



Original research article

A multi-group analysis of car-hailing and taxi on loyalty intention in Hong Kong

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ABSTRACT

This study proposes a Structural Equation Model (SEM) to explore the relationship between the behavior from the driver, perceived service atmosphere, perceived value, attitude and loyalty intention of customers from using taxi and car-hailing services. Meanwhile, the relationship of safety, green value, privacy, risk, sensitivity, and security as sustainability measures and customer attitude to the two services are also included in our model. Results suggest that behavior from drivers, service atmosphere, together with multiple sustainability measures, would have direct and indirect positive effects on loyalty intention, regardless of the user groups.

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1. Introduction

Transportation is a critical element in meeting the mobility requirements of citizens. Not only does the transportation system offer services to fulfil the derived transportation demand [1], the system itself also generates new traveling demand in specific regions and accelerates a country's economic development [2], [3].

While the number of vehicles on the road is increasing, the operation of the transportation system may adversely influence the environment and society.

Air, soil, and water degrade due to vehicle emission and hazardous substances spillover [4]-[7]. Traffic congestion has also become a severe and common issue in many cities worldwide, resulting in slow speed, increasing fuel consumption, and transportation delays. Not only developing countries have to face the problems of traffic jams due to the deficiency of their transport systems, but also developed countries. For example, the United States, France, the United Kingdom, and Germany together bear a burden of approximately more than two hundred billion US dollars traffic congestion expenditures [8].

Traditional transportation systems should inevitably have an evolution in order to achieve multiple sustainability measures, such as retaining mobility, limiting global warming, and facilitating economic and social well-being [9]-[12]. Over the past decades, with the rapid development of science and technology, smart transportation systems have been established and utilized to satisfy growing social needs [9]-[13]. Employing advanced technology in the transportation system can enhance safety, social mobility, productivity, and many others. Besides, the evolution of the transportation system assists in improving the transportation services supply by offering different selections from public transport services. For instance, a transit mode merely serves within an urban area, whereas another transit mode integrates numerous regions into an interlocal system, which could increase the population, freight negotiability and more profits [14].

In pursuit of an effective solution to relieve traffic congestion and save human lives, time and money, the pursuit of smart transportation systems has arisen [15]. The US Department of Transportation defines a smart transportation system as follows: a comprehensive, interconnected, and automatic transportation system that is assisted by a series of instruments enables to boost the information-intensive and offers better services to target users as well as make quick responses to the needs of operators and travelers [16]. As such, the Internet of Things (IoT) is the cornerstone of the smart transportation system [17]-[23]. It contains storing data and processing sensors and analytical tools to manage the transportation system efficiently. Smart transportation systems are established by connecting physical entities to the internet. IoT-based information sharing between vehicles and the internet generates a brand-new communication mode [24]. By collecting information like road conditions, traffic jams, and passenger data for cloud computing and supercomputers processing, the optimal transportation resource allocation and better-traveling routes can be computed for passengers [14], [19], [20], [22], [23], [25]-[31]. Therefore, smart transportation system promotes roadway automation and uplifts the quality of end users' experience [25], [26], [31]-[38].

With a vision to establish smart transportation systems for their citizens, a few countries adopted IoT systems in different aspects [39], [40]. In Toronto, a transportation system called Multi-agent Reinforcement Learning for Integrated Network of Adaptive Traffic Signal Controllers (MARLIN-ATSC) was put into use. Using smart signals according to the local

traffic situation at peak hours reduced around 26% of the trip time, and approximately 40% of traffic delays were cut off [24]. In Singapore, an Electronic Road Pricing system has been adopted in the city. With the support of an Expressway Monitoring and Advisory System and GPS systems installed in a part of the vehicles on the road, drivers could receive real-time transportation data and choose an unimpeded road that lessens traveling time, fuel and energy waste.

Hong Kong has one of the most frequently used transportation networks worldwide. According to Belz, et al. [41], Hong Kong citizens take nearly 12.5 million public transport trips daily, regarded as the highest public transportation adoption rate worldwide. With the second-highest density of vehicles per kilometer around the world, the traditional traffic methods could no longer cope with the increasingly dense road networks and support Hong Kong's vision to become a smart city [42], which utilizes a comprehensive approach to raise the city's progress and management level and stimulate citizens' urban growth and living standards.

Smart mobility is vital to establish a smart city in Hong Kong and is highly related to citizens' quality of life [42]. It intends to ease the traffic volume and allow people to enjoy a better transportation experience or services. It intends to ease the traffic volume and allow people to enjoy a better transportation experience or services. In order to obtain better traffic management and reduce traffic accidents, the department proposes a driver-intelligent traffic signal system at crossroads and road junctions [43]. With sensors in this system, automobiles and pedestrians can be alerted [44]. The Octopus card, a well-known contactless electronic payment system, was introduced to the public in September 1997 and adopted to shorten the fare transaction processes and bring convenience to passengers [45]. The emergence of smart transportation and intelligent systems in recent decades enables citizens to travel comfortably and efficiently. These adhibitions require the support of physical sensing techniques such as video-based and sensor-based techniques [27], [46], [47].

To a certain extent, the degree of convenience of public transportation in Hong Kong restricted the development of application-based mobility services years ago [48]. Hence, a comprehensive and efficient public transportation system may hinder the adoption, popularity, and progress of ride-hailing services in Hong Kong. However, with the progressive improvement of advanced technologies and urban transportation services, a brand-new application-based transportation service has gained widespread

popularity, which is called ride-hailing services. Ride-hailing services significantly differ from the conventional mobility methods that passengers and drivers have to match through a mobile application [49]. The possession of smartphones is critical to the acceptance and adoption of ride-hailing services. The younger generation tends to spend more time on the internet and is more familiar with technologies no matter in mobile devices or computers. Smartphones are considered as the most important device for younger generations in booking transportation services [50]. In contrast, although approximately 42% of seniors own cellular phones and nearly two-thirds of the elderly utilize the internet, many still hesitate to adopt new technologies and things due to psychological and physical challenges [51]. This research aims to bring all factors together in gaining insights into how sustainability and traditional transportation service, namely the perceived service atmosphere and perceived booking quality actually affect the loyalty intention of different user groups.

