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An Investigation in Decision Making and Destination Choice Incorporating Place Meaning and Social Network Influences

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Geography

by

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"You make known to me the path of life; in your presence there is fullness of joy; at your right hand are pleasures forevermore." Psalm 16:11

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ABSTRACT

An Investigation in Decision Making and Destination Choice Incorporating Place Meaning and Social Network Influences

by

Kathleen Elizabeth Deutsch

Travel demand models in the field of transportation have become increasingly sophisticated through the past several decades. The use of activity based modeling methods requires the integration of highly detailed information with statistical models but still substantial variation is unobserved. The pursuit of richer and more accurate models requires thinking outside of the proverbial box, and extending our research into various directions. This dissertation examines the process of destination choice, and the potential influence of place meaning and social networks in the process and in our ability to computationally replicate and predict behavior. Aspects of place meaning are examined, including different geographical aggregations, and the contributions of several theories such as sense of place. In addition, the role of individuals as decision makers is examined, in an attempt to determine whether there are different situations in which an individual's preferences or attitudes have more weight in the decision process. The research presented in this dissertation is motivated by the theoretical assumptions and underpinnings of the

discrete choice framework. Misspecification of choice models can lead to incorrect estimations, or biased parameters. It is therefore important to take care in specifying the models as accurately as possible to the actual decision process, and not relying on a stochastic error term to correct for any absent information. Although this work is framed by the discrete choice framework, the implications of the research also apply to broader domains in planning.

Results show that we can and should include sense of place attributes in a quantitative manner in modeling behavior. In addition, attitudes and perceptions of attributes of place can be used to challenge current assessments of accessibility and attraction to parts of a region. Though sense of place is a well-founded and widely discussed theory, there is still a considerable amount of work to do in capturing the emotional aspects of place in a quantitative manner. The work in this dissertation also explores the potential and shortfalls of the quantification of sense of place, and how we might better incorporated the phenomenon in models of decision-making. Lastly, findings of research conducted on the influence of social networks on decision making show that there is a wide range of cooperative decision making strategies, and as such, we must be more careful to model the influence of individuals in decision making more accurately.

TABLE OF CONTENTS

LIST OF FIGURES

1. Introduction

The introduction of the activity based approach into travel behavior research ushered in many changes in the methodologies and processes by which we understand behavior and make use of the analysis results. The premise of the activity-based approach lies in the assumption that travel is a derived demand that arises from the need or desire to participate in an activity (Ettema and Timmermans, 1997). Its predecessor, the four-step model, is still used to predict behavior, and is the primary model used for forecasting and policy development by many regional agencies. This involves the process of first generating trips from zone to zone, then distributing those trips across individuals, assigning modes, and routing those trips through the network (route choice). In contrast, the activity-based approach increased the sophistication and detail of model outputs in order to analyze emissions and the outcomes of different planning approaches. Trips are no longer the primary unit of modeling, as is the case in the four-step model. The progression of transportation modeling from the four-step to activity-based models has provided a catalyst for several new areas of research on human behavior. Modeling methods have moved from derivation of trips with origin destination matrices and gravity theory based assignments of trips, to the creation of synthetic populations with synthetic schedules, microsimulation or agent based modeling of activity participation, and utility maximization and rule based frameworks for decision making. In addition, the integration of the activity based transportation model with land use models is recognized as not only beneficial, but necessary in order to accurately assess the impact of land use and transportation policies, in a sense

bringing transportation modeling full circle and back to the spatio-temporal discussion of the great time space thinkers. The strong relationship between the built environment and travel behavior, and the impact of this behavior on both the transportation infrastructure and the built environment is captured through the integration of land use and transportation predictive models. Though, as Timmermans discussed in 2003, there had been a few researchers who had integrated land use and transportation models, and until recently the practice had encountered a sub prime representation in the travel behavior community. This integration is gaining momentum. However, there are many aspects of this land use-transportation interaction within the spatial and psychological domain that have yet to be understood and exploited for model improvement.

1.1. The evolution of the activity based approach

The activity-based approach was developed from various coinciding movements within several disciplines focused on an increased understanding of individuals, time use and activity patterns. Namely, work by Torsten Hägerstrand and Stuart Chapin in the 1970s on spatial and temporal constraints contributed significant theoretical frameworks to the development of the activity-based approach. These two researchers integrated the aspects of individuals (such as psychological factors like the desire to participate in activities) with spatial attributes (such as opportunities and constraints on the availability of opportunities) to derive a better understanding of how individuals organize their activities in space and time. Chapin defined several factors that he claimed contributed to the generation of activity patterns.

These ranged from psychological factors, such as the desire to participate in activities, which contribute to the propensity of engaging in specific activities, to opportunities such as services or facilities that would aid in activities (Chapin, 1974). Hägerstrand's work incorporates aspects of an individual and how his or her activities are scheduled given a spatial context. In his work, Hägerstrand defined several constraints applied to activity participation and subsequent patterns. The first, capability constraints, refers to physical constraints such as distances, or inability to be at multiple places at the same time. A second constraint is the coupling constraint, which refers to the necessary people, tools or objects that must be with that person at the time of his or her activity. A business meeting for example would require multiple people to have the same activity scheduled. The third constraint, the authority constraint, is implied by rules or regulations and impacts a persons activity scheduling (Hägerstrand, 1970). For instance, hours of operation of retail locations implies certain scheduling constraints for a person. The constraints in time and space are used to develop a space-time prism and a potential path area, which an individual can reach.

Cullen and Godson follow along these lines of Hägerstrand in their attempts to understand the way in which decisions within time and space are structured. They examine these decisions with a set of what they term propositions, which they acknowledge as "not so much as factual components of a theory of the decision process but as a useful way of looking at the problem for research purposes" (Cullen and Godson, 1975). They go on to explain that when broken down into items, it might give a false impression that a person considers each of these items separately

and objectively, which rarely happens. These propositions include organized behavior (organized episodes which give structure and pattern to behavior), the action space (the framework- structured by physical patterns and needs which an individual operates in), priorities (priority of activities in a person's schedule and the ordering of activities or alternatives), constraints (externally imposed limits to activities), flexibility of activities (the level of fixity in time and/or space of the activity), and scheduling (activities are ordered within the day depending on their fixity and estimated activity length). This work provided the conceptual framework from which the activity based approach emerged.

Implicit in the movement toward the activity-based approach was the necessity for more detailed and exhaustive data of individuals' activities, not merely trip information that had been previously relied upon. Data collection practices evolved from trip diaries, in which the respondent recorded only the trips and associated details within a day, to the collection of activity diaries, in which a respondent logs the way in which he or she spent time during the survey period, including where the activities took place, and the manner in which he or she moved within the activity space. In addition, traditional methods of pen and paper based diaries are being enhanced by the utilization of technology such as GPS loggers or trackers (for a review of several studies see Sen and Bricka, 2009), and smartphones (Clark and Doherty, 2008; Charlton et. al, 2011; Chen and Fan, 2012; and Jariyasunant, et al. 2012). This integration of technology is allowing researchers to reduce respondent burden by collecting several aspects of the activity (such as time, location, or mode of travel) in an automated fashion. By reducing respondent burden, researchers are

able to expand the survey by lengthening the duration of the survey, or including additional questions that probe the motivation behind the observed activity patterns. For instance, using GPS to collect trip details such as time and geographic coordinates in an automated fashion, researchers are allowed to focus efforts of planning (Auld and Mohammadian, 2011).

As the activity-based approach has progressed, research conducted in pursuit of higher accuracy in modeling and forecasting has expanded into many areas of time use and activity processes. Several factors identified and applied to travel behavior models have been honed and well-studied, with a long history of theoretical development, quantification and application. These factors include aspects of the individual (such as socio-demographic aspects such as employment, marital status, household income; aspects of the household (such as presence and ages of children, spouse, employment status of household members), and aspects of the built environment and opportunities (such as transportation network characteristics, parking availability, business information such as density of businesses and types, and employment information). Other factors involved in decision making have a relatively new or brief history in travel behavior research (such as household interactions (Timmermans, 2006; Yoon and Goulias, 2009), attitudes, personality types (Kitamura, et. al., 1997; Choo and Mokhtarian, 2002; Kuppam, et. al., 1999; Sunkanapalli, et. al., 2000; Dill, 2004), scheduling processes (and resultant behavior such as repetitive behavior, habit or temporal and spatial fixity of different activity types) (Arentze and Timmermans, 2000; Joh et al., 2002; Doherty and Miller, 2000; Roorda and Miller, 2005; Roorda et al., 2006; Auld, et. al., 2008; and Clark and

Doherty, 2008). Finally, a few factors contributing to behavior that will be explored in this research have very little exposure in travel behavior research. Interactions among social groups in which people belong has been discussed (see for instance Molin, et. al., 2008; Páez and Scott, 2007; Carrasco and Miller, 2006; Axhausen, 2005 and 2007, but the role individuals play as decision makers has had very little discussion. Additionally, the theoretical contributions of sense of place, and place attitudes have not been operationalized in the field. The research in this dissertation focuses on the decision making process, and more specifically on the social and psychological considerations of these two aforementioned aspects on the destination choice process.

1.2. Decision making processes

The decision-making processes of time-use and activity behavior and eventually destination choice is a complex web of interrelated actions of "causal" agents, which vary in significance given the context of the choice. Understanding the decision process underlying destination choice is rooted in a diverse range of disciplines including but not limited to economics, geography, sociology, and psychology. These disciplines offer a diverse set of foundational assumptions, approaches, and foci, contributing to a growing strength in understanding human behavior. They also however offer seemingly irreconcilable differences as a result of divergent approaches to scientific and humanistic exploration, and experimentation. Analysis of different facets of behavior, and application of this knowledge into models requires different methods and therefore assumptions. For instance, prediction of a

choice within the activity based approach framework traditionally relies on utility maximizing theory and rule based methods. The constraints and assumptions of these models (which will be further discussed later) can be limiting and in some cases might lead to incorrect estimation. On the other extreme, the analysis of the behavioral processes by which one makes a decision may include assumptions or premises rooted in critical theory, and have fewer limiting assumptions, but might have low empirical applicability due to a lack of mathematical formalization.

Perhaps one of the striking delimiters of methods used to approach and understand decision making is the assumption of rationality. On one side, theories of economic decision making (utility maximizing) rely on assumptions that include omniscience and complete logic in the decision maker to maximize the personal gain in each of the alternatives. On the other side, a number of behavioral economists and psychologists have endeavored into explaining the irrationality that exists in human decision-making, a stark contrast from the assumptions of rationality claimed by utility maximization. Attempts to reconcile this difference between reality and representation have led to several theories including Simon's theory of bounded rationality and satisficing (1956) (not aiming at the highest utility option but one that an individual is able to compute and satisfies a threshold of acceptability), and Kahneman and Tversky's (1979) prospect theory (asymmetry between losses and gains and associated willingness to risk by individuals in decision making).

Additional theories of decision-making and spatial patterns of people incorporate further aspects of human society and life. Theories such as Azjen's theory of planned behavior (Ajzen, 1991) introduce the idea of social norms and individual

attitudes into behavioral theory. This theory introduces concepts of attitudes and social influences, and recognizes the importance of these aspects in behavior. Moving away from economics and psychology are theories such as Bourdieu's theory on habitus (Bourdieu, 1998), stating that behaviors are a product of the history and the entirety of the individual being. This incorporates aspects of behavior including information, knowledge and past experiences into the process of decision-making. Additionally, several theories exist that explicitly treat space or spatial knowledge and can be applied to decision-making. Theories of time geography, as discussed above, have created the foundation for which the activity-based approach was built. However, aspects of these theories continue to be explored and applied to model decision-making. In addition, the contributions of psychological aspects of spatial knowledge have been recognized and explored. Development of a cognitive map, cognitive distances and perceptions of the physical environment have an important impact on decision-making (Golledge and Stimson, 1997). Additionally, the development of attitudes and perceptions about places has been widely explored and theorized. These theories and others contribute in varying degrees to existing practices in travel behavior modeling. In addition, the further exploration of these theories continue to challenge the comprehensiveness of current models. Although many of these theories present important aspects of the decision making process, the utility based models of discrete choice still exist as the primary method of incorporating decisions into the activity based approach. Discrete choice models provide a stable platform and allow for the incorporation of many of these aspects as latent variables or random variation. However, in order to incorporate

these various aspects into models, we must first collect data that will allow us to quantify the phenomena. Because of the ubiquity of discrete choice models in the activity-based approach, it is only natural to root much of the work presented in this research within this paradigm. The research presented is meant to both progress and challenge the assumptions and methods by which our current models of destination choice are developed. The following section provides an overview of the history of discrete choice models, and the estimation process, as well as the limitations and associated literature drawn upon in this work to challenge current practices.

1.3. Discrete Choice Models

Choice models have a long and rich history within the field of travel demand modeling. Choice model development began in the 1970's by researchers such as Daniel McFadden, a major pioneer in the model framework (see McFadden 2001 for a thorough review of discrete choice progression). The discrete choice framework has and continues to be instrumental to travel behavior modeling. Even in the early practices of the traditional four-step approach to travel demand modeling, one of the four steps (mode choice) employed 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.

Discrete choice model estimation involves first the specification of a utility, and second, the maximization across the alternatives in order to arrive at a choice. Utilities are specified for each alternative using Equation 1.1,

$$U_{it} = V_{it} + \varepsilon_{it} \qquad \text{Equation 1.1}$$

where,

i is the alternative (for all alternatives 1….n),

t is the individual (for all individuals 1….n),

V is the systematic portion of the utility, and

ε is the random portion or stochastic error term.

The systematic portion of the utility can be written as Equation 1.2

$$V_{it} = \beta_0 + \beta_{1t} X_{1t} + \beta_{2t} X_{2t} + \ldots + \beta_{nt} X_{it} + \beta_{1t} Z_{1t} + \beta_{2t} Z_{2t} + \ldots + \beta_{nt} Z_{it} \qquad \text{Equation 1.2}$$

where,

X is a vector of attributes defining the characteristic of the alternatives, and

Z is a vector of attributes defining the person.

The utility is then maximized such that ($U_i > U_j$) ∀ j, meaning that the utility of alternative i is greater that alternative j, where j represents all other alternatives in the choice set. If the random error terms have a suitable distribution, the probability of choice i being selected is given in Equation 1.3.

$$P(i) = \frac{e^{U_i}}{\sum_{j=1}^{J} e^{U_j}} \qquad \text{Equation 1.3}$$

where,

U_i is the utility of alternative *i*, and U_j is the utility of the other alternatives. The estimation procedures employ maximum likelihood estimation techniques (MLE) to converge on a maximum. In the systematic utility attributes of alternatives, decisions makers, and context are used to represent decision making in more realistic ways. Moreover, a variety of other formulations attempt to alleviate the impact of simplifying assumptions (Ben-Akiva and Lerman, 1985; Train, 2003).

One of the most fundamental assumptions of discrete choice methods and perhaps one of the most controversial is the assumption of rationality (perfect knowledge of the options, creation of a utility function for each option, and choice of the option with the maximum utility). 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. When the choice situation is about destinations that are many in number, researchers attempted to delimit the space within which choices are made to decrease the number of options and therefore make the application of equation 1.2 feasible. This practice as Thill (1992) discusses may lead to deleterious 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. The role of space in these discrete choice models adds complexity to the estimation process, and must be addressed.

1.3.1. 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. Within the usual four-step approach to modeling, trip distribution occurs using the gravity model, 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). Equation 1.4 provides one example of gravity model formulation.

$$T_{ij} = \frac{P_i(A_j F_{ij})}{\left(\sum_j^M A_j F_{ij}\right)}$$

Equation 1.4

where,

T is the flow of traffic from one zone (i) to the next (j) for all zones j (j= 1...M),

P is the total production of traffic,

A is the total of attracted traffic to the zone and

F is a travel time factor (e.g., a distance decay factor 1/distance), which incorporates distance in terms of a time necessary to travel between zones.

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.

1.3.2. 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 others at the Lund School in regional science in the 1970s challenged this "physics" based view of behavior. 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.

As mentioned above, one option for representing and modeling spatial interaction at a disaggregated level is to introduce new techniques (e.g., a utility based probabilistic discrete choice model) with increased detail to models. However, with this increase in detail, new challenges are 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 of above one hundred options for which a utility is computed that present estimation challenges both in data needs and run times. This also amplifies the lack of credibility of the perfect knowledge assumption. 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 and distance (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. Though 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. The process of choice set formation in Manski's proposed method is explicitly treated in this formulation.

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 made 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., 2012). These model formulations provide finer grained detail of the potential activities that are physically reachable. They also provide

guidelines in designating a consideration choice set (or subset) from a universal choice set. In addition, depending on the exogenous or endogenous nature of the choice set generation procedures, the model formulation can provide guidelines in defining attributes of the alternative for utility maximization.

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).

1.3.3. 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 and ease of 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 with an area or time), 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 producing probabilities to travel to the specified zone). 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; Yoon and Goulias, 2010a). 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 might only be 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. In addition, the decision making process often includes other individuals as decision makers. The complexities of modeling multiple decision makers simultaneously in a choice process has yet to be recognized within

destination choice discussions, but is an obvious reality in destination selection (as well as in decisions extending beyond destination choice). Although the inclusion of social influences is far from ready to implement, it is important to explore the attributes and potential that existing theories have in aiding this modeling improvement. These two aspects will be discussed in the next two sections, and are the two areas for which much of my interest in refining decision making theory and operationalization accuracy.

1.4. Person to Place Influences on Destination Choice

The decision making process of destination choice as discussed above involves a number of aspects ranging from attributes of the person (for instance his or her time budget), to the place (for instance the opportunities available, or the ease at which those opportunities can be reached). However, within this spectrum of aspects, there is an area of contributing factors that is underexploited. The manner in which people relate to, place expectations on, or develop associations with places impacts the likelihood that the place is considered as a destination. These aspects are both a product of the person, and of the place.

Sense of place theory provides a strong theoretical framework by which the influences of places and the development of these psychological associations can be investigated. Early theorists of sense of place such as Tuan (1974), and Relph (1976) described the meaning endowed to places but positioned sense of place as a highly individual and person specific phenomenon that was best described qualitatively rather than quantitatively. In addition to this, others have further

developed sense of place theory and discussed related concepts that are either enveloped into sense of place, or strongly associated with it. Place identity, place attachment and place dependence are three well-known concepts that have also been developed and theorized, and will be discussed further in the next chapter. Although sense of place theory had roots in phenomenological thinking, researchers have converted this thinking into an empirical form that is amenable to application in travel behavior. Additionally, scholars have discussed sense of place in the framework of attitude theory, attributing the concepts of place identity, dependence and attachment to the cognitive, conative and affective components (respectively) of attitude development (Jorgensen and Stedman, 2001). Although sense of place theory is well developed, the quantification of and the application of (especially within everyday activity settings) is still relatively small. It is therefore necessary to explore the development of sense of place, and the process of endowing specific destinations with meaning in the context of everyday travel behavior. This agenda is undertaken in chapters two and three, and will be further described in at the end of this chapter.

In addition to sense of place theory, the development of associations and meaning of places has been recognized and discussed within many domains outside Geography. Planners, architects, environmental psychologists among others have contributed to the mass of theory regarding the mental development of place associations. Lynch (1960) discusses the concept of legibility, which refers to the ease with which the symbols and patterns of a city can be grouped and interpreted by an individual. He then builds on this concept to discuss the construction of an

image, which is the "result of a two way process between the observer and his environment" (page 6). The objective of the studies conducted in his book is to understand the common image of a city that is held by a large number of the residents of the cities. This image is a product of a three-part process: first, identity; second, structure; and third, meaning. Assembly of these aspects as a process means that a person, for instance, must first recognize that a picnic table exists as an entity separate from the forest that it is placed in, in order to understand that the picnic table exists for sitting and eating, and associate that meaning to the object. A second concept introduced by Lynch, the concept of imageability, refers to the quality in the physical objects that contribute to the ability of a person to reach this understanding and meaning. In his discussion of these concepts, Lynch recognizes the importance of both physical attributes, and people (including the activities they conduct) in the process of endowing a place with meaning by saying "Moving elements in a city, and in particular the people and their activities, are as important as the stationary physical parts" (page 2). Much of Lynch's work brings light to the importance of physical attributes, or built environment in the creation of meaning in places. It is therefore natural that aspects of the built environment can be directly seen as having an impact on the development of place meanings and as such, impact the decisions of destination choice.

One aspect of place meaning that must be addressed in the process of applying it to decision making is the vague concept of place. The term place can both refer to an individual point location, for instance home, or a larger aggregation of space such as a city, state or country. Although individual places, and the associated sense of

place may be instrumental to the choice process, larger aggregations of areas are also endowed with meaning and impact the choice. The influence of spatial aggregation, and place attitudes or mental images (in the framework of Lynch) is also discussed in the literature (Shamai et al., 2012) but has less of a presence. However, in order to feasibly incorporate place attitudes, or perceptions of places into choice models, it is important provide attributes to all geographic areas that could have a choice alternative. Exploration of methods of incorporating scales of place meaning and larger aggregations of regions will be presented in chapter four, and will be further discussed at the end of this chapter.

1.5. Person to Person Influences on Destination Choice

The social nature of activities and the patterns of daily lives is an aspect of decision-making that must also not be underestimated and neglected in models of decision-making. As Solomon (1985) points out, activities are driven by the need to fulfill a sense of belonging. Solomon breaks activities of different types into categories that follow Maslow's theory of motivation (1954). In Maslow's theory, people are motivated to action by physiological needs, safety, belongingness, self-esteem, and self-actualization. Solomon uses these categories of motivation to associate activity types with different levels of needs in order to discuss telecommunications and whether the act of telecommuting will replace trips such as work, shopping or social/recreational. Following this framework, activities have a degree of social belongingness associated with them, with perhaps the most extreme case of this being social or recreational trips.

In a different, but still similar vein, as the four step model is slowly being replaced by the new activity based model, the recognition that there are multiple participants in a single activity, and thus decision makers, became an important aspect. This recognition most commonly happened within the context of the household, as allocation of tasks and time use became pertinent, and bargaining of duties such as grocery shopping and escorting children to school began to be incorporated into models. However, as Sharmeen et al. (2010) point out, joint activities are not just conducted within the context of the household network. The larger social network is involved in an individual's activity patterns. The authors state that "Each individual is a part of a social network and individual behavior may be influenced by the attitudes and behavior of peer groups."

