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Investigating the impact of Sense of Place on site visit frequency with non-motorized travel modes

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ABSTRACT

This paper examines the relationships between: (i) Sense of Place (SOP); (ii) non-motorized travel; and (iii) the use of information and communication technologies (ICT). A guiding principle in built environment design for sustainability and livability is a latent construct termed Sense of Place (SOP), which leads visitors to perceive and associate a strong identity or character with a particular location. We hypothesize that visitors' SOP affects their access of sites via walking/biking or other non-motorized travel modes. Furthermore, we also hypothesize their ICT use shapes their SOP. In an information era, mobile ICT provide ubiquitous information and communication across multiple geographies, expanding interaction with locations to include both the physical and virtual. Visitors can engage with a location pre and post-trip through online reviews or virtual visualizations, such as Google Street View. To investigate these interrelationships, we conduct a visitor intercept survey and analyze the responses to investigate the direction and magnitude SOP impacts on non-motorized site visit frequency. The estimation results indicate that SOP statistically impacts non-motorized visits; ICT use for learning about the site was found to positively impact visitors' estimated SOP.

1. Introduction

Increasingly geographers and urban planners focus on building livable communities that benefit community well-being. Livable communities require a *Sense of Place* (SOP), which characterizes human relationships with the natural and built environments. Locations with a strong SOP can facilitate visitors in building lasting connections with their environments. SOP has gradually entered several planning dialogues, from local municipalities and neighborhoods (Soini et al., 2012; Tester et al., 2011) looking to improve livability to international discussions on ecology and the environment (Newman and Jennings, 2012). Common applications include urban space design (Billig, 2005, Deutsch, 2013) and natural resource management (Brown and Raymond, 2007). Furthermore, the United Nations Environmental Program (UNEP) identifies SOP as an essential feature of sustainable environments, including aspects of the surrounding ecosystem (Newman and Jennings, 2012). From the perspective of the natural environment, a strong SOP may encourage or strengthen commitment and environmental stewardship towards a given place, such as national park (Williams and Stewart, 1998).

In this study, we investigate the interrelationships between: (i) Sense of Place (SOP); (ii) non-motorized site visit frequency; and (iii) the visitors' use of information and communication technologies (ICT) for gaining site information. The literature (Beidler, 2007; Stedman, 2003a, 2003b) agrees on the importance of following broad SOP components: (i) physical characteristics; (ii) human activities taking place and (iii) user perceived affects and meanings. We extend these components and also consider visitors' ICT use to interact with the location online. We also examine the impact of SOP on site visits and non-motorized access travel mode, such as walking and biking. We hypothesize that visitors' ICT use may shape their SOP by allowing interaction with the site online. This virtual interaction comes in many forms, from reading online reviews from other visitors to more directly interacting through Google Street View. Ubiquitous access to the site online may further affect visitors' SOP, although the interaction is only virtual. Additionally, a strong SOP may encourage non-motorized access to sites, allowing direct exposure to the environment. We address the following research questions:

1) Is there a relationship between visitor access of information about a location through ICT and their *Sense of Place*?
2) Does *Sense of Place* affect a visitor's non-motorized site visit frequency, for example by walking or biking?

To address these questions, we conduct a visitor intercept survey to model and estimate visitors' SOP perception with respect to several

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attitudinal indicators and site visit frequency. This work extends the existing literature on SOP by: (1) broadening previous components to include travel mode access and ICT adoption; (2) developing a framework for measuring SOP and quantifying its relationship to other dimensions; and (3) identifying the most salient SOP attitudinal factors as perceived by visitors.

We have two main hypotheses in this study. One hypothesis is that increase in mobile ICT use, recently, impacts visitors' underlying SOP. We argue that ICT has evolved to a point where online users can "visit" the sites without physically traveling to them. Existing examples include online museum sites which offer visitors access to many artworks via their mobile app. For neighborhoods, Google Street View offers views from the streets without physically visiting these locations. Second, we also hypothesize that non-motorized and sustainable travel access to sites can strengthen SOP development relative to personal auto, due to the direct exposure to the environment. Even for transit travel modes, riders can sit and observe the passing environment, as opposed to driving which requires focus on vehicle operations and wayfinding.

The next section discusses the literature related to SOP and its measurement. The following section presents the data collection effort and sample characteristics, followed by the model formulation. After a presentation and discussion of estimation results, this paper summarizes the main findings and future research directions.

2. Background: perspectives on Sense of Place (SOP)

Sense of Place (SOP) continues to play an important role in urban redevelopment and community-focused built environment design. From the perspective of geographers and planners, identifying the main factors driving SOP and measuring them can improve environmental design to ensure the site contributes positively to SOP and promotes sustainability and livability. For example, if a social atmosphere contributes positively towards SOP, then designers and planner may plan and allocate more space towards facilitating socializing. The majority of the literature in geography and anthropology consists of studies based on introspective, observational and theoretical writings, but not location specific, and indicates the challenge in defining SOP (Ryden, 1993; Seamon, 2014; Beidler, 2007, Beidler and Morrison, 2016). While theories and definitions vary, the literature shows consensus on three broad components: (i) the physical setting; (ii) activity within the setting and (iii) meaning associated with the setting, all of which are intertwined. We consider social interactions a sub-category of (ii) human activity, similar to Stedman (2003a, 2003b).

2.1. Definitions and concepts

Both human and physical dimensions comprise SOP (Stedman, 2003a, 2003b). Human dimensions find their basis in attitude theory (Deutsch, 2013; Stedman, 2003a, 2003b; Tapsuwan et al., 2011). With respect to SOP, researchers in the literature consistently characterize SOP along three dimensions (Jorgensen and Stedman, 2001). (i) *Place Attachment* indicates an affective positive bond between visitors and their environment (Low and Altman, 1992). (ii) *Place Dependence* measures the perceived strength of association between visitor and place (Stokols and Shumaker, 1982). (iii) *Place Identity* represents visitors' personal identity in relation to the environment (Proshansky et al., 1983, Proshansky, 1978). Other identified dimensions in the literature include *Place Satisfaction*, *Social* and *Place Aesthetics*. *Place Satisfaction* refers to a summary judgment on the perceived quality of a place/environment (Mesch and Manor, 1998). *Social* follows from a social atmosphere, the level of crowdedness, amount of activity, safety, the level of (general) friendliness to visitors and safety in walking around (Deutsch, 2013, Deutsch and Goulias, 2013, Deutsch and Goulias, 2009, Deutsch and Goulias, 2012). *Place Aesthetics* includes views on architecture, the beauty of the place, the balance of decorative and functional attributes, artistic value, peaceful and relaxing atmosphere.

While each dimension is important from the visitors' perspectives, the design practice and literature disagrees on which dimension weighs more for encouraging SOP, with some advocating the physical environment over activity facilitation or associated meaning (Jackson, 1994). The literature also disagrees on the role of time (Tuan, 1979). While long-term association with the place is necessary, some researchers argue that time erodes the acute awareness experienced, leading to increasing insensitivity towards a place.

Second, with respect to associating SOP with non-motorized travel few studies exist. Complete streets design guides focus on accommodating multi-modal and non-motorized travel, but do not directly indicate improvement in SOP as a result of these designs (Burden and Litman, 2011; Rue et al., 2017). In the literature, researchers have modeled SOP and included it as an explanatory variable for travel choice modeling. Zandvliet et al. (2006) studied *Place Identity* and its relation to destination choices in the Netherlands. Recently, a large body of research from University of California, Santa Barbara explore many trip-making facets of visitors (arrival time, mode, frequency, sequence of activities, companionship, and long-distance travel) and SOP at two malls in Santa Barbara, CA (Deutsch, 2013, Deutsch and Goulias, 2013, Deutsch and Goulias, 2012). One result from Deutsch and Goulias (2013) is that satisfaction with the amount of people at the location (*Place Satisfaction*) positively impacts the likelihood of walking. In this study, we focus exclusively on non-motorized travel which exposes the traveler to the surrounding environment, compared to auto travel. We hypothesize this exposure may impact visitors' SOP. Curiously missing from the literature on travel and SOP are network effects, such as the connectivity or accessibility of locations. These may play important roles in shaping SOP, especially for visitors residing far from the location of interest.

Research on the intersection of ICT use and SOP is virtually nonexistent in the literature, despite the widespread market penetration of personal mobile ICT. While past studies leverage data collected through mobile ICT to infer SOP (Sekar et al., 2017; Schwartz, 2015; Dias et al., 2013; Oz and Temizel, 2015), few studies examine how ICT use impacts SOP. The geography literature has long examined the concept of virtual geographies, but not the relationship between SOP and these virtual environments (Miller and Horst, 2013; Crang et al., 1999; Batty, 1997; Graham, 1998). Recently, Bork-Hüffer (2016) interviewed 30 German professionals in Singapore on their digital media choices and use during their relocation and settlement process. She develops a theoretical model on how digital and offline places combine in the construction of Sense of Place (SOP), and how the digital sphere affects engagements with place attachment. However, this model was based on personal interviews, and did not quantitatively assess SOP. We contribute to this growing body of geography literature on the digitization of places and quantify the impact of ICT use on SOP.

2.2. Methodology approaches for assessing Sense of Place (SOP)

With respect to evaluation methods, researchers used both qualitative and quantitative methods. Qualitative approaches, which dominate the literature, investigate the meaning in personal experiences from the study participants (Hammersley, 1992; Taylor and Bogdan, 1998). These methods include visitor interviews that engage the community with face-to-face conversation and photos of the location (Bork-Hüffer, 2016; Kyle and Chick, 2007; Stedman et al., 2004).

