].

Finally, innovation acceptance motivation refers to the tendency of users to try new services rather than existing choices [68]. Hirschman [69] was the first to explain the definition of consumer innovativeness: innovative users are relatively quick to adopt new lifestyles, products, and consumption patterns compared to others. In addition, Foxall [70] also found that innovative users are more likely to adopt new services faster when they perceive the relative benefits as high and that users with a high propensity for innovation are more willing to take risks in utilizing new services than those without. Integrated mobility apps are innovative transportation concepts that combine different modes of transportation and services to provide user-oriented services through a single interface, attracting attention as a solution for more adventurous users [71]. In this study, innovation acceptance motivation refers to the faster acceptance of new and innovative services and products when perceived to provide a greater relative benefit than the existing choices.

3. Research Methods

3.1. Hypothesis and Research Model

3.1.1. Motivation and Attitude toward Using Integrated Transportation Mobility App

The user's attitude toward the service refers to the personal behavior of the user in which the individual evaluates the service about the use or consumption of the asset [72]. Pala [73] explained that attitudes are the tendency to respond favorably or unfavorably to an object, person, institution, or event. Baker [74] defined attitudes as hypothetical components that describe the direction and consistency of human behavior. In addition, Fazio [75] stated that an individual's attitude is an evaluative response to an object, which is inferred based on the individual's beliefs or opinions about the object. Attitudes toward mobile services can be defined as the degree of positive feelings and attitudes toward the mobile services currently being used and the degree of cognition of usage awareness [76]. Attitudes for services come from service use motivations, and Lee and Kim [77] explained that in mobile apps, social motivations have a meaningful effect on user attitudes. Herziger and Hoelzl [78] argued that a 'habitual mindset' allows users to have a less attentive attitude toward new information or actions, thereby maintaining individual habitual behavior.

In addition, Malik et al. [79] found that mobile apps can be divided into two types (utilitarian and hedonic) and that user attitudes toward adopting them are determined by motivating factors such as expected performance, economic reward, ease, social impact, enjoyment, easy conditions, attractiveness, and trust. Park and Chen [80] said that smart mobile phone users lead an attitude of adoption, according to innovative attributes, and

eventually make perceived adoption. In the case of mobile apps, it is confirmed that motivational factors positively affect user attitudes. In this context, we will establish the hypotheses below that the motivation for using an integrated transportation mobility service app will also positively affect user attitudes.

H1. *The social motivation for using integrated transportation mobility apps will have a positive (+) effect on attitudes.*

H2. *The habit-congruence motivation for using integrated transportation mobility apps will have a positive (+) effect on attitudes.*

H3. *The economic motivation for using integrated transportation mobility apps will have a positive (+) effect on attitudes.*

H4. *The innovation acceptance motivation for using integrated transportation mobility apps will have a positive (+) effect on attitudes.*

3.1.2. Attitudes, Behavioral Intentions, and Customer Loyalty

The term behavioral intention to use refers to the probability that an individual's thoughts and attitudes will be translated into action by the will to undertake a planned future action to achieve a set goal [81]. Sigurdsson et al. [82] defined behavioral intention to use integrated mobility apps as an individual's belief and willingness to form an attitude toward a particular object and express it as the immediate determinant of behavior. The more positive a user's attitudes about a service or brand are, the more likely it is to lead to an intent to use it. These positive attitudes can also extend to continued use intention and build customer loyalty [83]. Customer loyalty to long-term use refers to the behavioral intention of users to utilize a particular service again based on their experience using it [84]. In addition, customer loyalty to long-term use, in many studies, refers to positive customer behavior after a satisfactory experience [85–87]. Based on these literature reviews, this study designed the hypotheses below.

H5. *Attitudes toward integrated transportation mobility apps will have a positive (+) effect on behavioral intention to use integrated mobility apps.*

H6. *Attitudes toward integrated transportation mobility apps will have a positive (+) effect on customer loyalty to long-term use.*

Furthermore, Dabrowski et al. [88] found that user attitudes positively affect behavioral intention to use integrated mobility apps and customer loyalty to long-term use when satisfied. Mujtaba Abubakar et al. [89] also presented empirical research showing that user attitudes influence behavioral intention to use integrated mobility apps and customer loyalty to long-term use. In addition, Liu [90] demonstrated that attitudes toward mobile commerce apps are positively and significantly correlated with initial intention to use and customer loyalty to long-term use. Wang and Wu [86] argued that positive attitudes toward mobile apps increase adoption and build loyalty to continued use. Based on these literature reviews, this study designed the behavioral intention to use integrated mobility apps that will positively affect customer loyalty to long-term use.