The rest of this paper is organized as follows: Section 2 describes the theoretical background and presents the hypothesis model. The research methodology is presented in Section 3. Section 4 illustrates the analysis from our Structural Equation Modelling (SEM) results. Section 5 describes the research findings and discussion. Finally, conclusions and future work are summarized in Section 6.

2. Literature Review and Hypothesis Model

2.1 Sustainability in transportation

The notion of sustainability consists of social, economic, and environmental aspects [52]. The comprehensive and long-period planning offers a structure and instrument to identify sophisticated correlations. Sustainable development can be regarded as the evolution to uplift the quality of life, economize on natural resources, and save time. Nevertheless, the definition of sustainability does not obtain a universal acknowledgement. Brundtland Commission came up with one of the most approved definitions: “meeting the needs of the present without compromising the ability of future generations to meet their own needs” [53]. Sustainability emphasizes sustainable exercises in several essential parts of a city. Examples include transportation, safety surveillance, communal facilities, energy consumption, and climate change [54], [55].

Mobility is a fundamental human activity for community involvement. Transportation has both positive and negative impacts on society. In 2016, transportation brought about 5% employment and gross value added in the European Union (EU). Nevertheless, increasing traffic flow resulted in higher greenhouse gases (GHGs) emissions in the transport domain. Transportation in the EU generated approximately 25% of GHG emissions in 2017. Nearly 71% of traffic emissions were induced by road transit [56]. Therefore, promoting sustainable transportation is crucial to address environmental issues while retaining mobility for economic development, and providing alternatives to facilitate social well-being [9]-[12]. In other words, the sustainable transportation system should be secure, cost-effective, harmless, and involve renewable energy and emission limitations [57]-[60].

Still, the solutions to current transportation problems mainly concentrate on combining transport into urban establishment in a financially feasible manner [61]. Due to the high-cost structure, there are only limited solutions to cater to the suburban areas' transportation needs. Suburbanization may increase carbon dioxide emissions by airplanes, trains, and vehicles, resulting in climate change. However, for the sustainable goal of economic welfare, the affiliated institution should offer adequate public traffic services, road capacity, and mobility choices. Transportation barriers will then be reduced to ensure clients' mobility. Providing adequate air, road, rail, and sea merchandise capacity can guarantee goods mobility and business productivity [52].

2.1.1 Ride-hailing service

Ride-hailing service has been in the spotlight recently due to the appearance of new advanced traffic technologies. Ride-hailing services are also called ridesharing, ride booking, on-demand ride services, or ride-sourcing. It existed to achieve the urban mobility demand in the defect of appropriate public transportation in developing countries [62]. It appeared to eliminate the difficulties induced by traditional taxi services, like failing to pick up passengers on schedule usually occur in countries with low and middle income [63].

Ride-hailing services target passengers who would like to experience door-to-door transportation. With state-of-the-art informative and communicative technologies, citizens can enjoy application-based and real-time services that reserve the car for their journeys online [62]. It is specifically designed for locating,

hooking up to, and seeking services from nearby drivers [63]. By utilizing the user-friendly mobile application and website interface, passengers can match a driver willing to offer user-defined and specific transport services in a private car and satisfy passengers' demands. Commercial companies, including Uber, Didi, Lyft, Cabify, and Ola, have been launched and run in numerous cities worldwide to provide ride-hailing services [64]. These platforms eliminate the need for exchanging money, simplifying the transaction processes and becoming more efficient.

Ride-hailing services can be categorized as a sustainable transportation system because the services provide a supply-demand management plan to uplift mobility in answer to a savage imbalance between supply and demand, assist in shortening the total amount of vehicles, and facilitate the use of multiple travelers. As a result, the value of regional mobility and society's effectiveness is generally boosted. Ride-hailing services can also attain sustainable goals in the environment and society by diminishing traffic jams and replenishing transport services. Therefore, there is less environmental contamination and the ecosystem can be preserved. Moreover, ride-hailing services can maintain and even enhance economic sustainability by adopting idle resources flexibly and creating more job opportunities [65].

2.1.2 Taxi service

Taxis have been the fundamental ingredient of the urban transportation system. They contribute to uplifting city mobility by offering customized services that are singularly flexible and enable one to reach any destination [66]. Compared with buses and trains, taxis are regarded as the most convenient transportation method since taxis are capable of offering 24-hour point-to-point services. In public transport, service suppliers usually predetermined the pickup and drop-off points, implying that passengers cannot make decisions alone.

Although taxi services contribute to balancing customers' demand and automobile supply, the dilemma still exists. On one hand, the multi-occupancy public transport, like a taxi, is better than private cars since it can decrease the number of road vehicles [67]. On the other hand, mispairing emerges between passengers' demand and taxi supply in taxi services, making passengers fail to be picked up punctually. Also, available taxis have to waste travel time to find the customers. The inefficient practice aggravates the current environmental pollution and traffic congestion issues quality [63]. To settle the

difficulties, taxi service booking systems have been established as a communication channel for clients and taxi drivers [66]. Due to the rapid evolution of online or application-based technologies, systems for booking taxi services have been brought into the taxi market. Two taxi service styles are available in the market, including regular taxi services and mobile or online taxi booking services [66]. This makes taxi services a similar but different service when compared to the emerging car hailing services in the market.

2.2 Hypothesis model

To understand whether there are differences in customers' perception towards the two services, this paper aims to test the differences in customers' perception of the two services with our hypothesis model based on the Theory of Planned Behavior (TPB). The TPB is a psychosocial framework Ajzen established to interpret human behavior [68]. TPB has been utilized to foresee and explain various behavior successfully in various behavioral fields, including election choice, smoking cessation, committing traffic offenses, and weight loss [69].

