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Modeling tourist accessibility to peripheral attractions

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Abstract

Urban destinations worldwide face the challenge of spreading tourists from central urban areas to less visited peripheral areas. However, visiting peripheral attractions often implies lengthy journeys and the engagement of multiple means of transport. This study provides a conceptual and methodological framework to assess utility-based tourist accessibility to peripheral urban attractions. A discrete choice experiment was designed to investigate tourist preferences with respect to different types and ratings of tourist attractions and the key characteristics of collective and individual public transport alternatives. The estimation of a hybrid choice model provides empirical evidence for the relevance of repeat visitation, length of stay and public transport system perceptions in the assessment of tourist accessibility to peripheral urban attractions.

Keywords: tourist accessibility, urban tourism, peripheral attractions, discrete choice experiment, hybrid choice model.

Introduction

Urban tourism typically concentrates in central urban areas (García-Palomares, Gutiérrez & Mínguez, 2015). Hong Kong is an example of a city destination for which the tourism concentration is typically focused in urban areas and attractions in peripheral areas receive substantially lower visitation. Although 43% of overnight visitors to Hong Kong in 2019 engaged in sightseeing activities, less than 5% visited peripheral attractions (Hong Kong Tourism Board, 2020). This discrepancy is particularly relevant given that Hong Kong as well as urban tourism destinations worldwide strive to spread tourists to less visited peripheral areas (Su, Spierings & Hooimeijer, 2020).

Visits to peripheral urban attractions often implies lengthy journeys and the engagement of multiple means of transport. The crucial role of transport at destinations is well-documented in the literature on tourist attractions. Previous research has used the analysis of tourist movement patterns to address the planning of transport infrastructures and services (Paulino, Lozano & Prats, 2021). At the local level, transport provision satisfies an existing demand (Duval, 2007), making it important to assess tourist preferences in connection with the relatively low demand for peripheral urban attractions. The need to facilitate tourist consumption of urban destinations is hindered by the lack of research on the tourists' use and perception of local transport systems (Gronau, 2017). Accordingly, a comprehensive analysis of tourist accessibility to peripheral urban attractions can provide a timely contribution to the current stream of research on tourists' use of urban public transport and visitation of peripheral areas.

Accessibility is a concept that has been applied in several research contexts, including transport geography, urban planning, transport planning, marketing, and tourism. While Hansen (1959, p. 73) defined accessibility as "the potential of opportunities for interaction", Geurs and van Wee (2004) asserted that the key components characterizing accessibility include elements related to land-use, transport, individual, and temporal constraints. As such, accessibility involves the interaction of these elements, providing individuals with opportunities to reach a destination and participate in activities (van Wee, Geurs, & Chorus, 2013). Thus, accessibility is considered as a relative concept due to the subjective and varying degree of perceptions associated with the inherent qualities of costs and benefits to visit a geographical area (Nassir, Hickman, Malekzadeh & Irannezhad, 2016). Thereby, relating environmental components and individual characteristics in studying accessibility is of high importance (AlKahtani, Xia, Veenendaaland, Caulfield, & Hughes, 2015). From the perspective of intra-destination accessibility, Lau and McKercher (2007) classified the factors affecting tourists' movement patterns in a destination into those related to the tourist, destination (e.g., territory, transport, and attractions), and trip. In the context of peripheral tourist attractions, the consideration of multiple accessibility components is argued to be particularly important because of the increased complexity associated with the transport decisions faced by the tourists. Accordingly, this study proposes a conceptual and theoretical approach to the analysis and modeling of tourist accessibility to peripheral attractions.

Literature review

Accessibility and its application to tourist attractions

The notion of accessibility has attracted an extensive stream of research since its initial conceptualization by Hansen (1959).

The components. Geurs and van Wee (2004) defined the concept of accessibility under four types of components. The land-use component describes the opportunities present at the destination in terms of quantity, quality, and local demand. The transportation component refers to the travel time, travel cost, and effort required by individuals to reach the destination with a specific transport mode. The temporal component relates to the temporal constraints from the perspective of supply (e.g., availability of opportunities at a given time) and demand (e.g., individual time budget). The individual component refers to the needs, abilities, and capabilities of individuals.

The measures. Different accessibility measures have been proposed in the literature to reflect the foci of the four components (Geurs & van Wee, 2004). These include measures related to i) the performance and service of the infrastructure (infrastructure-based measures), ii) the spatial distribution of the attractions (location-based measures), iii) the ability of individuals to partake in the activities (person-based measures), and iv) the utility derived by individuals in accessing the attractions (utility-based measures).

The utility measurement approach. The utility-based accessibility measures are conveniently expressed in economic terms (Koenig, 1980) and derived from the estimation of discrete choice models (Ben-Akiva & Lerman, 1985; Geurs, van Wee, & Rietveld, 2006), specifically from models of destination and mode choice (Dong, Ben-Akiva, Bowman & Walker, 2006). The use of discrete choice models allows for the inclusion of a variety of factors affecting the perceived accessibility, or utility (Koenig, 1980) and the treatment of preference heterogeneity in the assessment of accessibility (Nassir et al., 2016). Pot, van Wee and Tillemma (2021) emphasized the importance of individual-level subjectivity toward accessibility components, thereby advocating the incorporation of perceptions in the derivation of accessibility measures. The expected maximum utility, also called logsum, is a measurement of the individual utility associated with the choice set and represents a convenient measure of individual accessibility (Ben-Akiwa & Lerman, 1985; Dong et al., 2006). Empirical evidence in transport research supports the notion of logsum as a measure of accessibility (Bergantino, Capurso, & Hess, 2020; Geurs, Zondag, De Jong, & de Bok, 2010; de Jong, Daly, Pieters, & Van der Hoorn, 2007).

The crucial role of accessibility on the success of tourist attractions is well-recognized in the literature but mainly pertains to the mere transport component. Martin, Marrero-Rodríguez, Moreira, Roman, and Santana (2016) observed that the transport mode used by tourists to visit a World Heritage City highly affected the quality of their experience. Masiero and Zoltan (2013) analyzed the interrelation between the extent of the area visited by tourists at destination and the selection of transportation mode and demonstrated that public transport is generally associated with restricted movement patterns. AlKahtani et al. (2015) conceptualized the measurement of accessibility to tourist attractions by distinguishing the influence of factors related to attractions, transport systems, and tourists, including demographic/travel characteristics and perceptions. However, empirical applications that relate accessibility to tourism are scarce (Coppola, Carbone, Aveta & Stangherlin, 2020). To the best of the authors' knowledge, no previous study has adopted the utility-based approach to investigate tourist accessibility to destination attractions. In this vein, this study contributes to the current literature by proposing a unique framework for the analysis of tourist accessibility through the implementation of a discrete choice experiment.