H7. *The behavioral intention to use the integrated transportation mobility apps will have a positive (+) effect on customer loyalty to long-term use.*

As Sorce et al. [91] pointed out, there is a difference between low-age and high-age users in using mobile apps. Users in their 20s and 30s do not feel uncomfortable using the app and want to actively use it in their daily lives. On the other hand, for

those in their 50s and older who are not familiar with mobile apps, using the app requires continuous learning and tends to be less frequent in terms of familiarity [92,93]. Considering these preceding studies, in the case of integrated transportation service apps, the causal relationship between motivational factors and attitudes or behaviors will differ according to the age difference. Accordingly, this study attempted to compare and analyze the following hypothesis that there will be a difference between young users and old users.

H8. *The influence of individual motivational factors on the behavioral intention to use the integrated transportation mobile app and on customer loyalty will differ between younger and older users.*

Based on these hypotheses, this study designed a causal model of how individuals' motivation to use integrated transportation services affects their attitude, intention, and loyalty to the service. This study model is based on the motivational theory suggested by the related literature [36–38] and it was intended to examine how personal motivational factors of integrated transportation service users affect behavior.

Accordingly, as shown in Figure 1, the four motivational factors (social, habit-congruence, economic, and innovative motivation) for using integrated transportation services were set as independent variables based on the motivation theory of motivation and the preceding studies on digital technology-based motivation. The relationship by which this motivation affects behavioral intention to use integrated transportation mobility apps and customer loyalty to long-term use, mediated by attitudes, was designed. In addition, by considering users' familiarity with using integrated transportation service apps, a research model was established to draw differences by controlling variables and dividing users into younger groups and those in their 40s or older.

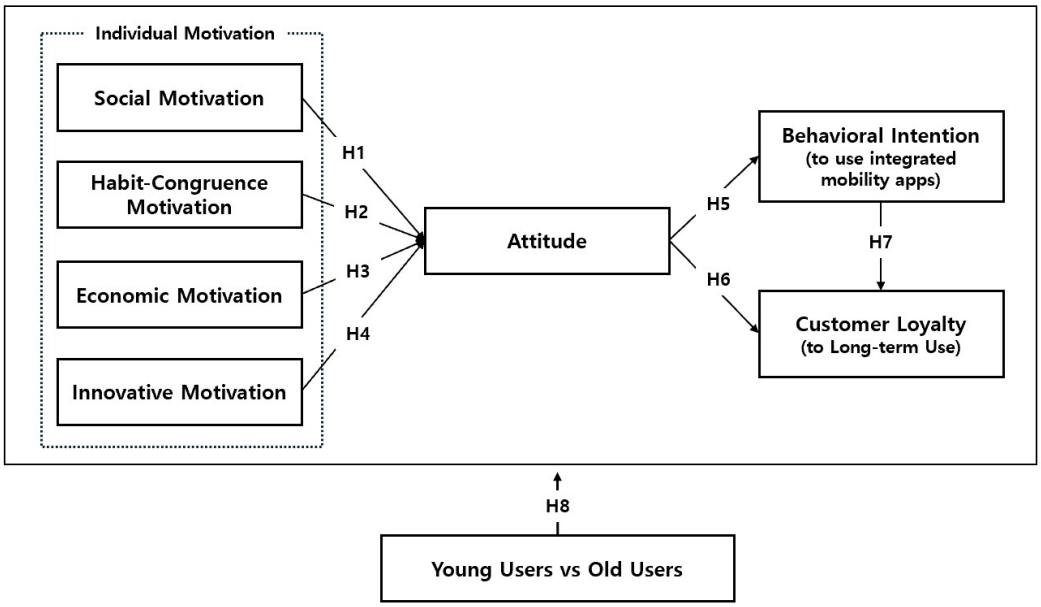

Figure 1. Research model.

3.2. Measurement Variable and Data Collection

A survey was conducted to collect data to analyze the study model. The questionnaire items, as shown in Table 1, were constructed through a literature review. The operational definitions of variables of the survey components were implemented to be composed of this research survey. In this study, customer motivational factors refer to the reasons why users use integrated mobility apps provided by mobile devices before and after traffic. For companies that offer integrated mobility apps, customer motivational factors are the influencing factors that companies must consider to strengthen their competitive advantage.