The TPB suggests that intention is the closest prerequisite of behavior, and it presumes three independent, decisive factors that may influence human behavioral intention. They are attitude, subjective norm, and perceived behavioral control. Attitude is a psychological feeling which contains the positive or negative assessment of particular behavior. Remarkably, people tend to express positive intentions if they have a positive attitude toward that behavior. Subject norm is a social element defined by the level of perceived social pressure in determining whether to implement a behavior. When a person considers a particular group momentous and close to himself or herself, the social pressure on the individual should be sufficient to affect the decision [70]. Perceived behavioral control refers to the perception of hardship or easiness of carrying out a particular behavior. Previous research on what factors affect customers' attitudes towards taxi and car-hailing services is rather fragmented [63], [68], [71]-[74]. Besides, these studies often see sustainability as narrowly defined green initiatives, which cannot fully cover the whole social, economic, and environmental picture [52] for high-order planning. With an extensive literature review, our study aims to extend these previous studies by bringing all relevant factors to our model to be tested. The detailed description for each factor will be covered in the next few sections.

Intention predicts human behavior. It discloses the willingness of people to engage in a specific behavior [65]-[68]. Take ride-hailing services as an example. Reuse intention is interpreted as passengers' trend to adopt the services again on the next trip. The intention to continuously support the specific public transportation services has been proven to make a remarkable contribution to building customer loyalty and thus results in the business's success.

The Integrating Theoretical Framework (TPB) should be employed to predict the passenger's loyalty and reuse intention of car-hailing and taxi services in Hong Kong. The present study will extend the TPB model by exploring perceived value, safety, green value, privacy, risk, sensitivity, security, positive WOM intention, and intention to reuse and recommend (Figure 1).

2.3 Behavior from the driver

Behavior from the driver can be categorized as intentional and unintentional features, which are actions a driver performs during vehicle operation [73]-[77]. A vehicle's physical appearance would reflect the behavior of the driver in traffic. The car's physical appearance plays an essential part in influencing and shaping passengers' standpoints about the vehicle's aggression or geniality. Meanwhile, the vehicle's exterior can be used to estimate the type of people who may own the corresponding vehicle and make an assumption about the driver's driving behaviors. Apart from external physical appearance, the vehicle's internal conditions and the drivers' physical appearance are also crucial evaluation factors.

Suitable behavior is defined as the extent to which a consumer in a consumption context felt that others in the service environment behaved appropriately. In order to earn the trust of consumers, appropriate behavior, attitude, and knowledge of drivers of application-based public transport services are highly crucial [71]. Only when drivers are well trained and willing to comply with behavioral rules and safety guidelines they know the way to behave appropriately, courteously, and safely such as do not ask private questions, do not exhibit symptoms of anxiety, never grumbling, strictly abided by traffic rules and never have risky driving while offering services which ensure passengers can enjoy a safe and pleasant journey [75].

In pursuit of an enjoyable journey, not only tangible criteria like physical appearance are significant, but also the interaction between drivers and passengers. When providing the service, drivers are expected to show their caring and one-to-one attention to passengers. Companies and platforms need to arrange ample opportunities for training drivers. Hence, they can possess helpful knowledge, skills, a polite attitude, and care to offer marvelous services to passengers [76].

Based on the above discussion, the hypotheses were generated to be tested as follows:

- H1** There is a positive association between physical appearance and the driver's behavior.
- H2** There is a positive association between suitable behaviors and behavior from the driver.
- H3** There is a positive association between suitable drivers and passengers' interaction and behavior of the driver.

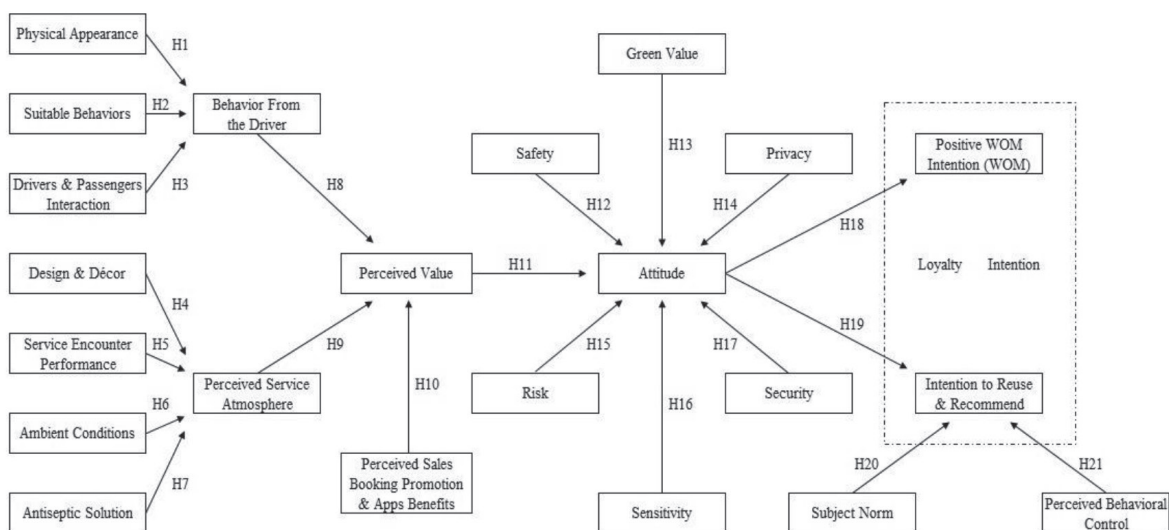


Figure 1. A theoretical model for loyalty intention for taxi and car-hailing service

2.4 Perceived service atmosphere

The perceived service atmosphere is critical when assessing the delivered services because it impacts consumers' emotional and psychological states and cognitive and rebuy intention. Service atmosphere is described as physical surroundings or physical status that service suppliers' control [68]-[71]. It was classified into three major constituents: design and décor, service encounter performance, and ambient conditions. Design and décor mean motivators at the bleeding edge of consumer consciousness, such as space positioning in the functional aspect and color, layout, and architecture in the esthetical aspect [71]. When customers spend more time in a pleasant physical surroundings, they are more likely to consider an atmospheric service experience. Service encounter performance is the quality of transactional interactions service providers offer consumers. The first communication will be new consumers' first impression of a service, which impacts their perception of the company. Service delivery techniques and capacities in the service encounter are crucial because service encounter performance plays a vital role in influencing consumers' decision-making [77].