In addition to these instances, which pointedly state the social nature of activities, an amassing body of literature is developing regarding social networks in travel behavior. Despite this, few researchers have investigated the role an individual plays as a decision maker in the social networks that he or she is involved in. This third research agenda is explored in chapter five, and will be further discussed in the following section

1.6. The content of this dissertation

This dissertation attempts to understand behavior and decision making through several aspects. First, it must be noted that the framework of the discrete choice model has influenced the motivation of this work, but the findings are applicable to a much broader body of work. The research encompassed in this dissertation explores

the interaction between land use, and transportation through examining the psychological and social influences in decision making. The remainder of this dissertation is structured as follows:

Chapter two: As previously mentioned, the work incorporating sense of place into travel behavior modeling is in its infancy. In order to adequately incorporate place meaning, we must first understand what should be measured. Sense of place theory and quantitative structure has been explored in several contexts, but these studies have involved investigations of highly meaningful and personal settings such as homes. One challenge to incorporating sense of place into travel behavior is measuring it correctly. Although theory and measurement methods exist, the transferability of these tools and theory from highly meaningful places to everyday activity locations must be examined.

This analysis is focused on two point locations (Paseo Nuevo and La Cumbre shopping centers), and is a continuation of previous work (Deutsch and Goulias, 2010, Deutsch et. al., 2013). Chapter two examines the structure of sense of place using two factor analysis models. One model incorporates the assumptions from theory, and applies an a priori structure to the model (theory driven model), and another assumes no a priori structure (data driven model). A portion of this chapter was presented at the International Choice Modeling conference in Leeds, United Kingdom in July of 2010.

Chapter three: Due to the phenomenological origins of sense of place, in addition to understanding the structural differences that exist in a quantitative manner, it is important to investigate what might be left out by using these methods,

or additional ways to measure the concepts. Chapter three explores sense of place from both quantitative and qualitative approaches, and examines the differences and similarities between the findings of these analyses. Chapter three is a continuation in the exploration of the measurement of sense of place presented in chapter two. The work in chapter three has been presented at the Transportation Research Board meeting in 2011, and was published in the Transportation Research Record in 2012.

Chapter four: In addition to exploring place meaning from individual points of interest, we must understand how larger areas are viewed by decision makers. Chapter three investigates subjective attraction to places through a survey conducted in the southern coast of Santa Barbara County- GeoTRIPS (***Geo****graphy of* ***TR****avel,* ***I****nterests,* ***P****laces and* ***S****ocial ties*). In this work, an attraction index is developed using attributes that attract and repel travel and applies a weighting schema to individualize the importance of these aspects in the destination choice process. Preliminary results of Chapter four were presented at the 2012 GIScience meeting, and in 2013 at an invited presentation at the Transportation Research Board meeting. The final results were presented in 2013 at the Annual Association of Geographers, and the manuscript of Chapter Four will be submitted for consideration as a publication imminently.

Chapter five: The social influences of destination choice are considered in Chapter five of this dissertation. The analysis of another portion of the survey GeoTRIPS involving social network involvement and decision making roles within those networks is conducted. The work of this chapter was presented at the Transportation Research Board Meeting in 2013, the University of California,

Transportation Center meeting in 2013, and is in press to be published in July issue of the journal Transportation.

Conclusion and Future Work: Last, the work presented in these chapters is summarized in the conclusion. In addition, the next steps and areas for further research are addressed, as are the limitations of this research.

It must be noted that due to the fact that each chapter was intended as a stand-alone paper, there is some redundancy between chapters. While this is mostly the case with the chapters dealing with sense of place, effort was made to reduce the redundancy.

1.7. Objectives and contributions

The research of this dissertation involves several objectives for scientific contribution to the field. The assumptions and methods of discrete choice models provide much of the motivation and frame the objectives. The two main objectives of this research are to examine ways in which place meaning and social networks can be incorporated in the decision-making framework. Within each of these objectives are a subset of objectives and contributions.

Within the objective of place meaning, the work presented in this dissertation attempts to: 1) measure and apply the theory of sense of place in everyday activity locations; and 2) develop methodology for incorporating and comparing subjective attraction to regions with accessibility measures representing attraction to regions.

Within the objective of social networks, this work intends to expand the current trend of examining decision-making and social network involvement to incorporate a variety of decision roles.

2. Sense of Place Theory and Structure: From Home to Everyday Locations

2.1. Background

There is a rich history of discussion and theory that has developed over the last half of a century by researchers exploring sense of place. The interest in the emotional connection between people and places has spanned across many domains and subject areas. Although sense of place theory was briefly presented in the last chapter, it is important to more completely expound on the theoretical contributions over the last several decades. In addition, though this theoretical framework has been honed throughout this time, there have been few instances of quantitative application. Even more important than this fact in the endeavor to apply sense of place to destination choice is the fact that these applications have been centered around places that are likely to elicit a higher level of meaning than everyday locations such as a second home location.

Tuan, one of the pioneering researchers defined sense of place 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 or related concepts, including place identity, which is "the individual's personal identity in relation to the physical environment" (Proshansky, 1978, p. 155), place attachment, "the bonding of people to places" (Altman and Low, 1992, p. 2), place dependence, the "[person's] perceived strength of association between him- or her-

self specific places" (Stokols and Shumaker, 1981, p. 457) and place satisfaction "the utilitarian value [of a place] to meet certain basic needs" (Guest and Lee, 1983, p. 234).

Sense of place has been examined on several scales. 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. 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 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, with the places

that more time is spent at being more important than those where less time is spent (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 geographic focus, and Canter's temporal focus of 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 (see also the biasing issues in Fotheringham et al., 2001), and their emotional associations. Additionally, Lynch in his discussion of the interpretability of landscapes and meaning presents an open ended question of the impact of geographic scale (buildings, cities, metropolitan areas) on the imageability 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 landscape (Lynch, 1960). For instance, park benches and picnic tables 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 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 his or her environment, 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.

2.2. Measurement of sense of place

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 (e.g., see Kallus and Law-Yone, 2000); therefore early researchers in the field focused more on the development of theory rather than operationalization. Years later, the charge towards measuring and applying sense of place became present in the literature (Canter, 1983, Golledge and

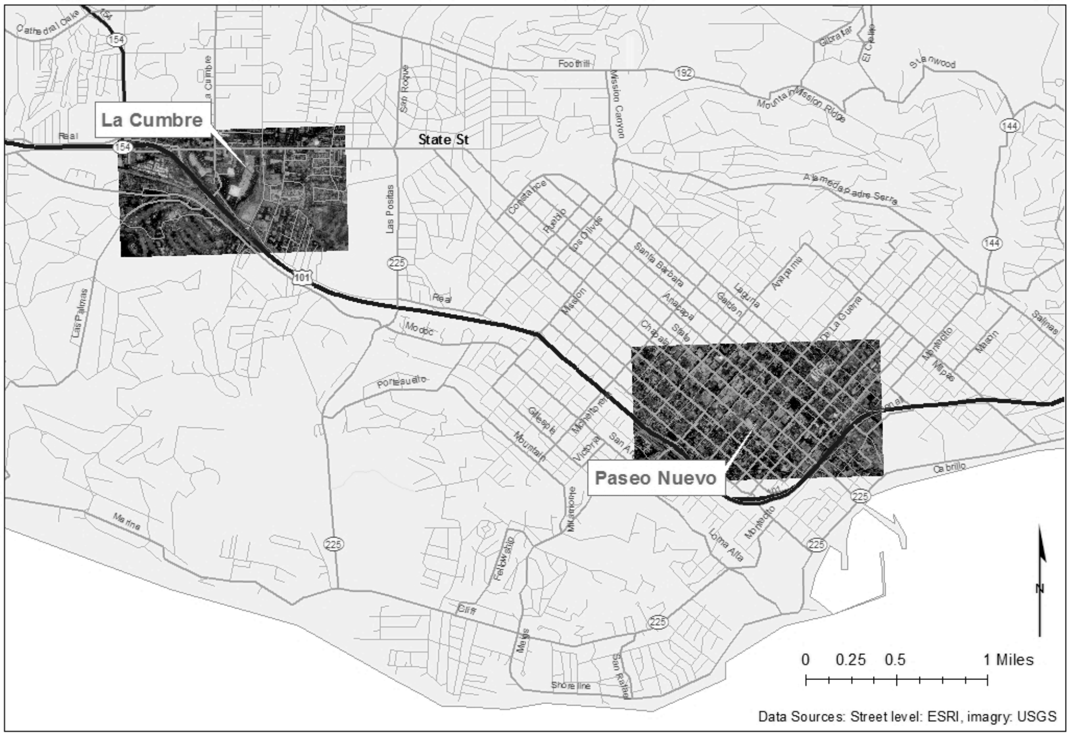
Stimson, 1997). However, most of the research quantifying sense of place tends to be focused on either highly personal places (for example, home or neighborhood), or historical places. Measurement techniques of sense of place must first be examined and understood in order to provide insight into how this concept can and should be integrated into choice models.

In order to explore these measurement techniques, a case study was designed using an intercept survey method to collect data from patrons at two outdoor shopping locations in Santa Barbara, California. Patrons responded to sense of place questions about each of the two shopping center locations (for study design see Deutsch and Goulias, 2009, and Deutsch, 2008). Paseo Nuevo, an urban shopping center is highly influenced by Spanish architecture seen throughout the city. La Cumbre on the other hand has the design of a typical California open-air mall. Each mall contains two big box brand stores, as well as several smaller retail shops, and restaurants. Figure 2.1 provides images of Paseo Nuevo, Figure 2.2 of La Cumbre, and Figure 2.3 shows a map of the geographic locations of each of the study areas. More information about the stores and maps see http://www.paseonuevoshopping.com/Map/ for Paseo Nuevo, and http://www.shoplacumbre.com/Map/ for La Cumbre.

Figure 2.1. Photos of Paseo Nuevo (taken by K. Deutsch)

Figure 2.2. Photos of La Cumbre (taken by K. Deutsch)

Figure 2.3. Map of La Cumbre and Paseo Nuevo in Santa Barbara



Survey questions were developed from theoretical discussions of sense of place in the literature. In addition, a subset of questions was adapted from a study focused on second home ownership (see Jorgensen and Stedman, 2001 and Stedman, 2003). Table 2.1 provides descriptive statistics of the sample used in this analysis. In this analysis, only respondents with complete information for variables entered into the model are used.

Table 2.1. Santa Barbara Sample Descriptive Statistics

Variable	
Sample	719
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. (2013), 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), and were combined into a final Confirmatory Factor Analysis (CFA) model. 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 using MPLUS version 6, with a geomin rotation (Muthen and Muthen, 1998-2010), and a resultant four-factor model was developed. The results of the two models (model one with six factors and heavily influenced by the study of sense of place of second home location and model two a data driven factor analysis with four factors) are presented in Table 2.2. In addition to the two factor analysis results, Table 2 reports the origin of the questions (adapted from Jorgensen and Stedman's work or not), and the intended aspect of sense of place targeted by the question following theoretical discussions in the literature.

Table 2.2. Sense of place questions, question origin, and model salience for models 1 and 2

Sat= satisfaction, dep= dependence, id= identity, att= attachment, phy= physical, cul= cultural, soc= social	J/ S	SOP aspect	M1	M2
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	
I only come when I have specific reasons in mind.*	X	Dep	F2	
Makes me feel like I can be myself.	X	Id	F3	
Is a good reflection of my identity.	X	Id	F3	F2
Reflects the type of person I am.	X	Id	F3	F2
Says very little about me.*	X	Id	F3	F2
I feel comfortable because I identify with the atmosphere.		Id		F2
Makes me feel too self-conscious.*		Id		F1
I am satisfied with the entertainment options		Sat	F6	
I am satisfied with the food options		Sat	F6	
I am satisfied with the products offered		Sat	F6	
Has stores that lack specific things.*		Sat		
I am satisfied with the parking		Sat		
I am satisfied with the level of services		Sat		
I am satisfied with the amount of people.		Sat		
[location]…is a 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
Has a definite social atmosphere.		Soc		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
Has visually appealing architecture.		Phy	F5	F4
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
Peaceful and relaxing atmosphere.		Phy	F5	
Reflects the culture of Santa Barbara (SB).		Cul	F5	F4

*reverse coded, J/S= Jorgensen and Stedman, M1= Model 1 salience, M2= Model 2 salience

Results of both factor models are provided in Figures 2.4 and 2.5, with factor scores reported for each in Tables 2.3 and 2.4. It should be noted that the factor loadings from EFA and CFA should not be directly compared because in CFA (Model 1) we set the factor structure using theory and fit a factor model. The first indicator is set to one unless the results are standardized. Usually standardization is used in cases where indicators are measured on different scales, which was not necessary in this model. Loadings for the theory driven model (model one) are reported as unstandardized loadings. In EFA (model two) however, we allow the data to drive the structure of the model, and for interpretability a rotation is applied. This rotation can either be orthogonal (for uncorrelated factors), or oblique (for correlated factors). The Mplus default of a geomin rotation was applied to the EFA under the assumption that the factors are correlated (Brown, 2006; Muthen and Muthen, 1998-2010). Although the magnitude of the loadings of model one and two should not be directly compared, conceptual comparisons of factor structure can be made.

Figure 2.4. CFA/EFA factor model 1

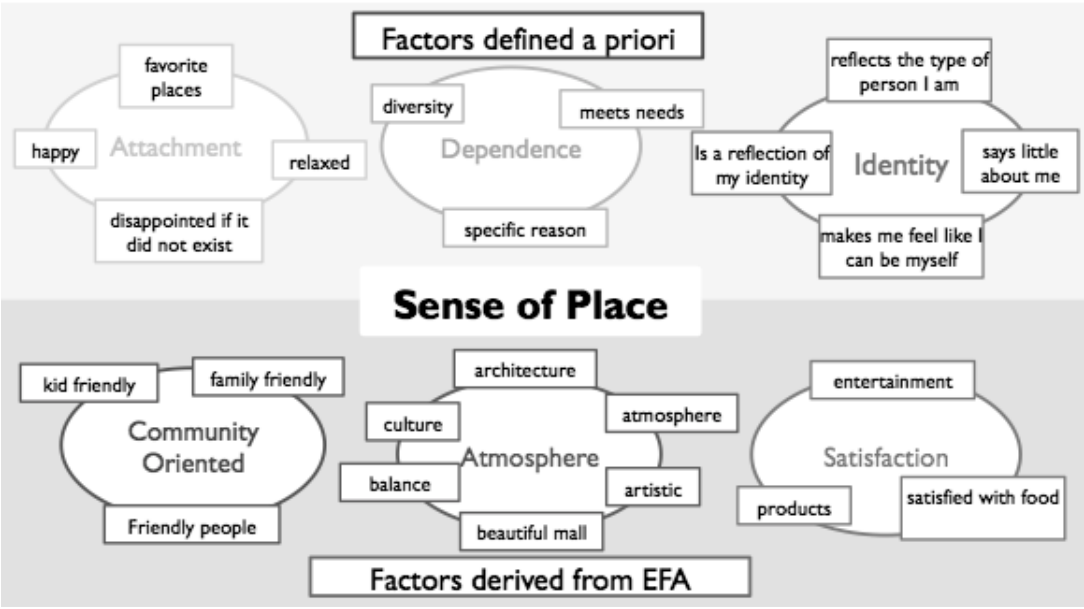
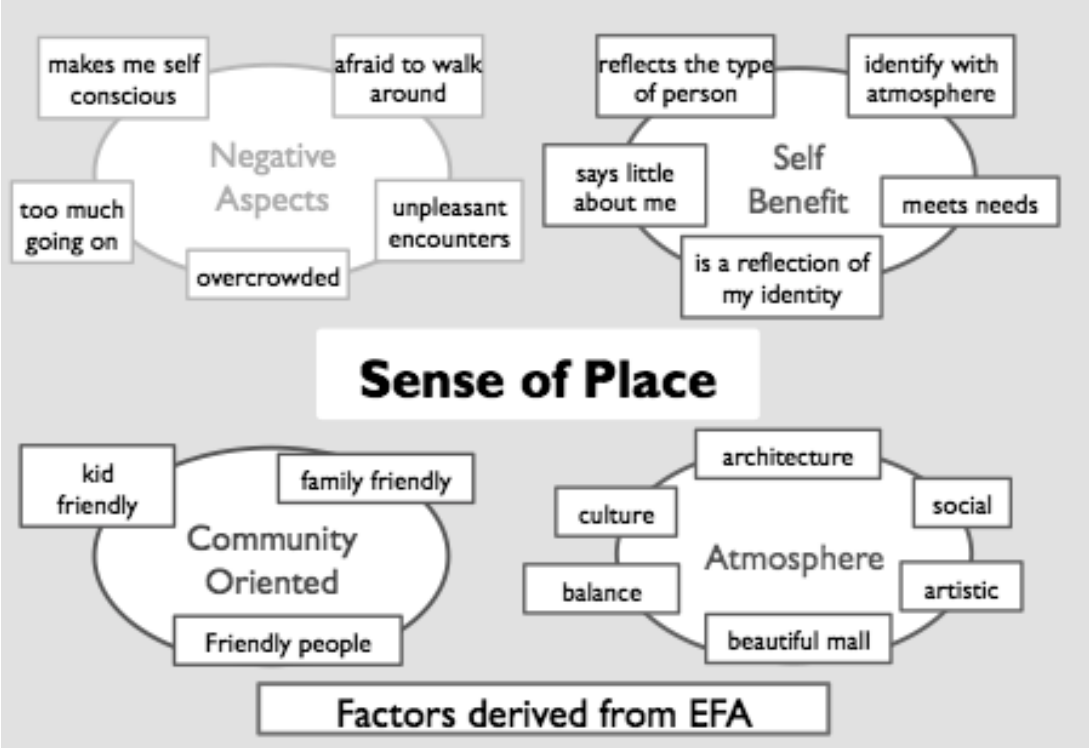


Figure 2.5. EFA factor model 2



Comparisons of the two model structures indicate some similarities and differences between factor compositions. 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 a lack of that factor (for instance attachment) or the combining of two factors (dependence and identity into one self-benefit factor)

Table 2.3. CFA model (χ^2(225 degrees of freedom) = 547.928, p<0.001, RMSEA=0.06, CFI=.95).

Sense of place factor	Indicator	Est.	S.E.	Est./S.E
Attachment	Makes me feel relaxed	1	0	0
	Makes me feel happy	1.131	0.04	28.155
	Would be disappointed if it did not exist	0.881	0.043	20.355
	One of my favorite places in Santa Barbara	1.052	0.042	24.869
Dependence	Meets my needs better than any other location	1	0	0
	Has better diversity than any other place	1.053	0.051	20.486
	I only come for a specific reason	0.639	0.059	10.91
Identity	Reflects the type of person I am	1	0	0
	Says little about me	0.676	0.044	15.368
	Makes me feel like I can be myself	0.793	0.041	19.153
	Good reflection of my identity	1.029	0.039	26.471
Satisfaction	Satisfied with the food	1	0	0
	Satisfied with the products offered	1.058	0.079	13.314
	Satisfied with the entertainment options	0.935	0.072	12.97
Atmosphere	Visually appealing architecture	1	0	0
	Peaceful and relaxing atmosphere	1.042	0.048	21.919
	Beautiful mall	1.084	0.044	24.595
	Good balance of decorative features and businesses	1.115	0.046	24.072
	Has artistic value	1.028	0.042	24.44
	Reflects the culture of Santa Barbara	0.965	0.046	21.096
Community-oriented	Family friendly	1	0	0
	Kid friendly	0.879	0.039	22.588
	Friendly people around	1.011	0.048	21.055

Table 2.4. EFA model (χ^2 (101 degrees of freedom) = 207.54, p<0.001, RMSEA= 0.05, CFI=.96).

	Atmosphere	Community Oriented	Negative Aspects	Self Benefit
Visually appealing architecture	0.910			
Beautiful mall	0.888			
Balance of decorative features and business	0.852			
Has artistic value	0.832			
Has a definite social atmosphere	0.592			
Reflects the culture of Santa Barbara	0.589			
Family friendly		0.774		
Kid friendly		0.855		
Friendly people around		0.444		
Involves a risk of unpleasant encounters			0.569	
Always overcrowded			0.818	
Has too much going on at it			0.831	
Makes me afraid to walk around			0.615	
Makes me feel too self-conscious			0.431	
Meets my needs better than any other place				0.402
Reflects the type of person I am				1.031
Good reflection of my identity				0.727
Says little about me				0.408
I feel comfortable because I identify with the atmosphere				0.720

The comparison of these models is not meant to challenge the legitimacy of either method, but rather to illustrate the differences and similarities that exist between theory driven and data driven models of sense of place. The obvious question resulting from these differences is whether existing sense of place constructs and questions developed for one type of place (e.g., home location) can be transferred to another type of place (everyday activity location in this paper). This

concept points back to the considerations of hierarchy in sense of place discussed earlier in this paper, and whether certain constructs are manifested more strongly in specific types of places over others (for example place attachment and home, which appeared in Jorgensen and Stedman's work (2001, 2006), but not the data driven model two). Although it has been shown that sense of place can be quantified and applied to behavioral analysis through this paper and our previous paper (see Deutsch et. al, 2013), there are still many challenges to overcome before sense of place is well understood in the context of everyday activity location and travel behavior. The point still exists however that 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.

2.3. Conclusion

It is common sense that rich scholarly discussions and empirical examination should be utilized to inform models of latent phenomena. Advantages exist in using existing theoretical developments as they provide researchers with measurement tools that have been successful in examining the concepts. However, caution must be exercised when transferring theory and measurement tools across different research agendas. As evidenced in this modeling exercise, the importance of specific latent factors (or theoretical concepts) of sense of place might be more pertinent to specific locations with respect to others. Questions intended to measure specific concepts of sense of place may or may not actually be successful in measuring the targeted concept. As seen in the exploratory factor analysis,

indicators intended to measure well defined attributes of sense of place did not manifest themselves in a common factor, but rather the complete opposite occurred in that these indicators attenuated out of the model due to either low loading values or cross loading into multiple factors.

Although it would be easy to reduce the importance of previous measurement methods and theoretical frameworks in less meaningful places due to the non-salience of the indicators in a data driven model, this must not occur. This research is not meant to develop a strong stance toward a completely data driven model of sense of place, it is meant to explore and open discussion regarding the differences in place meaning that develop among places where different activity types occur. Although the questions that were adapted from previous work did not load in an EFA model, it must not be understated that the fit of the CFA model indicated that the model was in fact a good model for the data. The imposed structure of the model produced a six-factor model that fit well, and provides insight into the aspects of each a priori defined concepts are most important.

The findings of the model comparison bring about some fundamental questions with regard to everyday activity settings and sense of place measurement. It is important to consider the type of activity, the type of location and the meaning that could or is necessarily endowed on the place. A comparison of using measurement methods developed for home location on shopping mall sense of place revealed that the questions might not be completely appropriate for the place. Additional aspects of the place however did contribute to the development of four latent factors. Future research should be conducted to understand what types of activities (and therefore

destinations) are associated with the various aspects that contribute to sense of place. For instance, does the aesthetic quality of a destination matter more for recreational activities than it does for maintenance activities (shopping and other errands).

