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ABSTRACT

With the introduction and increasing reliance on the activity based approach in travel demand analysis and forecasting, discrete choice methods are more often in spatial contexts (e.g., residential location, job location, destination/activity choice). A necessity in specifying spatial choice models is the inclusion of the alternatives decision makers consider, and a realistic inclusion in the specification of the attributes of these alternatives, the characteristics of the decision making context, and the relevant characteristics of the decision maker. These details describe differences that exist among choices and individuals making choices. In the case of travel behavior, attributes of the alternatives have traditionally included attributes such as cost, distance, time, level of service and opportunities. Researchers however have recognized the benefit of attitudes in the estimation of choice models, showing improvement in explanatory power with the inclusion of attitudinal attributes of the individual. There is still however a vast expanse of unexplored attitudinal attributes in choice modeling. Particularly lacking in choice modeling is a strong theoretical underpinning of attitude formation and attitude relation to choice. Theorists in geography in the mid to late 1970s recognized and developed one such theory regarding the emotional and attitudinal association that people have with places. This became known as the theory of sense of place, which is the "affective ties with the material environment" (Tuan, 1974). This theory presents great potential in furthering the descriptive power of choice models, particularly destination choice. However, challenges abound, as this theory is rich in development, but poor in computational operationalization. In addition, everyday activity locations have not been adequately explored in sense of place quantification. In this paper, an overview of developments in discrete choice methods is presented, followed by a discussion of sense of place. Current and future work is discussed and benefits to choice modeling are presented.

INTRODUCTION

Choice models have a long and rich history within the field of travel demand modeling. In fact, even in the most popular practice one of the four steps in the traditional four-step approach to travel demand modeling is mode choice, which often employs discrete choice methods to associate trips generated to modes. With the introduction and increasing adoption of the activity-based approach, discrete choice methods are becoming ever more present and are applied to non-spatial and spatial choices within the context of travel. The specification of choice models, from the creation of choice sets, to the specification of the utility function to be maximized must be carefully prescribed in order to ensure behavioral realism in a choice model. One of the most fundamental assumptions of discrete choice methods and perhaps one of the most controversial is the assumption of rationality. Much discussion has occurred regarding the assumption of rationality, and some have proposed alternative theories such as the theory of satisficing, where the objective is not to choose the alternative with the maximum utility but one which an individual is able to compute and satisfies some kind of a threshold of acceptability (Simon, 1978), and Kahneman and Tversky's prospect theory in which asymmetry between losses and gains and associated willingness to risk by individuals in decision making is included (Kahneman and Tversky, 1979). However, the discrete choice framework provides a succinct, conveniently simple, and statistically sound theoretical backbone to the choice process. Therefore, careful attention must be given to ensure that this strong theoretical backbone is representative of human behavior. Without this care, the possibility of introducing bias and confounding the errors in the models is high. For instance, Thill (1992) discusses the consequences of choice set misspecification. Without the proper choice set specification, the estimation of the parameters of the model will be biased and the predictions of the choices by the model could be erroneous. For instance, with an ill defined choice set, the researcher might not even include choice alternatives considered by the decision maker, or might even include choice alternatives not even remotely considered. In both of these cases, the alternatives considered in model estimation might have higher or lower parameter estimates, leading to misinterpretation of behavior and possibly incorrect assumptions regarding choice. It is therefore imperative to include a realistic, behaviorally based specification of both the choice set formation, and the utility maximization criterion. If the assumption of rationality is included in the model conditions, researchers must make certain that the data to be used as decision criteria are complete and representative of human behavior and the decision making process underlying this behavior. To this extent, the concepts provided in the theoretical framework of sense of place have the potential to offer added descriptive power and behavioral realism to choice model specifications. What follows is: 1) A review of past and current practices in discrete choice modeling of travel behavior; 2) An introduction to sense of place, a concept stemming from Geography that is steeped in theoretical development but lacking in application; and 3) An overview of current efforts in measuring and integrating sense of place with travel models including future directions.