Besides, ambient conditions are known as physical environments where services occur. They are artificial physical circumstances. Numerous studies have demonstrated that background conditions of service, like the properties of cleanliness, lighting, and temperature, may affect consumers' emotional responses and behavioral intentions [77]. Furthermore, an antiseptic solution should also be a critical factor that assists passengers in evaluating the perceived service atmosphere in public transit services. The role of the antiseptic solution is to weaken, eliminate or even prevent the development of microorganisms on the surface. With the help of an antiseptic solution, a desirable hygienic and cleaning status of the passenger compartment can be obtained. Cleanliness and sanitary conditions are parts of the criteria for measuring comfort in the service atmosphere [71].

Based on the above arguments, the following hypotheses were suggested:

H4 There is a positive association between design and décor and perceived service atmosphere.

H5 There is a positive association between service encounter performance and perceived service atmosphere.

H6 There is a positive association between ambient conditions and perceived service atmosphere.

H7 There is a positive association between antiseptic solutions and perceived service atmosphere.

The definition of perceived value is the general evaluation of the advantages that a product or service can bring for customers to deem. Consumers' perceived value is derived from their perception of a product or service and their life experience [78]. In the transportation industry, behavior from the driver and perceived service atmosphere are two prominent factors affecting perceived value. Ride-hailing, car-sharing, and traditional taxi services have relied on drivers to render services. Based on our previous discussion, good physical appearance indicates the discipline of a driver [76]. Behavior from the driver is of utmost importance to passengers' perceived value [75].

Service environments, comprising different dimensions of physical environments, are found to be influential when customers are evaluating their experiences in context of service marketing [79]. The perceived service atmosphere in public transportation significantly influences passengers' perceived value. Degree of crowdedness, available space, cleanliness, hygienic condition, and information usability are evaluative criteria of comfort level [71]. A sense of comfort in the service environment, which indicates the automobile compartment is fundamental to establishing a positive impression of the perceived service atmosphere by passengers. The better the perceived service atmosphere, the more superior the perceived value that service got.

Based on the discussions, the impact of perceived value on behavior from the driver and perceived service atmosphere is hypothesized as follows:

H8 There is a positive association between behavior from the driver and perceived value.

H9 There is a positive association between perceived service atmosphere and perceived value.

2.5 Mobile booking applications benefits and Perceived Value

The emerging application-based transportation services changed the perception and behavior of passengers about public transportation services. Perceived benefits are the trustfulness of positive results that react to risk circumstances [72]. Efficiency, convenience, easy approachability, and simple operation are the perceived benefits of mobile booking applications. Passengers' perceived benefits of using mobile booking apps, such as usefulness and easy accessibility, affect their perceived value, attitude, and continued use intention of a service [73]. Under the circumstance of car-hailing and conventional taxi services, the higher the perceived benefits of mobile booking

apps from consumers, the higher the perceived value can be acquired.

The perceived benefit of the booking application and perceived sales promotion influenced passengers' loyalty [73]. At the same time, research findings disclosed that consumers' behavioral intentions or loyalty are prominently affected by perceived value, quality of service, and customer satisfaction [73].

Consequently, perceived sales booking promotion and app benefits are positively related to perceived value, and the hypotheses are proposed as follows:

H10 There is a positive association between perceived sales booking promotion & app benefits and perceived value.

2.6 Attitude

Attitude is the level of an individual's positive or negative perspective about the execution of objective behavior. Faith in the behavioral consequences and the value of results influence the intention to achieve specific behaviors [80]. Attitude is verified to be an essential factor in deciding consumers' usage intentions and leads to a higher perceived value in public transportation services [68]. It should be the cornerstone for a service or product's success. Attitude is visible such that observability is evaluating the public transportation adoption that others can see [80]-[82]. Social attitudes reinforce the relationship between public transit service usage and perceived value. It can directly impact public transportation adoption. Passengers with a positive attitude toward a service obtain a higher liability to give an expression of interest in taking part in it.

Thus, it hypothesizes the effect of perceived value on attitude as follows:

H11 There is a positive association between perceived value and attitude.

Recently, sustainability has drawn more attention and interest in society and affects the public's attitude [52]. Many research papers and books have been issued to handle sustainability problems. Also, more and more social groups are participating in sustainable planning schemes. As a result, growing concerns are also raised in defining the factors that contribute to sustainability. The transportation industry plays a significant role in the development and progress of modern society. Meanwhile, it has become the biggest consumer of petroleum products and fossil fuels, contributing to several environmental concerns, including heavy carbon dioxide emissions, air contamination, and climatic change [56]. The notion of

green transportation has been raised and elaborated as a transport service that generates fewer adverse effects on the physical environment and human health with the same service goal [68]. Perceived safety is an individual evaluation of the degree of safety when adopting a service or using a product that will threaten one's security [81]. In the public transportation industry, drivers are responsible for ensuring passengers' safety. The more significant the safety concerns of transport services from passengers, the more negative impacts on attitudes.

Environmental benefits are often claimed by advocators of car-hailing services and other forms of sharing economy [82]. To this, perceived green value is emphasized on environmental protection awareness, sustainable development, and green demand. Previous research demonstrated that perceived green value has a positive relationship with an individual's attitude when participating in a behavior. Environmental responsibility becomes an important criterion when a passenger determines to use a transit service from different options. If the service or product can fulfil the long-term environmental requirement, people may have a better attitude, impression, and purchase intention. In public transportation, the perceived green value obtained from utilizing green transportation systems and green loyalty verify the positive impact on attitude and reuse intention.

The risk of privacy is related to the probable loss of personal details of a consumer buyer without their permission and authority [83]. Since personalized mobile phone apps are used for booking ride-hailing services, the location traces of each ride and rider's identity are often collected for marketing purposes. Misuse of this data could lead to a loss of privacy-sensitive information, such as riders' home address and contact.

Sensitivity refers to the price consciousness of a customer. The cost of transportation addresses the economic notion of sustainability [52]. Customers who have access to cheaper transportation options often have greater opportunities and are often more sensitive to price. Ride-hailing services are a new emergency public transportation mode that relies heavily on advanced technology; users may have a more positive attitude towards the ride-hailing services due to their ability to constantly check for low prices and reduce transaction cost through technology [82].