In addition, as discussed previously, sense of place theory is rooted within the qualitative realm. Although there is much agreement with the need and feasibility of quantifying at least a portion of the meaning that is endowed to places, there is still a lot of meaning that is not captured. Comparing the quantitative results of studies such as this one to qualitative data about the same location might provide further insight into the way in which place meaning can be captured and quantified.

3. Understanding Places Using a Mixed Method Approach

3.1. Background

As the implementation of the activity-based approach becomes more widely used in travel behavior, researchers have become more reliant on the task of understanding how people make decisions and organize their life, which in turn requires travel. With this task is the need and desire to represent human behavior and decision making with as much accuracy and realism as possible. Often times, this requires researchers to know the aspects that are important to understanding and modeling behavior, and measure these aspects and apply them in a meaningful statistical manner. Many times, researchers find themselves acknowledging the contribution of latent, complex or at times seemingly immeasurable dimensions of human agency. Measuring and applying these facets of behavior to models is, at bare minimum, challenging. As Goulias (2003) mentions, travel behavior researchers attempt to understand human behavior and foster positive change. In order to do this, we must strive towards behavioral realism to identify key facets of behavior, which needs to be done without forcing restrictive analytical methods and running the risk of masking differences that exist.

Researchers have approached these difficulties using differing approaches, all of which have contributed to increasing the sophistication of the state of the art in travel behavior. From a purely quantitative perspective, several advancements have been made in statistical modeling, allowing for increased flexibility and detail. One notable example, the multiple discrete continuous extreme value models developed

by Bhat et. al. (2005) allows for the simultaneous modeling of multiple interdependent decisions and is indicative of the type of advancements we experience that allow complex decision making modeling and simulation. In addition to this, several latent variable models have become primed for travel behavior analysis, including models that tease out random explained variance from the error term such as random coefficient regression or error component models, or models incorporating latent attributes such as latent factor, and latent class models. Structural equation modeling has also become a widely used tool, incorporating latent and observed variables and providing a method for analyzing the paths between these variables in describing the observed traits. All of these statistical advances allow for the development of models of complex behavior with increased detail regarding the behavioral process and decisions being made and those who are making the decision.

Another approach currently being advanced and enriched is the focus on the type of data collected and used, and the methods by which the data is obtained. Many have acknowledged that the use of the activity-based approach requires a new frame of reference for data needs in order to build successful models. The potential use of qualitative methods and mixed methods approaches have become more prevalent in discussions related to understanding behavior and tapping into nontraditional methods. Discussions however have also centered on the necessity to maintain an awareness of the philosophical underpinnings of such methods, and to proceed with caution in combining quantitative and qualitative methods. Goulias (2003) presents an overview of research methodologies and strategies emerging from

different philosophical positions, and suggestions on how to conduct research while staying consistent within positivist theoretical framework, which is the predominant travel behavior framework. He goes on to say that "many of the methods under this [qualitative methods] label offer the dynamic flexible tools needed in travel behavior to, on the one hand, extract this 'insider story', (behavior from the viewpoint of the agent) and, on the other, understand the 'emergence' of behavior and internal cause(s) that are characteristic of complex systems." Similarly, Clifton and Handy (2003) state that the more we understand about peoples travel behavior, the more we realize we don't understand, and qualitative methods offer powerful tools to obtain a deeper understanding of the complexity of behavior (Carr, 2008).

From a positivist standpoint, the benefit of qualitative methods in travel behavior is apparent. Clifton and Handy discuss the use of qualitative methods in conjunction with or independently from quantitative methods, and Goulias remarks that, "some techniques that are often used in qualitative methods can be used within the positivist and probabilistic paradigm as secondary aids of the primary data provision mechanism which is quantitative survey methods." Carr, likewise states: "although qualitative techniques do not yield significant results, they are ideally suited for exploratory research such as identifying influential factors of travel behavior" (Carr, 2008, pg. 3). It is clear that research attempting to understand decision-making behavior is prime for this combination of methodological approaches due to both our limited understanding of the decision process, and insufficiencies in capturing data to explain observed behaviors. The nature of these topics can be both quantitative and qualitative. It must be noted, that there are many

instances where qualitative methods (such as ethnographic studies) are not compatible with concurrent quantitative methods such as questionnaires, due to conflicting theoretical and methodological assumptions (for instance observation without interference). However, proper implementation of some qualitative methods can be useful in the positivistic paradigm and can be used to measure more subjective topics. Additionally, theoretical developments of these concepts provide a solid foundation upon which investigation of the details in decision-making can be conducted. Sense of place theory, for instance, provides a strong framework for research attempting to understand the connections between people and places. This theory focuses on the emotional and psychological interactions between a person and the environment. This can occur at different geographic scales and with different intensities. Further discussion of the theoretical framework of sense of place is provided in the following section.

In this paper, a mixed method approach is used to explore the application of both quantitative and qualitative methods in understanding sense of place. The authors have previously explored the quantification of sense of place, and its application in behavioral models (Deutsch and Goulias, 2010; Deutsch et. al, 2013), but have not examined these constructs in comparison to qualitative data collected. The use of qualitative methods allows for a comparison of the meaning of place extracted by quantitative methods. In addition, the usefulness of mixed method approaches in informing research and data collection involving latent constructs such as sense of place will be discussed.

3.2. Conceptual Framework

Discussions about qualitative methods in travel behavior have mostly taken place within the last two decades. In this time several researchers have discussed possible methodologies that can be used for data collection (Goulias, 2003; Clifton and Handy, 2003), and examples of applications of qualitative analyses in travel behavior (Gaber and Gaber, 1999; Mehndiratta, et al., 2003; Carr, 2008). The application of such methods first requires an understanding of the different strategies in both data collection and data analysis that exist within qualitative, and mixed method approaches.

3.2.1. Data collection and analysis strategies

In order to understand behavior and apply our knowledge to models and policies, one must collect data. Tashakkori and Teddlie (1998) present four main categories of methods for data collection used both in quantitative and qualitative research: 1) Asking people information (self-reporting, interviews, questionnaires, personality questionnaires, inventories and checklists, attitude scales, indirect self-reports), 2) seeing what people do- observational methods (participant observation, nonparticipant observation), 3) asking people about their relationship with others (sociometry), and 4) using data collected and or documented by others (archival data and meta-analysis).

In addition, they also present several data analysis strategies used when examining quantitative and qualitative data. Traditional quantitative data analysis methods include descriptive analysis, inferential, univariate and multivariate

methods. Traditional qualitative methods include simple valence analysis manifest content analysis, latent content analysis, constant comparative analysis, effects matrices and developmental research sequence. Mixed method approaches enable the researcher to utilize both quantitative and qualitative methods in analysis. Tashakkori and Teddlie present three strategies for mixed method data collection and analyses processes: concurrent mixed analysis, sequential qualitative-quantitative analysis and sequential quantitative-qualitative analysis, which will be discussed in more depth.

Concurrent mixed analysis

Within this strategy, sub-strategies are suggested. First, researchers can conduct a concurrent analysis of different data—that is to conduct a parallel mixed analysis using both quantitative and qualitative methods on data collected in the same study. Alternatively, one could choose to either conduct a concurrent analysis on the same data in which the researchers have converted quantitative data to qualitative data (such as converting the quantitative data into categories or narratives), or vice versa (convert qualitative data to quantitative data- for instance frequencies of themes or rating of the strength of themes). For more on discussion on the method of conversion see Tashakkori and Teddlie (1998).

Sequential Qualitative-Quantitative analysis

In this type of analysis, the researcher collects data to conduct a qualitative analysis, and follows this with a confirmatory quantitative data analysis on existing data, or quantitative data collection and analysis. In the first stage, qualitative data

are used to form groups (of people, themes, attributes or settings) or to establish order or causality, followed up by analysis using quantitative methods (ex. cluster analysis, factor analysis, structural equation modeling etc.) to further compare or confirm qualitative findings.

Sequential Quantitative-Qualitative analysis

Similar to the previous example, this two-part method involves first a quantitative analysis, which is followed up with a qualitative data collection and/or analysis. Groups of people (using for example cluster analysis), attributes or themes (using factor analysis or multidimensional scaling), or relationships (using path analysis or structural equation modeling) are developed and a comparison or confirmation of these results is made with qualitative data and analysis techniques such as constant comparative analysis, observations or interviews. In this type of analysis, the qualitative data is usually collected to explain the manifestation of the themes or groups observed in the quantitative analysis. These approaches each have advantages and disadvantages. Concurrent analysis allows researchers to gain a better understanding of the variables extracted from analysis and the relationship between them using one dataset. Sequential analysis uses a stepwise procedure of an initial analysis to inform following data collection and analysis. An example of this is the use of focus groups to inform quantitative data collection.

In this paper, a concurrent analysis is conducted using data collected from one time period at two different outdoor shopping malls. A quantitative factor analysis is conducted, followed by a qualitative analysis of an open-ended question,

allowing for comparison of the places and the factors derived using quantitative methods. Although this analysis follows a concurrent approach, the use of these methods illustrate both the power in comparative mixed methods on the same dataset, as well future sequential analysis when preparing data collection methods for subjective or latent constructs.

3.2.2. Sense of Place

The early roots of sense of place were based on a phenomenological perspective, beginning with theorists such as Yi Fu Tuan and Edward Relph. Tuan defines sense of place as a person's "affective ties with the material environment" (Tuan, 1974). However, in the 1980's and 90's, researchers in the positivist traditions within geography, environmental psychology and economics argued that sense of place can be quantified, and applied to research, and that it should be explored for the valuable information it can provide about human behavior (Golledge and Stimson, 1997, Canter, 1991). Sense of place has since been quantified and applied to topics such as home (Jorgensen and Stedman, 2001 and 2006), neighborhoods (Brown, 2009), natural areas (Davenport and Anderson, 2005; Smaldone, et al., 2005), and historical places (Lewicka, 2008). It has been studied in conjunction with physical attributes of the place (Stedman, 2003), at different geographic scales (Shamai, 1991), and with different applications including ecosystem management (Williams and Stewart, 1998), tourism (Brown, 2009), and place based teaching (Semken and Freeman, 2008). This has progressed sense of place research, however the operationalizing of sense of place is still limited, which

is especially true in the case of everyday activities such as travel behavior modeling and subsequent simulation. Traditionally, models explaining travel behavior such as destination choice have not included affective attributes that attract individuals to places. In order to meld the theory of sense of place and its limited measurement attempts with behavioral modeling in transportation, the structure of sense of place must be further examined. Because of the limited nature of quantitative research of sense of place, a uniform or standard metric of measurement has not been developed.

3.3. Data Description

To examine sense of place, an intercept style survey was conducted at two outdoor shopping centers, Paseo Nuevo and La Cumbre, in Santa Barbara, California using an interviewer facilitated paper and pencil survey. A printed questionnaire was given to patrons of each location willing to participate, containing questions about sense of place attitudes, travel behavior, and socio demographics. The sense of place portion of the survey included 34 questions about each location as well as one open-ended question. A list of questions is provided in Table 3.1. A more detailed description of the data collection efforts can be found in previous work (Deutsch and Goulias, 2009).

Table 3.5. Sense of place question content and answer type

Question (Paseo Nuevo or La Cumbre…)
I am satisfied with the food options (at PN or LC)
I am satisfied with the products offered (at PN or LC)
I am satisfied with the parking (at PN or LC)
I am satisfied with the level of services (at PN or LC)
I am satisfied with the entertainment options (at PN or LC)
I am satisfied with the amount of people (at PN or LC)
has visually appealing architecture
has a peaceful and relaxing atmosphere
is a beautiful mall
has a good balance of decorative features and businesses
has artistic value
has a definite social atmosphere
is a great family friendly place to be
is a kid friendly place to be
has generally friendly people around
reflects the culture of Santa Barbara
involves a risk of unpleasant encounters when traveling to it
is always overcrowded
has too much going on at it
makes me afraid to walk around
makes me feel relaxed
makes me feel happy
I would be disappointed if it did not exist*
is one of my favorite places in Santa Barbara
meets my needs better than any other location in Santa Barbara
has better diversity in activities than any other place in Santa Barbara
has stores that lack specific things*
reflects the type of person I am
makes me feel comfortable because I identify with the atmosphere
makes me feel too self-conscious*
says very little about me*
makes me feel like I can be myself*
is a good reflection of my identity
I only come when I have specific reasons in mind*
Please describe the differences that you believe exist between Paseo Nuevo and La Cumbre**

*reverse coded questions **all answers were 7-point likert scale except the last (open ended)

Patrons were intercepted at one of the two survey sites, and asked to complete the questionnaire about each mall. If respondents were unfamiliar with a location (for instance tourists), those questions were not answered. The sample used in this analysis included only those respondents who answered sense of place questions about each place and completed the open-ended portion of the questionnaire, resulting in a sample size of 509 persons. Sample descriptive statistics can be seen in Table 3.2.

Table 3.6. Sample descriptive statistics

Variable	
Gender	42.8% Male
Residency	86.6% Santa Barbara
Location surveyed	28.9% Paseo Nuevo
Mode taken to location	79.2% Car, 12.1% Walk 2.2% Bike, 6.5% Other
Age	Mean: 37.65 Max= 88 Min=18

3.4. Analysis

To analyze sense of place, a mixed method approach was used. In this way, important aspects that have influence (both positively and negatively) in attracting people to these places can be identified using two different techniques. A comparison between the two can be used to confirm validity of findings and to identify potentially important aspects for more in depth scrutiny. Ordered questions were included in a factor analysis, and open-ended answers to the question "please

describe the differences that you believe exist between Paseo Nuevo and La Cumbre" were analyzed using qualitative methods of content analysis. Previous work presents descriptive statistics of each of the questions included in the survey, and a more in depth analysis of several questions (Deutsch and Goulias, 2010).

3.4.1. Factor Analysis

In order to understand the latent factors that exist in the data, an exploratory factor analysis (EFA) was conducted using the scores of respondents for the location of patronage. A full explanation of the EFA conducted can be found in (Deutsch et al., 2011). Initial analysis involved all thirty four questions, which were reduced to nineteen questions loading into four salient factors. The four factors extracted using EFA consisted of: aesthetics and atmosphere, family and community oriented nature of the place, negative aspects of the place, and the self-benefit of the patronage. This four-factor structure was then imposed on two separate confirmatory factor analyses (CFA) of each place, with all patrons of both Paseo Nuevo and of La Cumbre included in the analysis regardless of place surveyed. The goodness-of-fit statistics in Figures 3.1 and 3.2 show that both are well fitting models.

Results of the two CFA models can be seen in Figure 3.1 (Paseo Nuevo) and Figure 3.2 (La Cumbre). The resulting factor loadings of the two analyses indicate some similarities and differences between places in the composition of factors and their contribution to explaining observed attitudes. For instance, the factor loadings within the community-oriented factor indicate that the contribution of the factor to the question "Paseo Nuevo (or La Cumbre) is a family friendly place to be" is much

stronger in the Paseo Nuevo factor analysis. Similarly, the factor highlighting the aesthetics and atmosphere contains some differences worth noting. For instance, the question regarding the architecture of the places ("[location] has visually appealing architecture" has a lower factor loading for Paseo Nuevo than La Cumbre. Upon further examination, it is clear that the question elicits very different responses at each location (mean response at Paseo Nuevo is 6.01 with a standard deviation of 0.922, mean response at La Cumbre is 4.70 with a standard deviation of 1.581). The responses to the question, as indicated by the descriptive statistics were stronger in the positive direction for Paseo Nuevo, with less variation among responses. Therefore this question could not contribute as much in describing differences observed. This is opposite for the question "[location] says little about me," where more of the observed data is explained by the latent factor in the case of Paseo Nuevo than La Cumbre.

Figure 3.6. Paseo Nuevo factor structure

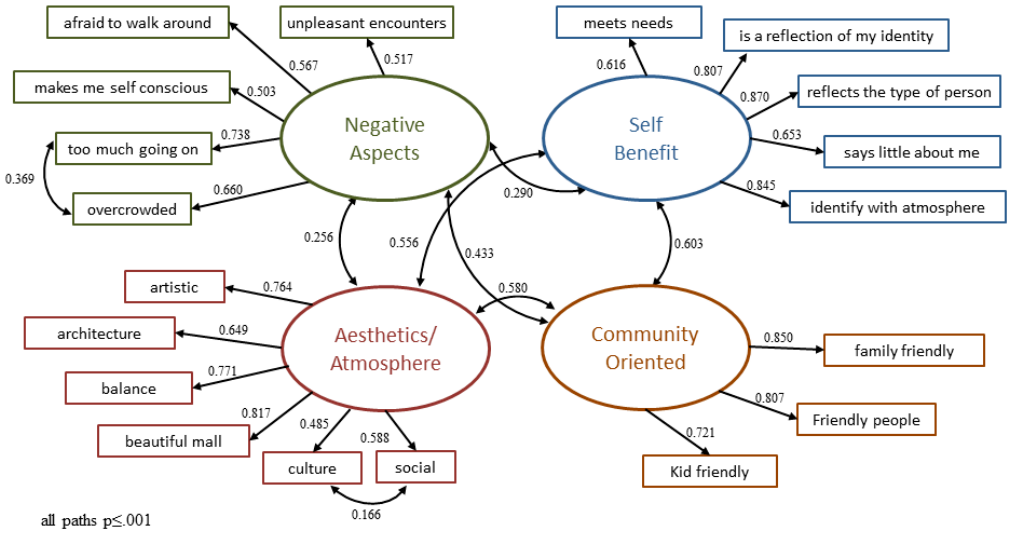
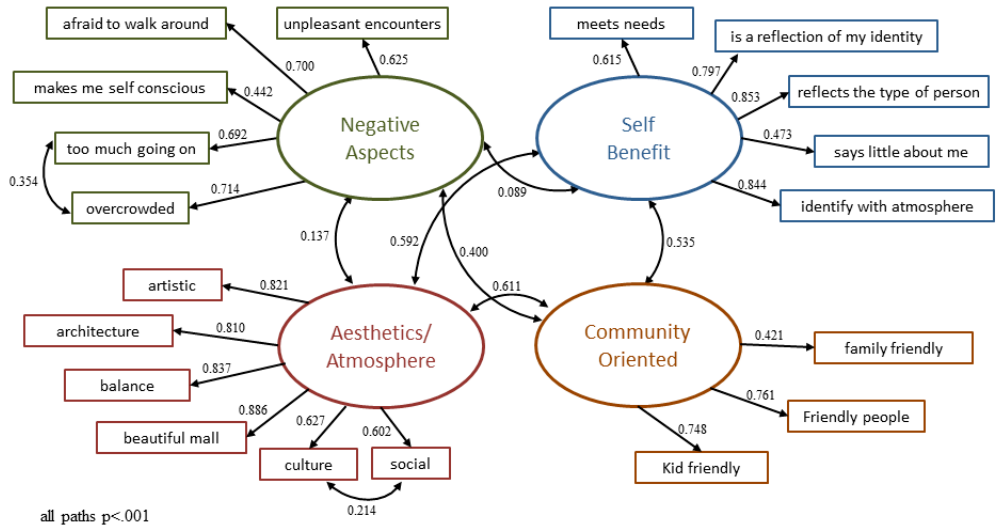


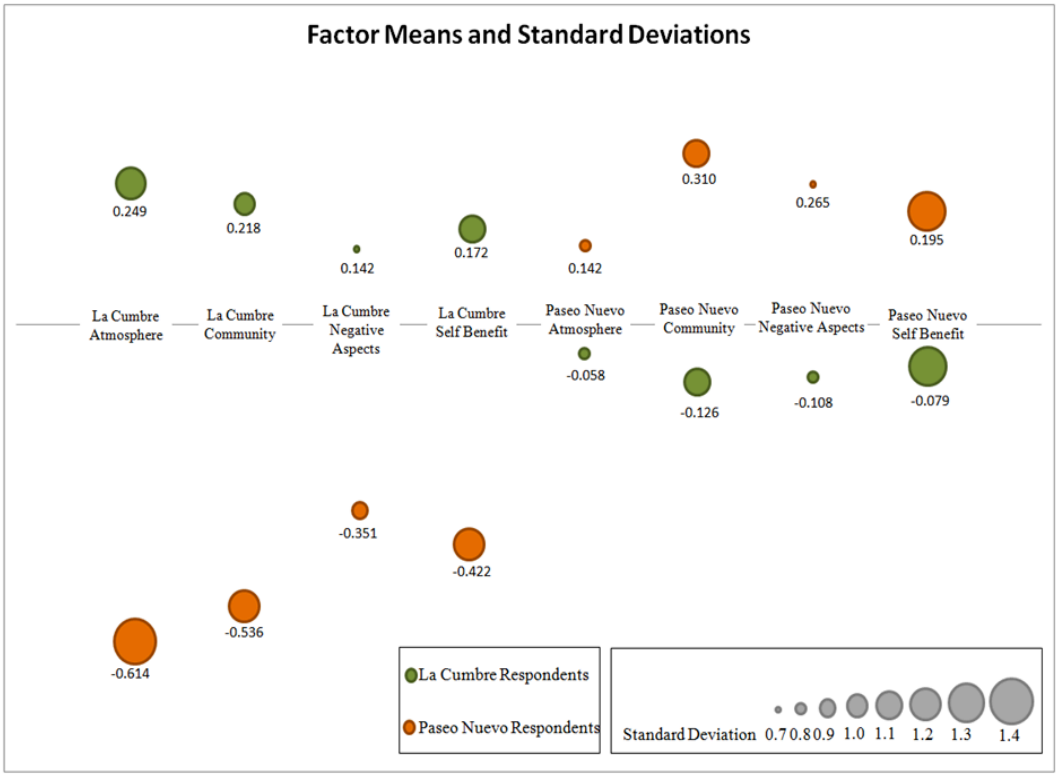
Figure 3.7. La Cumbre factor structure



In addition to analyzing the factor structure of each location, the factor scores were obtained for each individual respondent. While the mean score for all respondents should be equal to zero (due to standardization during the factor analytic procedures), an analysis of the respondents based on survey location was conducted. Analysis of the means and standard deviations of each group of respondents (those surveyed at Paseo Nuevo and those surveyed at La Cumbre) indicated that there are notable differences among the four groups of patrons and places (Figure 3.3). First, those at Paseo Nuevo had a positive mean for all Paseo Nuevo factor scores and a negative for all La Cumbre scores. Conversely, those at La Cumbre had a negative mean for Paseo Nuevo factors and a positive mean for La Cumbre factors. In addition to this, it is interesting to note the distance between the averages of the La Cumbre factor are much greater than those of the Paseo Nuevo factor. This shows that patrons at La Cumbre have lower negative factor scores (and therefore attitudes) about Paseo Nuevo than their counterparts at Paseo Nuevo have regarding La Cumbre (lack of symmetry in attitudes-behavior). In both cases, people have higher factor averages for the shopping center, which they are visiting. This finding can be viewed as either 1) the justification for their revealed choice, or 2) the attraction of the place and therefore the reason they chose to visit the place. That is to say, it is unknown whether the responses for people were conditioned by the fact that they were surveyed at a specific mall. Determining this would require further investigation out of the scope of this paper. The standard deviations of each factor indicate that more variation is present in factor scores of La Cumbre atmosphere and

aesthetics, as well as La Cumbre self benefit, and Paseo Nuevo community and self benefit factors.