Data-driven quantitative approaches have seen limited application in studying SOP (Pretty et al., 2003). These studies adopt a multi-dimensional perspective, examining the strength of each dimension for a particular location. One notable study is Stedman (2003a, 2003b) who develops a direct-effects model based on Likert-scale response to affective dimensions of SOP, but rejects this model based on poor fit with collected data. These studies typically use intercept surveys

containing Likert scale attitudinal statements as indicators for these dimensions (Stedman, 2003a, 2003b). Econometric models estimate the strength of each statement response towards each dimension. Factor analysis has also been used to relate a latent construct interpreted as SOP with other observed exogenous variables, such as trip frequency (Deutsch and Goulias 2014, Deutsch, 2013; Tapsuwan et al., 2011; Jorgensen and Stedman, 2001; Lee et al., 2015). While less common, increasingly the researchers are turning to data-mining methods for assessing SOP (Schwartz, 2015). Dias et al. (2013) analyzed online reviews of vacation rentals in Portugal through a heuristic approach. They identified broad themes that describe the surrounding landscape and associated leisure activities based on online recommendations for visitors. In another study, Oz and Temizel (2015) qualitatively analyzed FourSquare reviews from Turkey to identify parts of speech indicating *Place Attachment*. Recently, Sekar et al. (2017) employ topic analysis methods to analyze text reviews on Yelp and TripAdvisor for various locations in Rochester, NY.

The methodology used in this study has two main components: (i) a visitor intercept survey tool for collecting behavioral response and attitudinal information related to SOP and (ii) an integrated model relating latent constructs that collectively indicate Sense of Place with observed travel mode choices. Attributes pertaining to the decision-maker, the location or setting, trip-making, the travel modes available and ICT adoption will also be included in the estimation and final model to the extent possible. The data collection effort and sample characteristics are discussed next.

3. Data collection and sample characteristics

To investigate the interrelationships among (i) Sense of Place (SOP), frequency of (ii) non-motorized site access and (iii) site visits, and (iii) ICT use, we design and conduct a visitor intercept survey at three sites in Rochester, NY. This survey collects data for assessing visitors' SOP with respect to several attitudinal dimensions. Additionally, we collected respondent socio-economic and travel characteristics. We collect the following types of information: (i) respondent personal and household attributes; (ii) travel characteristics; (iii) ICT use; and (iv) responses to attitudinal statements relating to Sense of Place (SOP).

3.1. Site selection and characteristics

For this study, we selected three neighborhood sites in Rochester, NY that vary in their design elements. All three sites were mixed-use developments with a blend of residential and commercial land uses. The chosen sites were East End (EE), College Town (CT) and Rochester Public Market (RPM). These three sites differed with respect the centralized versus decentralized planning efforts. College Town was planned centrally and deliberately; the development follows a strict strategic guideline. RPM, in contrast, experienced decentralized planning with no strategic guidance in terms of design and development over time. EE lies between RPM and CT, with portions well planned, such as the Eastman Music School campus, and portions more organic, like RPM. Finally, all three sites differed in their urban fabric, which depends on the building massing, architecture style, and streetscape; the relationship between built and void objects characterizes urban fabric. Chen (2017) document these design differences between these three sites. A map of Rochester indicating these sites is shown below in Fig. 1. Additionally, photographs of main streets or walkways for each of these sites are shown below in Figs. 2, 3 and 4.

3.2. Collection and on-site visitor intercept logistics

The research team conducted all intercept surveys on site during the months of September, October and November 2015. We selected these months due to the high visitation rates to all three sites in the fall relative to other seasons. During the winter months, bicycle and walking access to all three sites severely decreases, relative to warmer months. Additionally, the EE and CT experience lower visitation rates during summer months due to summer break for educational institutions in Rochester. We discuss data collection at each site next.

3.2.1. Rochester Public Market (RPM)

For RPM, the team conducted all surveys on Saturdays (10/10/2015 and 10/24/2015) between 9 AM and 2 PM and on Thursday (10/8/2015) between 9 AM and 11 AM. Each respondent received a $5 food token for completing the survey. At the RPM, a dedicated tent was available for locating student assistants conducting the survey. The market administrators made a public announcement every hour at RPM. The weather on these days was sunny, with the temperature range between 55 degrees and 65 degrees Fahrenheit.

3.2.2. East End (EE)

For East End, the team conducted all surveys between 4 PM and 7 PM on a Tuesday (10/27/2015; 11/3/2015), Thursday (10/29/2015; 11/5/2015) or Friday (10/30/2015). These dates coincide with “Taco” and “Trivia” nights at the Temple Bar and Grille. Each respondent received a $4 food token for completing the survey. At the EE, since the neighborhood was unsafe in some parts, the team conducted the survey at Temple Bar and Grille, a neighborhood food and drink establishment. The owner of Temple Bar and Grille was the president of the East End neighborhood business association; visitors represented community members of the East End well. The weather on these days was cloudy, with the temperature range between 45 degrees and 60 degrees Fahrenheit. However, the majority of surveys were conducted indoors.

3.2.3. College Town (CT)

For CT, survey intercepts occurred in the afternoons on Monday (10/19/2015), Wednesday (10/21/2015) and Friday (10/23/2015) between 1 PM and 5 PM, and on Saturday (10/31/2015) morning between 9 AM and 12 PM. At CT, due to administrative difficulties, the team conducted the survey at Saxby's coffee shop and at the Barnes and Noble Bookstore, which serves university bookstore for University of Rochester. Each respondent received a $3 gift card to Saxby's for completing the survey. The research team conducted the intercept survey, with each student research assistant working one or more three hour shifts on the weekdays and weekends. The weather on these days was cloudy, with the temperature range between 55 degrees and 65 degrees Fahrenheit. However, the majority of surveys were conducted indoors.

We developed the survey in Survey Monkey, an online service for implementing and administering surveys. Additionally, each team member administered the survey from a tablet with internet access at the time of visitor intercept. Each student engaged with visitors using a pre-written script; student research assistants presented and obtained informed consent information orally. All student research assistants handling the data completed Human Subject Training as required by the institutional Internal Review Board (IRB).

3.3. Survey structure and information collected

The survey instrument designed collects three broad types of information from actual visitors to the sites. First, respondents faced a series of attitudinal statements related to SOP, and disagreed or agreed with the statement based on a seven point Likert scale. Second, we collected data on ICT use, specifically visitor habits regarding accessing online information about locations and leaving reviews or feedback. Finally, we collected personal and household attributes to help identify specific market segments, including travel and site visit characteristics.

3.3.1. Attitudinal statements

With respect to measuring SOP, we model SOP as a latent construct characterized by responses to attitudinal statements that serve as measurements for SOP, similar to other studies (Deutsch et al. 2011;

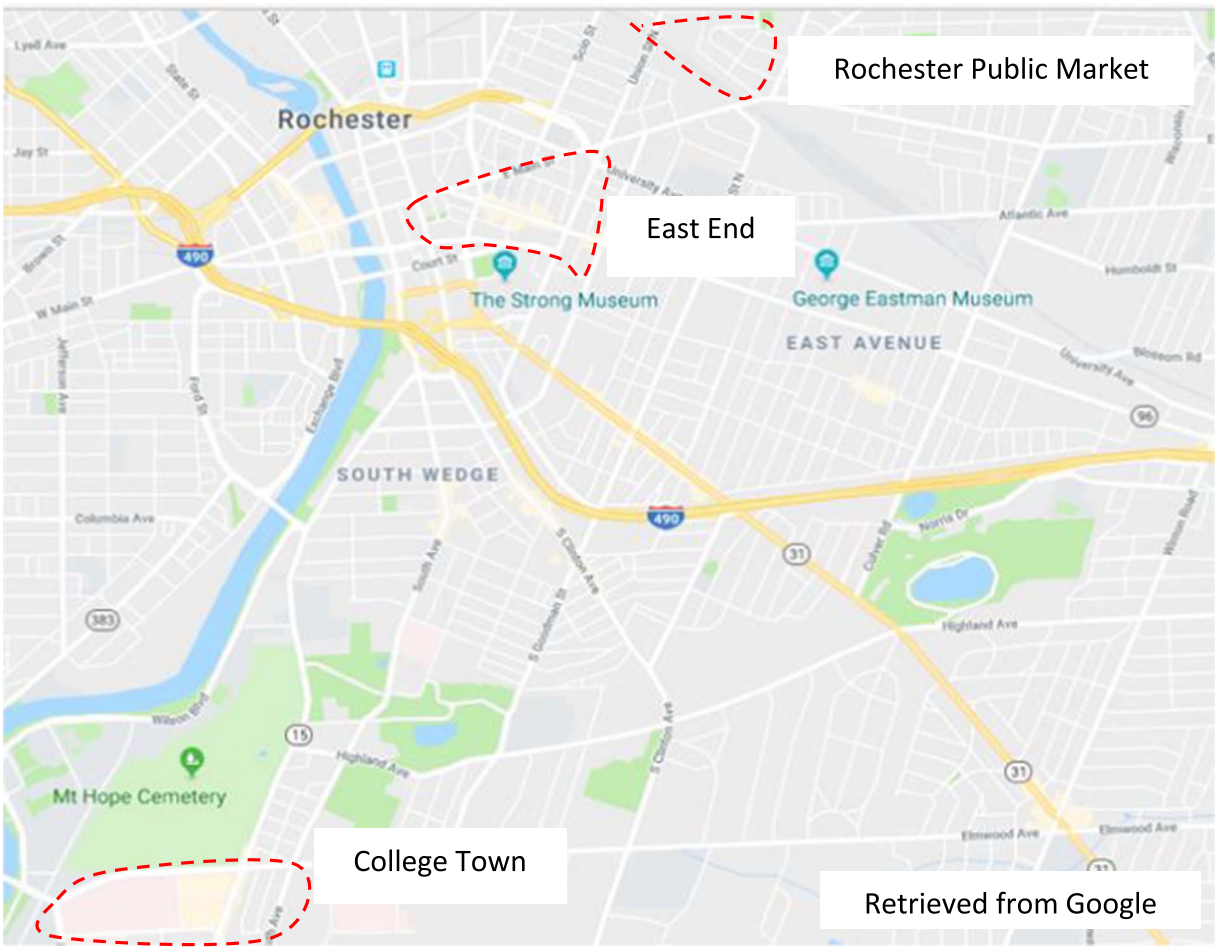

Fig. 1. Intercept survey sites in Rochester, NY.