Table 1. Variable definitions and measurement items.

Factors		Measurement Items	References
Motivation	Social Motivation	- Because many people will use it. - Because it will be recommended by people around you and in our country. - Because it will be conducive to a better environment, such as a safe return home and energy saving.	Schikofsky et al. [4] Nysveen et al. [76] Lee and Kim [77] Herziger and Hoelzl [78] Malik et al. [79] Park and Chen [80]
	Habit-Congruence Motivation	- Because there are taxis, regular buses, and other means of transportation that I will habitually use. - Because it will be easy to use, like other apps I use a lot. - Because I can use the means of transportation as a habit.	
	Economic Motivation	- Because the price will be reasonable. - Because the discount will be appropriate. - Because it will be convenient to pay with the app.	
	Innovative Motivation	- Because it stimulates my curiosity about new things. - When new features and services are available, I will try them out for fun. - I will take advantage of what is popular as soon as possible.	
Attitude		- I think the integrated mobility app service is a good choice. - Using the integrated mobility app makes transportation more convenient. - When using transportation, I think it is better to use an integrated mobility app.	Dabrowski et al. [88] Barki and Hartwick [94]
Behavioral Intention		- I am willing to use the new integrated mobility app. - I want to experience various services of the integrated mobility app. - I am willing to pay for it and use the integrated mobility app.	Netemeyer and Bearden, [81] Sigurdsson et al. [82]
Customer Loyalty		- I will continue using the integrated mobility app I currently use. - In the future, we will continue to use the integrated mobility app. - I would recommend the integrated mobility app.	Wang and Wu [86] Dabrowski et al. [88] Liu [90]

This study classified customer motivational factors into social motivation, habit-congruence motivation, economic motivation, and innovation acceptance motivation based on the motivational factors of mobile app service use. Social motivation means that the user's social environment, norms, recommendations, safety, local transportation infrastructure, and personal lifestyle are the motivating factors that influence the user's decision to use an integrated mobility app. Habit-congruence motivation refers to the habit-congruent factor in which the user's potential travel behavior influences their choice of travel means through repeated learning of the user's behavior patterns or familiar travel methods and routes during movement. Economic motivation refers to the user's perception that the price of the means of transportation purchased through the app is reasonable or at a relatively low price, including frequent discounts.

The perceptions of economic value in terms of real travel time, information acquisition, and transportation price have been defined as economic motivational factors. Innovative motivation refers to the quicker acceptance of new and innovative services when they are perceived as having better benefits than the existing alternatives, especially for innovators. Integrated mobility app services systematically bridge online and offline interactions through the combination of mobile phones and transportation. Innovative services such as future traffic forecasts (e.g., referred to as 'Time Machine' in T map), subway transfer suggestions for the closest door, and the fastest route provision are meaningful use factors.

In the case of 'attitude' being set as a parameter, it refers to the degree of positive feelings and attitudes of the mobile services currently being used and the degree of cognition of usage awareness. 'Behavioral intention' refers to a user's thoughts and attitudes that will be translated into action through the will to undertake planned future use. In addition, 'customer loyalty' refers to a user's behavioral intention to continue using an integrated mobility app based on their experience. These variables consisted of 18 questions in a questionnaire, as seen in Table 1.

However, factor analysis rejected one of the constructed questionnaire items related to attitudes, behavioral intentions to use integrated mobility apps, and customer loyalty to long-term use. SPSS 26.0 was used for data analysis to analyze demographic characteristics, descriptive statistics, and exploratory factor analysis. For the path analysis of the hypothesis, AMOS 27.0 was used to conduct the confirmatory factor analysis, path analysis, and direct and indirect effect analyses based on the structural equation model.

3.3. Data Collection and Progress

This study aimed to empirically analyze the effect of the user's motivational factors on behavioral intention to use an integrated mobility app. The motivation factor for use was set as the independent variable. In contrast, the dependent variables were behavioral intentions to use integrated mobility apps as well as customer loyalty to long-term use. A research model was designed by selecting attitude as a parameter, as shown in Figure 1.

This study involved an online survey among college students and office workers through a random survey sample. Before conducting the survey, a pilot sampling of 63 people was carried out, including a group of mobility experts, digital smart learning instructors, deep learning experts, and IT department graduate students. The pilot survey was conducted from 8 to 15 August 2022. They were well aware of the existence and functionality of the target service apps and were selected as a population of customers who used them.