Figure 3.8. Factor means and standard deviations



3.4.2. Qualitative Analysis

Although factor analysis is a rich technique and contributes to understanding of both the measurement of sense of place theory and the attitudes regarding specific locations, an additional qualitative analysis was conducted. Responses to the open-ended question "Please describe the differences that you believe exist between Paseo

Nuevo and La Cumbre" were divided into content describing Paseo Nuevo and content describing La Cumbre for content analysis. The responses for each were then analyzed using Wordle, a tool for semantic frequency analysis. This allows us to determine whether common themes exist in the open-ended responses that can be compared and contrasted to the outcome of the factor analysis. The analysis employs a Boolean technique in which after eliminating common words (is, and, that), provides frequency of occurrence. There are other techniques in the field of information retrieval for latent semantic analysis and indexing (Berry, et al., 1999; Konostanthis and Pottenger, 2006) and web crawler techniques (Srinivasan, et al., 2005) that have the potential for added value in text analysis that could be used in future analyses. Results can be seen in Figures 3.4 (Paseo Nuevo) and 3.5 (La Cumbre), with frequencies for the top twenty words in Table 3.3. This analytical method provided several important comparisons, contributing to the overall understanding of important aspects of sense of place. For instance, parking is discussed in comments about both locations (Paseo Nuevo 41 times, and La Cumbre 53 times). However, the context of the word is quite different for each location. To further analyze the nature of some words, each instance of the word was recorded as being positive, negative or neutral in tone. One comment out of 53 comments about parking at La Cumbre was negative, and one was discussing a parking lot, which had a neutral tone. The remaining 51 comments were positive toward the parking at La Cumbre, which has open-air surface lots surrounding the shopping center. Comments about parking with respect to Paseo Nuevo however were largely opposite, with 30 out of 41 comments focusing on the negative aspects of parking

(not enough, payment required, inconvenience and general dislike). Paseo Nuevo parking is mostly structured parking, with very limited on street parking. Parking is free for the first 75 minutes, but a rate of $1.50/hour thereafter.

Table 3.7. Top twenty words and frequencies

La Cumbre	count	Paseo Nuevo	count
stores	62	crowded	48
shopping	30	downtown	48
shop	21	stores	42
seems	16	parking	41
quiet	24	better	40
place	25	people	39
people	30	tourists	28
parking	53	shopping	28
much	21	much	26
mall	40	go	25
locals	17	like	22
like	35	location	20
less	43	state	20
good	18	atmosphere	18
friendly	15	mall	18
easier	18	around	17
crowded	20	restaurants	16
come	16	street	15
better	36	upscale	15
atmosphere	18	options	15

Figure 3.9. Paseo Nuevo context analysis

Figure 3.10. La Cumbre context analysis

Similar analysis was conducted on the other top appearing words. Many comments in both texts also discussed the locations based on the stores at each. The word stores appeared 42 times in text about Paseo Nuevo (with 37 of these comments being positive, and 5 being neutral), and 62 times in text about La Cumbre (with 20 positive comments, 36 negative, and 6 neutral). Many of the comments regarding stores at each place consisted of satisfaction with the stores and the diversity offered, or dissatisfaction with the diversity, cost, high end nature, and products (mostly at La Cumbre). Additionally, the themes of downtown (appearing 48 times, 39 of which were positive toned) and crowded (appearing 48 times, 6 of which were positive, 25 negative and 17 neutral or indiscernible tone) appeared in analysis of the text about Paseo Nuevo. Many comments framed the downtown location of Paseo Nuevo in a positive light, noting that it was lively, active, had diverse options, great accessibility and positive atmosphere. However, comments regarding the crowded nature of the Paseo Nuevo area were mostly negative, with a few people commenting that they liked it for people watching or other activities. Many comments also centered on the tourist nature of Paseo Nuevo (tourist or tourists appearing 47 times and touristy appearing 11 times), given its downtown location. La Cumbre on the other hand had many comments regarding the design looking like a typical suburban mall. Many of these comments continued to describe this design as boring, drab, unexciting or depressing. This initial analysis of the open ended comments of the qualitative comments indicate that different sentiments are apparent and provide grounds for larger data collection and more sophisticated qualitative analysis tools. Due to the pilot nature of the qualitative portion of this

analysis, no intercoder reliability tests have been conducted, but are certainly necessary for more sophisticated and more in depth analysis.

3.5. Discussion

Through the use of factor analytic techniques, differences between places and people at those places are evident. Factor analysis provides a strong technique for analyzing data and extracting latent themes or factors that can be used to explain the occurrence of the observed data. However, there are limitations in the ability of factor analysis to capture the complete story of a phenomenon. This might be the result of insufficient questions, poorly worded or designed questions, or lack of theory or previous examples used to capture the processes of interest. The use of qualitative methods can help to inform researchers to tell a more complete story, or design more complete data collection methods. In the instance of this research, several themes were apparent in a qualitative analysis that did not become manifest using quantitative methods. Parking for instance, was discussed at large in text about both locations, one with a more positive tone (La Cumbre) and the other with a more negative (Paseo Nuevo). It is important to note also that a quantitative question regarding satisfaction with parking was included in the original exploratory factor analysis and did not load in a salient factor. Given the combination of analysis methods, perhaps the lack of presence of the parking question is due to the unique nature of parking, that is to say it would potentially need a factor by itself. Within the confines of factor analytic methods a factor containing a single indicator would not be retained, thus eliminating this attribute from the analysis. Another

theme emerging from the qualitative analysis was focused on the stores and products offered at the location. This topic was also included through several measured questions, including "I am satisfied with the products offered" and "Paseo Nuevo (or La Cumbre) lacks certain things", and "meets my needs better than any other location in Santa Barbara" of which only one question (needs) loaded onto a factor. Many themes emerging from the qualitative analysis also mirror the factors that were found here. For instance, atmosphere and people are a common element in text from La Cumbre, while crowded, downtown, tourist and people are all elements of Paseo Nuevo which similarly can be found in the overall composition of the factor structure.

3.6. Conclusions

Understanding the detail and complexity of human behavior is an endeavor that transportation researchers should examine more closely. Although the quantitative tools that we use in modeling are well developed and have become increasingly flexible, we must consider the additional detail that we are failing to capture and explain sufficiently, otherwise we risk to missunderstand preferences and choices. It is for this reason that incorporating qualitative methods of both data collection and data analysis should be considered and applied. The findings of the research presented in this paper make a strong case for the use of a mixed method approach to understand behavior. Place attitudes, incorporated in the theoretical framework of sense of place, provide a well-developed foundation for this type of analysis. Using theory developments, a survey was developed incorporating both

ordered, closed-ended, as well as open-ended questions. Analysis of these questions using both quantitative and qualitative methods produced an interesting comparison and complementation of findings. This is one kind of triangulation one can create to identify common themes emerging from two (or more) analysis methods.

Results of the qualitative analysis identify several aspects of the places that were not significant in the factor structure. In this paper we conduct a concurrent analysis; however the findings of the analysis can be used both to further our knowledge of place as well as make contributions to the development of measurement tools thus utilizing a sequential approach to mixed methods. Additionally, further analysis of these qualitative themes can be conducted that would allow for some level of quantification. For instance, physical attributes of place (such as parking availability and costs by time of day) can be used to compare places and capture some of the differences that cause the differences in sentiment. Similarly, attributes such as the type and cost of products, volumes of vehicle and foot traffic, ambient noise levels or accessibility to types of activities can capture additional differences between places in a quantifiable manner to describe the existence of these themes. It is also important to note that while the differences between places are perhaps exaggerated due to the specific open-ended question "please describe the differences that you believe exist between Paseo Nuevo and La Cumbre," the similarities of sense of place for each location can be captured in the fact that the imposed factor structure had good fit statistics for both places. This relates to the geographic scaling of sense of place, in that at one aggregation shopping centers elicit certain similarities and differences in sense of place attributes compared to different activity locations, but

specific points in space elicit another set of similarities and differences from each other.

4. Assessing the Importance of Subjective Place Attributes in Behavioral Choices

4.1. Background

Humans participate in activities as a part of daily life. These activities range on a spectrum from mandatory activities that might be fixed in time or place or both (for instance work for some individuals), or discretionary activities that have ultimate flexibility in the temporal and spatial domains. The mechanisms that individuals use to conduct their daily activities of life and participate in society often involve both objective and subjective aspects of the physical environment, transportation system, social and cultural environment and the individual as a person. Deciphering these aspects and understanding their contribution to the choice process is wrought with complexities. However, it is imperative that proper attention is paid to unraveling these complexities to ensure that assumptions and theories of these decision-making processes used in predictive models and policy analysis are truly representative of what actually takes place.

In most current applications of destination choice, the choice of a destination is highly dependent on the ability and ease with which a person can access the place, and the number of opportunities available to the individual. Accessibility indicators are used as a representation of the attraction of each zone and the cost of travel between zones (Ortúzar and Willumsen, 2001). The use of accessibility indicators for each individual provides rich information about constraints from which discrete choice models can be estimated. These indicators have served as the foundation of

destination choice models, and have been used among other attributes as criteria by which a decision is made. In addition, accessibility measures have been used to guide policy analysis and assess the quality of transportation infrastructure and land use. Literature showcasing the development of theory of accessibility measures and their application is rich. For an extensive presentation of types of accessibility measures, and application of these methods see Geurs and Van Wee, (2004).

It is however important to note that the specification of choice models and the reliance on these attributes might only be a portion of the story. Although these aspects can be computed at various levels, and can include a variety of different components in the decision making process, they are often objective measures of the individual's ability to access specific goods, services or places. 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. A person's perception of access can be viewed as one aspect of the sense of place that one develops of a place or region. Work has been conducted to understand place level attitudes and the interaction of place attitudes and behavior, stemming from foundational work by both Tuan (1974, 1977) and Relph (1976). Given its roots in phenomenological theory, work to quantify sense of place has had a slow development. Many instances of these applications are centered on points of interest, or highly meaningful areas, and involve a variety of detailed aspects of sense of place (attachment, identity, dependence, etc). Within the discrete choice model framework, it would be difficult if not impossible to include this level of detail for each point location destination as an alternative to the choice. It would be

infeasible to collect this point of interest data for every point from each respondent, and it would pose major computational hurdles due to the number of alternatives. For this reason, alternatives are often considered as zones in destination choice models.

Many researchers within the GIScience domain have explored the measurement of place, and have sought to create computational models of places. In fact, at the 2008 meeting of GIScience, a workshop (and subsequent special issue of Spatial Cognition and Computation) was dedicated to the discussion of computational models of place (Winter et al., 2008). These have ranged from using textual tags on photographs on popular sites such as Panaramio to create popularity distributions of certain areas or views (Schlieder and Matyas, 2009), to focusing specifically on place names (Davies, et al., 2009). However, little work has still appeared that focuses on the emotional connection of places and the motivation that causes for travel to specific destinations.

Imbedded in discussions of sense of place and more broadly the acquisition of spatial knowledge is discussion regarding the multilevel aspects of place and psychological associations. The importance of the level of spatial aggregation and the psychological implications of considering place at different scales 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 attitudes and perceptions when selecting a destination, that both the actual

destination at a point location, and a larger region (or perhaps several regions nested within a hierarchy are considered). Earlier literature on 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 is nested within another, larger place (see Rapoport, 1977). These larger places are surrounding the more personal inner places to the individual. In his framework, the hierarchical levels are a product of the experience at the prior, more personally associated level. In addition, Lynch in his discussion of the interpretability of landscapes and meaning presents an open ended question of the impact of geographic scale (buildings, cities, metropolitan areas) on the imagability of the place (Lynch, 1960). It is therefore necessary to have a multileveled approach to the understanding and application of the influence of place attitudes. To the knowledge of the authors, regional level place attitudes have never been examined and assessed for the level of attractiveness to destinations.

In this research, we develop a subjective attraction surface using perceptions of several aspects. These perceptions include aspects of the landscape (attractiveness and opportunities that exist), possible detractors from an area (perception of danger) and the spatial knowledge of an area (familiarity). These attributes combine a variety of discussions on topics such as the development of cognitive maps and the influence of the physical landscape on psychological perspectives and human spatial interaction. Attractiveness of the landscape can be seen as an element that contributes to cognitive aspects such as the legibility of places (Lynch, 1960) and the development of sense of place (Bjørn and Bjorke,

2002). Additionally, Rengert and Pelfrey (1997) discuss the influence of perception of danger on effective patrolling of police recruits, and the differences that exist between perceptions and reality. The familiarity of an area also provides indication of both the level of exposure to the region, and the attachment of meaning and organizing of spatial information (see for instance Golledge and Spector, 1978), that are integral to patterns of movement and decision making for activities.

4.2. Data Description

4.2.1. Sample

The data used in this analysis are a portion of the data collected from a survey of the residents of the Southern portion of Santa Barbara County. This area includes the cities of Santa Barbara, Goleta as well as the Census-designated places of Montecito, Isla Vista, Mission Canyon, Mission Hills, Summerland, Toro Canyon and additional unincorporated areas. The sample consisted of 561 respondents. A table of sample statistics is provided in Table 4.1. It must be noted that this survey was initially a random sample based recruitment to households within the study area, but due to the web based nature and selection of respondents ages 18 and above, the resulting sample is not a representative sample of the population (county level and sampling area population statistics are also provided in Table 4.1).

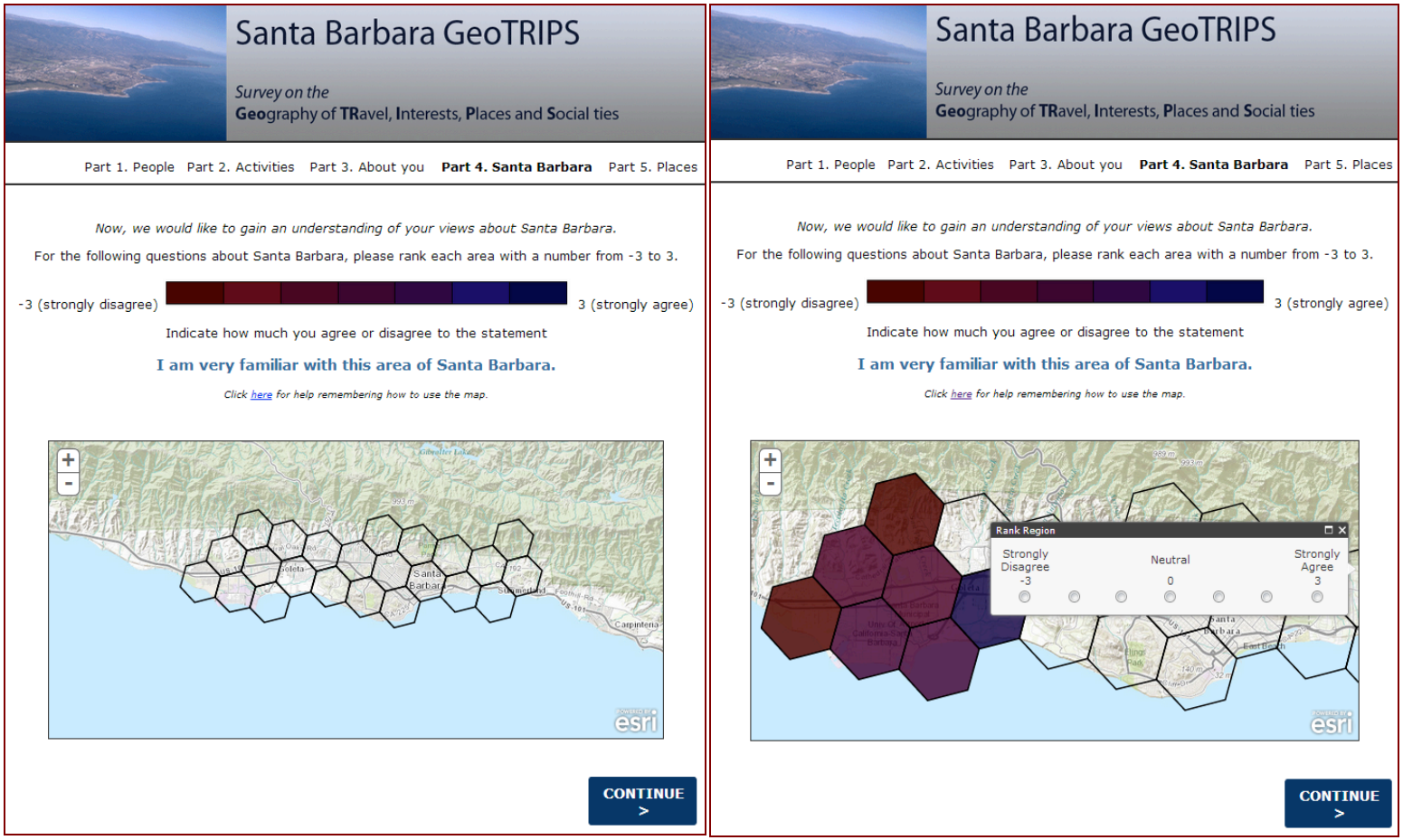
Table 4.1: Sample Statistics (county data source and study area population statistics: US Census)

Variable	County Population	Study Area Population	Sample
Gender	Female: 49.8%	Female: 49.4%	Female: 57.6%
Years in house			Mean: 9.67 Standard Deviation: 7.84
Age	Median: 33.6	30-34 years	Median: 49 years
Household income	Median: $61,896	Median: $50,000-$74,999	Median: $50,000-59,999
	Less than $10,000 5.00%	0 - $9,999 6.10%	Less than $10,000 5 .88%
	$10,000-$14,99 4.50%	$10,000-$24,999 13.06%	$10,000-$19,999 4.63%
	$15,000-$24,999 9.20%	$25,000-$34,999 8.12%	$20,000-$29,999 4.99%
	$25,000-$34,999 9.10%	$35,000-$49,999 11.90%	$30,000-$39,999 8.20%
	$35,000-$49,999 12.80%	$50,000-$74,999 17.80%	$40,000-$49,999 8.73%
	$50,000-$74,999 18.60%	$75,000-$99,999 11.18%	$50,000-$59,999 9.27%
	$75,000-$99,999 12.10%	$100,000-$149,000 15.28%	$60,000-$69,999 8.91%
	$100,000-$149,999 15.40%	$150,000-$199,999 7.93%	$70,000-$79,999 13.37%
	$150,000-$199,999 6.70%	$200,000 or more 8.63%	$80,000-$89,999 4.81%
	$200,000 or more 6.70%		$90,000-$99,999 4.46%
			$100,000-$109,999 5.70%
			$110,000-$119,999 2.14%
			$120,000-$129,999 2.50%
			$130,000-$139,999 1.78%
			$140,000-$149,999 2.14%
			$150,000 or more 12.48%
Households w/ children	33.9%	25.0%	25.1%
Household members	Mean: 2.86 persons	2.57	Mean: 2.69 persons
Size	423,895	84,475	561

4.2.2. Survey Instrument

The web-based GeoTRIPS (***G****eography of* ***TR****avel,* ***I****nterests,* ***P****laces and* ***S****ocial ties*) survey was conducted during the period of May 2012 through July 2012. The survey consisted of two waves of data collection, each lasting for one month. Recruitment was primarily by mail, with a very small portion of the resulting sample being recruited by email. The mail recruitment consisted of an initial recruitment letter, followed up by a reminder postcard. The survey consisted of several sections of content including a portion on mapping and a portion on socio demographics, which pertain to this analysis. Screenshots of the mapping exercises are provided in Figure 4.1.

Figure 4.1. Survey Instrument



For this portion of the survey, respondents were asked to respond to four statements on a likert-like scale of strongly disagree (-3) to strongly agree (3) with respect to specific predefined areas of Santa Barbara. The first screenshot of Figure 4.1 is a view of the survey instrument for this portion of the survey. The second screenshot is an example of a respondent scoring each hexagon, with the map zoomed in (the map was enabled with panning and zooming features). Following prior research in cognitive regions and spatial knowledge, a regular grid pattern was used to canvass the study area. The methodology of using a regular grid was originally used in Aitkin and Prosser (1990) and adapted to a study by Montello, et al., 2013. Aitkin and Prosser utilized a regular square grid pattern of neighborhoods in San Diego to understand the familiarity of a region and spatial knowledge acquisition by residents. Montello, et al. used a similar methodology to understand the designation of regions, more specifically Northern versus Southern within the state of California, and the province of Alberta. In this study, the researchers used a hexagonal grid pattern to cover the entire surface to avoid tight corners or directional biases caused by squares or equilateral triangles (the only other two options for tessellations with regular shapes). Each hexagonal area measured four kilometers in diameter. The size of each hexagon was determined by evaluating the trade-off between high levels of spatial aggregation, and higher respondent burden caused by a smaller hexagon scale. The four questions asked of each respondent were:

- This is an attractive area of Santa Barbara
- This is a dangerous area of Santa Barbara
- This area provides me with a lot of opportunities to do things I like to do
- I am very familiar with this area of Santa Barbara

In addition to the mapping exercises, at the end of the section of mapping exercises, respondents were asked to answer the following question:

"On a scale of 1-10, with 1 being not important and 10 being very important, please rate how important each of these aspects are in deciding whether to travel to a specific place for an everyday activity (shopping, eating out, meeting friends, family outing, etc)?

- Proximity to home
- Perception of danger
- Attractiveness of the area
- Familiarity with the area
- Provides a lot of things to do"

Through this data collection, hexagonal scores and attribute importance values provide the opportunity to examine the attraction of areas due to a combination of psychological attributes. Figure 4.2 provides a map of the study area, with each of the hexagons numbered for reference purposes throughout the rest of this analysis, and Figure 4.3 displays the respondent's home location by hexagon.