Fig. 2. Main entry into College Town in Rochester, NY.

Fig. 3. Main walkway in East End near Eastman Theater in Rochester, NY.

Deutsch, 2013; Deutsch and Goulias, 2010, Deutsch and Goulias, 2012). We asked visitors to rate a series of Likert scale attitudinal statements relating to SOP. For this survey, we relied on statements used by other studies on SOP (Deutsch, 2013; Deutsch and Goulias, 2010, Deutsch and Goulias, 2012).

3.3.2. Information and communication technology (ICT) use

To assess visitor ICT use, the survey had questions regarding accessing information for sites (EE, RPM, CT) online and reading reviews or feedback. ICT accesses of site information may serve to either strengthen or weaken visitor SOP.

3.3.3. Respondent personal and household attributes

Finally, we collect information on personal and household attributes through the intercept survey. These help disaggregate distinct segments that may differ in effects of non-motorized travel and ICT on SOP.

3.3.4. Travel and site visit characteristics

We collected information regarding visitors' travel and visit to the site. We used two questions that elicited stated responses to travel frequency, each stated as follows:

i) Which statement best describes how often do you visit this location?
ii) Which statement best describes how often do you bike/walk to this location during the summer and spring months?

Survey respondents had the following options for responding to these two statements:

i) Less than once a month
ii) Once a month
iii) Once in three weeks
iv) Once in two weeks
v) Once a week
vi) Twice a week
vii) Three or more times a week
viii) Every day (daily)

Fig. 4. Main entry into Rochester Public Market (note: outside business hours).

To further reduce the dimensionality of responses, the raw responses from visitors were further aggregated into three ordered responses for both questions:

1) Less than once a month, once a month
2) Once in three weeks, once in two weeks, once a week
3) Twice a week, three or more times a week, every day (daily)

3.4. Sample characteristics

A total of 283 responses were collected across all three sites with 78 from College Town (CT), 71 from East End (EE) and 134 from Rochester Public Market (RPM). The majority of respondents finished the survey within 15 to 20 min. Only visitors 18 years or older took the survey. The previous section provided details on the survey intercept logistics. Key visitor attributes are discussed next.

3.4.1. Age

The respondent age distribution differed across the three sites. Respondents 18 to 24 years and 25 to 34 years, not surprisingly, comprised the largest percentage of the sample from College Town which is adjacent to the University of Rochester. The East End neighborhood sample had a similar age distribution, but with more respondents 25 to 34 years relative to 18 to 24 years. Interestingly, for RPM, three age groups with the highest percentages were 25 to 34 years, followed by 45 to 54 years and 55 to 64 years, respectively. This difference may indicate the limited mobility of students' age 18 to 24 years. While RPM is a mixed-use type land use with restaurants, other food establishments in addition to a farmers' market within a residential area, access is severely limited to personal auto and transit routes are limited.

3.4.2. Number of years living in Rochester

With respect to years living in Rochester, both EE and RPM had a high percentage of respondents living more than 10 years, at 59% and 69% respectively. Not surprisingly CT had a high percentage of respondents living in Rochester less than one year and one to five years. These distributions suggest that while visitors to both EE and RPM maybe from outside of Rochester, they are predominantly visited by long time residences. CT in contrast is comprised of more visitors new to Rochester.

3.4.3. Number of vehicles in household fleet

The distribution of households' transportation resources indicates that most households have two vehicles and subsequently two or more drivers. Not surprisingly, the percentage of zero motor vehicle households was higher at CT, given its high student population.

Table 1 below presents the distribution of response to travel and site visit characteristics, and ICT use. This includes visitor travel resources available. These responses and their distributions are compared and contrasted next.

3.4.4. Number of bicycles in household fleet

Surprisingly, the majority of households in the sample own bicycles. The sample at RPM has the smallest percentage of zero bicycle households. Additionally, RPM had the highest percentage of households owning five or more bicycles across all three sites. This high bicycle ownership for RPM visitors contrasts with the bicycle/walking mode access to RPM both on the survey date and during summer/spring months. The survey respondent distribution shows that the RPM sample has the highest percentage of respondents who *do not* bike/walk to the site, even in summer and spring months when the weather is favorable.

3.4.5. Frequency of site visit

In terms of visiting frequency to the locations, the College Town sample showed the most infrequent visitation rate, with almost 20% visiting less than once a month. EE visitors have the higher visit rate, with 77% of respondents visiting at least once a week, compared to 53% and 47% for CT and RPM. While RPM had the least percentage of respondents visiting at least once a week, this may likely results from the market being open only three days a week (Tuesday, Thursday and Saturday) compared to the other two sites.

3.4.6. Travel mode access on survey date

Across all three sites, the majority of respondents used personal motor vehicle as the travel mode to the site, reflecting the strong car dependency in Rochester. Interestingly, the site with the most visitors accessing by walking on the survey date was EE with 30%, followed by CT at 10% and RPM at 3%. With respect to transit mode access on the survey date, CT had the highest percentage in its sample with 14% taking transit. These travel mode distributions on the survey date reflect the built environment features of the three sites. While visitors to RPM are predominantly bike owners, the market is located within a residential neighborhood difficult to access for visitors living far from RPM. The neighborhood of EE lies within close proximity to the Rochester downtown and Central Business District (CBD) and is easily accessed by surrounding residential areas. CT, while close to the University of Rochester campus, has a low percentage of visitors walking/biking to the site, possibly reflecting the positioning of CT at the intersection of Elmwood Ave. and Mt. Hope Ave., both of which are high traffic volume arterials.

3.4.7. ICT use

With respect to the ICT use characteristics of samples from all three sites, predominantly show a high rate of accessing online information on the three sites prior to visiting, and in particular reading reviews. However, writing reviews and leaving feedback appears has a significantly lower rate. These distributions indicate that online information on sites matter, with a high percentage of visitors searching for online information in the form of reviews and other logistical information. However, the reciprocal of leaving reviews and other feedback is low, indicating sharing of experience online has less popularity.

3.5. Attitudinal response characteristics

Examining the distribution of responses to attitudinal statements related to SOP reveals differences in the range of responses between the three sites, suggesting that the variation in response differs across sites and across dimensions. We graph the distribution of responses in Figs. 1–6. We use six dimensions comprising SOP: (i) satisfaction; (ii) attachment; (iii) identity; (iv) dependence; (v) aesthetics and (vi) social.

Visitor responses to attitudinal statements show a majority of strong agreement or disagreement with the statements, with the exception of statements about their *Place Identity* with and the *Social* nature of sites. Regarding “feeling like myself” under *Place Identity*, visitors did not strongly agree with this attitude, though a small percentage strongly disagreed (Fig. 4). Additionally, with respect *Social* (Fig. 7) and sites having a “definite social atmosphere” and “generally friendly people around,” visitors did not state strong agreement, but a low percentage stated strong disagreement.

For a majority of the attitudinal statement, visitors either agreed of disagreed with majority. Exceptions where visitors were more evenly distributed in their agreement/disagreement, or with a significant portion remaining neutral were statements related to transportation amenities under *Place Satisfaction* (Fig. 3), and “stores missing items” found elsewhere, under *Place Dependence* (Fig. 5).

Visitors' responses were more evenly distributed regarding *Place Satisfaction* and transportation amenities, especially motor vehicle and bike parking at the RPM and EE. For transit access, across all three sites, while a majority indicated agreement with satisfaction, compared to other statements where more than 80% indicated agreements, this response was not as strong. The motivation for these responses could be partially geographic. RPM resides at the edge of a residential

Table 1
Distribution of respondent travel and ICT use characteristics in the sample.