Attractiveness of tourist attractions

The experience of tourists at the destination generally depends on the appeal and ambience of its attractions. Therefore, analyzing the cause–effect relationship between attractions and visitation has become the subject of investigations in tourism research. To stimulate visitation, iconic attractions are duly marketed by Destination Marketing Organizations (DMOs). These organizations also promote and highlight other attractions that may interest tourists. Indeed, the decision of tourists to visit a given attraction is influenced by its popularity and rating (Kemperman, Arentze & Aksenov, 2019; Hernández, Santana-Jiménez & González-Martel, 2021). Shoval, McKercher, Ng, and Birenboim (2011) noted that tourist activity is typically concentrated in the proximity of their hotel, although tourists are prepared to travel further to visit iconic attractions. Paulino, Prats, and Whalley (2020) illustrated the direct relationship between the flow of tourists and the attractiveness of the attraction. Nonetheless, Lawton and Page (1997) detected a consistent discrepancy between the attractions visited by tourists and those promoted by the tourism industry in Auckland, New Zealand. Although most Auckland attractions are located in its peripheries, tourists mainly participate in activities at the city center due to the difficulty of reaching peripheral attractions. Ultimately, tourists decide to visit an attraction on the basis of its attractiveness and transport accessibility (Hardy, Birenboim & Wells, 2020). Thus, besides attractiveness, the development of effective and reliable transport connections is key to boosting tourism in peripheral urban areas.

Use of transport at destinations

Quality transport services can help derive maximum benefits from tourism. Kaul (1985) emphasized the importance of the transport system as a key factor in developing tourism, thereby possibly inducing the creation of new attractions and growth of existing ones. Sarma (2003) noted that transport within destinations is an essential factor in determining their attractiveness as tourist destinations. Visitation rates can be facilitated by marketing integrated tourism products that combine transport use with access to attractions in the form of destination cards (Zoltan & Masiero, 2012). If tourists' travels to preferred destinations are influenced or hampered by transport inefficiencies, then they may seek alternative destinations or shorten their length of stay (Khadaroo & Seetanah, 2008).

Knowing the places visited by tourists within a specific destination enhances the planning process for transport infrastructures, thereby gradually boosting destination development (Prideaux, 2000). Concerning tourists' use of public transport at the destination, Le-Klähn and Hall (2015) distinguished between transport in rural and urban areas by acknowledging that transport supply and user behavior vary significantly across the two contexts. Notwithstanding the scarcity of studies focusing on tourists' use of public transport to reach attractions located in peripheral urban areas, the importance of transport interchanges in travel behavior has been recognized in the general literature on public transport (e.g., Noland & Polak, 2002; Wardman, 2004; Hutchinson, 2009). Few investigations have generated useful insights into the recreational and leisure segments of travel. Wardman (2001) determined that relative to leisure travelers, commuters value interchanges less in terms of money. The aforementioned study argued that this result may be attributed to the fact that tourists have limited familiarity with transport networks. Similarly, Le-Klähn and Hall (2015) indicated that lack of information (Edwards & Griffin, 2013; Malhado & Rothfuss, 2013; Le-Klähn, Gerike & Hall, 2014) is a major deterrent for tourists' use of public transport and of different transport modes (Dallen, 2007). Transport interchanges are a burden on tourist experience (Owen, 1991). Although metro lines generally connect tourist attractions located in urban areas, the accessibility of peripheral tourist attractions often depends on the use of multiple means of public transport (typically a combination of the metro and local buses) or on the relatively more expensive taxi option. Consequently, peripheral tourist attractions typically receive considerably lower visitation than attractions with direct public transport accessibility. Thus, the performance of public transport at destinations can considerably affect the extent of tourist movement patterns and their visitation to less conveniently located peripheral attractions. The accessibility components reflecting the relevance and quality of the attractions (land-use component) and the availability of good public transport connections (transportation component) are therefore strictly interconnected for peripheral attractions and are vital to their success.

Tourist preference heterogeneity for accessibility

To understand how tourists consume an urban destination (i.e., visit attractions), the movement patterns of tourists within a destination have been increasingly analyzed in recent tourism literature (McKercher & Zoltan, 2014; Park, Xu, Jiang, Chen, & Huang, 2020). The assessment of attraction accessibility may vary depending on tourists' geographical knowledge as well as their way-finding and spatial abilities (Lawton, 2010). Accessibility further depends on tourists' needs, values, and the type of information they acquired prior to the visitation (Coppola, Carbone, Aveta & Stangherlin, 2020). Above all, the level of familiarity with the destination is arguably a major discriminator of tourist preference heterogeneity and a distinctive element in the ability of tourists to navigate the destination (Xia, Arrowsmith, Jackson & Cartwright, 2008). An increased familiarity with a destination from repeat visitation or extended stay affects the way tourists consume and perceive that destination. In particular, the relationship between length of stay and movement patterns indicates that a less time-constrained trip (i.e., longer-stay) allows for the visitation of more attractions, but short-stays typically involves the visitation of primary attractions (Jin, Cheng, & Xu, 2018; Kang, 2016). Further, empirical evidence revealed that repeat visitation is associated with a more in-depth exploration and increased intra-destination trip distance (Caldeira & Kastenholz, 2018; McKercher, Shoval, Ng, & Birenboim, 2012). Tourist perceptions and attitudes toward public transport at the destination can also affect their preference for different transport modes (Le-Klähn, Gerike & Hall, 2014).

Conceptual framework of the study

This research investigates tourist accessibility to peripheral urban attractions. In line with the literature reviewed in the previous section, the conceptual framework proposed in this article is based on the four components of accessibility and is illustrated in Figure 1.

Tourists choose whether or not to visit a peripheral attraction according to its quality (land-use component) and available transport mode (transportation component). The response of tourists to attraction quality and transport mode attributes is moderated by the travel characteristics related to the length of stay (temporal component) and repeat visitation of the destination (individual component). Furthermore, the latent construct associated with tourist perception of the local public transport (individual component) affects the evaluation of transport mode attributes and is moderated by the travel characteristics.