Figure 4.2. Study Area and Hexagon Numbering

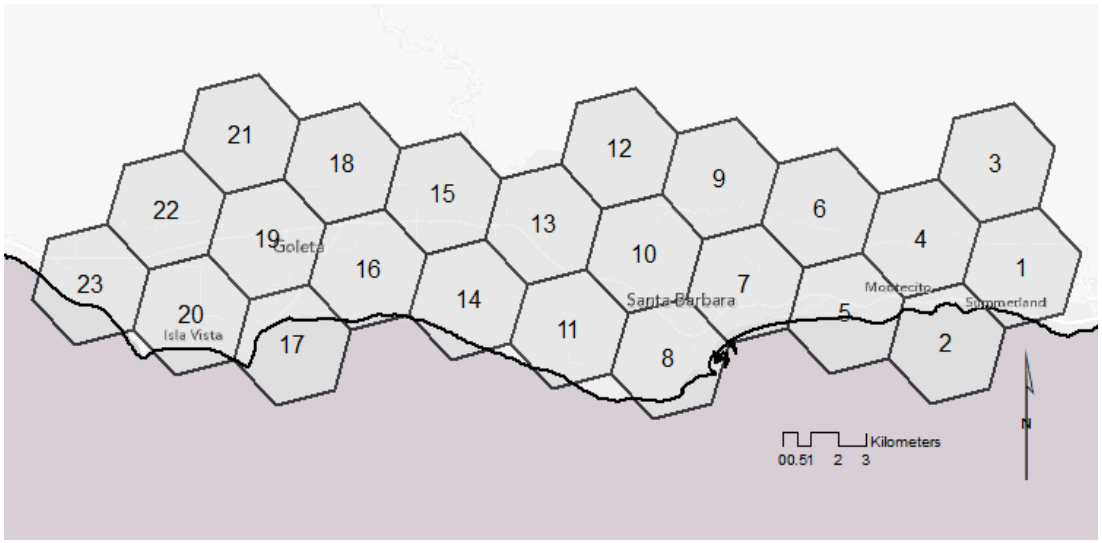
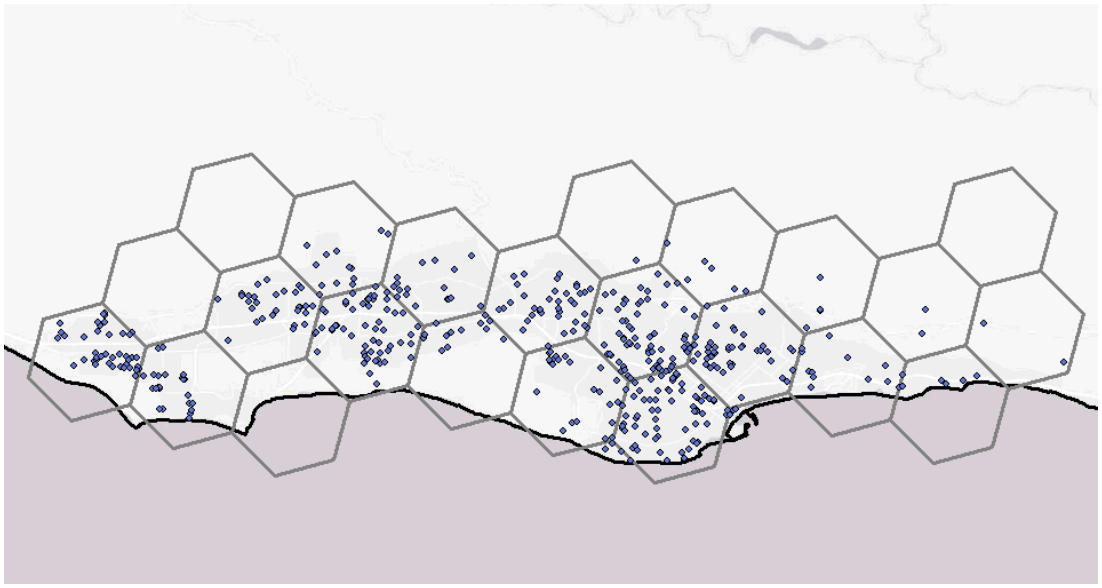


Figure 4.3. Respondent Home Locations



4.3. Analysis

4.3.1. Hexagon Values

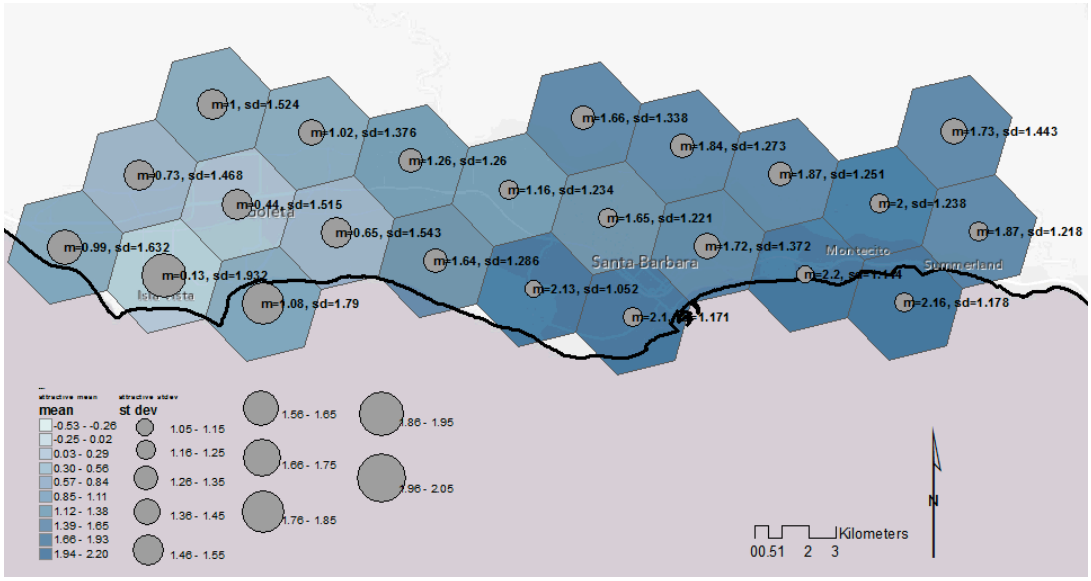
In order to understand the views of Santa Barbara residence with respect to each of the four attributes, the data were examined in multiple ways. First, a geographic analysis of the means and standard deviations was conducted by visualizing the attribute values for each hexagon. Figures 4.4 through 4.7 provide one map for each attribute measured. Means of each hexagon responses are provided using colors ranging from light blue (low) to dark blue (high) means. In addition, standard deviations for each of the hexagons are signified by the size of the circle within each hexagon. Table 4.2 provides a list of the minimum and maximum hexagon means and standard deviations that occur for each attribute, as well as the range of these values.

Table 4.2. Attribute Minimum and Maximum Means and Range

	Attractive		**Danger inverse**		**Opportunity**		**Familiarity**	
	mean	**std. dev**	**mean**	**std. dev**	**mean**	**std. dev.**	**mean**	**std. dev.**
Min	0.127	1.052	-0.210	1.373	-0.345	1.317	-0.528	1.119
Max	2.199	1.932	1.770	1.918	1.850	2.047	2.176	2.017
Range	2.071	0.880	1.980	0.545	2.195	0.730	2.704	0.898

Attractiveness

Figure 4.4. Attractiveness Means and Standard Deviations

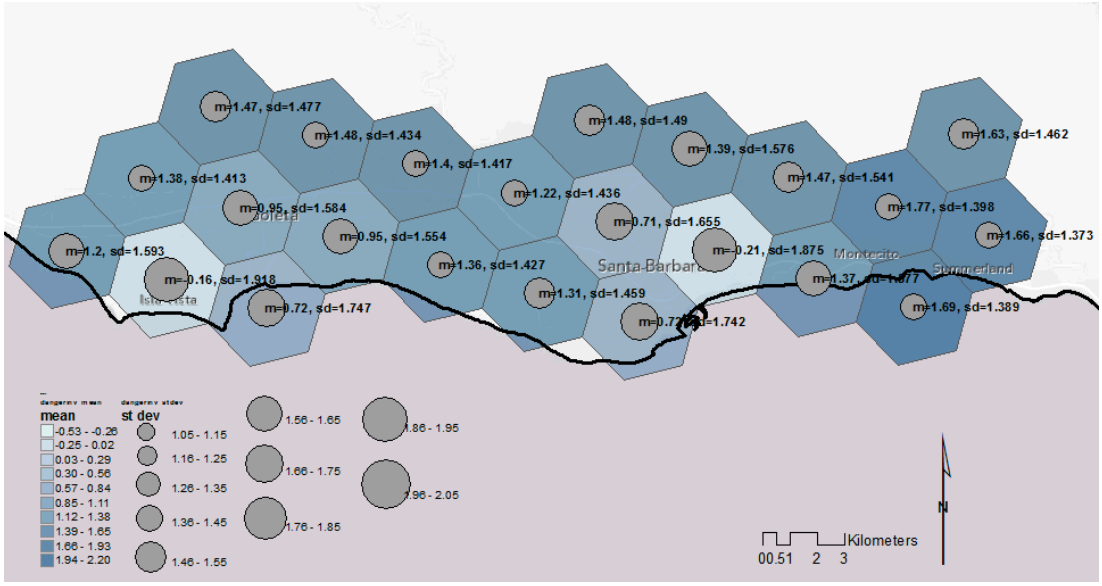


As seen in the maps, the overall attractiveness rating for each hexagon is consistently high for all hexagons in the study area on the scale of all attribute averages. Of the four attributes, this is the only one in which there is not an appearance of a negative mean for any of the hexagon regions (signifying disagreement with the statement). Although the values are on the higher range of values, there is a geographic trend that is observed from west (Goleta) to east (downtown Santa Barbara, Montecito and Summerland). The standard deviation of responses for these hexagons is also smaller than standard deviations of other

attributes. Like the mean values for the overall attractiveness, the standard deviation values are larger in the Goleta area as opposed to the city of Santa Barbara. The lowest hexagon value for the attractiveness attribute is the area that encompasses the UC Santa Barbara campus and Isla Vista. Isla Vista is the likely reason for this lower value, as it is a college town (often called a student ghetto) with high density of apartment complexes and known for the party atmosphere and college lifestyle.

Perception of danger

Figure 4.5. Perception of Danger Means and Standard Deviations

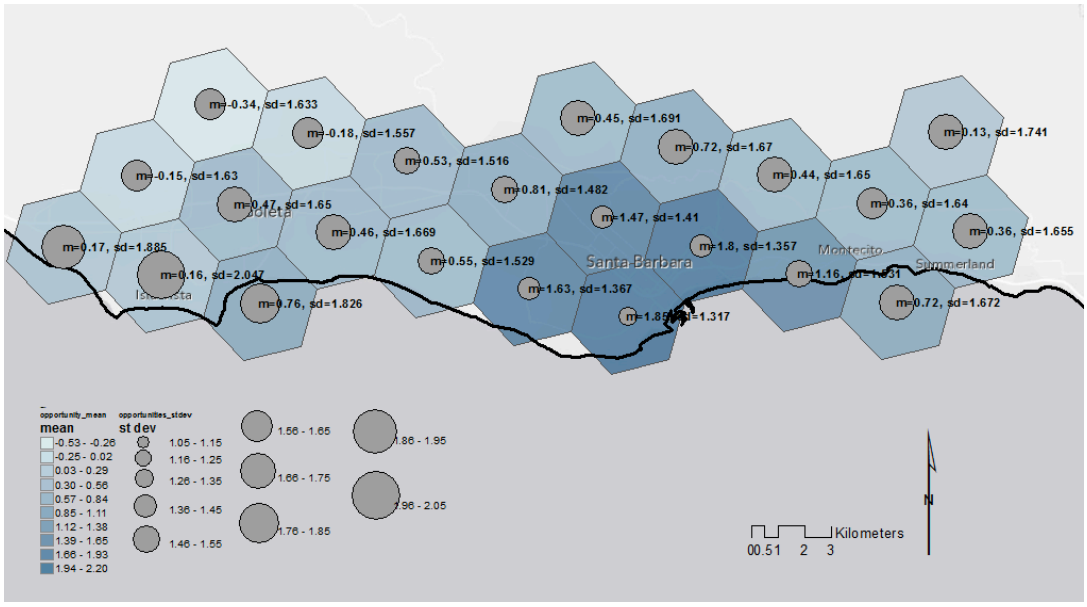


The values for perception of danger were recoded with inverse values to be consistent with the other three attributes (positive values being a positive view towards that hexagon). The values for the perception of danger exhibit some extremes for both low values for means, and high values for the standard deviation.

Notably, two hexagons (Isla Vista in the Goleta area- hexagon 20 from Figure 4.2, and the downtown/ lower East side of Santa Barbara- hexagon seven) have very low values (-0.16 and -0.21 respectively). This result might be consistent with the perception of these areas have higher crime rate reports and correspond to university students (more specific to hexagon 20) and lower income Santa Barbara residents. There is also some gang activity that is associated with areas of downtown Santa Barbara, specifically from the lower Eastside and lower Westside, and controversial legal discussions such as gang injunctions (see Magnoli, 2011 and Bush, 2013). It is important to note however, that although these two hexagons received the lowest rating for being safe, the standard deviations of these two regions are the highest. This indicates that there is a large discrepancy of the perceptions of the danger attribute. In addition, the standard deviations for the values of perception of danger are higher on average than for other attributes (although the highest value across all attributes do not occur here). The areas that have the most positive values regarding danger (the darkest blue hexagons) are all located in areas that are highly residential in land use, and have lower densities, with mostly single-family houses. These areas are also areas where there is a lower discrepancy with respect to respondent views of the danger. All of the residential areas are within the northern region of the study area, as well as the western and eastern areas are all very similar, with only a small increase in the mean in the eastern portion (the Montecito area).

Opportunity

Figure 4.6. Opportunity Means and Standard Deviations

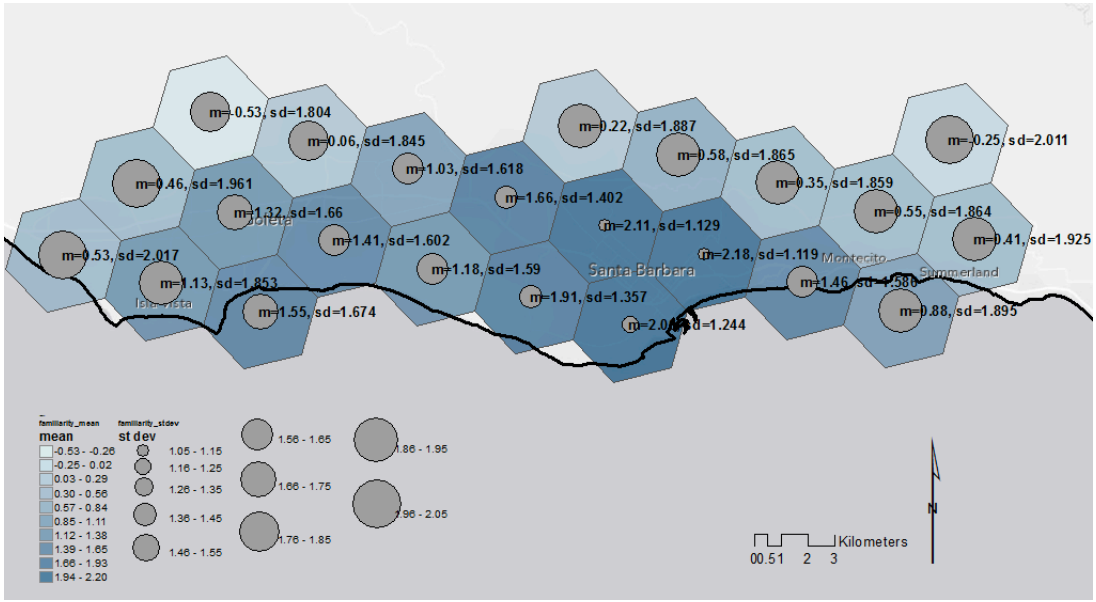


The perception of opportunity values shows the strongest geographic pattern, with the downtown and surrounding hexagons having the highest perceived opportunities. These also have some of the lowest values of standard deviations. Interestingly, hexagons containing additional shopping centers in Santa Barbara do not appear as being areas that are perceived to have a lot of opportunities, despite the presence of several retail and dining establishments. This is likely due to the fact that the shopping center houses many stores like Costco and Kmart, which might be more of the necessity type of shopping instances rather than the opportunities that a person "likes to do" as phrased in the survey question. Further analysis is necessary to examine the relationship between business types, density of businesses and

therefore opportunities, and the perception of opportunities seen here. Though this is an interesting and much needed area of research, for this specific study and the manner in which this map data was collected, the objective of this much detail of opportunities was not included. Decision criteria for different types of activities (shopping, entertainment, dining, etc) were included in another section of the survey instrument; however the respondent burden to include hexagon ratings for each activity opportunity type was not feasible given respondent burden.

Familiarity

Figure 4.7. Familiarity Means and Standard Deviations



The familiarity of regions of the Santa Barbara shows the widest range of values (between -0.53 to 2.18). These values also have the highest standard

deviations on average (1.69). The geographic pattern of the familiarity of regions is to be expected, with the downtown region being the most familiar, with the lowest standard deviation, and the northern regions being the least familiar. This is also true for the extreme west and east regions of the study area (Goleta and Summerland). The familiarity averages also have the largest range of values for the standard deviation as reported in Table 4.2. Interestingly, the areas of lowest familiarity (areas that are almost neutral, or even in disagreement with the statement of being familiar with the area) correspond to areas of low perceived danger. This finding poses some interesting questions regarding the information used to evaluate these areas as safer than others, and whether the fear of the unknown (given the lack of familiarity) is different in different environments (urban versus suburban for instance).

4.3.2. Aspect Importance

In order to understand the importance of each of these aspects to an individual in the destination choice process, respondents were asked to indicate the level of importance that each aspect has in decision-making. In addition to the four aspects discussed above, proximity to home was also included in the list of destination choice considerations. Table 4.3 provides the mean (on a one through ten scale) and standard deviations for the importance that each respondent places on each of the five aspects for destination choices. The frequency of responses for each value of importance is also reported in Figure 4.8 and by gender in Figure 4.9. The means for each attribute indicate that the highest rated criteria are the attractiveness

(7.73), followed by the opportunities that are available in that area (7.5), with the average for proximity to home (7.49) very close behind. Perception of danger was ranked lowest of the criterion with a mean of 6.31. Interestingly, however, the perception of danger has the highest standard deviation of all criteria (3.095), showing a larger discrepancy among individuals as to how important this attribute is. Proximity to home has the second highest standard deviation. An analysis of the frequencies for each criterion shows that perception of danger has the highest frequencies for the one through four values (out of all the criteria, it is most often found to be of low importance), but it also maintains the highest number of respondents who ranked it with an importance of ten. The attractiveness and the opportunities of the area have the lowest standard deviation for attribute importance (1.875 and 1.972 respectively), and both have low numbers of respondents who rated these attributes of very low importance (values of one through four), and a peak at a value of eight for both. Women tend to rate all attributes higher than men in importance, with a noticeable difference (nearly one point) for the perception of danger. Additionally, the percentage of women who rate the perception of danger as a 10 in importance level is substantially higher than all others.

Table 4.3: Attribute Importance Mean and Standard Deviation

	All Respondents		Females (n=323)		Males (n=238)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Attractiveness of the area	7.73	1.875	7.91	1.90	7.50	1.81
Perception of danger of the area	6.31	3.095	6.83	3.14	5.60	2.89
Area provides a lot of things to do	7.5	1.972	7.64	1.96	7.31	1.97
Familiarity with the area	7.27	2.185	7.46	2.18	7.01	2.17
Proximity to home	7.49	2.205	7.62	2.21	7.32	2.19

Figure 4.8. Attribute Importance Rankings

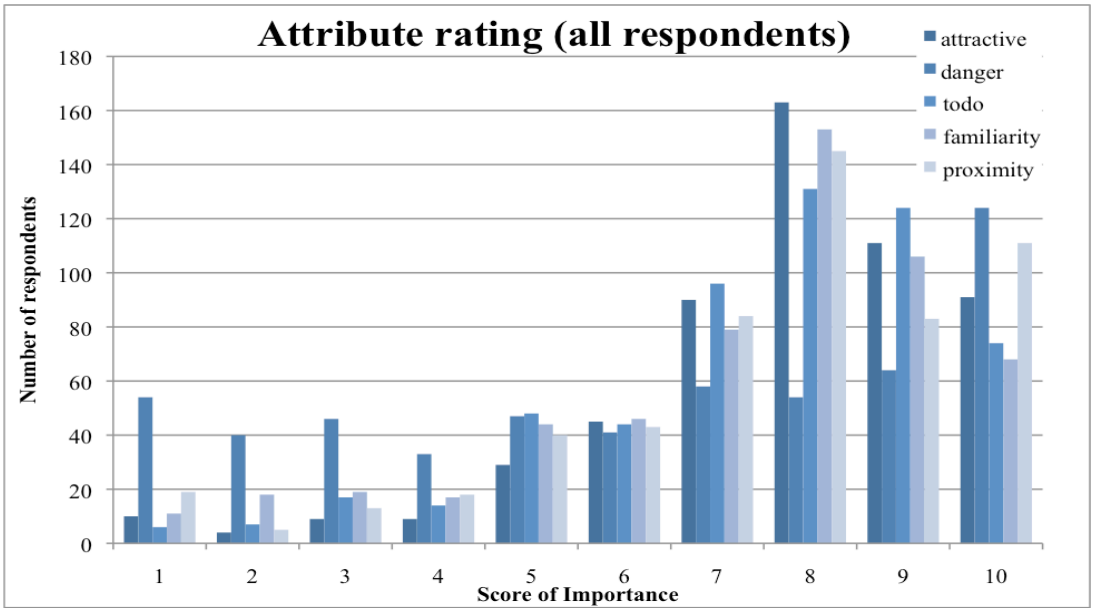
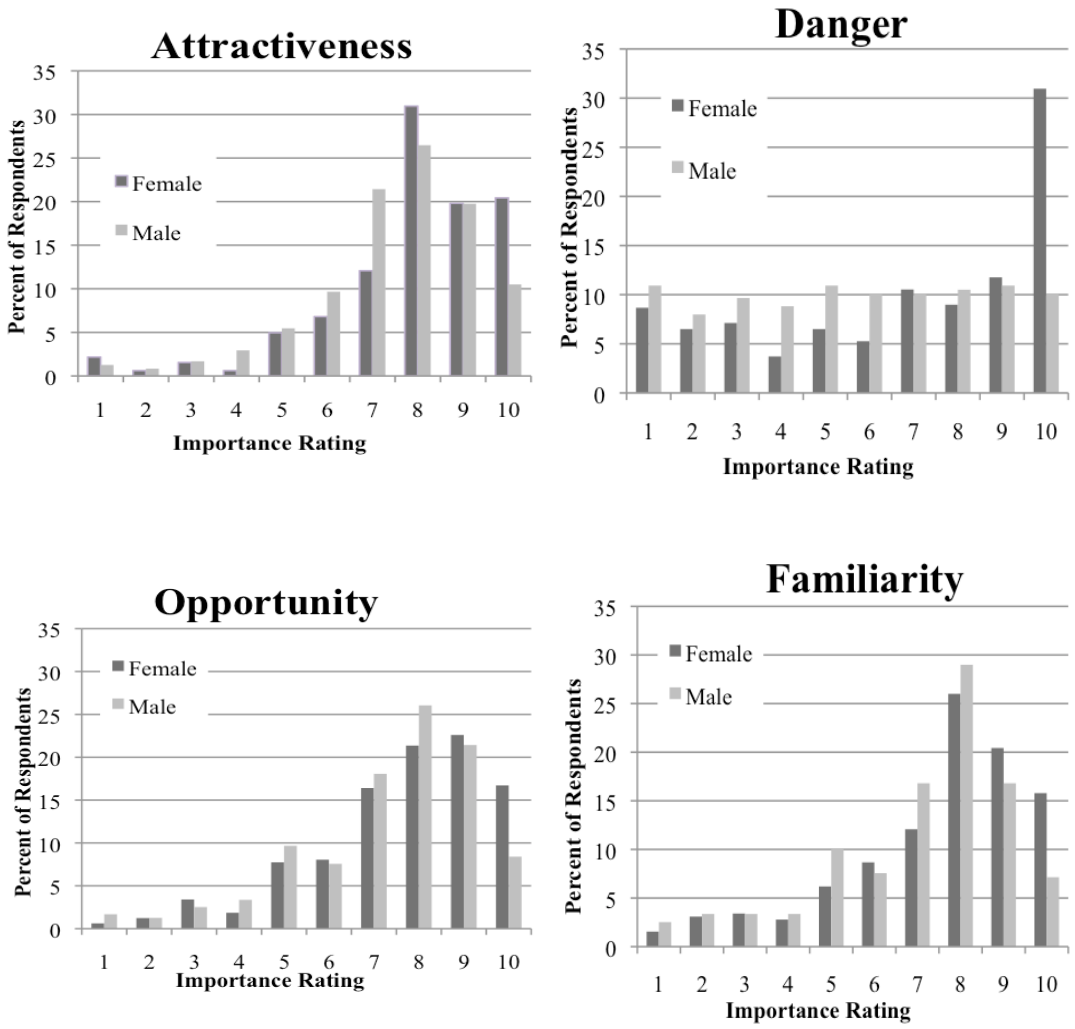
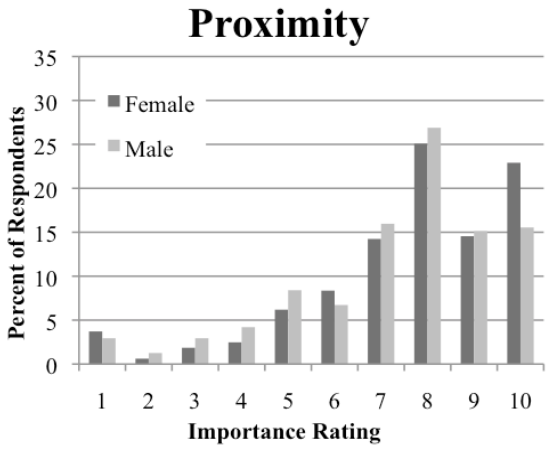