Participant/visitor response	College Town (n = 78)	East End (n = 71)	Rochester Public Market (n = 134)	Participant/visitor response	College Town (n = 78)	East End (n = 71)	Rochester Public Market (n = 134)
Number of vehicles in household fleet				Frequency of site visit			
0	14.10%	7.04%	6.72%	Everyday	12.82%	28.17%	0.00%
1	24.36%	30.99%	29.85%	Three or more times a week	14.10%	12.68%	1.49%
2	32.05%	42.25%	41.04%	Twice a week	6.41%	16.90%	2.24%
3	12.82%	8.45%	13.43%	Once a week	20.51%	19.72%	44.03%
4 or more vehicles	11.54%	4.23%	7.46%	Once in two weeks	8.97%	5.63%	12.69%
Decline to answer	5.13%	7.04%	1.49%	Once in three weeks	3.85%	4.23%	3.73%
Number of drivers in household				Once a month	12.82%	5.63%	17.16%
0	2.56%	2.82%	3.73%	Less than once a month	20.51%	7.04%	18.66%
1	23.08%	32.39%	19.40%	Bicycle/walking frequency during summer/spring			
2	34.62%	43.66%	51.49%	I do not bike/walk (0 times)	51.28%	38.03%	71.64%
3	15.38%	14.08%	14.93%	Less than once a month	6.41%	4.23%	2.99%
4 or more drivers	12.82%	4.23%	10.45%	Once a month	7.69%	7.04%	5.97%
Decline to answer	11.54%	2.82%	0.00%	Once in three weeks	0.00%	1.41%	2.99%
Number of bicycles in household fleet				Once in two weeks	6.41%	0.00%	3.73%
0	26.92%	30.99%	20.90%	Once a week	10.26%	8.45%	7.46%
1	28.21%	25.35%	19.40%	Twice a week	7.69%	11.27%	2.24%
2	20.51%	21.13%	26.87%	Three or more times a week	10.26%	29.58%	2.99%
3	11.54%	12.68%	12.69%	Travel access mode on survey date			
4	3.85%	2.82%	7.46%	Bicycle	5.13%	0.00%	7.46%
5 or more bicycles	8.97%	7.04%	12.69%	Carpool or ride-share (passenger)	3.85%	9.86%	15.67%
Did you ever access the online profiles/ information for this site prior to today's visit?				Personal motor vehicle (driver)	61.54%	57.75%	69.40%
No	39.74%	29.58%	42.54%	Public transit	14.10%	2.82%	3.73%
Yes	60.26%	70.42%	57.46%	Walking	15.38%	29.58%	3.73%
Have you ever written reviews about this place online?				Have you ever read reviews about this place online?			
No	94.87%	84.51%	92.54%	No	71.79%	42.25%	70.15%
Yes	5.13%	15.49%	7.46%	Yes	28.21%	57.75%	29.85%

neighborhood with limited street parking. EE is adjacent to the downtown CBD of Rochester. While there is a dedicated parking lot at both sites, parking is still an issue. Another explanation is the complex nature of transportation; depending on the time of day parking may be favorable. Additionally, visitors to the EE responded with a relatively even distribution for specific attitudinal statements. These were notably a “risk for unpleasant encounters” and the “family-friendly” nature (Fig. 7). Once again this may be its adjacency to the Rochester CBD.

Overall, there is either a strong agreement or disagreement with the statements, with some specific statements receiving a less strong response. These statements related to *Place Identity* and *Social*, and depending on the statement, visitors may have difficulty understanding them concretely. Additionally, statements regarding transportation amenities at the site and the social atmosphere also did not receive strong responses. These may play complex roles in fostering Sense of Place, suggesting these require further investigation to disentangle and understand the more tempered responses from visitors (Figs. 7 and 10).

4. Model formulation and framework

In this study, we consider SOP as a latent construct measured through attitudinal responses. The integrated model combines factor analysis which models latent constructs from observed response data (Walker, 2001) and discrete choice modeling under a random utility maximization (RUM) estimation framework (Ben-Akiva and Lerman, 1984). These latent constructs are linked to the utility of travel mode choice alternatives in an attempt to explicitly analyze psychological factors and their effects on behavior which cannot be determined through revealed preferences alone. Fig. 8 shows the entire model system.

Utility, latent variables and indicators all have measurement and other errors indicated as ε, η and ν respectively. Model estimation is accomplished through simulated maximum likelihood estimation (Walker and Ben-Akiva, 2002). The estimated model parameters of the model provide the best fit for both the choice utilities and latent variable indicators that collectively describe SOP and travel mode choices. In the current study, SOP is modeled as a single latent variable that informs observed stated responses. The stated responses modeled include frequency of (i) visit and (ii) bike/walk to the three sites. The theoretical and modeling framework for the integrated choice model is presented next, followed by the model specification.

Researchers in other behavioral and social science fields have investigated similar latent constructs in consumer/marketing, sociological and psychological studies (Bearden and Netemeyer, 1999; Jarvis et al., 2003). The main components of the modeling framework in Fig. 8 are as follows:

4.1.1. *Explanatory variables (X)*

These include observed attributes of the decision-maker, the setting/site and ICT adoption decisions. These are collected through the visitor intercept survey administered at the sites.

4.1.2. *Latent variables (X*)* or constructs (including utility U)

These singularly (if only one latent variable) or collectively describe Sense of Place (SOP), typically perceptions, attitudes or preferences. We formulate our model with two latent variables: (i) SOP (X*) and (ii)

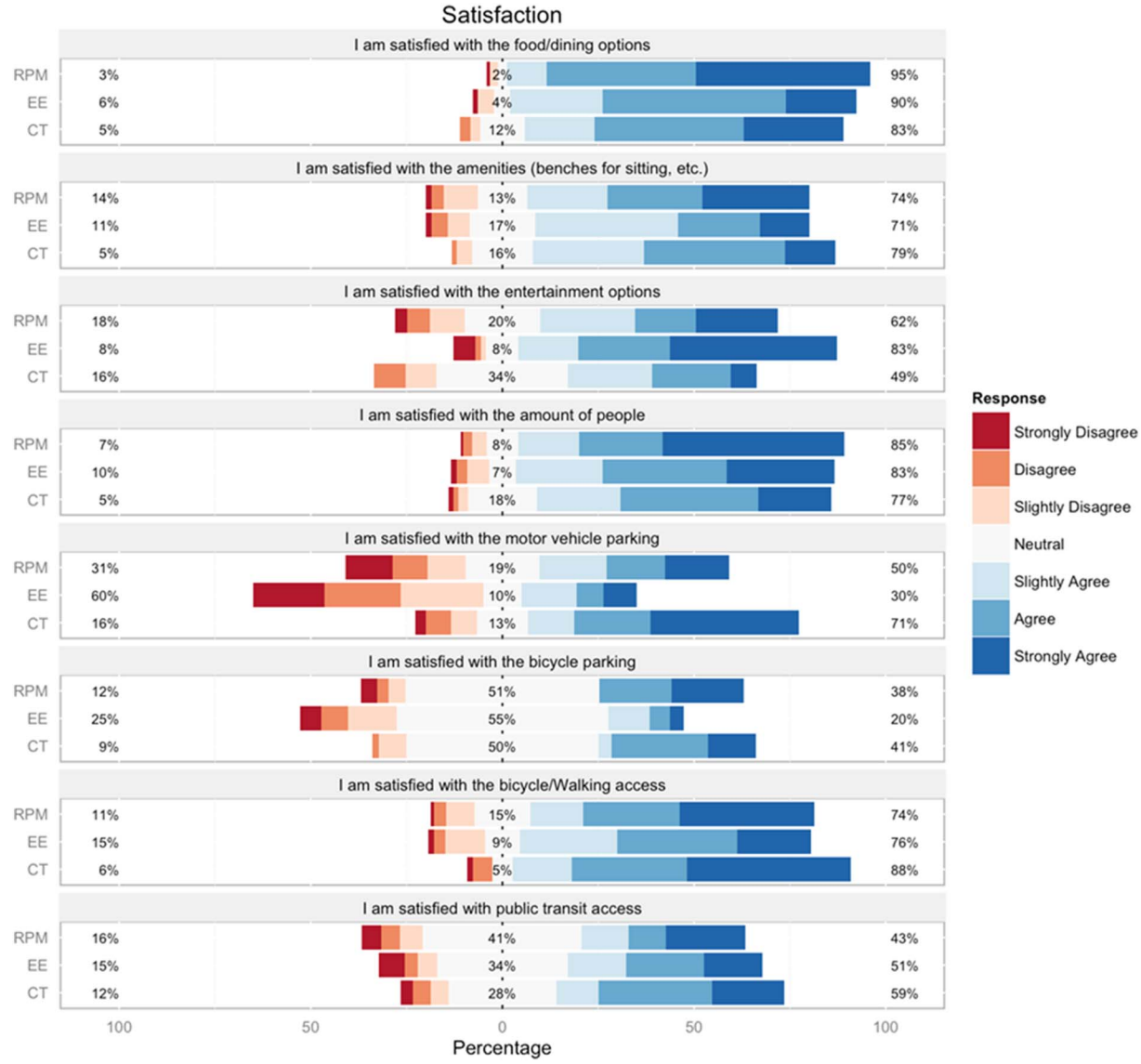

Fig. 5. Distribution of Likert Scale response to satisfaction statements.