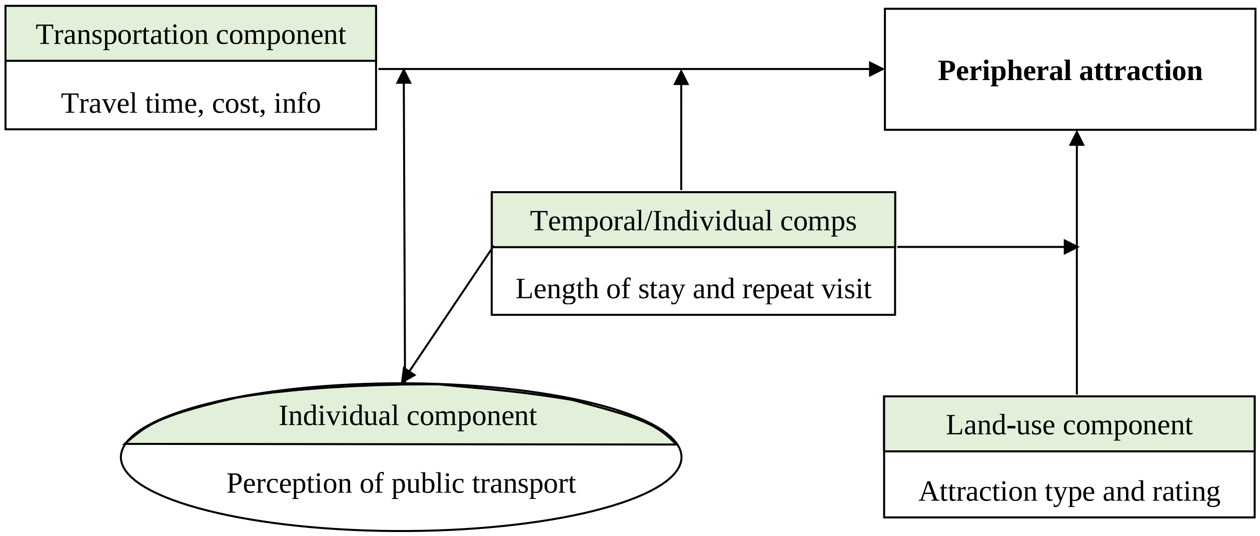

Figure 1. Conceptual framework for tourist accessibility to peripheral urban attractions

Methodology

Research design

To investigate tourist accessibility to peripheral urban attractions, this study relied on the implementation of a discrete choice experiment for the collection of tourists' stated preference data. Discrete choice experiments are the primary source of information for the analysis and valuation of consumer behavior in relation to transport services (Bliemer & Rose, 2011). The initial stage of the research involved the setting of the discrete choice experiment and the final selection of attributes. Semi-structured in-depth interviews were conducted with nine travelers with recent experience with the public transport service in Hong Kong. The qualitative interviews indicated a consensus on the importance of travel time and the relevance of clear information on the transfer between public transport modes and alighting stops. Cultural and natural attractions were the predominant interests. Information acquired from the preliminary investigation confirmed the validity of the proposed attributes in the destination under consideration.

Table 1 presents the attributes and attribute levels considered in the discrete choice experiment related to the selection of a transport mode for the visitation of a peripheral urban attraction. The choice context was introduced using two scenario attributes describing the type of tourist attraction (i.e., culture or nature) and its rating/promotion. In particular, the top 10 attractions visited and promoted on Visit Hong Kong (i.e., DMO website) are distinguished from the top 10 attractions listed on TripAdvisor. Moreover, trendy attractions promoted through the official destination promotion channel of Hong Kong are distinguished from off-beaten track attractions promoted on unconventional channels. Hence, this attribute distinguishes between direct promotion (i.e., DMO) and indirect promotion (user-generated review and third-party contents).

Table 1. Attributes and attribute levels

	Attribute levels	
Scenario attributes		
Tourist attraction	Nature	$Att.Type_0$ *(base level)*
	Culture	$Att.Type_1$
Rating tourist attraction	Top 10 attraction on TripAdvisor	$Att.Rating_0$ *(base level)*
	Top 10 attraction on Visit Hong Kong	$Att.Rating_1$
	Trendy attraction on Visit Hong Kong	$Att.Rating_2$
	Off-beaten attraction on unconventional sources	$Att.Rating_3$
Collective transport attributes		
First leg travel time	10 min; 20 min; 30 min; 40 min	TT_1 (metro)
Connecting transport	No information	$Con.Info_0$ *(base level)*
	Generic map	$Con.Info_1$
	Detailed map	$Con.Info_2$
	Pavement markings	$Con.Info_3$
Second leg travel time	10 min; 20 min; 30 min; 40 min	TT_2 (bus/minibus)
Alighting	No information	$Ali.Info_0$ *(base level)*
	Next stops on screen	$Ali.Info_1$
	Announcement for the attraction	$Ali.Info_2$
Total cost	10 HK$; 25 HK$; 40 HK$	TC
Taxi attributes		
Taxi travel time	15 min; 30 min; 45 min	TTT
Taxi travel cost	100 HK$; 200 HK$; 300 HK$	TTC

Scenario attributes are invariant across the four alternatives considered in the choice experiment, allowing a contextualization of the choice scenario. Meanwhile, alternative specific attributes for collective transport and taxi allow the differentiation across transport modes in the experimental setting. Two alternatives refer to the use of collective public transport and, considering the research context on peripheral urban attractions, involve the use of two means of transport, namely, the metro and either a bus or minibus. This setting reflects the typical combination of collective transport available to tourists at the destination under consideration, where metro stations are easily accessible from hotels and are used for the first leg of the itinerary which is then completed by either a double-decker bus (i.e., metro + bus) or a 16-seater minibus (i.e., metro + minibus). Apart from travel time and travel cost, the off-vehicle information (connecting transport) and in-vehicle information (alighting) of these alternatives are considered particularly important for tourists and are used as additional attributes to describe the combined (or intermodal) transport service. The levels for travel time and travel cost attributes were defined by considering the actual travel time and fare required to reach the most popular peripheral attractions while ensuring reasonable overall travel time. Considering that tourists are generally more familiar with the metro than the public bus, the experimental design included two separate attributes for mode-specific travel time to capture any differences in the perception of travel time across the transport modes. Information on connecting transport and alighting were drawn from an array of current practices implemented by local transport and tourism operators. In particular, the levels for the connecting transport attribute range from the absence of information to maps and pavement markings. For the alighting attribute, the experiment considered visual (on screen) and verbal (announcement) information, apart from the absence of information. The experiment assumes that the collective transport service grants immediate access to the attraction. A taxi alternative was included in the experiment and described by travel time and travel cost. The choice exercise also included a no-option alternative enabling the respondents to refrain from visiting the hypothetical attraction. Apart from the discrete choice experiment, other information was collected in the main survey, including tourist profile, travel characteristics, and perception toward the local public transport.