LITERATURE REVIEW

The early years of modeling spatial interactions

When attempting to understand the integration of discrete choice models with spatially oriented contexts, it is helpful to review some key aspects of the progression of modeling techniques. In the four-step approach to modeling travel demand, the second step that is trip distribution often uses the gravity model, which is a function describing the flow from one traffic analysis zone (TAZ) to another. The gravity model made its way into transportation through discussions of traffic movement in which flow was expressed as a movement from one zone (i) to the next (j). The production and attraction of traffic are based on the amount of activity and land use intensity at each TAZ and a travel time factor (usually a distance decay function) is specified to represent difficulty of travel (impedance function). Extensions on this basic model involved the inclusion of terms to represent social and economic differences between zones, and a generalized cost function replacing the simple travel time factor in the impedance function. These terms are used to more accurately calibrate the model to observation (Black, 2003, pg 169). Notable early implementations of the gravity model include Reilly's law of retail gravitation in which the interplay between distance and cost associated with distance are taken into consideration simultaneously with the amount of activity offered at each location. Reilly also proposes a breakpoint, a point at which the attraction of the zone (or city in his example) becomes less than the cost involved in traversing the distance, and causes a shift in the desired destination.

Choice set generation

The gravity model provided a theoretical starting block for the inclusion of spatial interaction principles in travel behavior and demand modeling. Different researchers including Hägerstrand, and the Lund School in the 1970s challenged this aggregate "physics" based view of behavior offering further support for disaggregate/individual-based models. However, with the arrival of the activity based approach came a new momentum of added appreciation for the use of disaggregate modeling techniques (also refined in the 1970s), as choice is represented as an optimization problem for each individual decision maker. Conversely, the gravity models capabilities are most reasonably applied to a larger aggregation of travelers, not individual decision makers. The need to model spatial interaction at a disaggregated level introduced new techniques and again provided increased detail to models. However, with this increase in detail a new set of challenges were also introduced. Prior choice models, which lacked a spatial element, contained a smaller set of more manageable alternatives to be considered in the estimation procedure. With the added spatial element, this set of alternatives that an individual might consider can rapidly reach levels that present estimation challenges both in data needs and run times. The literature and research dedicated to this challenge has persisted with constant flow for the past several decades. One of the most common demarcations of choice set formations is the delineation between deterministic and stochastic procedures. Using deterministic procedures, an analyst often sets rules by which to designate a smaller subset of choice alternatives. These rules often involve distances or travel time (Aldokius, 1977), inclusion of only those alternatives observed as choices (Southworth, 1981), and a combination of activity purpose(s) and distance(s) from geographic pegs (Bowman and Bradley, 2006). Stochastic methods however incorporate statistical specifications to avoid any bias that might result from erroneous rules used in deterministic methods. For example, Manski (1977) presents a two-stage method of choice set formation incorporating a conditional probability in which the utility of a choice alternative is developed conditional upon the fact that the alternative is within the specified choice set. Although this formulation was not developed specifically to solve challenges within the spatial domain, this model presents effective ways in reducing the number of alternatives in the universal choice set.

Manski's model of choice set formation marks the beginning of a long series of proposed choice set formation methods. Several researchers built upon this work to include additional elements important to choice set formation such as perceptions of access (Swait and Ben-Akiva, 1987), or attitudes and perceptions (Ben-Akiva and Boccara, 1995). Zheng and Guo (2008) provide an overview of both deterministic and stochastic methods before proposing their own spatial two-stage model. In this model, they argue that incorporation of space in an explicit manner in the two-stage model is lacking. Their model includes a distance threshold represented as a set of exogenous variables in the equation of the probability of choice set selection.

Although there is significant work furthering the approach originated by Manski in the late seventies, other positions have developed regarding the treatment of choice set formation. Much discussion has occurred over the necessity of two stages in choice set formation, and whether this process is best treated exogenously or endogenously, explicitly or implicitly. Bierlaire et al. (2009) review many of the same models reviewed in Zheng and Guo (2008), but differentiated between explicitly treated choice set formation and implicit choice set formation. They argue that explicit treatment of the choice set generation process (such as Manski, 1977; Swait and Ben-Akiva, 1987; and Ben-Akiva and Bocarra, 1995) creates models that are overly complicated and computationally difficult with the exception of a few types of models. However, Swait (2001) incorporates the two-stages of previous explicitly treated choice set generation models into one step, and makes the generation implicit in the utility maximization. This model, named the GenL model (short for G*eneration* L*ogit*) incorporates the process of defining the choice set as a preference in the utility of a Generalized Extreme Value (GEV) choice model. The GenL model formulation still consists of a two-stage specification, however the choice set generation is considered endogenously within the GEV framework.