The respondents were provided with a definition of integrated mobility app provision and a conceptual explanation of the functions of each integrated mobility app in Korea. The questionnaire verification was conducted for 7 days to increase the questionnaire's reliability and validity. Moreover, of the 345 respondents who participated, 311 valid samples were analyzed, excluding 34 respondents who answered improperly. The demographic characteristics are shown in Table 2.

Table 2. Demographic information of the participants.

Section		Frequency	Ratio(%)
Gender	Males	236	75.9
	Females	75	24.1
Age	10–19 years of age	34	10.9
	20–29	77	24.8
	30–39	98	31.5
	40–49	81	26.0
	50–60	21	6.8
Vocation	Students	99	31.8
	Company employees	105	33.8
	Specialized Job (Medical doctor, lawyer, & professor)	33	10.6
	Owner-operators	46	14.8
	Households	11	3.5
	Government Employees	17	5.5
	Students	99	31.8
Monthly Transportation Fee (Korean currency unit)	50,000–100,000 (Korean currency unit)	42	13.5
	100,000–200,000 (Korean currency unit)	87	28.0
	200,000–300,000 (Korean currency unit)	74	23.8
	300,000–500,000 (Korean currency unit)	77	24.8
	500,000 and over (Korean currency unit)	31	10
Transportation App Use Cycle	Almost every day	121	38.9
	At least once a week	169	54.3
	At least once a month	11	3.5
	At least once a year	10	3.2
App Experience	Kakao T	145	46.6
	T-money GO	38	12.2
	T map Family App	128	41.2

The integrated mobility apps used in this study were 'T map', 'Kakao T', and 'T MoneyGO', which are the top three brands in the Korean MaaS app market. From 2010, T

map was operated by Korean conglomerate SK Telecom, and it evolved based on navigation for drivers. A mobile internet company, Kakao Group's Kakao T evolved based on taxi-calling services, and the government's T MoneyGO evolved based on public transportation, such as buses and subways. Now, all three apps support various means of transportation and mobile payments. Each app has different service strengths, and their operational strategies differ depending on their pursuit.

4. Results

4.1. Analysis Results of Reliability and Validity

As shown in Table 3, the analysis of the reliability and intensive validity of the measurement model were both found to be good. The factor load was 0.624–0.923, both good at 0.6 or higher, and the internal reliability (CR) was 0.701–0.879, which showed significance. The t-value was at least 2.610, which was statistically significant. The mean extract variance (AVE) value was 0.506–0.767, and the Cronbach α value was 0.623–0.879. The analysis of the fit-to-fit model of the structural equation found that χ^2 (pdf) was 129.856 (114) and χ^2/degree of freedom was 1.139. The goodness-of-fit index (GFI) value was 0.955, the adjusted goodness-of-fit index (AGFI) was 0.933, the normal fit index (NFI) was 0.931, and the root mean square error of approximation (RMSEA) was 0.021.

Table 3. Result of reliability and convergent validity test.

Variables	Measurement Questions	Standard Loading	Standard Error	T Value (*p*)	CR	AVE	Cronbach α
Social motivation	SV1	0.852			0.876	0.678	0.865
	SV2	0.852	0.079	13.700 ***			
	SV3	0.906	0.082	14.148 ***			
Habit-congruence motivation	HV1	0.787			0.879	0.670	0.879
	HV2	0.912	0.120	12.353 ***			
	HV3	0.888	0.121	12.397 ***			
Economic motivation	EV1	0.816			0.767	0.506	0.767
	EV2	0.785	0.114	8.405 ***			
	EV3	0.792	0.131	8.448 ***			
Innovation acceptance motivation	DV1	0.911			0.866	0.688	0.842
	DV2	0.863	0.061	13.289 ***			
	DV3	0.781	0.064	11.510 ***			
Attitude	AT1	0.624			0.798	0.612	0.651
	AT2	0.923	0.169	6.680 ***			
Behavioral intention	BI1	0.861			0.823	0.767	0.751
	BI2	0.853	0.484	2.610 ***			
Customer loyalty	ID1	0.818			0.701	0.545	0.623
	IU2	0.663	0.957	3.353 ***			

Measurement model fit: χ^2(df) 129.856, χ^2/degree of freedom 1.139, RMR 0.033, GFI 0.955, AGFI 0.933, NFI 0.931, TLI 0.988, CFI 0.991, RMSEA 0.021. Note: *** $p < 0.001$.