Scenario				
Type of attraction: Cultural attraction (e.g., historical site, architecture, and museum)				
Rating of attraction: Top 10 attraction on TripAdvisor				
	Metro + Minibus	**Metro + Bus**	**Taxi**	**No visit**
	First transport			
Travel time	40 minutes	30 minutes		
Connecting transport information	Detailed map	No information		
	Second transport			
Travel time	30 minutes	10 minutes		
Alighting information	Announcement for the attraction	Announcement for the attraction		
Taxi travel time			30 minutes	
Total travel cost	HK$ 25 (US$ 3.2)	HK$ 40 (US$ 5.1)	HK$ 100 (US$ 12.8)	
Which option you prefer?	○	○	○	○

Figure 2. Example of a choice card

The attributes and their levels were combined according to an efficient experimental design that maximizes the statistical properties of the discrete choice model estimates, although its generation requires previous knowledge of the parameter estimates (Rose & Bliemer, 2007). A pilot survey with 50 respondents tested the survey consistency and acquired preliminary information on the parameter estimates. Ultimately, the choice experiment used in the main survey focused on the estimate of main effects and consisted of 12 choice tasks generated through a D-efficient design with prior values derived from a multinomial logit model estimated on the pilot data. To reduce the length of the survey and limit respondent fatigue, the experimental design was randomly divided into two blocks of six choice tasks each and presented to the respondents accordingly. Figure 2 illustrates an example of the choice task.

Data collection for the main survey was conducted in the summer of 2019. The target survey population included individual inbound tourists to Hong Kong who had taken the local metro at least once. Tourists joining tour groups were excluded because they typically visit the destination through private tour buses. The exclusion of tourists with no previous experience with the metro ensured a minimum level of familiarity with the main transport system of the destination across the sample. A trained research assistant conducted computer-assisted personal interviews by randomly approaching potential respondents in main Hong Kong tourist areas.

Model specification

Data collected with the choice experiment were analyzed through discrete choice modeling. Discrete choice models are based on the random utility framework which postulates that a choice from finite and discrete alternatives is the result of utility maximization (McFadden, 1974). Hence, individuals are expected to choose the alternative associated with the highest level of utility. The utility for individual *n* associated with alternative *i* is derived as follows:

$$U_{ni} = V_{ni} + \varepsilon_{ni} = ASC_i + \sum_k \beta_k x_{ik} + \varepsilon_{ni} \ , \tag{1}$$

where V_{ni} represents the systematic part of the utility function composed of an alternative specific constant (ASC_i) and a linear combination of coefficients (β_k) and attributes (x_k). With the choice set consisting of *J* alternatives, one of the alternative specific constants must be normalized to zero, and the remaining *J-1* alternative specific constants are estimated. The unobserved part of the utility (ε_{ni}) is assumed to be independent and identically distributed following the extreme value type 1 distribution. Given the attributes considered in the choice experiment, the systematic part of the utility function for the four alternatives is specified as follows:

$$\begin{aligned}
V_{MMB} &= ASC_{MMB} + \beta_{TT_1} TT_1 + \beta_{TT_2} TT_2 + \beta_{TC} TC + \sum_k \beta_{Cont_k} Cont_k + \sum_k \beta_{Alig_k} Alig_k \\
V_{MB} &= ASC_{MB} + \beta_{TT_1} TT_1 + \beta_{TT_2} TT_2 + \beta_{TC} TC + \sum_k \beta_{Cont_k} Cont_k + \sum_k \beta_{Alig_k} Alig_k \\
V_{Taxi} &= ASC_{Taxi} + \beta_{TTT} TTT + \beta_{TTC} TTC \\
V_{No-visit} &= \beta_{Att.Type_1} Att.Type_1 + \sum_k \beta_{Att.Rating_k} Att.Rating_k
\end{aligned} \ , \tag{2}$$

where MMB and MB refer, respectively, to the “metro + minibus” and “metro + bus” alternatives, travel time is specified for the first (TT_1) and second (TT_2) legs of the combined collective transport as well as for the taxi alternative (*TTT*). Total cost is considered for both collective transport (*TC*) and taxi (*TTC*) alternatives. The proposed model specification assumes linearity among the levels of travel time and travel cost, whereas the categorical attributes reflecting the information on connecting transport ($Cont_k$) and alighting ($Alig_k$) were dummy coded. The scenario attributes associated with the type ($Att.Type_1$) and rating ($Att.Rating_k$) of the attractions were dummy coded and entered only in the no-visit option. Therefore, the proposed model specification reflects the interdependency of attraction quality and transport availability in the tourist choice to visit the attraction. That is, for most sought-after attractions, tourists are expected to exhibit a lower utility score of the no-visit option or, similarly, a higher level of tolerance for transport-related attributes.

In accordance with the conceptual framework, this research aims to capture three different sources of individual preference heterogeneity: unobserved heterogeneity, deterministic heterogeneity, and latent variable-induced heterogeneity. Unobserved heterogeneity refers to the random variation of preferences following a predefined statistical distribution, whereas the deterministic and latent variable-induced sources of heterogeneity are associated with destination familiarity (i.e., long-stay and repeat visitation) and perception of public transport at the destination, respectively. Given the inclusion of a latent variable among the sources of preference heterogeneity, this study relies on the estimation of an integrated choice and latent variable model, also called hybrid choice model. The hybrid choice model has become the widely adopted approach to account for latent psychological factors (e.g., attitudes and perceptions) in explaining observed choices (Ben-Akiva et al. 2002) and represents an interesting approach in the tourism research context (Kemperman, 2021). Considering that the hybrid choice model involves a discrete choice model component and a latent-variable model component, it provides an increased explanatory power to the choice process (Bolduc & Alvarez-Daziano, 2010).

The latent variable model component of the hybrid choice model consists of a structural equation explaining the latent variable with individual characteristics and a set of measurement equations assessing the relationship between the latent variable and the indicators used to measure it. The structural equation is specified through the following linear relationship:

$$\alpha_n = \tau_{\alpha_{n,LS}} z_{n,LS} + \tau_{\alpha_{n,RS}} z_{n,RS} + \eta_n \ , \quad (3)$$

where the estimated parameters $\tau_{\alpha_{n,LS}}$ and $\tau_{\alpha_{n,RS}}$ respectively capture the effect of the travel characteristics 'long-stay' ($z_{n,LS}$) and 'repeat visitation' ($z_{n,RS}$) on the perceptions toward local public transport (α_n), and η_n is an error term following the standard normal distribution. Thus, the structural equation component within the integrated model allows for the explanation of the latent perceptions toward local public transport through travel characteristics.