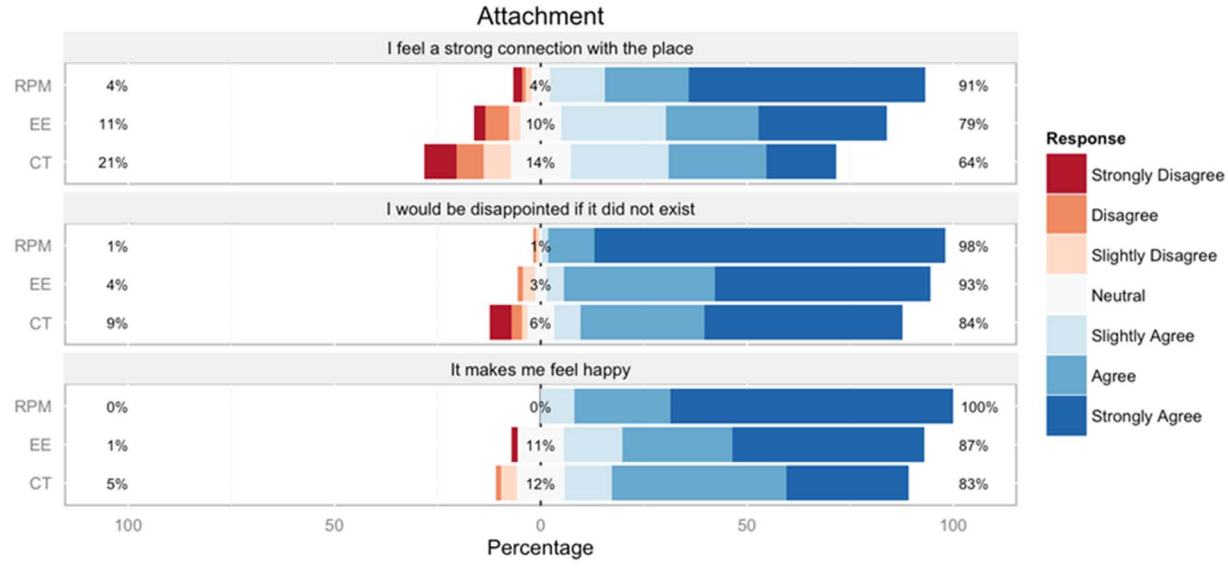

Fig. 6. Distribution of Likert Scale response to attachment statements.

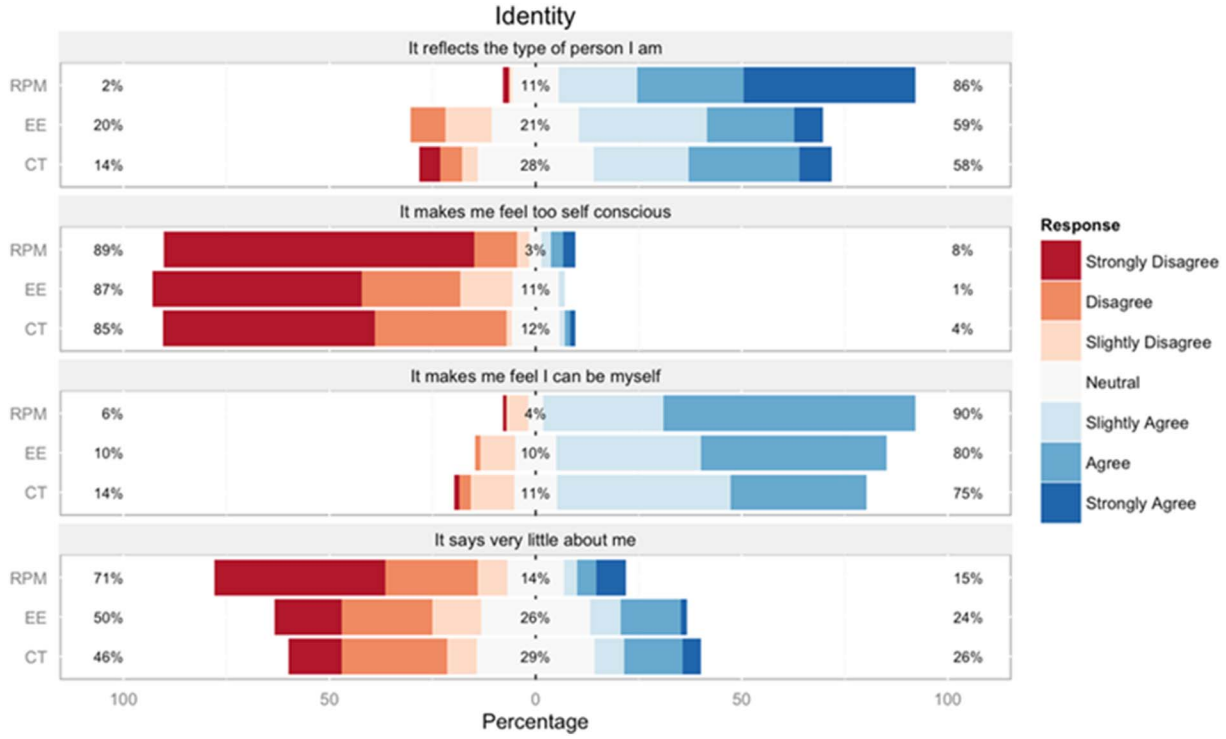

Fig. 7. Distribution of Likert Scale response to identity statements.

underlying utility (U) of the ordered choices.

4.1.3. Attitudinal and perceptual indicators (I)

These consist of ratings towards statements regarding the dimensions of SOP that are latent and psychological. The marketing field has long developed scales that evaluate latent consumer perceptions (Bearden and Netemeyer, 1999). This proposed work adopts a similar approach for SOP.

4.1.4. Travel responses (Y)

Observed stated responses to travel to the site. In our study we examined the frequency of (i) site visit and (ii) non-motorized access.

4.2. Model specification

Given the theoretical concepts, this section provides the model specifications for frequency of (i) visits and (ii) bike/walk access to the site. For both models, a single latent variable for Sense of Place (SOP) was estimated jointly with the observed stated responses. This latent variable was modeled based on responses to a 27 Likert scale indicator responses, of which only 11 were found to be statistically significant in the final model specification. The structural equation was specified as follows:

$$X^* = \beta_0^S + \beta_1^S X_1 + \beta_2^S X_2 + \ldots + \beta_K^S X_K + \sigma^s \varepsilon^S \quad (1)$$

X^* a latent variable, in this case *Sense of Place* (SOP)
X a vector of explanatory variables, observed and/or unobserved
β^S a vector of parameters to be estimated from the data
ε^S a random error term, which is assumed to be normally distributed $N(0,1)$

The measurement equation Z that related the latent variable X^* to the observed responses to indicators I was specified as follows:

$$Z_i = \beta_{0i}^m + \beta_i^m X^* + \sigma_i^m \varepsilon_i^m \quad (2)$$

This term $\beta_i^m \sigma^s \varepsilon^s + \sigma_i^m \varepsilon_i^m$ is normally distributed with mean 0 and variance $(\sigma_i^*)^2$, where:

$$(\sigma_i^*)^2 = (\beta_i^m \sigma^s)^2 + (\sigma_i^m)^2 \quad (3)$$

If σ^s is normalized to 1 then

$$(\sigma_i^*)^2 = (\beta_i^m)^2 + (\sigma_i^m)^2 \quad (4)$$

$$Z = \beta_{0i}^m + \beta_i^m \overline{X}^* + \sigma_i^* \varepsilon_i^* \quad (5)$$

$$I_i = \begin{cases} j_1, & Z_i < \tau_1 \\ j_2, & \tau_1 \le Z_i < \tau_2 \\ \vdots & \\ j_7, & \tau_6 \le Z_i \end{cases} \quad (6)$$

X^* a latent variable, in this case *Sense of Place* (SOP)
Z_i the measurement equation for indicator i, which is a function of the latent variable X^*
β_i^m a vector of parameters for indicator i to be estimated from the data, for indicator
σ_i^* a vector of scaling parameters for the error term ε_i^m
ε_i^* a random error term for indicator i, which is assumed to be normally distributed $N(0,1)$
I_i response to an indicator statement, such as an attitudinal statement $i = 1$ to 27

There are seven measurement levels M = 7 in Eq. (6). We define six parameters τ_i and their relationships as follows:

$$\tau_1 = -\delta_1 - \delta_2 - \delta_3 \quad (10)$$

$$\tau_2 = -\delta_1 - \delta_2 \quad (11)$$

$$\tau_3 = -\delta_1 \quad (12)$$

$$\tau_4 = \delta_1 \quad (13)$$

$$\tau_5 = \delta_1 + \delta_2 \quad (14)$$

$$\tau_6 = \delta_1 + \delta_2 + \delta_3 \quad (15)$$

The choice model based on stated responses to bike/walk and visit

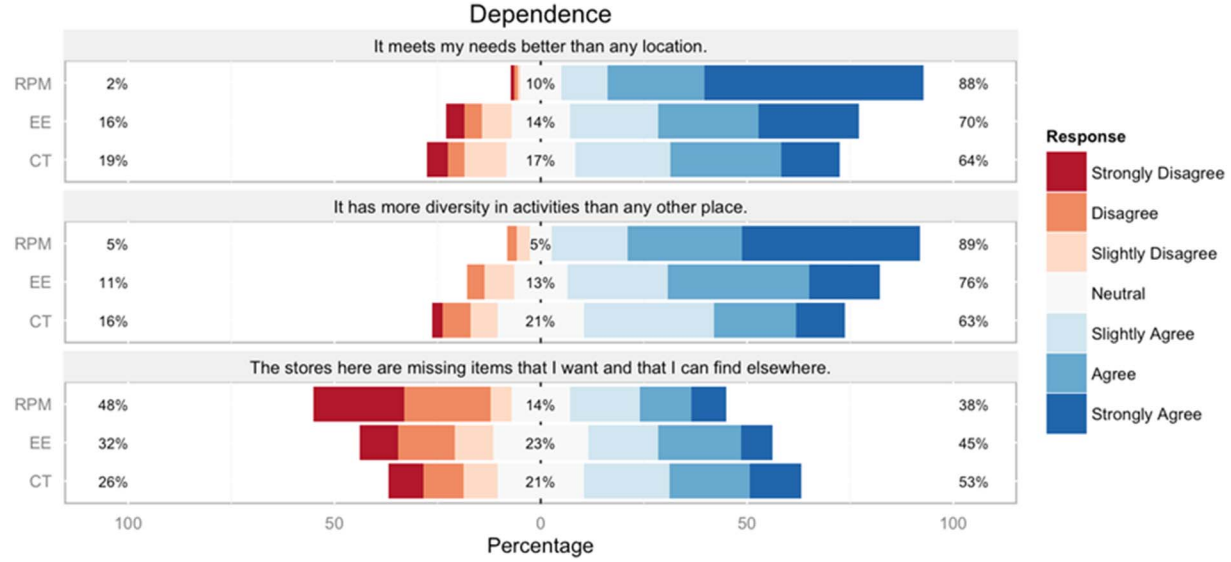

Fig. 8. Distribution of Likert Scale response to dependence.