Perceived risk is a decisive attitude factor [79]-[81]. Risk is the outcomes and uncertainty customers might perceive when considering an unavoidable purchase decision. In a word, perceived risk is the personal expectation of losses in a deal. For instance,

a loss to the corresponding user will be generated when a service or technology cannot fulfill the expected effect. Mobile application-based ride-hailing services contain several risks and indeterminacy, like hazards in electronic payment, insecure drivers, the risk of encountering delays, and others. Perceived risks can influence passengers' trust in the effectiveness of a service, product, or even technology. If the perceived risk associated with a service adoption is lower, consumers are more likely to use the service and have a more positive attitude towards it.

When passengers have an optimistic viewpoint of security of the services, their attitude towards the services should be affirmative and vice versa [81]. The potential of personal privacy disclosure and online security risks remain the critical problem of adopting mobile applications. Ride-hailing service providers or application developers must be sensitive and proactively act to offer better privacy protection and security upgrade. Perceived privacy, security, and sensitivity of the particular public transport service are positively related to attitude.

In conclusion, it hypothesizes the influence of safety, green value, privacy, risk, sensitivity, and security on attitude as follows:

H12 There is a positive association between safety and attitude.

H13 There is a positive association between green value and attitude.

H14 There is a positive association between privacy and attitude.

H15 There is a positive association between risk and attitude.

H16 There is a positive association between sensitivity and attitude.

H17 There is a positive association between security and attitude.

2.7 Loyalty intention

Loyalty could be classified into two domains: consumers' intention to reuse and willingness to recommend a product or service to others, known as positive WOM [71]-[74]. In public transport services, especially for the newly emerged ride-hailing services, passengers' loyalty is of utmost importance since it helps to generate a competitive edge and preserve market shares. Decisions made by a customer with attitudinal loyalty primarily depend on integrating feelings and facts. Once passengers emotionally attach to ride-hailing services, their belief in the services will enhance and influence decision-making over objective facts. Word-of-mouth (WOM) advertising

can be obtained when a solid positive attitude exists in consumers with attitudinal loyalty [72].

From the behavioral point of view, behavioral loyalty is described as if a consumer iteratively adopted a product or service; the consumer is unnecessary to possess an admirable attitude toward the specific product or service. This phenomenon exists because of habit, convenience, hesitation to change, etc. Consumers with behavioral loyalty may want to reuse a product or service.

The determinant factors of behavioral intention include attitude, subject norm, and perceived behavior control [84]. An individual's positive attitude looks at behavior issues with a higher intention of accomplishing the abovementioned behavior. Attitudes determine consumers' intentions. Suppose passengers have a favorable opinion of ride-hailing services, a higher trend to show interest in reuse and recommend the services to people around [68]. Passengers' future behavior can be predicted by the intention to reuse. Planned behavior theory inspects the intention to reuse public transport services. The variables of planned behavior theory, such as subject norm and attitude towards passengers' behavior, are markedly influenced by their intention to reuse [74].

Besides, subject norm conduces to the formation of people's purpose in performing a behavior. As social influence impacts consumers' decision-making to choose a service, the subject norm confirms the positive influence on consumers' intention and attitudes to adopt ride-hailing services in like manner. So, the subject norm should be considered a reliable predictor of consumers' intention to use or reuse public transport services. The perceived social pressure or group pressure from significant others could sway passengers' usage intention of ride-hailing services. Users will prefer to use a particular public transportation service if it is recommended or utilized by their fellow.

Moreover, the capacity for controlling obstacles to behaviors and sufficient resources affect the performance of a behavior. The fewer barriers and more resources are in one's perception, the better perceived behavioral control and the stronger intention to accomplish behaviors [84]. If the transportation services are readily accessible, passengers will possess higher usage intention. Perceived behavioral control and attitude are two of the most crucial elements motivating passengers to employ certain types of public transport services [65]. The mentioned relationship exists not only in the ride-hailing services industry, but also in hospitality, ticket sales and other service sectors. Consequently, perceived behavioral control positively affected the behavioral intention of consumers.

Therefore, the impact of loyalty and intention (distinguished by positive WOM intention and intention to reuse and recommend) on attitude, subject norm, and perceived behavioral control is hypothesized as follows.

H18 There is a positive association between attitude and positive word-of-mouth intention.

H19 There is a positive association between attitude and intention to reuse and recommend.

H20 There is a positive association between subject norm and intention to reuse and recommend.

H21 There is a positive association between perceived behavioral control and intention to reuse and recommend.

3. Methodology and data analysis

Prior to the distribution to the public, a pilot study was conducted. There were 100 participants in the pilot study (50 participants each for taxi and car-hailing service), distributed in both English and Chinese versions. After the collection of questionnaires in the pilot study, a reliability test of data was implemented to check the relevance of the questions set and the corresponding variables. Opinions of participants in the pilot study were also gathered. A final version of the questionnaire was generated after incorporating all necessary amendments as shown in Table 1.