Upon analyzing the AVE value and correlation coefficient between the latent variables in this study, it was found that the square root of the AVE value for each latent variable was greater than the correlation coefficient between them, as shown in Table 4, confirming the discriminant validity. Each motivation factor in this study was validated for this study as a distinct and independent factor without overlapping with other motivational factors.

Table 4. Correlation matrix and AVE.

	AVE	SM	HCM	EM	IAM	AT	BI	CL
Social motivation (SM)	0.678	**0.823**						
Habit-congruence motivation (HCM)	0.670	0.060	**0.819**					
Economic motivation (EM)	0.506	0.107	0.189	**0.711**				
Innovation acceptance motivation (IAM)	0.688	−0.080	0.113	0.163	**0.829**			
Attitude (AT)	0.612	0.329	0.317	0.267	0.090	**0.782**		
Behavioral intention (BI)	0.767	0.127	0.004	0.029	0.073	0.099	**0.872**	
Customer loyalty (CL)	0.545	0.101	−0.026	0.085	0.124	0.152	0.401	**0.738**

Note: The square root of AVE is shown in bold numbers.

4.2. Analysis Result of Structural Equation Model

As shown in Table 5, the goodness of fit analysis of the structural model showed that χ^2(df) was 169.12(122) and χ^2/degree of freedom was 1.392. The goodness-of-fit index (GFI) was 0.912, and the normal fit index (NFI) was 0.876. The root mean square residual (RMR) was 0.035, the adjusted goodness-of-fit index (AGFI) was 0.909, and the root mean square error of approximation (RMSEA) was 0.057. Although it was not affected by the sample, the CFI that indicated the model's explanatory power was 0.923, and the TLI that determined the explanatory power of the structural model was 0.921, indicating that the basic model is highly suitable.

Table 5. Results of the hypothesis test.

	Hypothesis (Path)	Standardization Coefficient	t Value (*p*)	Support (Y/N)
H1	Social motivation → attitudes	0.563	3.582 ***	Accepted
H2	Habit-congruence motivation → attitudes	0.398	3.395 ***	Accepted
H3	Economic motivation → attitudes	0.348	2.591 **	Accepted
H4	Innovation acceptance motivation → attitudes	0.231	1.713	Rejected
H5	Attitudes → behavioral intention	0.678	3.471 ***	Accepted
H6	Attitudes → customer loyalty	0.567	1.588 **	Accepted
H7	Behavioral intention to customer loyalty	0.313	1.216 *	Accepted

Structural model fit: χ^2(df) 169.12, χ^2/degree of freedom 1.392, RMR 0.035, GFI 0.912, AGFI 0.909, NFI 0.876, TLI 0.921, CFI 0.923, RMSEA 0.057. Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

As a result of hypothesis testing through the path analysis of structural equation models, one out of seven hypotheses was rejected, as shown in Table 5. Among the motivations for using service apps, innovation acceptance motivation did not affect attitudes, so the hypothesis was rejected. Social motivation (3.582, $p < 0.001$), habit-congruence motivation (3.395, $p < 0.001$), and economic motivation (2.591, $p < 0.01$) had positive (+) effects on attitudes. On the other hand, attitude had a positive (+) effect on the behavioral intention to use integrated mobility apps (3.471, $p < 0.001$) and customer loyalty to long-term use (1.588, $p < 0.01$). Finally, the behavioral intention to use integrated mobility apps had a positive (+) effect on customer loyalty to long-term use (1.216, $p < 0.05$), and hypothesis 7 was adopted.

In summary, it was confirmed that social motivation, habit-congruent motivation, and economic motivation greatly affected attitude. In addition, attitude greatly influences the intention to use the integrated mobility app and customer loyalty to long-term use.

4.3. Analysis Results of the Direct, Indirect, and Total Effects

As can be seen from Table 6, the bootstrapping method was used to derive direct, indirect, and total effects to verify the significance of indirect effects. Social and economic motivations were found to influence the attitude-mediating both the behavioral intention to use the integrated mobility app and customer loyalty to long-term use. In addition, it was found that attitude influenced customer loyalty to long-term use by mediating behavioral intention to use the integrated mobility app. In the end, it can be confirmed that among the

factors of motivation for using the integrated transportation service, social and economic motivational factors act as factors that influence use behavior and sustainability.