Figure 4.9. Attribute Importance by Gender





4.3.3. Attraction Surface

Building from the regional rating of places regarding the four attributes, and the evaluation of importance of these aspects in destination choice, an importance based measure of attractiveness for each hexagon was developed. First, the raw survey values for each hexagon were recoded on a one through seven scale to avoid negatives and more importantly any zeros in the calculations. Using these recoded values, an average attraction for each hexagon for each attribute was calculated using Equation 4.1.

$$AV_{ij} = \frac{\sum_{k=1}^{n}\left(x_{ijk} w_{jk}\right)}{n} \qquad \text{Equation 4.1}$$

Equation 4.1

Where,

i=1,..., 23 (number of hexagons shown to respondents).

j=1,2,3,4 (for attractiveness, danger, opportunity, familiarity respectively).

k=1,..., n (n=561)

AV_{ij} is the average of the specific attraction variable of hexagon *i* for attribute *j*

x_{ijk} is the hexagon (*i*) specific response by individual k to the likert ranking of each attribute *j*

w is the weight of attribute *j* for each individual *k* (constant across each hexagon).

In this way we obtain 4 values of weighted attributes averaged over all respondents for each of the 23 hexagons.

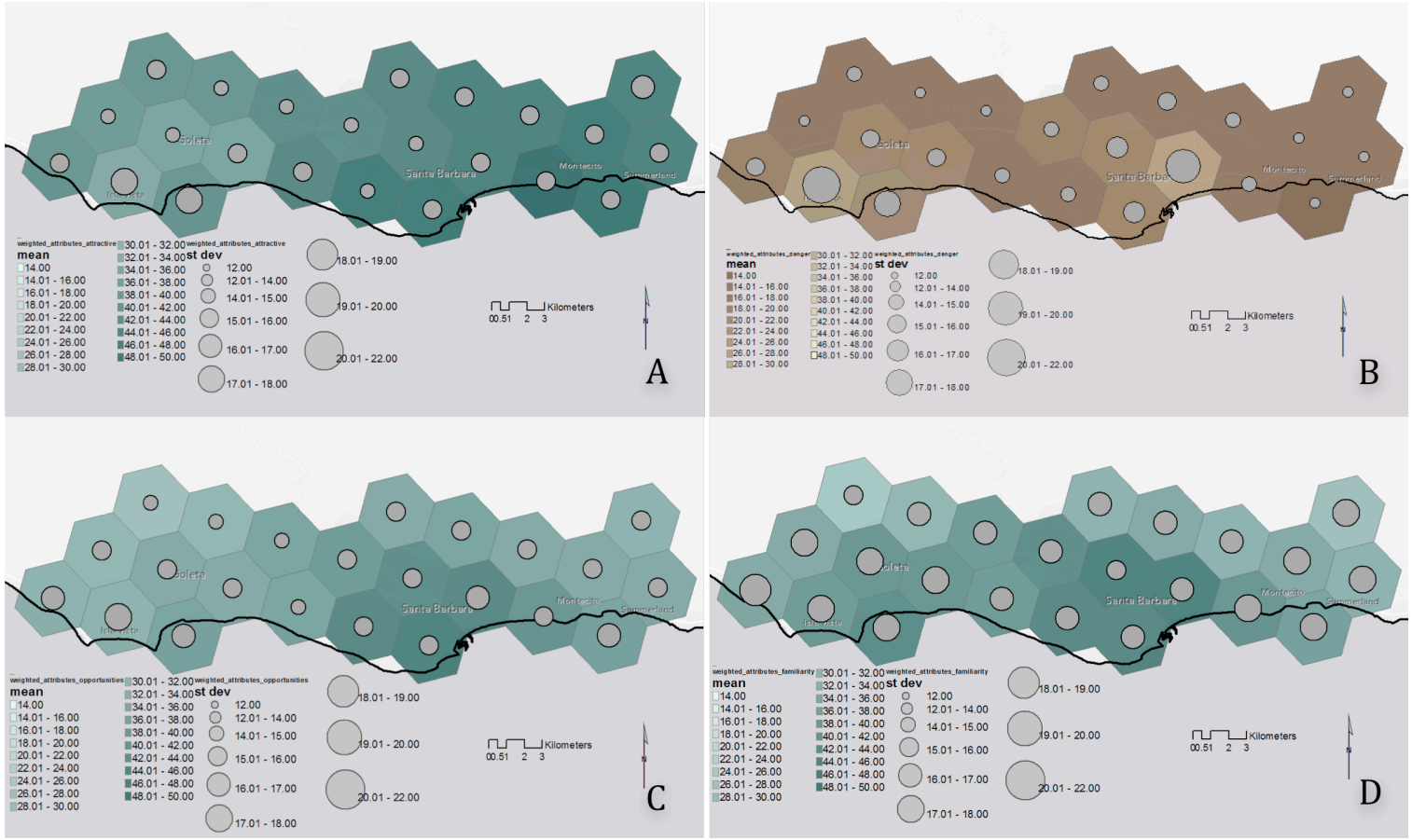
This formulation enabled the inclusion of the influence of these aspects on destination choice on a person-by-person basis. The results of the average attraction for each attribute are visualized in Figure 4.10 (a-d). It should be noted that in order to remain consistent for visualization purposes the danger surface is shown with a reversed color scale. The values for this attribute were not inverted prior to the transformation in order to preserve the original meaning of the question and consistency between the scoring of hexagons and rating of importance. Additionally, the resulting values should be interpreted opposite of the other three attributes; a higher value means the area is more dangerous and therefore viewed negatively. Because of this, interpretation of this map and comparisons to the other three attribute maps should be done with caution, as these values are now values of detraction, and the magnitude of the value has different meaning. To emphasize this, the danger map has been rendered in brown. As it would be expected, the trends exhibited in the weighted attribute surfaces show some similarities to the averaged raw numbers for each attribute means. When examining the weighted surfaces, the

attraction that is caused by the overall attractiveness of an area has the highest mean values and some of the lowest standard deviations across all attributes. The average values for each of the hexagons across this feature are also fairly consistent. This is consistent with both the low standard deviations of the attractiveness raw scores for each hexagon (as seen in Figure 4.4) and the low standard deviation for the importance that the attractiveness aspect has on destination choice. The lack of attraction, or higher detraction potential, due to the perception of danger is again seen highest in the downtown and UCSB/Isla Vista areas, with the highest standard deviations of the 23 hexagons for this attribute. With the exception of these two hexagons (and a few surrounding hexagons to a small extent), the average and standard deviation values for each hexagon are very similar. The means for the opportunities attraction are lower than those of the attractiveness attribute, and similar to the values for familiarity. The standard deviations for the opportunities attraction surface however are also lower than the familiarity attribute, and similar to the attractiveness. This indicates that there is a higher level of agreement among respondents about where activities locations are. As a result of the weighting, the familiarity aspect no longer has the largest range of values for the standard deviation. The perception of danger has a much larger range (7.021) of standard deviation values when compared to the other three (Attractiveness: 3.387, Opportunities: 3.783, and Familiarity: 2.637), as reported in Table 4.4. The familiarity attraction surface as expected identifies the areas of eastern Goleta eastward toward the downtown area of Santa Barbara as having a higher attraction potential. This is likely a product of the residential locations of the respondents.

Table 4.4: Weighted Attribute Mean Minimum, Maximum and Range

	Attractive		Danger		Opportunity		Familiarity	
	Mean	**St. Dev**	**Mean**	**St. Dev**	**Mean**	**St. Dev**	**Mean**	**St. Dev**
low	32.039	14.188	14.941	13.111	27.670	14.169	25.178	15.676
high	48.246	17.576	28.112	20.132	44.086	17.952	44.784	18.314
range	16.207	3.387	13.171	7.021	16.415	3.783	19.606	2.637

Figure 4.10. Weighted Attribute Surface (a: attractiveness, b: perception of danger, c: opportunities, d: familiarity)



Following the creation of the attraction by each attribute, a combined attraction surface for the hexagon regions was created. First, the individual components of Equation 4.1 were used to calculate attribute attraction indices for each hexagon and attribute for each respondent (given in Equation 4.2).

$$AI_{ijk} = x_{ijk} w_{jk} \qquad \text{Equation 4.2}$$

Where,

i=1,..., 23 (number of hexagons shown to respondents).

j=1,2,3,4 (for attractiveness, danger, opportunity, familiarity respectively).

k=1,..., n (n=561)

x is the attribute score from strongly disagree to strongly agree, rescaled on a 1-7 scale

and

w is the importance of that attribute in the decision process

Next, a composite index of attraction was computed and averaged across all respondents. The overall attractiveness, familiarity and opportunities were all deemed as positive attributes and were summed, while the perception of danger was deemed a negative attribute of the region and was subtracted from the overall score (a higher value for this attribute indicates agreement with that region being more dangerous).

$$I_i = \frac{\sum_{k=1}^{n} (x_{i1k} w_{1k} - x_{i2k} w_{2k} + x_{i3k} w_{3k} + x_{i4k} w_{4k})}{n} \qquad \text{Equation 4.3}$$

Where,

I_i is the overall attraction index

i and *k* are the hexagons and respondents respectively, as defined above

x is the attribute score from strongly disagree to strongly agree

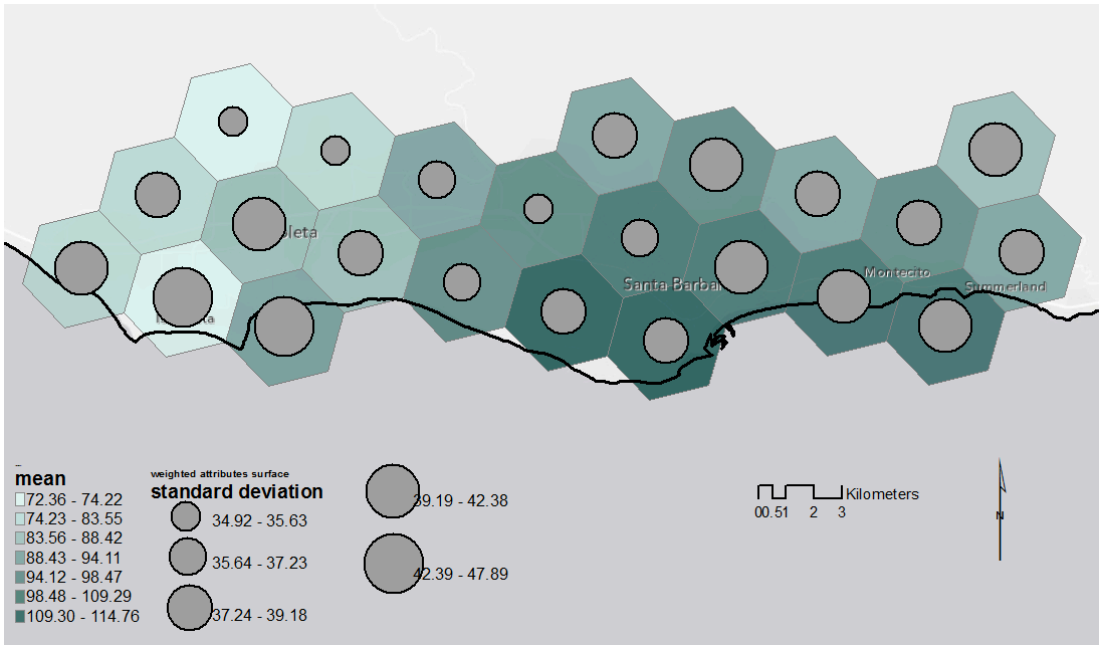
w is the importance of that attribute in the decision process

and *j* from Equation 2 is replaced with specific attribute numbers

1= attractiveness, 2= danger, 3= opportunities, and 4=familiarity

The resulting attraction surface of this calculation can be seen in Figure 4.11. As seen in the figure, the western portion of Santa Barbara (downtown Santa Barbara and Montecito) has a higher attraction compared to the eastern portion (Goleta). Additionally, the coastline (with the exception of the UCSB/ Isla Vista- hexagon 20) tend to have higher values than do the inland hexagons, and there is a slight trend of more attraction following State Street, which is one of Santa Barbara's main arterial streets, with many shops and businesses.

Figure 4.11: Attraction Surface



It is important to note that this linear composition of the attraction surface is one of many methods for creating this index. Due to the exploratory nature of this work, there is no substantial literature pertaining to travel decision-making that would provide a framework for the appropriate methodology. It could be debated that the approach should be multiplicative rather than additive, where familiarity would be multiplied by the sum of the other three aspects as shown in Equation 4.4.

$$IM_i = \frac{x_{i4k} w_{4k} \sum_{k=1}^{n} (x_{i1k} w_{1k} - x_{i2k} w_{2k} + x_{i3k} w_{3k})}{n} \qquad \text{Equation 4.4}$$

Where,

I_i is the overall attraction index

i and k are the hexagons and respondents respectively, as defined above

x is the attribute score from strongly disagree to strongly agree

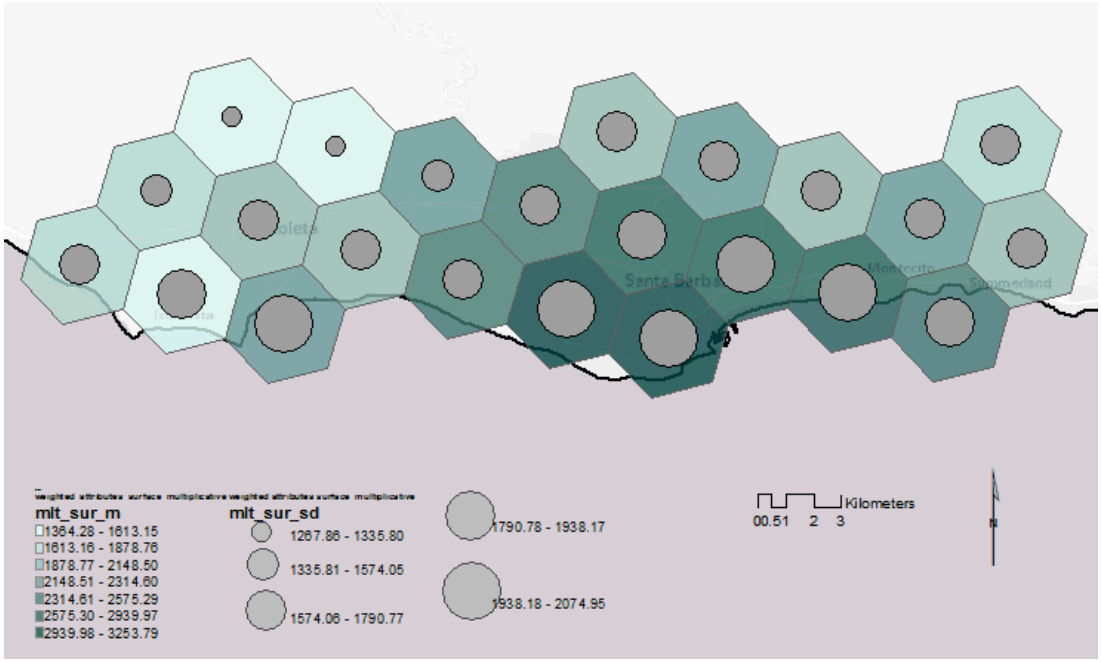
w is the importance of that attribute in the decision process

and *j* from Equation 2 is replaced with specific attribute numbers

1= attractiveness, 2= danger, 3= opportunities, and 4=familiarity

The resulting surface of this multiplicative surface is provided in Figure 4.12.

Figure 4.12: Multiplicative Attraction Surface



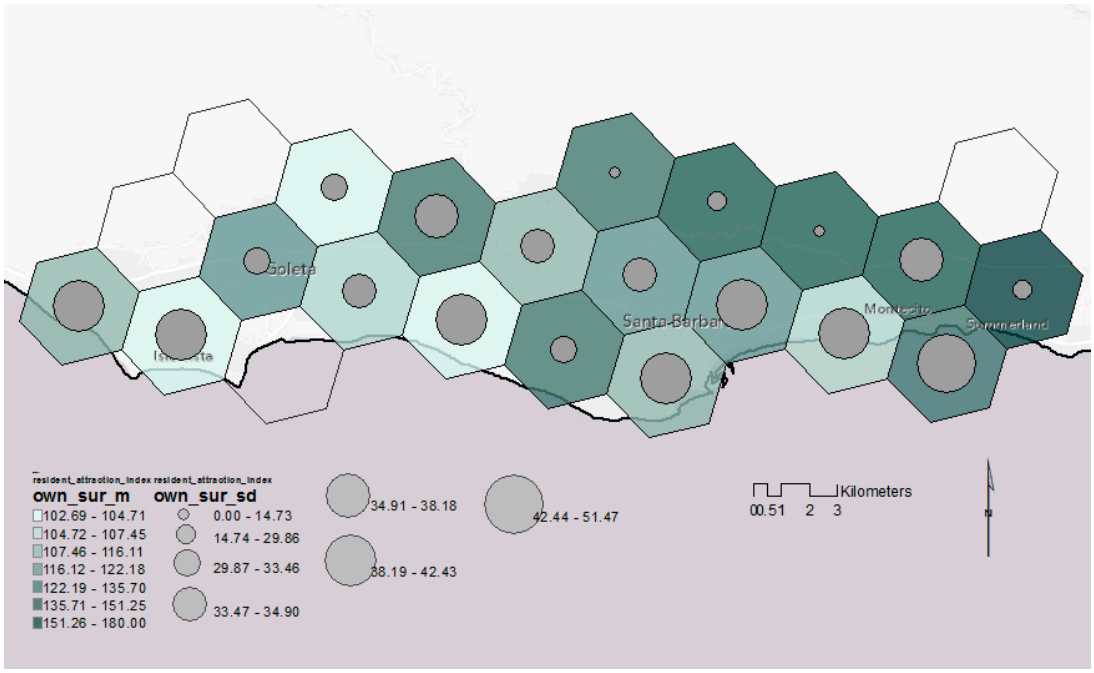
A few findings are important to note when comparing the additive versus multiplicative indices. First, the downtown area is the most attractive area, and Isla Vista area the least, regardless of the method of creating the index. Additionally, the east to west trend is still apparent along State Street as well. Although multiplying the attractiveness, danger and opportunity perceptions by the familiarity one has can be justified as appropriate due to the impact of a mental map and the individuals

spatial knowledge of choices, there are perhaps equal justifications for a linear or other approach. With a multiplicative index for instance, there is an implied assumption that an individual might not seek to increase his or her knowledge of the area, or be attracted to places he or she hasn't been to previously. Additionally, due to the spatial aggregation, an individual might have rated a hexagon with a low familiarity rating, but might be substantially familiar with one small shopping center within the hexagon. With a multiplicative index, these instances are exacerbated, and might not be appropriate. Further research into how destination choice and spatial knowledge acquisition is necessary to more fully develop an index perhaps with unique transformations to better mirror the psychological processes of individuals, without adding bias through researcher assumptions. It is believed that the individual weights applied to each of the attributes accounts for a portion of this variation in the value and influence of the attractiveness, perception of danger, familiarity and perception of opportunities. For these reasons, the linear index will be used in the remainder of this discussion.