Table 1. Questionnaire items

Factors	Questions
Physical Appearance	PA1 I would concern about the appearance of the driver while traveling by this service.
	PA2 I would concern about whether the driver is dressed appropriately.
	PA3 I would concern about whether the driver is nice.
	PA4 I would concern whether the driver looked like he/she was my type of people.
Suitable Behaviors	SB1 I would concern the driver behavior is pleasant.
	SB2 I would concern the driver is behaving well to me and others.
Driver & Passengers Interaction	DPI1 I have developed friendships with the driver.
	DPI2 I enjoy spending time with the driver.
Design & Décor	DD1 The décor of the vehicle is stylish and attractive.
	DD2 The interior of the vehicle is impressive.
	DD3 The color used in the vehicle is pleasant.
	DD4 The color used in the vehicle appeared to be currently fashionable.
Service Encounter Performance	SEP1 The staff from the physical and online platforms are polite about my questions.
	SEP2 The staff from the physical and online platforms are friendly about my questions.
	SEP3 The staff from physical and online platforms are knowledgeable about my questions.
Ambient Conditions	AC1 The smell in the vehicle is pleasant.
	AC2 The area inside the vehicle is bright.
	AC3 Overall, the vehicle is clean.
Antiseptic Solution	AS1 The driver provides enough disinfection supplies (e.g., hand sanitizer) in the vehicle.
	AS2 The driver sanitized the vehicle before you traveled.
	AS3 The driver has worn the respirator properly.
Behavior from the driver	BD1 The driver is polite.
	BD2 The driver is friendly.
	BD3 The driver has good knowledge of the service.
	BD4 The driver has a professional appearance.
Perceived Value	PV1 Compared to the money I spent, I think the traveling service is worthwhile.
	PV2 Compared to what I spent on time, I think traveling with this service is worthwhile.
	PV3 Compared to the time I spent, I think the traveling service is worthwhile.
Perceived Sales Booking Promotion & Apps Benefits	PV3 Overall, traveling by this service is worthwhile.
	PSAB1 The online booking app provides periodic promotions to the user.
	PSAB2 The online booking app provides points redemption to the user.
	PSAB3 The online booking app provides welcome gifts to the new user.
	PSAB4 Electronic payment on the online booking app is safe
	PSAB5 I find the online booking app to be easy to use.
	PSAB6 The online booking app loads quickly.
	PSAB7 Interaction with the online app does not require much mental effort.
	PSAB8 When I use this online booking app, there is very little waiting time between my actions and the booking app's response.
	PSAB9 I am able to see the graphics clearly on this booking app
	PSAB10 The booking app provides accurate information about the driver and vehicle
	PSAB11 I can quickly contact a customer service representative on the app
PSAB12 The online booking app displays the accuracy of the origin and destination on the map	

Safety	SY1	I feel safe from crime by traveling on this service.
	SY2	I feel safe from traffic accidents when traveling with this service.
	SY3	I feel safe using this traveling service in the daytime.
	SY4	I feel safe using this traveling service at night.
Risk	RK1	I might be exposed to the risk of COVID-19 when I use this traveling service.
	RK2	I am worried that the money in my e-Wallet, which connects to online platforms, will be stolen.
	RK3	I am concerned that my personal information will be shared or sold to other parties.
Green Value	GV1	I feel more environmentally sustainable if the vehicle is operated electronically.
	GV2	I consider whether the traveling method is environmentally friendly or not.
	GV3	I consider the receipt could be shown in the apps rather than physical paper to reduce the waste.
Privacy	PY1	The service requires a reasonable amount of personal information necessary for active use.
	PY2	The service has a security system to protect my personal information.
Security	SE1	I am vulnerable to physical assault by drivers in this service.
	SE2	I can prevent myself from being assaulted by the driver.
	SE3	The physical assaults in this service can be predicted
	SE4	I voluntarily take the security risk of using this service.
Sensitivity	SE1	I will use this traveling service only if they have a promotion.
	SE2	When choosing a transport mode, I rely heavily on price.
	SE3	I always compare the price of (taxi/car-hailing) with (car-hailing) before traveling.
Attitude	AE1	I think that using this service is a positive behavior.
	AE2	I think that using this service is a valuable behavior.
	AE3	I think that using this service is beneficial behavior.
Subject Norm	SN1	Most of my friends and relatives' support that I use to share this service.
	SN2	Most of my friends and relatives agree that I use this service.
	SN3	Most of my friends and relatives recommend that I use this service.
Perceived Behavioral Control	PBC1	I am capable of using this service.
	PBC2	If I want, I can easily use this service.
	PBC3	I have enough time and energy to use this service.
Intention to Reuse & Recommend	IRR1	I consider this traveling service to be my first choice when I travel.
	IRR2	I like to travel with this service
	IRR3	I would like to recommend others to travel by this service.
	IRR4	I would like to keep traveling by this service in future
	IRR5	I feel great after traveling with this service.
Positive Word-of-Month Intention	WOMI1	I would recommend this traveling service to those who ask for advice on the traveling option
	WOMI2	I would suggest my friends travel with this travel service.
	WOMI3	I would suggest my relatives travel by this travel service.
	WOMI4	I would suggest my foreign friends and relatives travel by this traveling service.

In our main study, 1000 questionnaires were collected, and all respondents were voluntary and anonymous physically. The survey was conducted at 7 outdoor locations in Hong Kong from January 2023 to March 2023 and data was entered directly through an online questionnaire form. Out of 858 qualified respondents, 452 males (52.68%) and 406 females (47.32%). Most respondents are aged 20 to 29, with 351 samples (40.92%), followed by 30 to 39, with 252 samples (29.37%). Most male and female respondents attained a bachelor's education level, with 654 samples (76.22%). Most respondents were full-time employees, with 359 samples (41.84%). The multi-item measurement scale – a 7-point Likert scale (one refers to strongly disagree and seven refers to strongly agree) was used [85]. This study developed a theoretical model to measure the effects of sustainability, perceived service atmosphere, and perceived booking quality on loyalty intention in Hong Kong.

The data were then analyzed by multi-group analysis (MGA) with partial least squares structural equation modelling (PLS-SEM). Not only does the PLS-SEM provides better flexibility for data requirement as an alternative for Covariance-based SEM, PLS-SEM enables between group analysis which serves as a means of testing if there are significant differences in loadings and path coefficients between predefined data groups [86]. In the current research, a multi-group analysis compare with taxi and car-hailing is constructed; the model includes the behavior from the driver (three factors), perceived service atmosphere (four factors), perceived value (three factors), attitude (seven factors), positive word of mouth, and intention to reuse and recommend. It was assumed that the relationships would be positive and were investigated by the mean value of measurement items in the 7-point Likert scale separately.