Many researchers reiterate the opinion and motivation of Swait. For instance, Horowitz and Louviere (1995) state that the process of first generating a choice set and second selecting an alternative might lead to erroneous forecasts. They make the claim that data about consideration sets should be used to determine preferences, which can be used in the estimation of choice model parameters rather than the explicit generation and therefore inclusion or exclusion of certain alternatives. However, while all of the presented discussion and progress has certainly enriched the field and can and will without a doubt help modeling in a spatial context, challenges still exist that inhibit researchers and analysts from being able to appropriately specify choice models with behaviorally and psychologically realistic representation. For instance, even with an implicit framework of choice set formation, universal choice sets must be determined. This determination must be specified by the researcher, and will inevitably involve some sort of rules (distance, time, etc), bringing the research methodology full circle and back to deterministic methods.

A somewhat separate methodology to dealing with spatial choice has emerged recently in practice that can offer solutions to many issues presented. Thill in the early nineties laid a theoretical foundation and initiated the incorporation of time-space geography principles in the creation of behaviorally sound methodology for choice set generation (Thill, 1992). Although Thill presented a framework for which a simulated time-space prism based choice set would be generated, it was not until the late nineties that the idea was fully developed and applied. Kwan and Hong (1998) combined Hägerstrand's theory on time-space prisms (Hägerstrand, 1970), and theory of mental maps to collect data and derive a feasible choice set for destination choice. In addition to this, further development has taken place to integrate planning horizons and time-space constraints (Auld and Mohammadian, 2011), and time of day potential path areas while accounting for activity opportunities (Youn et. al., 2011). These model formulations provide a finer grained detail of the potential activities that are physically reachable and can provide both guidelines in designating a universal choice set or subset from a universal choice set, and/or attributes of the alternative for utility maximization depending on the exogenous or endogenous nature of the choice set generation procedures.

Throughout the development of more sophisticated and behaviorally synergetic choice set formation, very few instances have included an explicit treatment of the interaction of space and places with the thoughts, attitudes and perceptions of those places. The scant work in this domain has been limited to theoretical development (such as the formulation of Swait and Ben Akiva (1987), Ben-Akiva and Boccara (1995) adding preferences), or small-scale projects (Kwan and Hong (1998) adding mental maps). Suggestions and a theoretical model incorporating these specifics are presented in the following sections.

Specification of the attributes of the alternatives

Another component of choice modeling that has received much attention and development has been the specification of attributes for each of the alternatives considered in the choice. For spatial choices, a universal set of attributes is usually considered in the utility maximization function which serves as a set of criteria by which a decision is made. Each alternative is then evaluated based on a unified set of attributes and the utility is maximized. In the case of destination choice, the chosen alternative is highly dependent on the ability of and ease with which a person can access the place. The use of accessibility measures and their application provides rich information about the attraction of each zone and the cost of travel between zones (Ortúzar and Willumsen, 2001). These indicators have been used among other attributes as criteria by which a decision is made. However, accessibility is measured using several different measures and methodologies. Accessibility measures are generally categorized into two separate types, place based accessibility and person-based accessibility (Kwan, 1998). In place-based accessibility, the density of opportunities offered by a zone is used as attraction, and network service and travel related costs (time, money, etc) are used to describe the ease or difficulty in traveling to the zone (impedance). These two zonal attributes are combined to derive indicators of the provisions and disadvantages of traveling to specific areas. Place based accessibility measures have also been categorized as distance measures (distance or cost associated with travel), cumulative opportunity measures (number of opportunities within an area or time buffer), gravity measures (derived from the attracted traffic to the zone and travel factors, as described in the gravity model) and utility-based measures (utility derived measures from probabilities to travel to the specified zone known as logsums). Place based accessibility indicators are highly correlated with land use; for instance, the larger the number of establishments enabling specific activity participation, the greater the accessibility. Dong et. al. (2005) provide a nice overview of the progression of accessibility measures from trip-based to activity-based methods. More recent efforts to enhance accessibility measures have included the development of accessibility measures that include opportunities available given employment and network conditions by time of day (Chen, et. al. 2011).