Table 6. Total effect, direct effect, and indirect effect.

Explanatory Variable	Direct Effect	Indirect Effect	Total Effect
Social motivation → attitudes	0.563 **		0.563
Social motivation → attitudes → behavioral intention	0.442 **	0.185 **	0.627
Social motivation → attitudes → customer loyalty	0.201 *	0.119 *	0.320
Habit-congruence motivation → attitudes	0.398 **		0.398
Habit-congruence motivation → attitudes → behavioral intention	0.191 **	0.127 **	0.318
Habit-congruence motivation → attitudes → customer loyalty	0.135	0.106	0.241
Economic motivation → attitudes	0.348 *		0.348
Economic motivation → attitudes → behavioral intention	0.302 *	0.214 *	0.516
Economic motivation → attitudes → customer loyalty	0.370 *	0.118 *	0.488
Innovation acceptance motivation → attitudes	0.231		0.231
Innovation acceptance motivation → attitudes → behavioral intention	0.112	0.107	0.219
Innovation acceptance motivation → attitudes → customer loyalty	0.109	0.116	0.225
Attitudes → behavioral intention	0.678 *		0.678
Attitudes → behavioral intention → customer loyalty	0.313 **	0.234 **	0.547

Note: * $p < 0.05$, ** $p < 0.01$.

However, habit-congruence motivation was found to affect behavioral intention but not customer loyalty for continuous use, while innovation acceptance motivation did not affect either behavioral intention or customer loyalty. In the end, it can be confirmed that social and economic motives are the most important motivational factors that affect users' behavior and sustainability of integrated transportation services.

4.4. Analysis Result of Moderating Effect

To verify whether there is a difference between the group under 40 and the group over 40 regarding the influence of the moderating effect and the path coefficient of the research model according to each generation, configural invariance and metric invariance analyses were performed. The significance of the difference between the two paths was confirmed by comparing the parameters for each correspondence.

As shown in Table 7, both constrained models correspond to a satisfactory level in the case of configural invariance. For metric invariance, the significance probability of χ^2 was higher than the significance level in the unconstrained model and constrained model 1. Meanwhile, the identification verification of the path analysis between the groups was satisfactory in constrained model 1.

Table 7. Results of the invariance test.

Model	Configural Invariance					Metric Invariance		
	χ^2	df	TAG	CFI	RMSEA	χ^2 Dif.	The DF Dif.	*p*-Value
Unconstrained models	327.740	244	0.943	0.954	0.033			
Constrained model 1	344.695	255	0.941	0.951	0.034	16.954	11	0.109
Constrained model 2	387.756	262	0.920	0.932	0.039	60.016	18	0
Constrained model 3	398.584	272	0.923	0.931	0.039	70.843	28	0

Constrained model 1: Measurement weights, constrained model 2: structural weights, constrained model 3: structural covariances.

The analysis results of the moderating effect by generation are presented in Table 8. In this study, there was a difference (CR value ± 1.96 or higher) in two paths between the groups. In other words, the habit-congruence motivation factor had a more significant influence on attitudes in the group under 40 (1.986, $p < 0.05$) compared to the group over 40 (0.336, $p < 0.05$). Innovation acceptance motivation, which was already rejected as a

motivational factor in hypothesis testing and mediated effect investigations, was excluded from the moderating effect analysis.

Table 8. Results of moderating effects.

Hypothesis (Path)	Under 40s (n = 209)			Over 40s (n = 102)		
	Standardization Coefficients	Non-Standardized Coefficients	t-Value	Standardization Coefficients	Non-Standardized Coefficients	t-Value
Social motivation → attitudes	0.292	0.066	1.248	0.209	0.177	1.970 *
Habit-congruence motivation → attitudes	0.340	0.087	1.986 *	0.033	0.024	0.336 *
Economic motivation → attitudes	0.120	0.026	0.928	−0.023	−0.019	−0.214
Innovation acceptance motivation → attitude	0.273	0.249	2.041 *	0.039	0.009	0.449 *
Attitudes → behavioral intention	0.972	2.954	1.993 *	0.121	0.254	1.177
Attitude → customer loyalty	8.046	4.948	1.882 *	1.650	0.947	3.849 ***
Behavioral intention → customer loyalty	7.974	4.875	0.083	−0.025	-0.007	−0.244

Note: * $p < 0.05$, *** $p < 0.001$.