4. Results

The standardized factor loading, Cronbach's alpha (α), Composite Reliability (CR), and Average Variance Extracted (AVE) of the measuring items comprise the measurement reliability of the study. The acceptance criteria of each measurement are stated as follows: The reliability is acceptable when the Standardized Factor Loading is more significant than 0.700 [87]; the internal consistency as measured by Cronbach's Alpha of each latent variable, of which the passing criteria are above 0.800, and AVE is more significant than 0.500 to prove the strong-enough correlation between items [87]. α measurement achieved internal consistency of the confirmatory analysis. Table 2 presents the results and measurement of the confirmatory factor analysis. CR varies between 0.815 and 0.989, while AVE presents a value between 0.812 and 0.990. Furthermore, the Fornell-Larcker criterion was considered in the evaluation of discriminant validity [88]. In general, the correlations of the latent variables loaded higher values than other constructs, indicating no overlapping of different con-

structs in our model. Therefore, the proposed model is valid and reliable with a good fit. Structural Equation Modelling using SPSS-AMOS 25 was adopted to conduct with the non-discriminated sample [89]. The proposed model with the non-discriminated sample was evaluated, together with the estimated path coefficient and p-value.

The summary of the hypothesis testing results for the taxi industry was provided in Table 3. To measure the fitness of the collected data from the questionnaire, the model fit should be further considered to demonstrate the measure's adequacy and validity. For measuring the model fitness under the multi-group scenario, the p-value of χ^2 statistics less than 0.05; the χ^2/df should be acceptable when below 3; the Comparative Fit Index (GFI) should be acceptable, which equals to or above 0.900; Tucker-Lewis Index (TLI) should be acceptable, which is more significant than 0.900; the Root Mean Square Error of Approximation (RMSEA) should be acceptable which equals to or below 0.080; Standardized Root Mean Square Residual (SRMR) should be acceptable which equals to or below 0.100. Akaike Information Criterion

Table 2. Results and measurement of the confirmatory factor analysis

Factors (Internal Consistency)	Number of items	Standardized factor loading	α	Composite Reliability	Average Variance Extracted
Physical Appearance	4	0.823-0.950	0.855	0.960	0.831
Suitable Behaviors	2	0.801-0.897	0.878	0.918	0.902
Driver & Passengers Interaction	2	0.823-0.882	0.968	0.846	0.852
Design & Décor	4	0.817-0.955	0.939	0.957	0.955
Service Encounter Performance	3	0.821-0.842	0.908	0.946	0.852
Ambient Conditions	3	0.868-0.934	0.849	0.827	0.954
Antiseptic Solution	3	0.852-0.940	0.982	0.962	0.990
Behavior from the driver	5	0.817-0.910	0.898	0.832	0.840
Perceived Value	4	0.935-0.964	0.985	0.815	0.898
Perceived Sales Booking Promotion & Apps Benefits	12	0.800-0.953	0.950	0.923	0.871
Safety	4	0.839-0.959	0.896	0.986	0.812
Risk	3	0.899-0.929	0.929	0.827	0.886
Green Value	3	0.809-0.889	0.962	0.879	0.899
Privacy	2	0.855-0.865	0.870	0.937	0.985
Security	4	0.828-0.957	0.908	0.989	0.904
Sensitivity	3	0.910-0.995	0.900	0.905	0.840
Attitude	3	0.810-0.855	0.839	0.889	0.829
Subject Norm	3	0.839-0.931	0.987	0.975	0.924
Perceived Behavioral Control	3	0.809-0.870	0.870	0.936	0.818
Intention to Reuse & Recommend	5	0.800-0.965	0.831	0.865	0.988
Positive Word-of-Month Intention	4	0.814-0.938	0.873	0.934	0.821

Table 3. Summary of the hypothesis testing results for the taxi industry in Hong Kong

Hypotheses	β	T-statistics	Sign.
H1	0.801	2.813	<0.05
H2	0.772	9.167	<0.01
H3	0.598	2.299	<0.01
H4	0.313	10.73	<0.01
H5	0.730	14.005	<0.01
H6	0.801	17.807	<0.05
H7	0.332	6.609	<0.05
H8	0.685	10.738	<0.01
H9	0.583	9.177	<0.1
H10	0.595	17.81	<0.01
H11	0.730	19.927	<0.01
H12	0.824	10.888	<0.05
H13	0.355	12.95	<0.01
H14	0.793	6.772	<0.01
H15	0.479	2.977	<0.01
H16	0.461	17.83	<0.01
H17	0.259	4.58	<0.05
H18	0.540	14.027	<0.1
H19	0.475	15.996	<0.1
H20	0.210	16.94	<0.01
H21	0.432	1.921	<0.01

(AIC) is adopted for the multi-group analysis which the value is lower and better because of representing a reasonable compensation between fit and complexity.

5. Discussion and implications

This study explored the relationships between different values affecting customer loyalty intention in taxi and car-hailing services in Hong Kong's transport industry. This study confirmed that all three elements in the Theory of Planned Behavior (TPB), namely the attitude, normative beliefs for subjective norms, and control beliefs for perceived behavioral control, are all relevant in interpreting travelers' behavior. This study confirmed that all factors in a number of previous studies [63], [68], [71]-[74] can be considered from a macro and holistic perspective.

The major finding extends the current literature and fills the gaps in the current literature by constructing and providing empirical evidence for the value creation by app benefits, and green value affected the usage of both services. The results show that behavior from drivers, service atmosphere, attitude, and subject norm constructs would have direct and indirect effects on the loyalty intention to the customers, in-

cluding the taxi or car-hailing services. These hypotheses are based on the literature and explain that the customers would concern about lots of factors before adopting these two transportation services in Hong Kong. Based on this phenomenon, the marketing of these transport services could be more active to provide better customer service to gain a higher loyalty intention. Sustainability is one of the vital factors that affect the customers' selection. This concept explains the tendency of taxis and vehicles engaged in the car-hailing business to adopt alternative fuel options or electronic vehicles due to customer preferences.

5.1 Discussion for individual factors

Mobile application-based services have reformed the modern transportation and traveling industry. This relatively new service enhances customers' experience and improves service satisfaction. According to Siyal, et al. [86]-[89], if consumers can undergo the advantages that bring by the services expediently, they may have more content to reuse. Thus, the level of customer satisfaction is a symbol of their intention to reuse it. The results imply that the travel and transport suppliers should improve service quality and boost customer satisfaction since consumers' per-

ception is essential to service loyalty and reputation. In the intensively competitive marketplace of public transportation, customer loyalty is of paramount importance to the sustainability of public transportation services. Customer loyalty has a relation to consumer response which is based on service commitment. It is divided into two significant domains, including attitudinal and behavioral loyalty [72]. Attitudinal loyalty is closely related to brand and quality commitment, emotional reliance, and trust. Behavioral loyalty stresses the chance of consumers' intention to reuse and refer to others. Two types of loyalty joined together to result in growing loyal customers. Apart from this, several factors influence loyalty towards using public transport, like ride-hailing services used taxi services shown from the results which are affected by the customers.