The main difference between these measures and person-based measures is the addition of the person's activity patterns and schedule. Person based measures center on the ability of the individual to reach certain activity opportunities. The extent and manner in which the experiences of the individual are added to accessibility measures has differed. For instance, researchers have included home and work based information (Abreu et. al., 2006), activity schedules to develop spanning trees Shonfelder and Axhausen (2002), potential path areas (Miller, 1991), and time geography based time-space prisms and their spatial footprints (Kwan, 1998; Yamamoto et. al., 2004, Pendyala, 2003; Yoon and Goulias, 2010). The application of person based time geography based accessibility measures overlaps very closely with the application of time-space prisms in choice set formation. If considered endogenously, the treatment of each is potentially synonymous in the sense that the time-space prism footprint is an envelope of the choice set.

It is however important to note that the derivation of accessibility measures and the reliance on these accessibilities is only part of the story. Although accessibility can be computed at various levels, and can include a variety of different indicators, it is an empirical measure of the individual's ability to access specific goods, services or places, based on objective, measureable attributes. These measures have never been compared to the attitudes and perceptions of an individual with regard to the very traits that the measure is supposed to represent. For instance, although a specific alternative might have a high accessibility, a negative association with that place might prevent an individual from considering the place as an alternative. These emotional associations have yet to be considered in the spatial choice model context and will be discussed in the following section.

Sense of place

Sense of place researchers have long theorized the emotional connection between people and places, and in more recent work, have attempted to quantify the meaning. Tuan, one of the pioneering researchers of sense of place defined it as a person's "affective ties with the material environment" (Tuan, 1974). From Tuan's early theorizing, researchers have divided sense of place into several smaller subsets, including **place identity**, which is "a person's identity with relation to the physical environment" (Proshansky, 1978), **place attachment**, which is defined as "the positive bond that develops between a person and their environment" (Altman and Low, 1992), **place dependence**, which is defined as the "perceived strength of association between a person and a place" (Stokols and Shumaker, 1981), and **place satisfaction** defined as "a person's level of satisfaction with the services, environment and needs provided for by a specific place" (Stedman, 2003).

A glimpse at the object of researchers interest can illustrate the scale at which sense of place is studied. For instance, sense of place has been studied as associated with home (Jorgenson and Stedman, 2001, and 2005), neighborhoods (Brown and Werner, 2009), natural areas (Davenport and Anderson, 2005, Smaldone, et. al. 2005), and even historical places (Lewicka, 2008). This illustrates an important aspect of sense of place research, which has largely gone unattended in one single study. The importance of scale and the psychological implications of scale have been discussed in Montello (1993) that claims scale should matter when attempting to understand actions and behaviors of individuals. Most of this discussion centers around the impact of scale on the act of navigation and wayfinding, however, it is reasonable and testable that the use of scale should be considered in the examination of sense of place research. Earlier literature of sense of place unveils this very concept, discussed and even debated, which is largely ignored in individual research attempts. Past discussions have centered on the existence of a hierarchy of places, in which one place corresponds to another. Rapoport for instance, posits that places are nested within each other, for instance a house in a neighborhood and a neighborhood in a community. These larger places are surrounding the more personal inner places to the individual (Rapoport, 1977). In his model, the hierarchical levels are a product of the experience at the prior, more personally associated level. Canter, on the other hand, focuses on the level of interaction that the individual has with a place as a main component of hierarchy (Canter, 1977). This view reduces the meaning of nesting and emphasizes a more linear relationship between different aggregations of space into places. Both Rapoport's focus of geographic aspects of place, and Canter's focus of temporal associations with the place are equally integral to the establishment of several sense of place associations within a geographic region. Regardless of the manner in which these hierarchies are developed, these theories present interesting and foundational reasoning to explore a wide range of geographic aggregations of place, and their emotional associations. In addition, Lynch in his discussion of the interpretability of landscapes and meaning presents a open ended question of the impact of geographic scale (buildings, cities, metropolitan areas) on the imagability of the place (Lynch, 1960).