Latent constructs are measured through indicators that are manifestations of the latent variable. In recognizing the ordinal nature of Likert-scale type indicators typically used to measure the latent variable, recent studies (Hess, Spitz, Bradley, & Coogan, 2018; Song, Hess, & Dekker, 2018) advocated the adoption of an ordered specification. Thus, following Daly, Hess, Patruni, Potoglou, and Rohr (2012), the measurement equations herein were estimated through ordered logit regressions such that the likelihood of level *k* associated with an indicator is obtained as follows:

$$LI_{nk} = (s|\alpha_n) = \frac{e^{(\mu_{k,s} - \zeta_k \alpha_n)}}{1+e^{(\mu_{k,s} - \zeta_k \alpha_n)}} - \frac{e^{(\mu_{k,s-1} - \zeta_k \alpha_n)}}{1+e^{(\mu_{k,s-1} - \zeta_k \alpha_n)}}, \quad (4)$$

Where ζ_k measures the impact of the latent perception of public transport at the destination α_n on its two indicators I_s defined as "public transport in Hong Kong is convenient" and "public transport in Hong Kong is very accessible" and measured on a five-point agreement scale (1 = strongly disagree; 5 = strongly agree). The parameters $\mu_{k,s}$ are the estimated thresholds of the ordered logit regression with the normalization $\mu_{I_s,0} = -\infty$ and $\mu_{I_s,5} = +\infty$.

The discrete choice model component of the hybrid choice model incorporates different sources of preference heterogeneity. To account for the unobserved preference heterogeneity across the respondents, the discrete choice model coefficients are specified as random parameters (McFadden & Train, 2000), where the mean (β_k) and standard deviation (σ_k) coefficients for attribute *k* are estimated with the assumption that the preference heterogeneity follows a specific random distribution. Although the normal distribution is typically used in empirical applications (McFadden & Train, 2000), the selection of bounded or constrained distributions has been proposed in the literature (Hensher & Greene, 2003). Both normal and lognormal distributions were tested in the current application for the travel time and travel cost random parameters. Given that the two specifications produced similar model fit, the unobserved preference heterogeneity for the entire set of random parameters in the model was assumed to follow the normal distribution ($\xi_{\beta_{n,k}}$). The deterministic preference heterogeneity is captured by an additional set of estimated coefficients, $\gamma_{\beta_{n,k,LS}}$ and $\gamma_{\beta_{n,k,RS}}$ measuring respectively the effect of the travel characteristics 'long-stay' ($z_{n,LS}$) and 'repeat visitation' ($z_{n,RS}$) on the mean parameter. Both long-stay and repeat visitation are specified as binary variables. In particular, a tourist is considered as a repeat visitor if the current visit is at least the second visit to Hong Kong. Meanwhile, considering that the average length of stay in Hong Kong is around three nights (Hong Kong Tourism Board, 2020), long stays are defined in the current study as those exceeding three nights.

The latent variable is incorporated in the choice model component through an additive form. Considering the categorization of public transport in Hong Kong (Transport Department, 2020), the heterogeneity induced by the perceptions was integrated in the transport-specific attributes related to collective (i.e., "metro + bus" and "metro + minibus") and taxi alternatives. Thus, the following specification of the random parameters associated with transport-specific attributes is obtained:

$$\beta_{n,k} = \overline{\beta}_{n,k} + \sigma_{n,k}\xi_{\beta_{n,k}} + \gamma_{\beta_{n,k,LS}} z_{n,LS} + \gamma_{\beta_{n,k,RS}} z_{n,RS} + \lambda_k \alpha_{n,k} \, , \quad (5)$$

where λ_k captures the impact of the latent variable on the marginal utility coefficients. Consequently, the parameter λ_k measures the deviation from the mean associated with a change in the perception of local public transport.

Given that the respondents completed multiple choice tasks, the model specification accounts for the pseudo-panel structure of the data allowing for correlation among the choice observations recorded for each subject. Hence, the choice probabilities for the hybrid choice model are derived as follows:

$$P_{in} = \int_\alpha \int_\beta \prod_t \frac{e^{(V_{ni})}}{\sum_j e^{(V_{nj})}} \prod_s LI_{s,n}\, f(\alpha) f(\beta) d_\alpha d_\beta, \quad (6)$$

Where $t = 1,\ldots,T$ indicates the number of choice tasks, $s = 1,\ldots,S$ indicates the number of perception indicators, and $f(\alpha)$ and $f(\beta)$ relate to the density function associated with the random terms specified to follow the normal distribution. The integral in Eq. (6) has no closed form and must be approximated by using a simulation. Therefore, the model parameters are estimated by a simulated maximum likelihood procedure involving the simultaneous estimation of the likelihood of observed choices and the likelihood of indicators. A total of 2000 pseudo-random draws were used to approximate the integral. Model estimations in this study were performed with the software package Apollo (Hess & Palma, 2019).

Results

Sample description

Table 2 shows the descriptive statistics for the 516 respondents in the sample. According to Orme (1998), the estimation of a model with main effects from an experiment with a number *a* of alternatives (not including the no-option), *t* tasks and the highest number *c* of attribute levels, should guarantee that the result of the expression *nta/c* is greater than 500. This is equal to 2322 in the current application, thereby supporting the appropriateness of the sample size for the proposed discrete choice experiment.

Table 2. Descriptive statistics of the sample

	Frequency	Mean	Std. dev.
Gender			
Male	46.9%		
Female	53.1%		
Age			
16–25	14.5%		
26–35	43.0%		
36–45	30.2%		
46–55	9.9%		
56–65	1.9%		
65 or above	0.4%		
Traveling party			
Alone	7.6%		
Partner/Spouse	29.3%		
Friends	31.8%		
Family with kids	26.4%		
Relatives	5.0%		
Destination familiarity			
Long-stay (> 3 nights)	21.3%		
Repeat visit	19.6%		
Perception of public transport [(a)]			
Public transport in Hong Kong is			
Convenient		4.3	0.6
Very accessible		4.0	0.8

[a] Five-point scale (1 = Strongly disagree; 5 = Strongly agree).