Regarding reuse intention and WOM, once passengers are satisfied with a particular transportation service, they may be more willing to keep using that service and recommend it to other clients, known as word-of-mouth [63]. Reuse intention means consumers continuously patronize a specific service. Faithful clients are familiar with the services, resulting in unobstructed and effective communication and easing the processes for service. Consumer retention enhances profit by reducing operational and market expenditures; hence, customer loyalty builds up gradually. WOM describes consumers' willingness to introduce public transport services to family and friends after experiencing them [63]. As one of the vital constituents of customer loyalty, WOM is considered an effective marketing tool since it draws more attention from potential clients and the public and performs better than traditional marketing tactics. It is a more excellent way of reaching new customers.

Service quality is paramount to realizing consumer behavior about traveling or transport services. Perceived service quality is a subjective appraisal of a product or service's competitive edges or perfection from consumers' vision. While experiencing, customers often assess the diversity between expectations and services they receive. Passenger loyalty can be consolidated if customers are confident that the services' outcomes can fulfill their expectations [73]. As an activator of service or brand identity, perceived service quality should be improved to reach brand commitment and gain consumer loyalty. Only when the commuting experiences lead to the eudemonia of travelers their faith and specific traveling habits might come into being.

Consequently, customer loyalty helps to solidify and even extend the client base and facilitate business

growth by uplifting competitiveness and preserving market shares [72]. Consumer behavioral intentions, including re-usage of transport services and intention to spread positive WOM, are highly related to service quality and consumer satisfaction [90]. Maintaining customer loyalty is fundamental in the competitive public transport services industry.

5.2 Further enhancing the smart transport system in Hong Kong

Our results explain the car-hailing and taxi services' popularity [64]. Assuming the technological advancement can bring even better booking services and app benefits to customers, it is suggested that customers would have better attitudes towards the two services [62], [49], resulting from a higher intention to use both services in the future. Although both car-hailing and taxi services are considered a part of sustainable transport systems in terms of providing traveling options for increased mobility while decreasing private cars on the road [62], [65], [67], both of them can still contribute to traffic congestion, especially if the two services are widely used in point-to-point travel [63].

In particular, dynamic pricing as a part of an intelligent transport system [15] can be promoted in Hong Kong. Taking reference from the Stockholm ERP system, the toll rate changes vary in the peak hour periods, which can be divided into 30, 60, and 90 minutes. The last type is responsive tolls. Toll rates are changed according to the actual traffic conditions. The system can automatically raise the rate when an accident happens in the toll roads and tunnels to avoid drivers using the tolled roads during that period. Some high occupancy toll lane has adopted responsive tolls, such as San Diego I-15 and Minneapolis I-394. Hong Kong's time-of-day rates are more suitable than the other two types. Since reducing traffic congestion during peak hours is the objective of Hong Kong to promote electronic road price system in the business area, time-of-day rates can help facilitate traffic movement and encourage residents to take public transport instead of driving.

6. Conclusion and future research

Our study established a model explaining sustainability and service quality and their relationship with customer loyalty for car-hailing and taxi services in Hong Kong. The results in this study conclude that behavior from drivers, perceived service atmosphere and sales booking promotion, and App benefits are

important factors influencing the perceived value of non-public transportation. Together with multiple sustainability measures, these factors would affect the attitude of the non-public transportation users and hence their loyalty intention. In the multi-group analysis, factor loadings for both car-hailing and taxi services in Hong Kong are equal, meaning that the same sets of factors are considered important in gaining loyalty intention for the traditional taxi industry and the non-public car-hailing services.

As we mentioned in the earlier chapter, research on applications on other intelligent transport system domains is needed due to the highly potential improving evaluation of taxi and car-hailing services due to technological advancement. To ensure a more sustainable environment in Hong Kong, the model could further test the elasticity of both transports compared to mass public transport by proposing dynamic pricing on the transportation system. The first type of dynamic pricing is the flat rates. Flat rates refer to a fixed rate charged for drivers entering the charging zones; travel distance and time are not considered under this rate. The second type is the time-of-day rates. This rate type is set according to the time interval and time used in each step. It has been applied in Singapore and Stockholm Electronic Road Pricing (ERP) systems [24]. The toll rate of the Singapore ERP system is adjusted every quarter, and toll rates will be lower than the usual period when there are any school holidays, which are June and December. The toll rate changes every half hour during peak hour periods.

Despite the fact that satisfactory results are achieved, this study possesses two limitations. First, although the TPB is widely accepted, there is no guarantee of loyalty to the actual usage behavior as demographic variables like gender, age, and income are all potential moderators in choosing public transportation modes. Secondly, all factors are assumed to be valid and important in evaluating traditional taxi and car-hailing services in our research. This work assumes that customers of taxi services and car-hailing services are two separate groups of customers. Still, it is possible that few customers use these two services selectively based on their needs on that particular occasion. For example, if customers travel a short distance in just a few blocks, they may perhaps have less concerns about the physical attributes of the carrier. On another occasion, if customers are travelling with their families, lovers, or close colleagues, they may have fewer concerns about the interaction with drivers. That means that there is a chance that some underlying factors are still uncovered and yet to be

important in differentiating the public and non-public transport services from the customer's perspective.

Therefore, future research can also be extended to a broader range of factors, which may yield a more mature model in explaining the customers' choice of public and non-public transport services separately. Besides, as this study was taken place in Hong Kong, a city with one of the highest public transportation adoption rates worldwide, further research can be conducted in different cities with varying transportation infrastructure and policies. Lastly, as the car-hailing business matures, it is possible that new forms of public transport and car sharing concepts may become more common. Examples include luxury taxis services or shared car-hailing services. Replicating this study would certainly provide insights into these emerging forms of transportation services.

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