frequency is specified next. Since both responses are ordinal in nature, the ordinal logit model is used. Specify the utility as follows:

$$U = \beta_0 + \beta^* X^* + \beta X + \varepsilon \tag{16}$$

X^* a latent variable, in this case Sense of Place (SOP)
X a vector of explanatory variables
β a vector of parameters to be estimated from the data
ε a random error term, assumed to be logistically distributed

In the final model specification, only 11 of the original 27 Likert scale indicators for *Sense of Place* (SOP) were found statistically significant. The final specification for the integrated latent choice model had the following equations:

a) 1 structural, for the single latent variable SOP (Eq. (1))
b) 11 measurement equations, one for each of the SOP indicators retained (Eqs. (5) and (6))
c) 1 utility function for the choice of frequency level for bike/walk and visits (Eq. (16))

The final likelihood function for the observed sample is:

$$L_n(Y, I \mid X; \beta, \beta^s, \beta_r^M, \tau^U, \tau, \Sigma) = \int_{\varepsilon_r^*} Pr(Y = i) \bullet \prod_{r=1}^{11} Pr(I_r = j_{in} \mid \varepsilon^s) \bullet \Phi(\varepsilon_r^*) d\varepsilon_r^* \tag{17}$$

We estimate the final model using Full Information Maximum Likelihood (FIML) using the likelihood function in Eq. (17). The model was implemented and estimated in BIOGEME (Bierlaire, 2016) an open source freeware designed for the maximum likelihood estimation of parametric models in general, with a special emphasis on discrete choice models.

5. Estimation results

This section presents the estimation results for the integrated latent variable model, where SOP is modeled as one single latent variable driving responses to indicator statements and impacting the underlying utility of ordinal responses to site visit and bike/walk (non-motorized) access frequency. We present the estimation results for site visit

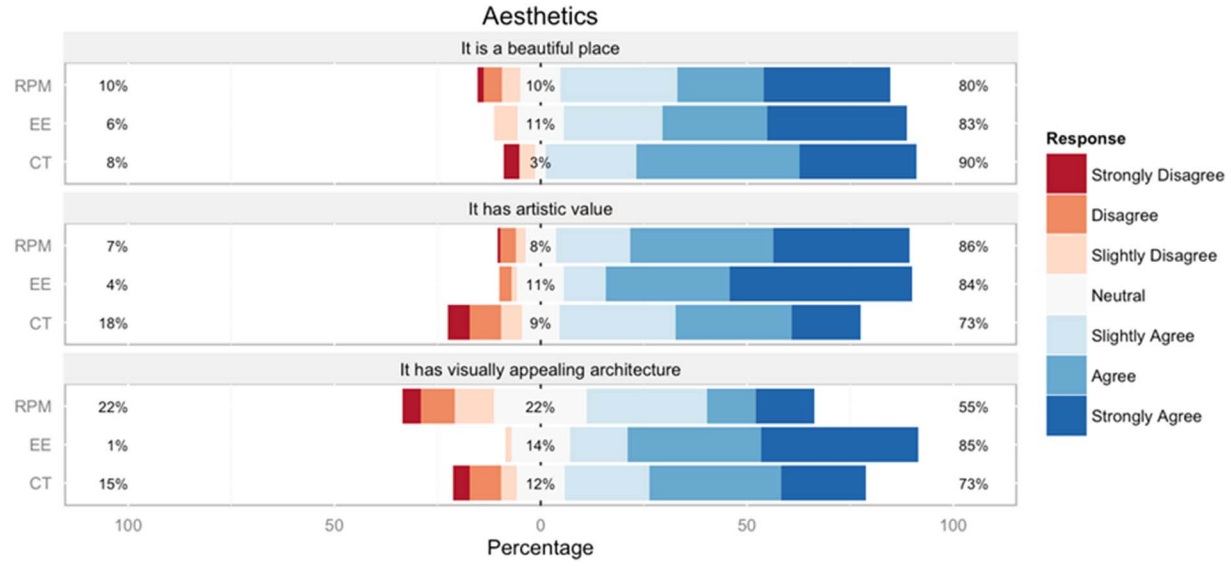

Fig. 9. Distribution of Likert Scale responses to aesthetics statements.

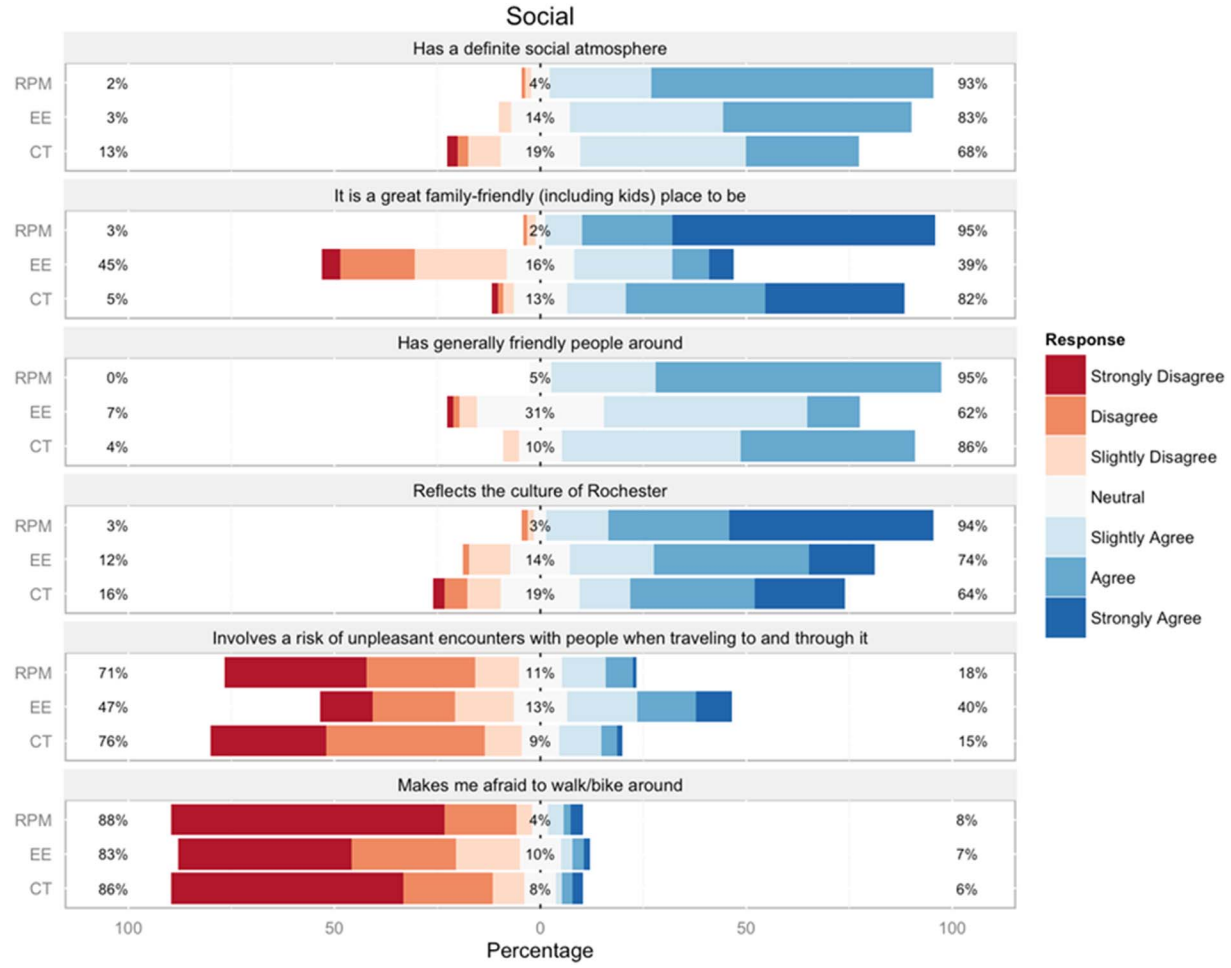

Fig. 10. Distribution of Likert Scale response to social statements.