Lastly, attitudes showed differences between groups in their impact on customer loyalty to long-term use. Among the under-40s group (1.882, $p < 0.05$) and older-40s group (3.849, $p < 0.05$), the 40s-and-older group was found to have a more significant impact on customer loyalty to long-term use. However, social and economic motivations did not differ in influencing attitudes in either group. In addition, it was found that there was no difference between the younger generation and the older generation according to age in the process of attitudes influencing the behavioral intention to use integrated mobility apps or the behavioral intention to use integrated mobility apps influencing customer loyalty to long-term use.

5. Conclusions

5.1. Theoretical Implications

This study investigated the relationship between the motivations, attitudes, behavioral intentions, and customer loyalty to the long-term use of integrated transportation mobility apps. Therefore, the analysis results show three theoretical implications.

First, social motivation, habit-congruence motivation, and economic motivation—among the motivations influencing use—positively affect attitudes toward using integrated transportation mobility apps; as a result, these motivations have been proven to positively influence both the intention to use and customer loyalty. These results show that the motivational factors of mobile app service users also affect the continuous intention to use, service satisfaction, and loyalty, corresponding with previous studies [42,46,57]; these were discussed in the existing motivation theory. In particular, Alyavina [95] argued that users prefer MaaS' long-term subscription plan due to cost stability and personal habits. In addition, Schikofsky et al. [4] explained that the motivation to use integrated transportation apps is driven by the social relationship and matching with users' habit schemas. Eventually, in the context of mobility apps for integrated transportation services, users' personal motivational factors drive intentions and behaviors to use and further stimulate continuous use. As a result, in the case of integrated transportation mobile app services, a system or support that considers users' economic, social, and habit-congruence motives is required to promote and sustain users' use.

Second, it was found that innovation acceptance motivation did not affect all attitudes, behavioral intentions, and loyalty of users using integrated transportation service apps. The result differs from the results that the motivating factors for innovation described by Pala [73] affect digital technology-related behavior. Further Zhang et al. [10] argued that mobile apps stimulate new curiosity or add new features and content, while in integrated transportation service apps that require offline transportation, the actual movement of users affects motivational factors. However, the results differ from these previous studies. This difference in research results can be interpreted as the fact that in integrated transportation service apps, technology resistance is higher because innovation in technology or curiosity

about new technology is associated with existing usage habits or behavior patterns rather than simply stimulating behavior. As Schmidt et al. [96] noted, new innovation services involve innovation resistance from users. This study also shows that integrated transportation service apps encounter more resistance to motivation than innovation acceptance motivation when introducing new usage, tools, and habits. After all, in integrated transportation services based on new digital technology, it is necessary to consider the users' resistance to motivation.

Third, among the motivational factors of integrated transportation mobility apps, social motivation is the most important factor. These results show that social capital and social relations influence individual motivational factors, as Kim and Lee [77] argued. Moreover, integrated transportation mobility apps are unique in that they directly connect online and offline and are affected by regional characteristics, citizen mutual influence, and national transportation policy [33]. Therefore, it was confirmed that social motivation can be an important influencing factor in app use behavior for integrated transportation mobility app users. As explained by Nikitas et al. [97], investments in public transportation infrastructure, social network participation, and environmental protection policies directly affect the service capabilities of integrated transportation mobility apps. Chen et al. [9] emphasized the importance of potential influencing factors such as social norms. As such, transportation is affected by various social factors such as the safe return of families and energy-saving behaviors for social policies related to the safety of the community. Eventually, it was confirmed that social motivation greatly influenced the characteristics of the transportation system, even for the users of the integrated transportation service.

5.2. Managerial Implications

In terms of management implications, as Schikofsky and Dannewald [3] first pointed out, the application of MaaS today is a new paradigm used for creating business models that can solve environmental pollution and urban transportation problems as well as stimulate a new economic market through various ideas and applications. As mentioned in Jitrapirom et al. [7], how to induce user participation in integrated mobility services is important to solve social transportation problems. In the results of this study, it was verified that users' social motivational factors greatly influenced behavioral intentions and continuous use. Eventually, integrated mobility app services that take into account users' safety, environmental protection, and energy conservation will effectively increase customer participation.