An important aspect of the attraction index is the influence of the home location. Extensive exploration can be conducted in attempts to understand the correlation between residence and individual hexagon ratings. This can be further exploited and individualized by incorporating the importance weight of proximity to home (equivalent to each of the other attribute weights). Though this is not within the scope of this analysis, a preliminary analysis was conducted to examine the attraction to hexagons in which respondents live. Geocoded addresses were assigned to the hexagons in which the individual lives. Due to insufficient address

information, seven respondents were excluded from this portion of the analysis (resulting in a sample size of 554). Figure 4.13 provides a map of the average attraction index by respondents who live in each hexagon. Blank hexagons are those in which no respondents live. While the average values for attraction range from 72-114 for all respondents, when examining home specific hexagons, the average values are much higher (from 102 to 180). Within this range, those respondents who live on the eastern side of the study area have higher attraction values for their own residential hexagons than those in the western portion. Caution should be used when interpreting the standard deviation values, as a small standard deviation could also be a byproduct of a small sample within that hexagon.

Figure 4.13. Home Based Attraction Index



4.3.4. Latent Class Cluster Analysis

In order to understand the way in which people differ from each other in their attraction to areas of Santa Barbara, a cluster analysis was conducted using all 561 respondents. Using the framework of a latent class cluster analysis (LCCA) allows for the grouping of individuals into clusters exhibiting commonalities due to a latent, unobserved reason or factor. The latent class cluster model was estimated using Latent Gold 4.5. The analysis was conducted using the 23 continuous indicators (one for each hexagon), and was estimated using Maximum Likelihood and Posterior Maximization methods for parameter estimation. A discussion of LCCA can be found in Vermunt and Magidson (2002). The equation used to derive the latent clusters is provided in Equation 4.5.

$$f(y_i \mid \theta) = \sum_{k=1}^{K} \pi_k f_k(y_i \mid \theta_k) \qquad \text{Equation 4.5}$$

where

$\boldsymbol{y_i}$ is the respondent's score (i=1,...,N) on the measured variables (in this case the 23 attraction scores- one for each hexagon)

N is the number of respondents (561)

$\boldsymbol{K}$ is the number of clusters (k-1,...,K)

$\boldsymbol{\pi_k}$ is the prior probability of belonging to a latent class or cluster $\boldsymbol{k}$

And $\boldsymbol{y_i|\theta}$ is the distribution of y given the model parameter $\boldsymbol{\theta}$

Models were estimated iteratively and compared using a combination of fit statistics and parameters. After an evaluation of the fit statistics and resulting model profiles, an eight-cluster model was selected as the most appropriate model (Log

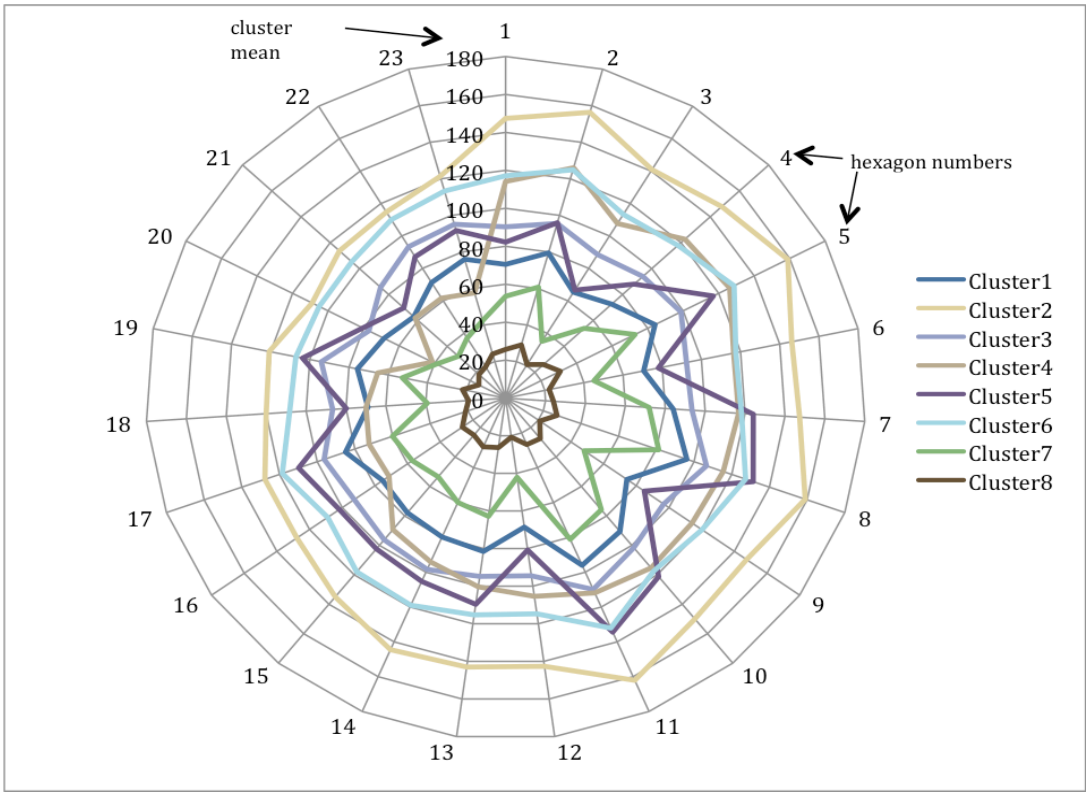
likelihood: -59701.32, BIC: 121776.29, Classification error: 0.0289). The eight clusters were interpreted by examining two aspects: first, the differences between clusters and the values of attraction surfaces were compared, and second a geographical interpretation was used. Table 4.5 provides the profile means for each hexagon, as well as the maximum, minimum and range of means for all eight factors.

Table 4.5. Cluster Analysis Profile Means

	Cluster Number							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Hex 0	79.44	156.38	95.59	126.04	95.96	124.94	60.74	29.12
Hex 1	96.18	159.02	106.60	115.48	131.40	127.38	81.24	27.26
Hex 2	84.13	158.93	98.77	126.20	116.96	128.66	72.89	30.79
Hex 3	70.46	147.39	90.26	114.15	82.187	117.16	53.67	25.67
Hex 4	96.04	162.10	109.91	111.89	134.45	132.09	81.12	26.65
Hex 5	83.97	147.37	93.42	116.81	124.14	118.24	71.90	23.95
Hex 6	72.55	147.88	93.93	122.68	88.00	117.89	53.87	25.93
Hex 7	84.97	127.74	96.31	72.45	109.85	118.51	60.05	21.26
Hex 8	79.78	144.50	98.42	94.09	105.30	118.98	59.90	27.98
Hex 9	90.59	149.96	101.58	115.31	121.24	117.41	75.80	27.45
Hex 10	70.52	146.15	92.37	116.47	77.99	117.58	45.14	22.26
Hex 11	65.30	140.88	88.52	107.67	66.62	113.30	35.06	20.69
Hex 12	68.48	108.96	77.02	41.20	80.41	104.97	38.97	15.09
Hex 13	75.27	127.76	92.65	71.39	101.75	108.93	57.13	26.47
Hex 14	81.54	143.01	94.80	100.35	109.66	115.28	62.86	26.29
Hex 15	74.25	147.50	96.73	114.13	84.91	120.22	48.10	20.91
Hex 16	76.00	121.35	95.12	57.58	91.69	113.30	42.46	24.13
Hex 17	75.70	120.74	94.14	65.34	103.74	107.11	52.78	22.03
Hex 18	77.85	134.98	96.22	89.31	102.39	117.99	53.41	25.09
Hex 19	68.60	142.63	94.47	105.40	80.78	114.71	42.12	20.78
Hex 20	71.25	114.76	93.37	61.66	87.15	110.03	37.03	19.24
Hex 21	69.01	120.01	86.69	69.97	79.85	108.28	39.28	18.58
Hex 22	62.80	113.69	85.54	61.87	69.65	105.26	32.31	18.22
Min	62.80	108.96	77.02	41.20	66.62	104.97	32.31	15.09
Max	96.18	162.10	109.91	126.20	134.45	132.09	81.24	30.79
Range	33.38	53.14	32.89	85.00	67.82	27.12	48.93	15.70

In addition, Figure 4.14 provides these values graphically, to better understand the between cluster differences that exist. Several aspects can be seen through the radar plot provided in this figure. First, there is a clear distribution of several clusters as being either "all high" values or "all low" values. For instance, clusters two and seven are both hexagons that have values that are consistently high for all hexagons, and cluster eight has values that are consistently low for all hexagons. Secondly, there is a visual trend that is noticeable among many of the clusters showing a lopsided circle, favoring the right side of the plot (clusters two and four are the most extreme cases of this). These hexagons are the western hexagons as seen in the map of hexagon numbering provided earlier (Figure 4.2), and indicate a strong Montecito, downtown Santa Barbara attraction.

Figure 4.14. Cluster Means by Hexagon

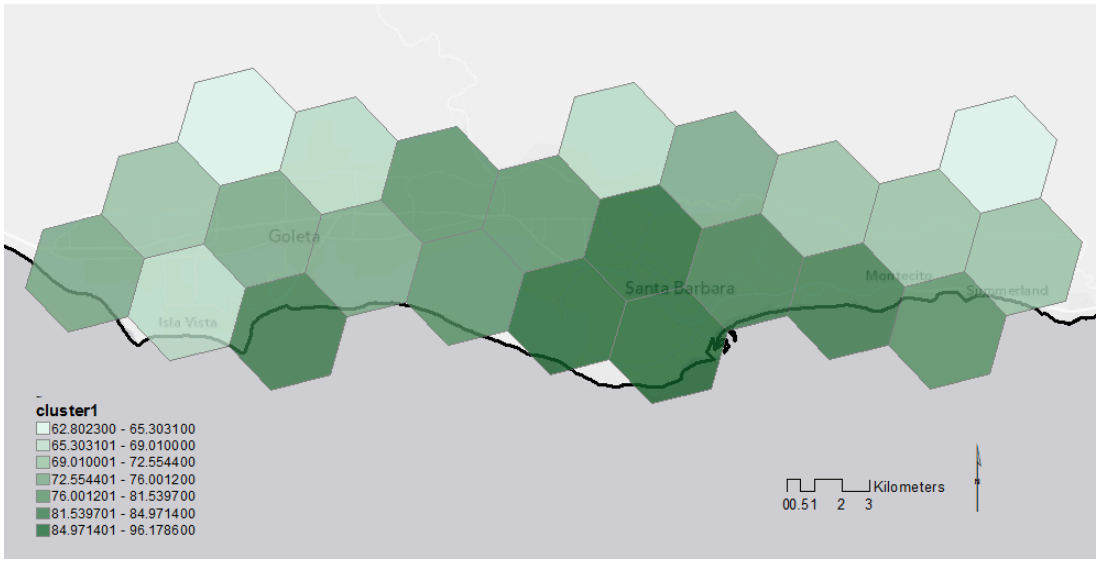


It is important to note however, that there is a combination of several factors that are contributing to the emergence of these clusters. The development of these clusters appears to be a product of both the manner in which individuals answer the questions (for instance rating everything high or low), and the geographic attraction to different areas. To explore the geographic differences that exist in the clusters in combination with the examination of the attraction values, each cluster was mapped using the profile means for each hexagon. It is important to note that these maps are not normalized to a common scale. This was done in order to more easily compare hexagon to hexagon within a single cluster, rather than compare clusters to each

other. The results of this cluster analysis and interpretation of each cluster reveal some interesting aspects of the respondent's attitudes.

Cluster one: Cluster one (Figure 4.15) is comprised of values in the middle of the means when compared across all cluster values, with a range that is also in the middle across all eight clusters. Though there is less of a geographic trend, there is still a noticeable attraction to the coastal areas as well as downtown Santa Barbara, and the lowest values of attraction being the mountain areas (Northern region) and UCSB/Isla Vista (hexagon 20).

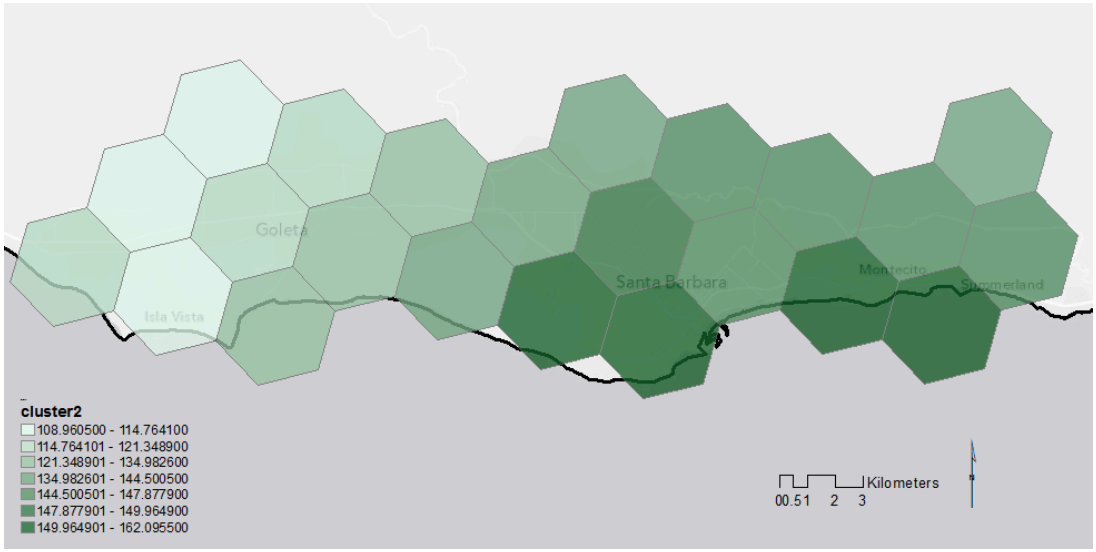
Figure 4.15. Cluster One Profile Means



Cluster two: Cluster two (Figure 4.16) is comprised of the highest hexagon means across all clusters. This cluster has one of the larger ranges

(as noted in Table 4.5) across the eight hexagons (it is the third largest). There is a noticeable geographic pattern within the hexagon mean values for this cluster, with a stronger attraction to the western portion of the Santa Barbara region. More specifically, this cluster has a higher attraction to downtown Santa Barbara and the surrounding hexagons, as well as the beach areas of Montecito.

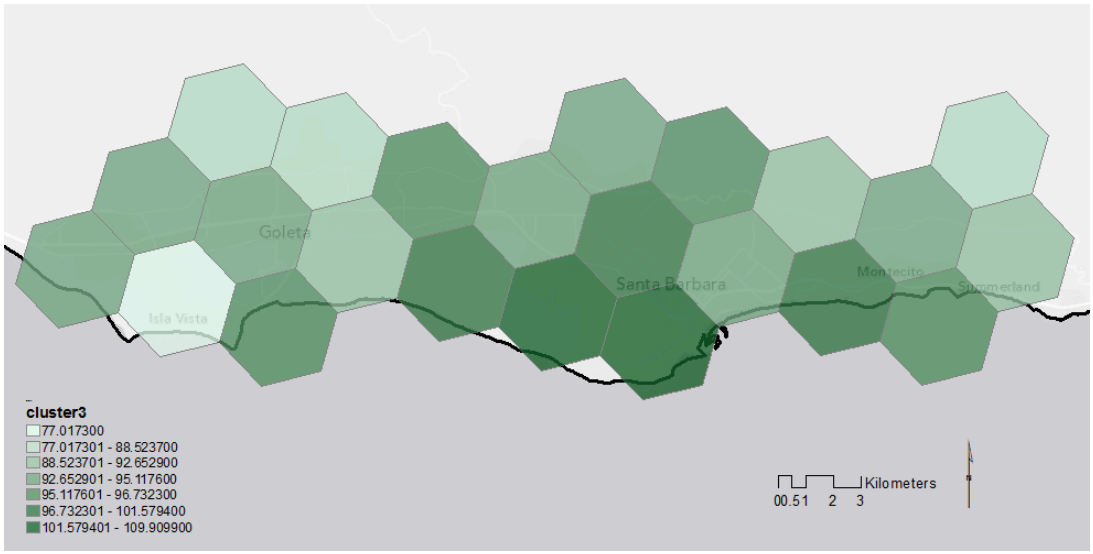
Figure 4.16. Cluster Two Profile Means



Cluster three: Cluster three (Figure 4.17) is comprised of hexagon means that are within the middle of the values across all clusters. It also has a range that is in the middle of the eight clusters. Geographically, downtown Santa Barbara can still be viewed as an area of attraction, however it is not as clearly defined when compared with other hexagons. Cluster three exhibits a

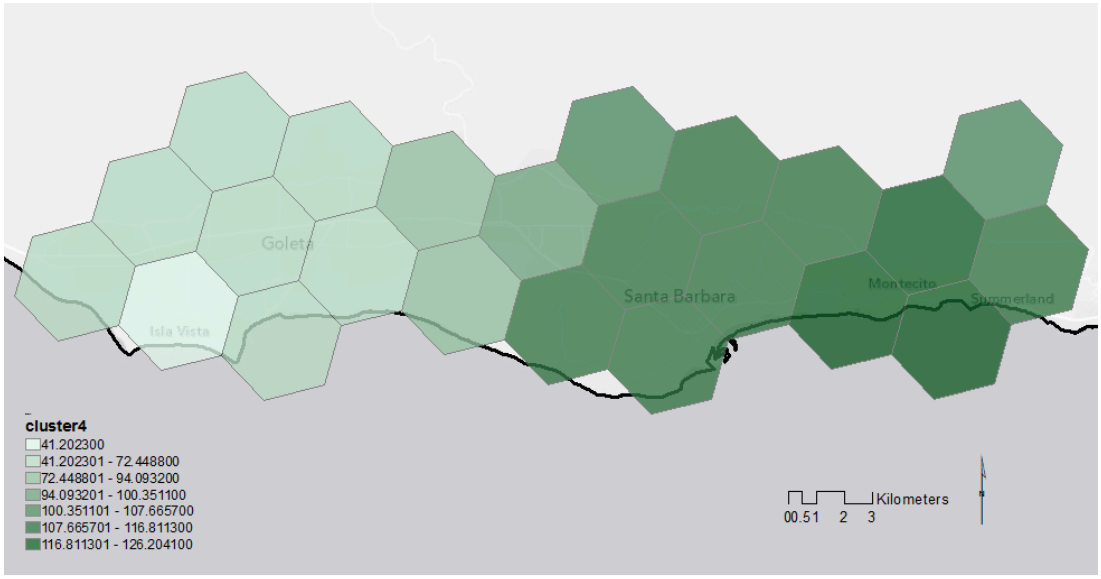
lot of similarities with cluster one, but has a few noticeable differences. While cluster one showed higher attraction values along the east to west arterial of State Street, cluster three does not. Cluster three appears to have higher attraction values for small pockets of Santa Barbara that are perhaps either areas of residences, or more local activity centers. Further analysis is needed to understand exactly why these hexagons might have higher attraction values.

Figure 4.17. Cluster Three Profile Means



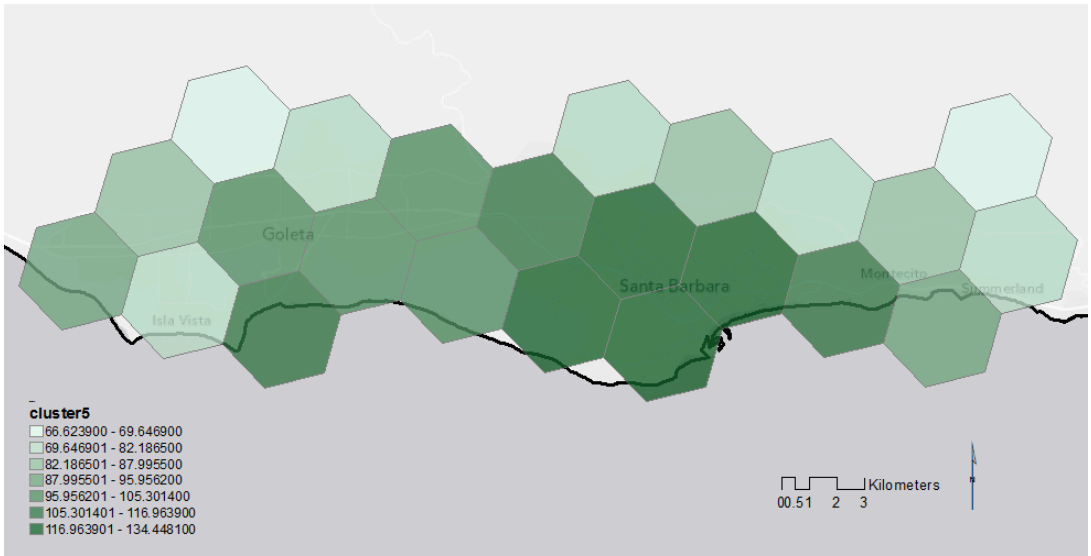
Cluster four: Cluster four (Figure 4.18) has values ranging from the middle to high end of the spectrum of values across all clusters. It is the cluster with the highest range of values (approximately 85). Geographically, cluster four shows many similarities with cluster two. It shows the strongest east to west pattern of differences between hexagon values. The eastern (downtown and Montecito) region of Santa Barbara clearly has a much higher attraction than the western region.

Figure 4.18: Cluster Four Profile Means



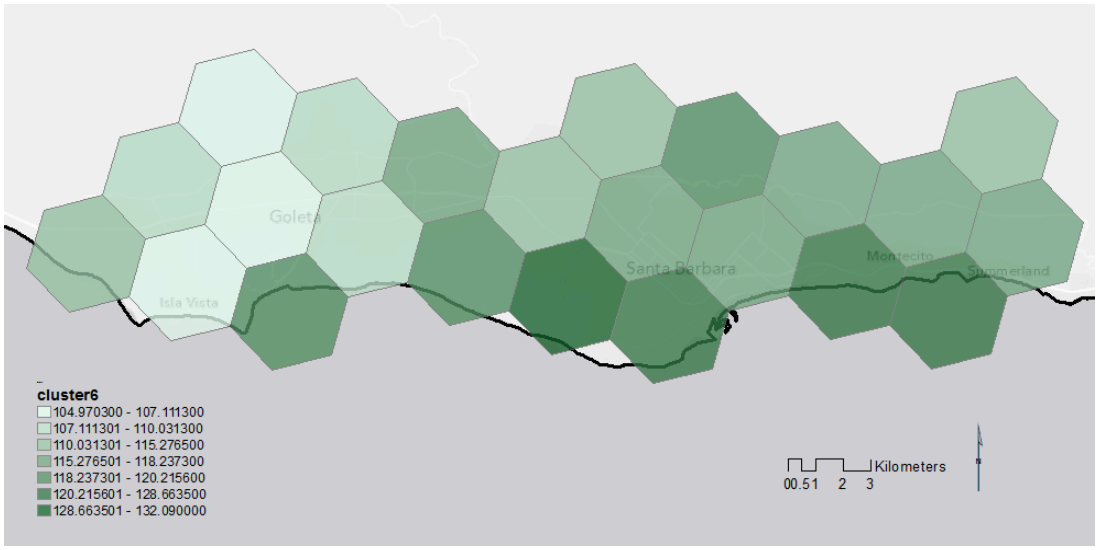
Cluster five: Cluster five (Figure 4.19) has means that are within the middle range of values, and has one of the largest ranges across the eight clusters (second largest, with a range of approximately 68), indicating that there is a large spatial variation in the attraction to different hexagons. Within cluster five, there are both north to south and east to west patterns that can be seen in the attraction values. The northern regions of the study area that are comprised of more mountainous and residential areas are areas of lower attraction values. Similarly, the most eastern and western regions of the study area are also areas of lower attraction.