Furthermore, many theorists have discussed the impact of the physical environment on the experience of individuals. Lynch's imageability definition includes the physical cues that act as a facilitator in interpreting meaning of a specific landscape (Lynch, 1960). For instance, park benches and picnic tables could act as physical cues to designate a picnic area from a forest grove. The ideas of imageability and sense of place go hand in hand, as it is in part the physical cues that contribute to a meaning that is first interpreted and then attributed to a place. In addition, Canter (1983) discusses the experiential nature of sense of place as being a multivariate phenomenon that exists and evolves over time. This breaks away from any attempt to quantify a single aspect of place and link it to sense of place, but rather identifies the linked and intertwined relationship among physical variables as well as the temporal aspects. Additionally, he goes on to connect the discussion of several individuals regarding the utilization of the environment in forming experiences as opposed to the environment being merely a visual, secluded entity of a place.

Lastly, Canter defines places further by saying that given the interaction with physical attributes and experience, a person has an understanding of the environment in which he or she is in, which in turn impacts the purpose and expectation of the activity at that place. A person in other words will understand and value a place as "being purposively used by people as a way of completing plans or achieving objects" (Canter, 1983). The range of these plans or objects can be very diverse however, and can include specific objectives such as grocery shopping or dining, or can be less defined such as relaxing or enjoying family time. These are however, activities and ways that people spend time, which deeply connects the activity and time use of a person with the place in which they conduct their activities. It is therefore important to acknowledge that spatial decisions include a wider grasp of elements than just distance, cost, time and overall physical ability to reach the destination.

CURRENT SENSE OF PLACE WORK

One of the challenges of implementing sense of place in choice models is the scarcity of research quantifying the concept. The foundational theories of sense of place are built using phenomenological approaches, therefore early researchers in the field focused more on the development of theory rather than operationalization in data collection and quantification using statistical techniques. It was not until the eighties (Canter, 1983) and nineties (Golledge and Stimson, 1997) that the push towards measuring and applying sense of place became present in the literature. However, most of the research quantifying sense of place tends to be focused on either highly personal places (such as one's home or neighborhood), or historical places. Therefore the authors have identified three steps in integrating sense of place with choice models of everyday destinations. The first step is to determine whether sense of place can be successfully measured in everyday activity locations, second, determine the important aspects of sense of place in the activity type, and third identify the scales at which sense of place can be measured and introduced to choice modeling. The first of these three steps has been successfully accomplished in a pilot study conducted in Santa Barbara, California. This case study was designed using an intercept survey method to collect data from patrons at two outdoor shopping locations. Patrons responded to sense of place questions about each of the two shopping center locations (details of the study design can be found in Deutsch and Goulias, 2009). Survey questions were developed both from previous literature and survey development focused on second home ownership (see Jorgensen and Stedman, 2001 and Stedman, 2003), and from existing theoretical discussion. A table providing descriptive statistics for the sample used in this analysis can be found in Table 1.

TABLE 1 Sample Descriptives

Variable	
Gender	42.8% Male
Residency	77.7% Santa Barbara
Location surveyed	38.7% Paseo Nuevo
Mode taken to location	78% Car, 13.5% Walk 2.4% Bike, 6.1% Other
Age	Mean: 36.99 Max= 88 Min=18

A factor analytic approach was used in two separate analyses. The first, discussed in more detail in Deutsch et. al. (2011), consisted of a factor analysis using a priori assumptions of factor composition of three factors taken from previous work by Jorgensen and Stedman (2001). Additional factors were derived using an exploratory factor analysis (EFA). These factors were then applied to a series of logit regression models of behavior to determine significance of factors and their associations with the observed behavior. Although these models were not fully developed choice models, the use of discrete outcome models of behavior incorporating sense of place provided indication that sense of place can be measured in a meaningful manner, and that it can be applied with significant contribution to models describing behavior.

A second factor analysis was conducted to test the similarity in factor structure without the a priori assumption of factor composition from the literature or past studies. All questions were entered into an exploratory factor analysis and a resultant four factor model was developed. The results of the two models (model 1 with six factors and heavily influenced by second home location choice sense of place and model 2 a data driven factor analysis with four factors) as well as the origin of the questions and targeted sense of place aspect can be seen in tabular form in Table 1.