Female travelers (53.1%) are slightly more represented than male travelers (46.9%), and most of the respondents (73.2%) are between 26 and 45 years old. This result is consistent with the demographic profile reported in the official statistics for overnight visitors in 2019 (Hong Kong Tourism Board, 2020). The majority of the respondents in the sample traveled with family or friends (87.5%), visited Hong Kong for the first time (80.4%), and expressed high interest in experiencing cultural diversity and visiting cultural and sightseeing attractions. The average length of stay of 2.9 nights is in line with the official statistics (Hong Kong Tourism Board, 2020) and most of the tourists in the sample stayed between two and five nights. In particular, about 21% of the respondents spent more than three nights at the destination. Approximately 20% of the sample had previously visited Hong Kong. On average, tourists in the sample consider the public transport in Hong Kong very accessible and convenient.

The data from the choice experiment are represented by 3096 choice observations (each respondent faced six choice tasks). The analysis of the descriptive statistics reveals that the combined public transport options were chosen in 2184 (70.6%) observations. Reflecting the actual aversion of tourists to take the public minibus due to its lack of out- and in-vehicle information, the combined public transport with the bus option (44.8%) results more popular than its counterpart with the minibus option (25.8%). The taxi alternative was preferred in 15.2% of the cases and the “no-visit” option was selected in 442 (14.3%) choice observations.

Model results

Initial analysis on the indicators used to measure the latent variable assessed the validity of the perception construct and its internal consistency. Principal component analysis on the two items

"Public transport in Hong Kong is convenient" and "Public transport in Hong Kong is very accessible" resulted in a single underlying component that explains 76% of the variation. Reliability analysis suggested a satisfactory scale reliability (Cronbach's α > 0.6) with a moderate inter-item correlation (> 0.3). This result suggests that the indicators could be used as valid proxies of the latent variable associated with tourists' perceptions of public transport in Hong Kong.

Table 3. Hybrid choice model results

Latent variable component					
Measurement eqs.	Indicator I_1[(1)]	Indicator I_2[(2)]			
	Coeff. (Prob.)	Coeff (Prob.)			
Perception of PT	3.362 (0.000)	1.927 (0.000)			
t_1		–7.457 (0.000)			
t_2		–4.220 (0.000)			
t_3	–6.290 (0.000)	–2.455 (0.000)			
t_4	0.448 (0.075)	1.139 (0.000)			
Structural equation	Coeff. (Prob.)				
Long stay	–0.480 (0.000)				
Repeat visit	–0.353 (0.007)				
Choice model component					
	Coeff. (Prob.)	σ (Prob.)	$\gamma_{long\ stay}$ (Prob.)	γ_{repeat} (Prob.)	λ (Prob.)
$ASC_{Metro + Bus}$	8.095 (0.000)				
$ASC_{Metro + Minibus}$	7.805 (0.000)				
ASC_{Taxi}	13.559 (0.000)				
$Att.Type_1$	–2.218 (0.000)	1.744 (0.004)	–0.841 (0.241)	1.376 (0.067)	
$Att.Rating_1$	–6.049 (0.053)	3.781 (0.011)	4.923 (0.005)	0.362 (0.817)	
$Att.Rating_2$	5.038 (0.000)	2.510 (0.000)	0.862 (0.222)	–2.331 (0.005)	
$Att.Rating_3$	4.972 (0.000)	3.788 (0.000)	–0.755 (0.46)	–1.434 (0.147)	
TT_1 (metro)	–0.083 (0.000)	0.037 (0.000)	0.030 (0.085)	0.001 (0.946)	–0.009 (0.238)
TT_2 (bus/minibus)	–0.108 (0.000)	0.075 (0.000)	0.037 (0.059)	0.033 (0.087)	–0.056 (0.000)
$Con.Info_1$	1.124 (0.000)	0.659 (0.107)	–0.750 (0.108)	–0.057 (0.902)	0.508 (0.030)
$Con.Info_2$	0.534 (0.060)	1.175 (0.000)	–0.840 (0.086)	–0.305 (0.526)	0.909 (0.000)
$Con.Info_3$	1.595 (0.000)	0.065 (0.811)	–0.742 (0.002)	–0.180 (0.457)	0.251 (0.044)
$Ali.Info_1$	4.079 (0.000)	0.133 (0.501)	–1.612 (0.000)	–1.459 (0.001)	1.660 (0.000)
$Ali.Info_2$	2.938 (0.000)	0.003 (0.988)	–0.993 (0.011)	–1.245 (0.002)	1.760 (0.000)
TC	–0.084 (0.000)	0.024 (0.000)	0.010 (0.281)	0.008 (0.396)	–0.018 (0.000)
TTT	–0.093 (0.001)	0.114 (0.000)	0.010 (0.783)	–0.061 (0.083)	0.021 (0.285)
TTC	–0.062 (0.000)	0.010 (0.063)	–0.002 (0.773)	0.006 (0.305)	–0.004 (0.165)
Log-likelihood					
Choice	–2.695.86				
Full model	–3.633.37				

(1) I_1 = Public transport in Hong Kong is convenient.
(2) I_2 = Public transport in Hong Kong is very accessible.

Table 3 presents the estimation results from the hybrid choice model. The estimates for the two components of the model, namely, the latent variable and discrete choice models, are discussed in the following sections. Probabilities refer to two-tailed t-tests.

Latent variable model component

Results from the measurement equations reveal the relation between the latent variable and the indicators used to measure the corresponding latent construct. The positive coefficients associated with the latent variable α ("Perception of PT") imply that an increased value in the perception of local public transport leads to a higher probability of agreeing to the indicator by respondents. Given that no responses were provided for Levels 1 and 2 of Indicator 1 ("Public transport in Hong Kong is convenient"), only two threshold parameters were estimated, as already proposed by Song et al. (2018). Although the low variability in Indicator 1 might create identification problems, the estimation of models without the latent variable provided stable results in terms of sign and magnitude of the model parameters. Moreover, the uneven gaps between the threshold parameters confirm the necessity of the ordered specification in measuring the latent variable (Song et al., 2018). The estimated parameters of the structural equation explain public transport perceptions deterministically by the predefined segments, long-stay and repeat visitation. The negative signs of the parameters for long-stay and repeat tourists (–0.480 and –0.353, respectively) suggest that these segments have less favorable perceptions toward public transport in Hong Kong.

Choice model component

Results of the choice model component of the hybrid choice model are presented in the lower panel of Table 3. Alternative specific constants are estimated for the three transport options considered in the choice experiment ("metro + minibus," "metro + bus," and "taxi") and express the overall preference for the transport alternatives over the no-visitation option. Mean and standard deviation values are estimated for each parameter in the model, except for the alternative specific constants. For the metric alternative attributes (e.g., travel time and travel cost), the mean estimates reflect the average change in the utility function as a result of a unit increase in the attribute value. For the categorical alternative attributes "connecting transport" and "alighting," the mean estimates are interpreted with respect to the base attribute level expressing the absence of information. The categorical scenario attributes "tourist attraction" (base level: nature) and "rating attraction" (base level: top 10 attraction on TripAdvisor) are entered in the utility function associated with the no-visitation option (see Eq. [2]). Hence, their coefficients are interpreted with respect to the intention of not visiting the tourist attraction. The standard deviation parameters indicate unobserved preference heterogeneity.