For example, sending information about the passenger's location and car number to family members, suggesting a means of transportation during commuting times, and urging the passenger to use personal mobility such as a bicycle can be effective solutions. By activating the hourly parking sharing system for residents-first parking lots or bicycle community clubs, integrated mobility services can be increased by stimulating social motivation (in terms of environmental protection and parking problems). It will also need to continually send messages for social integration or consensus. After all, companies and organizations involved in integrated mobility services should continue to provide service information to users, emphasizing that using integrated transportation services is a means to integrate society and solve social transport problems.

In addition, this study confirmed that users' motivations for habit alignment are essential factors in promoting customer loyalty to their behavioral intentions to use integrated mobility apps and their long-term use. This is something that companies must consider when formulating their marketing strategies to succeed in the mobility app market. As Tabucanon and Lee [11] pointed out, users are much more likely to choose habitual transportation modes based on their lifestyle. Whether going to school, going to work, making an appointment, or going back home, users prefer to reach their destination by the easiest, fastest, and fewest means of transportation possible. Therefore, the most important aspects in policy-making or commercializing integrated transportation services involve minimizing the distance, maximizing convenience, and reducing travel time for users.

When using integrated transportation services, the maximized advantages of integration should be highlighted. Accordingly, it should be possible to consider a marketing strategy that provides customized services through an individual app usage data analysis system or optional services that take into account transportation usage according to the user's lifestyle type. In particular, it can provide customer convenience and continuous usability by reinforcing subscription services. Since subscription services are based on long-term contractual behavior rather than one-time purchases, economic benefits or personal needs are important factors. Analyzing the path and frequency based on an individual's lifestyle and presenting the most effective subscription model for each individual will have a positive attitude toward customer satisfaction.

5.3. Research Limitations and Future Plans

This study has regional limitations because it was conducted to integrate mobility apps in South Korea. Specifically, South Korea is not adjacent to other countries, and it is possible to move mainly by one means of transportation. Hence, users in Korea naturally tend to prefer routine routes. Since MaaS services are highly influenced by user lifestyles, topography, and social characteristics, it is necessary to consider regional differences and characteristics. Therefore, in future research, researchers should consider expanding the study to target regions or countries of integrated mobility app users. In particular, considering the differences in transportation characteristics and service app usage by region, a country-by-country comparative study may be insightful in finding new solutions.

Additionally, this study examined the relationship between user intention and loyalty to the continued use of integrated transportation services, but it is important to examine the relationship between consumption intention, satisfaction, loyalty, and variables like continuous use intentions influence consumption attitudes. In this regard, future research needs to include a more in-depth discussion of consumption behavior in integrated transportation services, taking into account the traditional theories of consumption behavior and consumer psychology.

Furthermore, this study did not identify each market segment differentiation based on the type of integrated mobility app used. It may not fully explain the heterogeneity between target groups because it is difficult to secure more balance for the gender or age group when securing active-user demographic data. Thus, it is recommended that future researchers identify the market segmentation based on each user group's characteristics, such as car owner groups, traveler groups, daily user groups, more recruited age groups, gender groups, etc.

Moreover, this research is unique in that it surveyed users who have used "Integrated Mobility Apps" in practice. Since this study focused on the users of integrated mobility apps as the main target of analysis, it overlooked the opinions of most people indifferent to integrated mobility apps. If researchers conduct a study on the differences between the groups of customers who are indifferent to integrated mobility apps and users of integrated mobility apps, more meaningful implications for business players in expanding users can be derived.

Lastly, this study limited the research scope to transportation-integrated mobile application services. However, MaaS is a research field that integrates various transportation methods and urban planning for roads and usage systems. In this respect, it is necessary to discuss comprehensive research on various transportation systems and supply channels beyond application services. Therefore, future research will continue exploring services in terms of transportation supply that mediate between users and suppliers.

Author Contributions: Conceptualization, I.J.T.; methodology, I.J.T. and B.Y.K.; software, B.Y.K.; validation, B.Y.K.; formal analysis, I.J.T. and B.Y.K.; investigation, I.J.T.; resources, I.J.T.; data curation, B.Y.K.; writing—original draft preparation, I.J.T.; writing—review and editing, B.Y.K.; visualization, I.J.T. and B.Y.K.; supervision, A.B.-S. and B.Y.K.; project administration, A.B.-S. and B.Y.K.;

funding acquisition, A.B.-S. and I.J.T. All authors have read and agreed to the published version of the manuscript.

Funding: This paper is written with support for research funding from aSSIST University.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

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