TABLE 2: SOP questions, origin, and model salience (note: J and S= Jorgensen and Stedman, 2001)

Sat= satisfaction, dep= dependence, id= identity, att= attachment, phy= physical, cul= cultural, soc= social	J and S adapted question	SOP aspect	Salient in model 1	Salient in model 2
"I am satisfied with the food options"		Sat	F6	
"I am satisfied with the products offered"		Sat	F6	
"I am satisfied with the parking"		Sat		
"I am satisfied with the level of services"		Sat		
"I am satisfied with the entertainment options"		Sat	F6	
"I am satisfied with the amount of people.		Sat		
"Has visually appealing architecture."		Phy	F5	F4
"Has a peaceful and relaxing atmosphere."		Phy	F5	
"is a beautiful mall."		Phy	F5	F4
"Has a good balance of decorative features and businesses."		Phy	F5	F4
"Has artistic value."		Phy	F5	F4
"Has a definite social atmosphere."		Soc		F4
"[location]…is a great family friendly place to be."		Soc	F4	F3
"[location]…is a kid friendly place to be."		Soc	F4	F3
"Has generally friendly people around."		Soc	F4	F3
"reflects the culture of Santa Barbara (SB)."		Cul	F5	F4
"involves a risk of unpleasant encounters"*		Soc		F1
"is always overcrowded."*		Soc		F1
"Has too much going on at it."*		Soc		F1
"makes me afraid to walk around."*		Soc		F1
"makes me feel relaxed."	X	Att	F1	
"makes me feel happy."	X	Att	F1	
"I would be disappointed if it did not exist."	X	Att	F1	
"is one of my favorite places in SB."	X	Att	F1	
"meets my needs better than any other location in SB."	X	Dep	F2	F2
"Has better diversity in activities than any other place in SB."	X	Dep	F2	
"Has stores that lack specific things."*		Sat		
"reflects the type of person I am."	X	Id	F3	F2
"I feel comfortable because I identify with the atmosphere."		Id		F2
"makes me feel too self-conscious."*		Id		F1
"says very little about me."*	X	Id	F3	F2
"makes me feel like I can be myself."	X	Id	F3	
"is a good reflection of my identity."	X	Id	F3	F2
"I only come when I have specific reasons in mind."*	X	Dep	F2	

*indicates reverse coded questions

Results of both factor models are provided in Figures 1 and 2. Comparisons of the two models indicate some similarities and some differences between factor structures. In both models, one factor representing the community-oriented nature of the place and one factor representing the physical and social atmosphere of the place were developed. Interestingly, several questions from the implied factors fell out of the four-factor model due to cross loading or non-salience. The result is either an entire lack of that specific factor (for instance attachment) or the combining of two factors (dependence and identity into one self benefit factor)