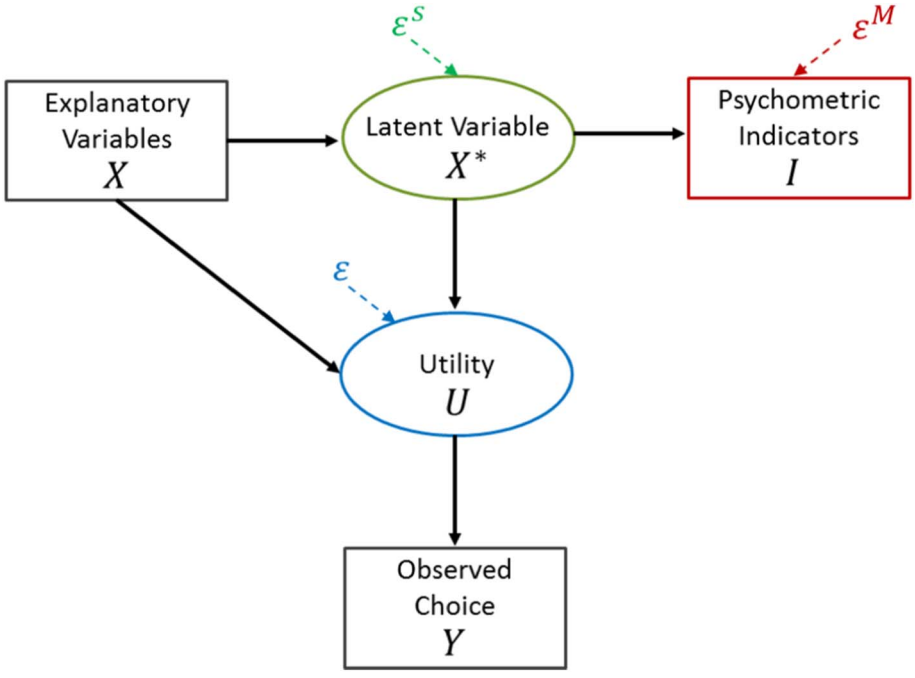

Fig. 11. Framework or integrated latent factor and discrete choice models.

Table 2
SOP Latent Variable Model Component – Visit Frequency (Note: σ refer to the scale parameter in Eq. (5)).

Latent variable model - Sense of Place (SOP)			
Structural model	Value	Standard error	t-Statistic
Respondent age is 45 to 54 years (1/0)	0.489	0.173	2.83
Respondent age is 55 or more years (1/0)	0.344	0.152	2.26
Intercept term	0.958	0.253	3.79
Location - Rochester Public Market (1/0)	0.990	0.122	8.15
Search/review online information on location (1/0)	0.176	0.125	1.41
Respondent years in Rochester: 1–10 years (1/0)	0.373	0.189	1.97
Respondent years in Rochester: + 10 years (1/0)	0.470	0.179	2.63
Measurement model	Value	Standard error	t-Statistic
Satisfaction - food	1.000	–	–
Satisfaction - amount of people	0.731	0.121	6.02
Attachment - connection	1.610	0.172	9.38
Attachment - disappointed	1.850	0.213	8.70
Attachment - feel happy	1.190	0.124	9.60
Dependence - diversity in activities	0.955	0.111	8.57
Dependence - needs	1.210	0.138	8.75
Identification - myself	0.950	0.116	8.20
Identification - type of person	1.240	0.115	10.77
Social - friendly encounters	0.742	0.092	8.07
Social - Rochester culture	0.928	0.121	7.68
Tau 1	0.459	0.036	12.74
Tau 2	0.829	0.056	14.94
Tau 3	1.290	0.077	16.77
Intercept satisfaction - food	0.000	–	–
Intercept satisfaction - amount of people	0.485	0.230	2.11
Intercept attachment - connection	− 1.110	0.328	− 3.37
Intercept attachment - disappointed	− 0.090	0.333	− 0.27
Intercept attachment - feel happy	0.363	0.202	1.80
Intercept dependence - diversity in activities	− 0.355	0.221	− 1.61
Intercept dependence - needs	− 0.669	0.278	− 2.41
Intercept identification - myself	0.685	0.212	3.23
Intercept identification - type of person	− 1.060	0.240	− 4.39
Intercept social - friendly encounters	1.070	0.164	6.55
Intercept social - Rochester culture	− 0.014	0.23	− 0.06
Sigma-star satisfaction - food	1.000	–	–
Sigma-star satisfaction - amount of people	1.530	0.122	12.51
Sigma-star attachment - connection	1.540	0.134	11.44
Sigma-star attachment - disappointed	1.330	0.148	8.97
Sigma-star attachment - feel happy	0.957	0.091	10.51
Sigma-star dependence - diversity in activities	1.270	0.100	12.72
Sigma-star dependence - needs	1.490	0.123	12.07
Sigma-star identification - myself	1.230	0.109	11.32
Sigma-star identification - type of person	1.070	0.088	12.16
Sigma-star social - friendly encounters	0.951	0.084	11.36
Sigma-star social - Rochester culture	1.390	0.111	12.51

frequency are first, followed by bike/walk access. For each choice dimension, we first discuss the latent variable model estimation results, followed by those for the ordinal choice model. Finally, while a joint model on both site visit frequency and bike/walk access, we estimate these separately, one integrated latent variable model for each dimension.

5.1. Site visit frequency

For site visit frequency, estimated coefficients of the measurement model indicate that visitors with more SOP have a higher likelihood of giving a higher rating (strongly agree) with respect to the 11 statements shown in Table 2, with statistical significance. For example, a higher visitor SOP leads to a higher rating to the *Place Identity* statement "It makes me feel I can be myself." We expect these positive coefficients for these attitudinal statements; as SOP increases, we expect a higher rating (strong agreement) with these statements associated with SOP in the literature, and used by past researchers.

Looking at Table 2 below, statements with the highest likelihood of agreement were associated with *Place Attachment*, *Place Dependence* and *Place Identification*. All of the coefficients associated with these statements were positive and had coefficients higher than 1.0. The first statement on *Place Satisfaction* with site food offerings was scaled to $\beta_{01} = 0.0$ (intercept term) and $\beta_1{}^m = 1.0$ (slope). Statements related to *Place Satisfaction* and *Social* had estimated coefficients lower (less than 1.0) than those for *Place Attachment*, *Place Dependence* and *Place Identification*. The dimension of *Place Aesthetics* did not have any statistically significant statements; none were included in the final specification shown, suggesting a weaker relationship between design and architecture and SOP, relative to other dimensions.

With respect to visitor attributes, the estimation results in Table 2 indicate that respondent age positively impacts the latent variable SOP. Older aged visitors perceive a higher SOP relative to those younger than 45 years of age. A similar outcome holds for length of Rochester residency. Visitors who lived in Rochester from for at least 1 year have a positive association with their SOP. Both of these estimation results further suggest that SOP improves with time. The estimation results also indicate that visitors specific to Rochester Public Market (RPM) perceive a higher SOP, relative to the other two sites. Interestingly, one notable design difference of RPM is its organic planning over time. Finally, one of the main hypotheses of this study was the impact of ICT use on SOP. While the coefficient relating visitors' online information use for the site was positive, indicating a positive impact on SOP, it was statistically insignificant.

The estimated choice model for visit frequency indicates that the latent variable Sense of Place (SOP) has a positive impact that is statistically significant, such that sites with a higher SOP see higher stated visit frequencies. According to Table 3, the estimated coefficient on the SOP was 0.393. Similar to SOP, visitors with longer residencies in Rochester responded with a higher stated frequency relative to those less than one year of residency. The coefficients were 1.39, 1.31 and 1.09 for living 1–5 year, 6–10 years and more than 10 years in Rochester respectively. Additionally, with respect to specific locations, visitors to RPM tend to state lower visit frequencies, relative to CT, while the EE visitors stated higher visit frequencies. However, the lower frequencies for RPM may be attributable to the limited hours the market is open, not necessarily infrastructure related access. While the shops within the RPM grounds are open most days of the week, the actual market is only open Tuesdays, Thursdays and Saturdays.

Table 3
Choice model component – visit frequency (Note: $\tau = \tau_1$ is the lower cutoff, δ is the distance to the upper cutoff $\tau_2 = \tau_1 + \delta$ in the ordinal choice model).

Ordinal choice model - visit frequency to destination			
Explanatory variable name	Value	Standard error	t-Statistic
Location - East End (1/0)	1.430	0.378	3.78
Location - Rochester Public Market (1/0)	− 1.380	0.374	− 3.68
Sense of Place (latent)	0.393	0.157	2.50
Respondent years in Rochester: 1 to 5 years (1/0)	1.390	0.433	3.20
Respondent years in Rochester: 6 to 10 years (1/0)	1.310	0.596	2.20
Respondent years in Rochester: + 10 years (1/0)	1.090	0.388	2.80
Tau	0.334	0.417	0.80
Delta	2.440	0.208	11.73
Number of observations			263
Log-likelihood (initial)			− 7533.841
Log-likelihood (final)			− 3906.493
− 2(LL(β0)-LL(β))			7254.695
Rho-squared			0.481

Table 4
SOP Latent Variable Model Component – Bike/Walk Frequency (Note: σ refer to the scale parameter in Eq. (5)).