The alternative specific constants for the public transport options ($ASC_{Metro + Bus}$, $ASC_{Metro + Minibus}$) are statistically significant and positive. In particular, the no-visitation option is less likely to be selected if the scenario involves the visitation to cultural ($Att.Type_1$), as opposed to natural, tourist attractions. Furthermore, the choice to visit the attraction significantly depends on how the attraction is rated and promoted. Compared to the 10 top-rated attractions on TripAdvisor, the counterparts promoted on the DMO website ($Att.Rating_1$) are associated with a higher probability of visitation. By contrast, trendy ($Att.Rating_2$) and off-beaten ($Att.Rating_3$) attractions are less likely to be visited compared to TripAdvisor's top 10 list. Therefore, as expected, the opportunity to engage in cultural top-rated attractions is associated with a higher tolerance level for transport-related attributes. The specification of deterministic heterogeneity indicates that long-stay tourists have a higher preference for attractions listed on TripAdvisor than those promoted on the official DMO website. Repeat tourists exhibit a lower preference dominance for attraction type and attraction rating than first-time tourists as well as a higher interest for natural attractions and trendy attractions.

Travel time and travel cost estimates for taxi (TTT and TTC) and collective transport (TT_1 (metro), TT_2 (bus/minibus) and TC) have negative signs, thereby indicating a decrease in utility for transport options with longer travel time and higher travel cost. In terms of travel time for the combined collective transport options, the respondents are statistically more sensitive to changes in the bus or minibus transport segment than in the metro counterpart (mean coefficients equal to, respectively, −0.108 and −0.083; t-ratio = 1.66, sig. < 0.10). For transport cost, tourist sensitivity toward the fare for public transport (mean coefficient equal to −0.084) is higher than their sensitivity to taxi fare (mean coefficient equal to −0.062). The estimates related to the deterministic heterogeneity suggest that long-stay tourists are less sensitive than short-stay ones to public transport travel time, and repeat tourists are less sensitive than first-time tourists to (mini)bus travel time and more sensitive to taxi travel time. The result of the latent-variable induced heterogeneity indicates that a high perception of public transport is associated with a high sensitivity toward (mini)bus travel time and cost. Given the significance of both deterministic and latent-induced sources of heterogeneity, the results indicate the presence of a distinctive categorization in the sensitivity for the minibus and bus travel time. Hence, for a perception of public transport equal to the average level in the sample, and assuming a constant differential effect across the categories of the two binary variables ‘long-stay’ ad ‘repeat visitation’, first-time tourists staying less than four nights have the highest sensitivity for minibus and bus travel time (−0.108). First-time tourists staying more than three nights and repeat tourists staying less than four nights exhibit a similar sensitivity, respectively −0.071 and −0.075, whereas repeat tourists staying more than three nights are associated with the smallest sensitivity (−0.038) for minibus and bus travel time.

In terms of finding connecting transport at stations and in-vehicle information provided to tourists, the positive estimated parameters suggest a preference for information provided to tourists as opposed to no information. Interestingly, generic maps ($Con.Info_1$, mean coefficient equal to 1.124) are preferred over detailed maps ($Con.Info_2$, mean coefficient equal to 0.533), whereas directions marked on the pavement ($Con.Info_3$) provide the greatest utility to tourists. For the alighting information in the second segment of the intermodal transport service, tourists prefer speaker announcements ($Ali.Info_2$) and, to a greater extent, displayed visual information ($Ali.Info_1$), as opposed to no information. Regarding deterministic heterogeneity, long-stay tourists are less sensitive to connecting and alighting information than short-stay tourists, and repeat tourists are less sensitive to alighting information than first-time tourists. As for the latent variable-induced heterogeneity, tourists with high perception of public transport have a high sensitivity toward any type of information. As observed for minibus and bus travel time, the results indicate a distinctive categorization for alighting information across tourists with different destination familiarity as well as with different perception of the public transport at the destination.

Logsum accessibility

The model estimates allow the calculation of the logsum accessibility, defined as the natural logarithm of the expected utilities associated with the alternatives in the choice set $\left(ln \sum_j e^{(V_{nj})}\right)$. Considering the specification of the no-visit option in the current application, the accessibility measure is specified as the difference between the logsum of the utilities associated with the j transport alternatives and the utility associated with the no-visit option $\left(ln \sum_j e^{(V_j)} - V_{No-option}\right)$. Table 4 reports an illustrative example demonstrating the derivation of average measures of logsum accessibility in a basic scenario consisting of two peripheral attractions accessed from two specific locations (e.g., districts, hotels). Location *A* is equally distant from the two attractions and the journey implies a travel time between 30 and 50 minutes depending on the means of transport. Instead, location *B* is relatively more distant from attraction 1 (between 45 and 70 minutes) but closer to attraction 2 (between 15 and 40 minutes).

Following the specification of the random parameters in Equation (5), and assuming an average perception toward public transport, the mean of the parameters is calculated by taking into consideration the deterministic heterogeneity associated with tourist length of stay and repeat visitation. The systematic utilities V_{ni} in Equation (2) are then calculated for specific levels of the alternative attributes and scenario attributes allowing the computation of average logsum accessibility measures for different categories of tourists (Table 4). As expected, attraction 1 has a higher accessibility from location *A* whereas location *B* is associated with a higher accessibility to attraction 2. However, the assessment of accessibility differs across the four tourist categories. The largest gap in the accessibility to the two attractions is registered for short-stay first-time tourists in location *A* where attraction 1 is considered five times more accessible than attraction 2 (i.e., 13.5 versus 2.5). Instead, the accessibility to the two attractions is considered approximately the same (about 6.2) by long-stay repeat tourists in location *B*. Overall, location *A* is associated with a higher accessibility to the two peripheral attractions than location *B* in each group of tourists except for long-stay first-visit tourists that register approximately the same accessibility (about 12.5) from both locations.