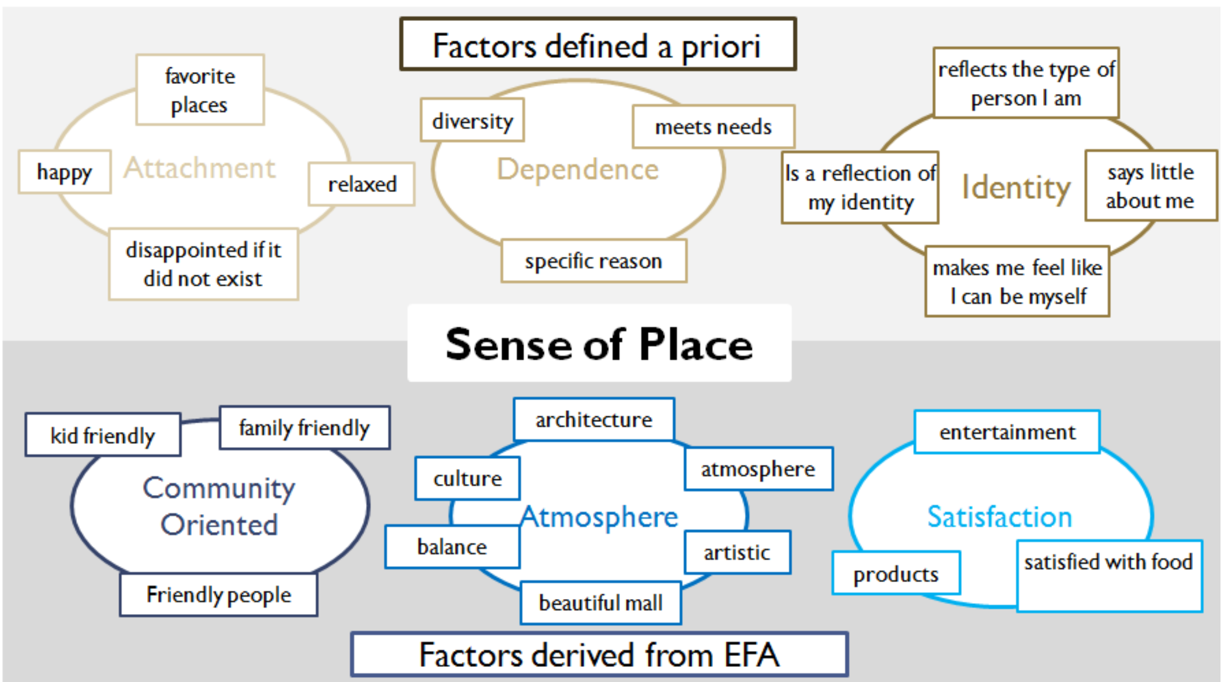

FIGURE 1: CFA/EFA factor model (χ^2(225 degrees of freedom) = 547.928, p<0.001, RMSEA=0.06, CFI=.95).

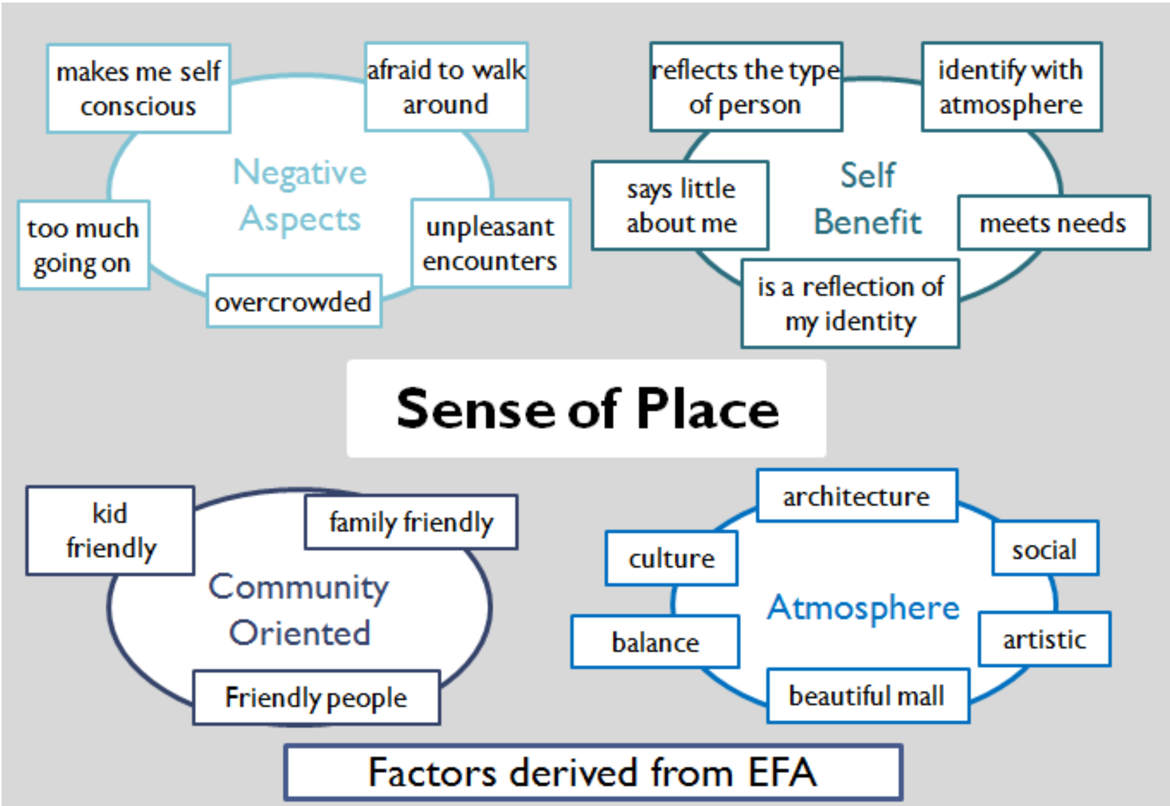

FIGURE 2: EFA factor model (χ^2 (101 degrees of freedom) = 207.54, p<0.001, RMSEA= 0.05, CFI=.96).