Latent variable model - Sense of Place (SOP)			
Structural model	Value	Standard error	t-Statistic
Respondent age is 45 to 54 years (1/0)	0.488	0.173	2.82
Respondent age is 55 or more years (1/0)	0.346	0.152	2.27
Intercept term	0.958	0.253	3.79
Location - Rochester Public Market (1/0)	0.994	0.122	8.16
Search/review online information on location(1/0)	0.179	0.125	1.44
Respondent Years in Rochester: 1–10 years (1/0)	0.466	0.180	2.59
Respondent Years in Rochester: + 10 years (1/0)	0.377	0.190	1.99
Measurement model	Value	Standard error	t-statistic
Satisfaction – food	1.000	–	–
Satisfaction - amount of people	0.732	0.129	5.68
Attachment – connection	1.590	0.228	6.98
Attachment – disappointed	1.850	0.293	6.3
Attachment - feel happy	1.190	0.139	8.59
Dependence - diversity in activities	0.956	0.123	7.79
Dependence – needs	1.200	0.162	7.38
Identification – myself	0.955	0.133	7.19
Identification - type of person	1.240	0.143	8.63
Social - friendly encounters	0.741	0.098	7.58
Social - Rochester culture	0.932	0.145	6.45
Delta 1	0.460	0.0361	12.74
Delta 2	0.831	0.0556	14.94
Delta 3	1.290	0.0768	16.78
Intercept satisfaction - food	0.000	–	–
Intercept satisfaction - amount of people	0.485	0.230	2.1
Intercept attachment - connection	− 1.090	0.327	− 3.33
Intercept attachment - disappointed	− 0.087	0.332	− 0.26
Intercept attachment - feel happy	0.358	0.202	1.77
Intercept dependence - diversity in activities	− 0.356	0.221	− 1.61
Intercept dependence - needs	− 0.657	0.277	− 2.37
Intercept identification - myself	0.678	0.212	3.19
Intercept identification - type of person	− 1.050	0.240	− 4.39
Intercept social - friendly encounters	1.070	0.164	6.56
Intercept social - Rochester culture	− 0.020	0.230	− 0.09
Sigma-star satisfaction - food	1.000	–	–
Sigma-star satisfaction - amount of people	1.530	0.122	12.51
Sigma-star attachment - connection	1.540	0.135	11.47
Sigma-star attachment - disappointed	1.330	0.148	8.96
Sigma-star attachment - feel happy	0.954	0.091	10.49
Sigma-star dependence-diversity in activities	1.270	0.100	12.72
Sigma-star dependence - needs	1.490	0.124	12.08
Sigma-star identification - myself	1.230	0.108	11.31
Sigma-star identification - type of person	1.070	0.088	12.16
Sigma-star social - friendly encounters	0.951	0.084	11.36
Sigma-star social - Rochester culture	1.390	0.111	12.51

5.2. Bike/walk access frequency

Looking at Table 4, for bike/walk frequency, estimation results for the latent variable model were similar to those for the site visit frequency model. *Place Identity*, *Place Dependence* and *Place Attachment* all had higher coefficient values relative to *Place Satisfaction* and *Social*. Additionally, estimates in Table 4 indicate that visitor age positively impacts SOP, with older visitors perceiving a higher SOP relative to those 45 years of age and younger. Length of residency in Rochester had a similar outcome, with visitors that lived in Rochester for at least 1 year also with a positive estimated coefficient. Both of these estimation results suggest improvement in SOP with time, similar to the estimation results in Table 2. Additionally, visitors specific to Rochester Public Market (RPM) perceive a higher SOP, relative to the other two sites, which is also similar to the results in Table 2 for the latent variable model for site visit frequency. The similar estimation results for the latent variable SOP for both site visit and bike/walk access frequency indicate consistency in which attributes associate SOP and its impact of ratings for attitudinal statements.

Table 5
Choice model component – walk/bike frequency (Note: $\tau = \tau_1$ is the lower cutoff, δ is the distance to the upper cutoff $\tau_2 = \tau_1 + \delta$ in the ordinal choice model).

Ordinal choice model - bicycle/walking frequency to destination			
Explanatory variable name	Value	Standard error	t-statistic
Location - East End (1/0)	0.911	0.348	2.62
Location - Rochester Public Market (1/0)	− 1.330	0.382	− 3.49
Number of bikes in HH	0.261	0.098	2.65
Number of vehicles in HH	− 0.639	0.156	− 4.09
Sense of Place (latent)	0.250	0.164	1.53
Tau	− 0.255	0.433	− 0.59
Delta	0.844	0.123	6.85
Number of observations			263
Log-likelihood (initial)			− 6492.264
Log-Likelihood (final)			− 3887.699
− 2(LL(β0)-LL(β))			5209.130
Rho-squared			0.401

According to Table 5, the estimated choice model for bike/walk access frequency indicates that SOP has a positive impact that is statistically significant. The estimated coefficient on the SOP was 0.250, similar to site visit frequency, but slightly lower. Unlike site visit frequency, length of residency in Rochester did not have a statistically significant impact on bike/walk access frequency. Both the number of bikes and number of vehicle in household fleets had statistically significant coefficients of 0.261 and − 0.639 respectively. Not surprisingly, households with a higher bike fleet had a higher likelihood of stating a bike/walk access frequency. However, for number of vehicles, the result is surprising from the standpoint that auto ownership in Rochester is common and is not mutually exclusive with biking/walking. Similar to site visits, visitors at RPM state lower visit frequencies, relative to the other two sites. Once again, the lower frequencies for RPM may be attributable to the limited hours the market is open.

5.3. Synthesis and discussion

The estimated latent variable model for SOP was similar for both the site visit and bike/walk access frequency models, suggesting consistency in attributes that affect SOP across the two. For both models, SOP had a positive impact on the positive rating (agreement) for attitudinal statements from the survey. Statements associated with *Place Identity*, *Place Dependence* and *Place Attachment* all had higher coefficient values relative to *Place Satisfaction* and *Social*; statement associated with *Place Aesthetics* had no impact. Based on the literature review, SOP was developed under the concept of connection with the surrounding environment. Not surprisingly, *Place Identity*, *Place Dependence* and *Place Attachment* were the stronger dimensions in terms of estimated coefficient magnitudes. *Place Satisfaction* and *Social*, while relevant in the conversation on SOP are indirectly related with SOP and do not necessarily speak about connection with the environment. Interestingly visitors to RPM, where the design planning was more organic and evolved over time, were found to perceive a higher SOP, relative to the other two sites. The length of time, in terms of visitor age and residency in Rochester, positively impacts perceived SOP. At the start of this study, we hypothesized that ICT use had a positive impact on SOP in both situations. While the estimation results showed this, the estimate was statistically insignificant. One possible explanation may be the generalness of the question used in the model estimation, “Did you ever access the online profiles/information for this site prior to today's visit?” The majority of visitors stated “yes” in response, which

may not capture differences in perceived SOP.

The estimation results showed further similarities and differences between the choice model components of the two integrated latent variable choice models. Most importantly, SOP had a positive impact on both stated frequencies. Site specific indicators revealed similar impacts on stated frequencies. RPM had a lower likelihood of stated site visit and bike/walk frequencies relative to the other two sites. Interestingly, length of residency in Rochester positively impacted the likelihood of site visits, but did not for bike/walk access. Not surprisingly, bike and auto household fleet size positively and negatively impacts the likelihood of buke/walk access respectively, but had no impact of site visit frequency.

6. Conclusions

In this paper, we investigate the interrelationships between: (i) Sense of Place (SOP); (ii) non-motorized site visit frequency; and (iii) the visitors' use of information and communication technologies (ICT) for gaining site information. In our approach, we conduct a visitor intercept survey at three sites in Rochester and estimate an integrated latent variable choice model to examine these interrelationships based on survey responses. We modeled SOP as a latent variable; stated site visit and bike/walk access frequency were the choices modeled. One hypothesis put forth is that a positive relationship exists between SOP and non-motorized travel. The estimation results indicate that SOP positively and statistically explains both choice dimensions. Interestingly, time plays an important role in impacting visitors' SOP. Visitors with lengthier residencies in Rochester and years of age perceive SOP more positively, relative to visitors with less than a year of residency. Additionally, the estimation results showed site differences in SOP perception, with RPM, a site with a more organic planning process relative to EE and CT, having a higher inherent perceived SOP. A second hypothesis put forth is that ICT use shaped perceived SOP. While the estimation results showed a positive impact for both integrated models, this was statistically insignificant.

As adoption of personal mobile ICT continues to grow, travelers will increasingly access online information and share experiences on their destinations. Many physical sites already offer online experiences of their physical places, such as museums making artwork available online through mobile apps. Furthermore, increasingly virtual environments are created to allow visitors to “visit” a neighborhood or location without physical travel. Examples of these virtual environments include Google Street View and other 3D renderings provided online by tourist destinations. The estimation results suggest a positive impact of ICT on SOP, but this requires further exploration beyond this paper. Furthermore, organizations increasingly adopt policies that promote non-motorized travel as more sustainable travel options become necessary. The findings of this paper have policy implications within this context. First, a positive relationship exists between SOP and site visit and bike/walk access. This suggests that designing and improving infrastructure for SOP also advocates more biking/walking. Additionally, if sites seek increases in visitation rates, improving SOP perception would also improve visit frequency. This higher perceived SOP associated with Rochester Public Market, suggests that built environments with less design uniformity from planning, such as College Town, encourage more positive SOP. One possible explanation is the variation and character of the outcome from this design perspective.

Many future extensions are envisioned which extend the model presented to capture SOP joint with other measurement mechanisms. For example, there is a growing interest in data mining approaches to assessing SOP from online data. Integrating this with the econometric analysis presented in this paper would further improve the explanatory power or models developed. This would also provide new insights into the relationship between information found through mobile ICT and definitions of SOP from attitudinal statements. Additionally, we envision estimating other travel decision dimensions along with the models in this paper, jointly, to consider any underlying effects operating across multiple dimensions. Furthermore, we envision partitioning the single latent variable SOP into multiple latent constructs that represent the dimensions of SOP found in the literature, such as satisfaction and dependence, separately.

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