Table 4. Example of average logsum accessibility measures

	Location A				Location B			
	Attraction 1		Attraction 2		Attraction 1		Attraction 2	
Attraction Type	Culture		Culture		Culture		Culture	
Attraction Rating	Top 10 on DMO		Off-beaten		Top 10 on DMO		Off-beaten	
Combined transport	*Bus*	*Minibus*	*Bus*	*Minibus*	*Bus*	*Minibus*	*Bus*	*Minibus*
First leg travel time	20 min	20 min	20 min	20 min	30 min	30 min	10 min	10 min
Connecting transport	No info	No info	No info	No info	No info	No info	No info	No info
Second leg travel time	30 min	20 min	30 min	20 min	40 min	30 min	30 min	20 min
Total cost	25 HK$	25 HK$	25 HK$	25 HK$	40 HK$	40 HK$	10 HK$	10 HK$
Alighting	Screen	No info	Screen	No info	Screen	No info	Screen	No info
Taxi Travel time	30 min		30 min		45 min		15 min	
Taxi Travel cost	200 HK$		200 HK$		300 HK$		100 HK$	
Accessibility measure								
Short-stay first visit	13.5		2.5		10.3		4.8	
Long-stay first visit	9.9		4.5		7.5		6.4	
Short-stay repeat visit	11.6		2.4		8.9		4.5	
Long-stay repeat visit	8.1		4.5		6.2		6.2	

Conclusions

Tourism in urban destinations is typically characterized by short stays (Ashworth & Page, 2011) and high demand for primary tourist attractions (Lau & McKercher, 2007). This form of urban tourism enables tourists to experience the urban vibe of destinations and visit their highlight attractions, but urban destinations have considerably more to offer. DMOs have started to increasingly promote a wide range of tourist attractions, including emerging or trendy attractions and rural or natural attractions in the attempt to spread tourists to less-visited peripheral attractions (Su, Spierings & Hooimeijer, 2020). This effort may drive tourists to experience an extensive variety of attractions and increase the positive economic impact of tourism in less popular tourist attractions. Nevertheless, visitation to peripheral attractions often requires tourists to engage in multiple modes of public transport, unless they opt for the more expensive taxi option. Assessing the accessibility of peripheral attractions from the perspective of tourists is therefore crucial. This study considered the four components of accessibility (land-use, transportation, temporal, and individual) and proposed a framework to assess utility-based tourist accessibility to peripheral tourist attractions.

A discrete choice experiment was designed to investigate tourist preferences toward transport services for the visitation of peripheral attractions. A hybrid choice model was estimated to analyze tourist preferences with respect to different types and ratings of tourist attractions (i.e., land-use component) and the key characteristics of collective and individual public transport alternatives (transportation component) and investigate the moderating role of travel characteristics and tourist perceptions (temporal and individual components). The main theoretical contribution of this research lies in its conceptual and methodological approach. The desirability and flexibility of the utility-based approach is used to link the four components of accessibility into a unique framework for the analysis of tourist accessibility. The model results provide empirical evidence for the relevance of preference heterogeneity, whether unobserved, deterministic, or latent variable-induced, in the modeling of tourist accessibility to peripheral urban attractions. The derivation of the utility-based accessibility measure from the model results is further presented through an illustrative example.

The findings of this study facilitate the elaboration of several practical and managerial implications. First, the results confirm the importance of the type and rating of the tourist attractions in the decision to travel to peripheral attractions. The adoption of strategic promotions launched by institutional tourism organizations could provide benefits to peripheral attractions and further exploit the potential demand for a larger set of tourist attractions. For example, DMOs could nudge tourists by including a selection of peripheral attractions in the "must-see" category and rotate them according to thematic or natural seasons. Second, tourists exhibit a general tendency to ascribe a higher disutility to travel time spent in a bus or minibus than to metro travel time. This result may be explained by the general familiarity that tourists have with the metro relative to the bus and minibus services. Collaboration between DMOs and transport companies could facilitate the identification of lengthy bus segments and explore the possibility to shorten the travel time with the provision of special services catered mainly for tourists. Third, although tourists prefer pavement markings to help them transition between the first and second legs of the combined public transport, detailed maps are not preferred over generic maps. This finding could be explained by the excessive amount of information included in detailed maps that can disorient tourists. DMOs should incentivize the use of simple maps displayed at the exit of metro stations. The maps should clearly indicate the direction to the connecting transport and report only essential information. Fourth, although tourists appreciate verbal in-vehicle announcements alerting the arrival at attractions, a high level of utility is registered for visual information displayed in monitors. The ability to have constant control over the information displayed in monitors may reassure tourists, although verbal announcements provide a feeling of easy travel. DMOs could partner with local transport companies to install in-vehicle monitors displaying the next stops and announcing the arrival at specific tourist attractions. This aspect is particularly relevant for the minibus transport service in Hong Kong, which is currently characterized by lack of in-vehicle information. Fifth, the deterministic heterogeneity observed for the attributes related to bus and minibus travel time and alighting information indicates the presence of different groups with distinctive preference sensitivity depending on the destination familiarity. The sensitivity to bus and minibus travel time and alighting information is further intensified with the increase of tourist perception of the local public transport. That is, tourists with a positive perception of local public transport have high expectation about the performance and quality of the transport service. Moreover, long-stay and repeat tourists are likely to have low perception of the public transport in Hong Kong. A reasonable explanation might be due to the fact that these tourists, being exposed to the destination for longer or multiple periods, have a higher awareness of the difficulties to engage with local bus and minibus. This result should further motivate local transport providers to make the transport service, especially the local bus and minibus, more tourist friendly.

The proposed framework can be generalized to any other urban or regional context subject to ad-hoc customization to reflect the typology of different destinations. Extensions can also be implemented by integrating elements related to any of the accessibility components, and we call for future studies in this direction. An interesting integration of the proposed model regards the investigation of interaction effects between attraction-specific attributes and transport-specific attributes. Further investigations in the model specification could focus on the assessment of non-linearity among the levels of travel time and travel cost. Considering that important transport dimensions such as affordability, multimodal connectivity, and travel information are neglected in urban transport plans (Boisjoly & El-Geneidy, 2017), increasing awareness of tourist accessibility in urban destinations becomes particularly relevant. In this context, we acknowledge that only a single aspect of tourist perception has been investigated in the present study and other attitudinal and perceptual aspects related to the transport (e.g., environmental attitudes) and destination (e.g., destination image) could be integrated in future studies. From a policy perspective, a natural continuation of this work is to develop case studies aimed at assessing the overall tourist accessibility of peripheral attractions from different districts of the destination. Ultimately, an increased attention to tourist needs in relation to accessibility to peripheral attractions could provide short- and long-term benefits. The former is in the form of tourist satisfaction, and the latter is in the form of the destination image and economic sustainability of peripheral tourist attractions.

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