The comparison of these two models is not meant to challenge the legitimacy of either model. Given that the data input of a factor analytic procedure is the variance covariance matrix of the raw data, it is easy to see that the deletion of questions in the exploratory factor analysis (as was the case with model 1) will result in different factor structures. It is difficult in this pilot stage of research to make claims as to the superiority of either the statistical findings or the theoretical and instrumentation validity in the context of everyday settings (in other words the validity of imposing factor structure from literature using questions adapted to the research). However, both approaches to developing sense of place factors lead to interpretable constructs that can be used as variables in discrete choice models or can be used to define choice sets. The examination and comparison of these models here is primarily used to illustrate the further challenges and directions of research implementing sense of place into destination and location choice models.

Sense of place implementation

The findings of the model comparison bring about some fundamental questions with regard to everyday activity settings and sense of place measurement. In addition, the theory discussed in this paper presents further directions and considerations in order to successfully implement sense of place data in choice models. First, sense of place can be considered in the initial choice set formation process of exogenous generation frameworks. Individual's attitudes might indicate certain regions are out of consideration for choice alternatives because of the emotional or attitudinal association. The inclusion of sense of place information can occur at several geographic scales of regions, from cities, to neighborhoods, tracts, TAZs or blocks. The granularity of the region is dependent upon available data. As mentioned in the review of literature, attitudes regarding places have not been compared to or combined with measures of accessibility used to represent attractiveness within choice models. An analysis such as this would provide further insight into the behavioral realism of the assumptions of accessibility measures. Additionally, individual place specific sense of place can be used in the specification of alternative attributes to be used in the utility maximization function. While this might be difficult to incorporate (due to the larger amount of data needed for each of the alternatives), region level and location level data might work in tandem to provide enhanced information. For instance, data about the existence of favorite or top ranked places or highly undesirable places could be used to augment region level data on sense of place to enhance the level of attractiveness of those regions. The level of detail regarding specific activity locations is at the discretion of the researcher and is dependent on the research objective. Additionally, measurement methods and assumptions of transferability of questions should be tested. As observed in the model comparison, factor structures can differ depending on the a priori imposed structure on the analysis. Equally important to theoretical assumptions are assumptions of transferability of measurement instrumentation from one context to another. Lastly, important sense of place aspects should be considered for different types of activities. For instance, the weight of aesthetic nature of a place might have more importance in a leisure activity rather than a maintenance activity. Both sense of place research and choice research could benefit immensely from these endeavors. These aspects are currently being examined using a GPS based data collection methodology to develop a destination choice model integrating sense of place data.

CONCLUSION

Methodologies in choice set formation have gone through various improvements since the initial development in the early 1970's. Substantial attention has been dedicated to the process of choice set formation, and much discussion has been centered on the appropriateness of the explicit versus implicit treatment of choice set generation. Regardless of the preferred method of the researcher, attention must be given to the specification of a choice model to avoid biasing parameter estimates. In addition to this, researchers must strive to specify models in a behaviorally realistic manner in which the utility maximization is a reflection of the decision making process. The assumption of rationality underlying discrete choice methods further exemplifies the importance of the attributes considered, in that the utility maximization occurs with only the information provided by the data. One way in which the choice set generation and utility specification portions of discrete choice models can be enhanced is through the inclusion of sense of place variables in the probability of choice set and/or probability of alternative choice (of course there is a third option of specifying models that are not discrete choice models and/or are based on spatial hierarchy principles). Past work in sense of place provides a theoretical framework for which applications to everyday activity locations can be tested using data. Several aspects of sense of place at different scales should be considered in the various portions of the choice model framework, which again has the potential of important intellectual and practical gains. The value of sense of place in transportation has been recognized by planners and discussed, however the potential in travel behavior modeling has not been realized yet. Ewing for instance discusses the importance of signage and vegetation in facilitating a sense of place in pedestrian and transit-oriented design. The use of trees for example aid in achieving the pedestrian-friendly design objectives such as comfort and safety and an overall sense of place (Ewing, 1999). Considering that planners are implementing principles of sense of place to cultivate specific behaviors and attract people to “greener” behaviors, the travel behavior community should at least introduce these principles and practices in models attempting to explain behavior to enable testing of their effectiveness in changing behavior and to perform policy analysis.

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