Figure 4.19: Cluster Five Profile Means



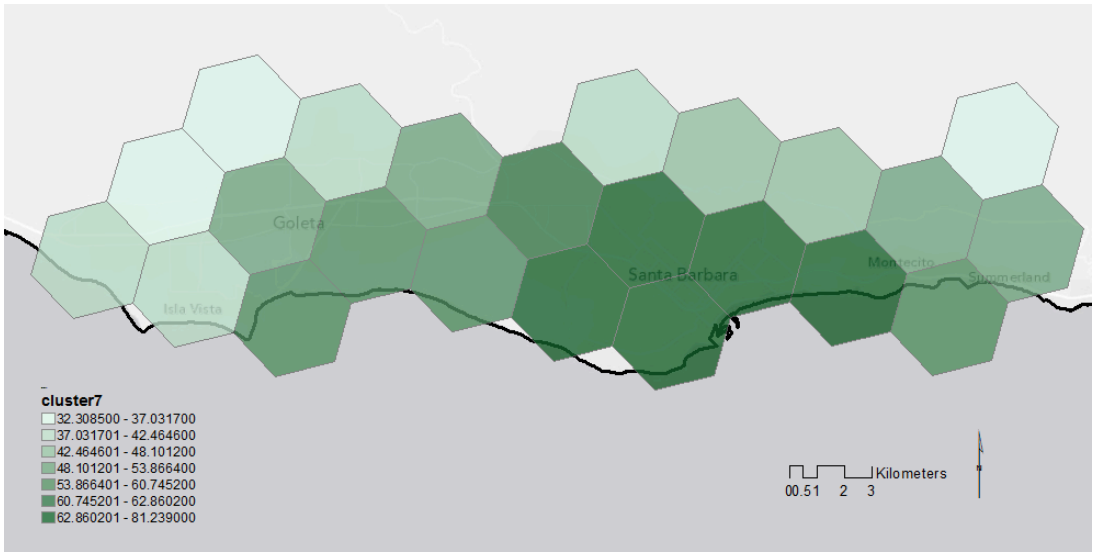
Cluster six: Cluster six (Figure 4.20) has mean values that are on the higher end of the spectrum across clusters, indicating a higher attraction to the regions. In addition, cluster six has a lower range of values across the 32 hexagons (second lowest), indicating a high level of attraction across all hexagons. Cluster six shows the least geographic trending of any cluster. The areas of highest attraction fall along the coastal areas of Santa Barbara, and the areas of lowest attraction fall within the Goleta area.

Figure 4.20: Cluster Six Profile Means



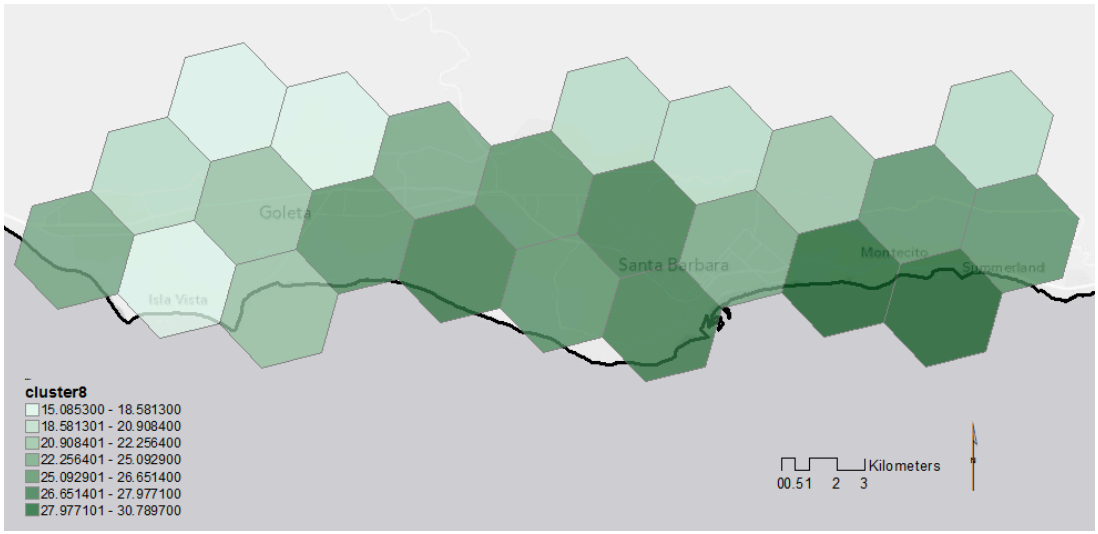
Cluster 7: Cluster seven (Figure 4.21) when compared to the other clusters is made up of individuals who have lower values of attraction to areas of Santa Barbara. The range of these values however is in the middle of the eight clusters. Like in cluster five, there is a noticeable trend of attraction in both the east to west and north to south directions. While it is similar in that the border regions of the north, east and west have the lowest attraction values, the average values are lower, and the extremes within the values are not as large as cluster five.

Figure 4.21: Cluster Seven Profile Means



Cluster 8: Cluster eight (Figure 4.22) members have both the lowest attraction values and the smallest range of mean values across hexagons when compared to the other seven clusters. Within this cluster, there is only a very slight geographic trend that can be seen. More residential regions of Santa Barbara (western most and northern regions) tend to have lower attraction values. The coastal areas and downtown have slightly higher attraction values, although there is a noticeable dip in the attraction value for hexagon 7 (the lower eastside of downtown).

Figure 4.22: Cluster Eight Profile Means



4.3.5. Home Location

To further the understanding of the cluster membership of respondents, the home residence was explored for each cluster. Figure 4.23 provides a map of cluster

membership for each hexagon in which respondents live. In addition, these hexagons have been grouped into three regions: the Montecito and Summerland region (blue), the downtown and midtown region (tan) and the Goleta region (purple), and charts have been provided to display the total respondents in each cluster by these three regions. Additionally, Figure 4.24 provides the cluster by cluster membership with respect to these three regions of the study area. There are several notable aspects of the home residences with respect to cluster membership. First, cluster two and four have a much higher representation in the Montecito/ Summerland and the downtown/ midtown regions of the study area. This is consistent with the cluster interpretation, as members of these clusters have a stronger attraction to the eastern portion of Santa Barbara. Additionally, cluster eight has the highest representation percent in the eastern portion (more specifically the coastal region of downtown Santa Barbara and Montecito. The members of this cluster were people who had a low attraction to all hexagons in a fairly uniform manner, but exhibited some bias toward the beach areas. This might be a reflection of the respondent's preference toward the lifestyle and housing that the coastal areas have to offer. Clusters one, three, five and six on the other hand have a larger representation within the western portion of the study area (Goleta, and some parts of the downtown and midtown). With the exception of cluster 3 (which has approximately 46%), these clusters each have over 50% of the members living in the Goleta region of the study area. The members of clusters one, three and six showed the least amount of spatial trends with respect to cluster attraction. The Goleta region of Santa Barbara has lower housing prices and is further from the downtown

area, and these respondents are likely people who value their home location and surrounding community, but also enjoy the other regions of Santa Barbara. The high frequency of Goleta residents (approximately 52% of the cluster members) in cluster five is another interesting result. These cluster members show a higher attraction to the downtown area, and a much lower attraction to the mountain regions (the northern hexagons). Cluster five members are distributed primarily within the Goleta and downtown/midtown region hexagons. This is perhaps a certain segment of the population that is attracted to higher density regardless of what their home location is. Further analysis is needed to understand the membership and spatial patterns and preferences of these members.

Figure 4.23: Respondent Home Locations by Cluster Membership

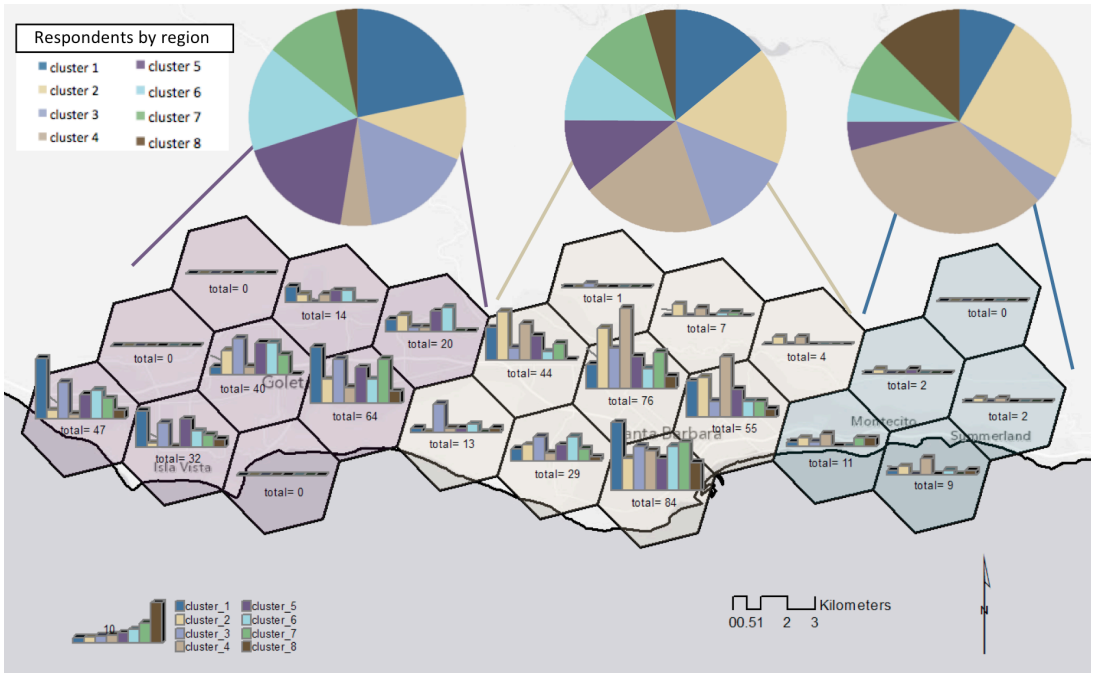
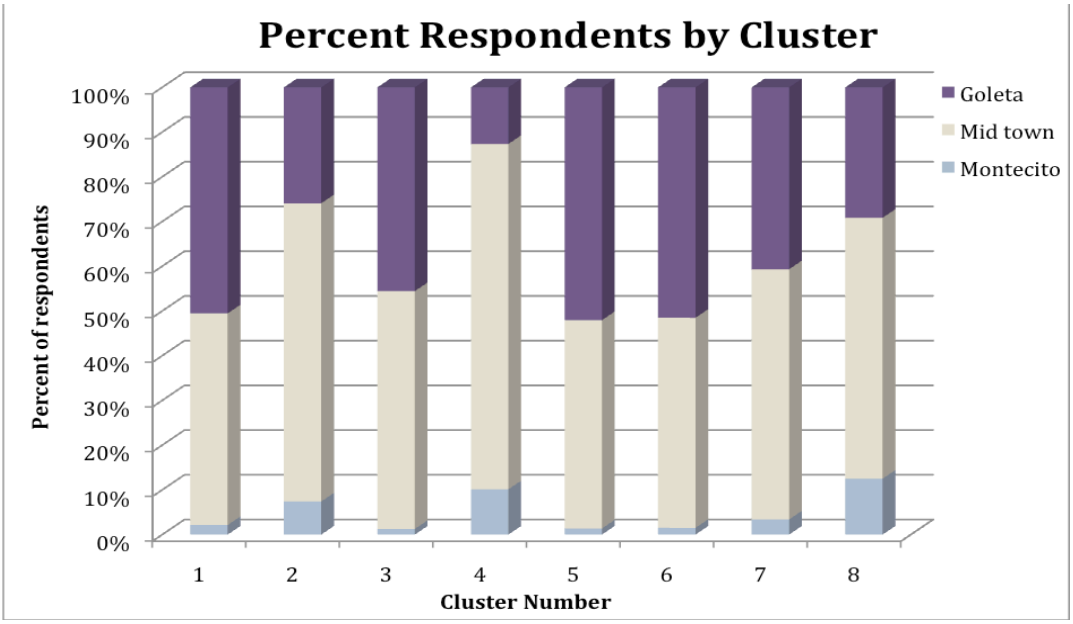


Figure 4.24: Cluster Membership by Region



It is apparent through differentiating by location of residence, that where an individual lives can influence his or her views of different areas. This has implications for the potential path area and the geographic region delimiting a persons destination options. In essence destination choice consideration sets may be strongly influenced by a variety of factors not considered in current state of the art models. Proximity to some areas does not completely capture the attraction to them. The overall attraction of an area depends on many other attributes that are subjective and weighted in differential ways among the people as seen in this sample, that are not solely based on their socio-demographics (as is the practice of current models). In essence here we show that unobserved heterogeneity (in the random error terms) and taste variation (in random attribute coefficients) of discrete choice models is

even more heterogeneous than originally thought and unraveling it requires a more carefully scrutiny of attractiveness factors as well as studies that in the pilot stage will be ad hoc but over time will become more conclusive about questions to ask, attributes to quantify, and model specification.

4.4. Conclusions

The development of accessibility measures to understand and predict human movement is an integral component of correctly predicting people's behavior. In creating these indicators however, there is a strong possibility that human preferences and actual behavior is misrepresented. Utilizing a combination of quantifiable aspects such as transportation network infrastructure, travel time and the availability of opportunities assumes that all places are created equal from an emotional or psychological perspective. Deciphering differences that exist across different places involves understanding both the differences that exist spatially, and the differences that exist across different persons.

In this research, we use a set of subjective attributes to understand how residents view the South Coast of Santa Barbara County. In addition to scoring regions of the study area, the respondents rated the four attributes with a value importance in order to create individualized weighted scores and develop an attraction surface. Although the averaged attraction surface can provide insight into the views of residents at an aggregate level, it is also important to understand the differences that exist among individuals. Using a latent class cluster model, eight

groups of respondents were extracted based on their subjective attraction potential. These eight clusters showed several aspects both at an aggregate level about attitudes regarding Santa Barbara as a whole, and at a disaggregate level (hexagon-by-hexagon). Preferences toward regions of Santa Barbara were noticeably different among clusters, as were the degree to which respondent's attitudes across regions of Santa Barbara varied. When cluster membership was examined with respect to home location, noticeable trends were present. Residents of the Montecito and Downtown/midtown region had higher memberships in clusters that had a noticeable geographic preference toward the downtown and Montecito areas. Goleta residents however were less geographically biased. This result is consistent with indicators of attraction based on density of opportunities, as the downtown area has a higher density of businesses. However, the results reflect the fact that residents of Goleta might have a higher attraction to more opportunities than those who live in the eastern portion of Santa Barbara. In other words, members of less geographically biased clusters (who tend to be residents of Goleta) might avail themselves to a greater number of opportunities due to the fact that they have higher attraction values to all areas of the region.

There are several important future directions that must be addressed. First, this analysis does not incorporate the aspect of "proximity to home" in a comprehensive way. This aspect was not incorporated into the attraction surface primarily because distance is an objective attribute rather than an attitude or perception in the case of the four attributes for which the respondents scored. Moreover, residential location is considered a longer-term decision that conditions

destination choice for activity participation. A necessary next step in understanding residents preferences associated with destination choice is to compare these surfaces to a weighted measure of proximity to home (distance weighted by the respondents evaluation of importance in destination choice). This will allow for an evaluation of the differences that exist between the attraction surface developed in this analysis and the proximity surface. Additionally, cluster membership should be further explored to understand socio-demographic differences. A regression model of cluster membership explained by socio-demographics was not undertaken in this analysis for several reasons. Primarily, due to the sample size, a sparse matrix is developed in which there are many instances in which the independent variables have zero instances of individuals for several clusters. Aspects of this analysis (for instance the rating of the individual attribute importance, or scoring of hexagons) however can be individually explored to understand how socioeconomic and demographic attributes can be used to further understand these subjective perceptions. Lastly, this research is motivated by the necessity to understand and predict destination choice. The results of the data collection should be compared to measures of accessibility currently used in destination choices. The perception to opportunities values for instance should be explored and compared with businesses and the types of opportunities available to people. In addition, the perception of danger should be compared to crime rates, and attractiveness can be analyzed and compared using various physical aspects of the built environment. Current fieldwork is taking place to quantify aspects of the physical environment for comparison. This follows discussion and theory regarding the influence of physical

attributes of landscape contributing to the development of psychological associations (Canter, 1983 and Lynch, 1960). Lastly, destination choices often differ depending on the activity that is being conducted. A portion of the survey instrument that was not utilized during this analysis is a disaggregate rating of decision making criteria by various activity types (eating, spending time with family, shopping for groceries, etc.). These importance ratings in combination with the attraction surfaces and available opportunities can provide a powerful description of the most likely areas for conducting activities by individuals.

5. Decision Makers and Socializers, Social Networks and the Role of Individuals as Participants

5.1. Background

Current practices within travel demand rely on the use of activity based modeling methods. Foundational to this modeling framework is the concept of travel being a derived demand from the necessity or desire to participate in activities (but also travel as a desirable activity per se). This paradigm has reshaped the approach that is taken to modeling individuals in a transportation setting. It is being recognized however, that the assumption and simplistic representation of activities as being economically and psychologically driven is not all that is needed. Activities many times are social in nature, and should be modeled as such. Even when activities are not social in nature, it is possible that they are influenced by other social activities that could constrain the time and space dimensions of an activity (Páez and Scott, 2007). Several attributes of activities are considered in modeling behavior as well as important factors that influence the choice process.

Although the literature is just recently gaining momentum within travel behavior, the acknowledgement of the influence of others on time use and travel behavior has long been realized. For instance, Salomon (1985) made the claim that the desire for a sense of belongingness drives people to want to participate in activities. This in turn drives the need for travel, as already discussed as a premise

of the activity based approach. In addition to this, the time geography concept of "coupling constraints" has been empirically examined by researching the influence of social contacts on an individual's travel (Páez and Scott, 2007). The broader concept of social networks has also been explored by several others (Axhausen, 2005, Axhausen, 2007; Arentze and Timmermans, 2008; Carrasco and Miller, 2006 and Habib and Carrasco, 2011). As stated by Paez and Scott (2007), "the need for social contact, and the effect of social influence on travel behavior, is one such aspect of decision-making that deserves attention." Prior to these explorations arising in the mid to late 2000's, other considerations in social influences had debuted in the travel behavior research community (Kitamura, 1988). Details such as with whom activities and travel were conducted (Harvey and Taylor, 2000; Habib et al. 2008), or for whom the activity was conducted (Goulias and Kim, 2004) have made their way into surveys as interesting and thought provoking data types, leading to pioneering analyses. Although the social aspects of these examples are more broadly cast, research focused on understanding within household interaction and the implications of these interactions on time use and travel behavior has received most of the attention regarding social influences (Gliebe and Koppleman, 2002; Golob and McNally, 1997; Yoon and Goulias, 2010b), and can be more easily analyzed with a household level data collection exercise.

In addition to the research discussion based on social influences, several researchers have focused more specifically on the composition of social networks from a traditional social network definition. The original use of the metaphor of a network to describe a person's social relationships came from a group of sociologists

in Germany (Scott, 1988). Social networks are made up of nodes (people), which are connected by links. The analysis of these social networks, using techniques such as graph theory, gives researchers a computational representation of the relationships and possibly the connectivity between people (closeness, interconnectedness, etc). Carrasco and Miller (2009) break down several characteristics into various elements. First, the composition of a social network identifies the number of similar relationships to the individual (e.g., family, friends, coworkers, schoolmates, fellow church goers) and the level of closeness of each of these types of relationships. Second, they identify several key characteristics defining the network structure (the size, instances of isolates or people only connected to the individual, density, network subgroups and potential of activity propagation from different types of relationships or people). These elements provide a theoretical basis for the development of survey questions used in this research to understand social networks and their contribution to decision making.

In order to develop the most accurate models of decision making and behavior, it is therefore important to keep in mind that the manner in which social networks influence behavior, and explore ways in which they can be introduced into models. Much of the current practices in travel demand modeling rely on modeling the choice process. It is recognized through several theories that social influences impact behavior, and therefore implicitly the decision making process. For instance the Theory of Planned Behavior (Ajzen, 1991) includes the influence of social norms. In addition, many theories focus on the attainment of social capital, which includes by nature social interactions and influenced decision processes (Bourdieu,

1984; Bourdieu, 1998). Within travel behavior, researchers have focused on several aspects of social activities. For instance: telecommuting (Páez and Scott, 2007), the propensity to conduct social activities (Carrasco and Miller, 2006) and activity duration (Habib and Carrasco, 2011). In addition, research has extended into examining who activities are conducted with and their social nature (Sener and Bhat, 2007), as well as both with whom and for whom an activity is conducted (Goulias and Kim, 2004; Goulias and Henson, 2006). We envision developing choice models that explicitly incorporate the power in decision making of individuals in social networks. These models will most likely be task and time allocation models with the important addition of representing power in a system that has explicit unequal power among agent-roles. Before developing the functional forms and deriving the mathematical apparatus to estimate models of this type we need to understand the roles played by individuals in different decision contexts. One example of this "negotiation" and task allocation within a household is the generation and allocation of escort responsibilities in a household (e.g., taking children to school or a household member needing medical attention to the doctor) and its associated household car type allocation (Bhat, et al. 2012). In activity location choice or destination choice we do not have models that explicitly assign decision roles among the persons participating in the activity at the destination. To develop this type of choice models in activity-based model systems it is very important to identify the power structure in decision making when groups of individuals participate in activities. These concepts have yet to be woven sufficiently into the framework of discrete choice models, which are perhaps the most widely accepted models for

decision making. In order to do this, we must first examine the roles that different social networks play in decision processes, and determine how best to represent heterogeneity among social interactions.

5.2. Data Description

The data used in this study is a portion of a survey conducted in Santa Barbara, California. The data collection consisted of a mail recruit letter, with a web based response. The survey included questions about social network involvement, size, strength and frequency of contact of the social network, and the role the respondent plays in decision making for activities conducted with that specific network type. The survey also included a section of household and individual level socioeconomic and demographic questions, as well as several additional sections regarding general decision making linked to destination choices. The resulting sample statistics are provided in Table 5.1 from 574 respondents.

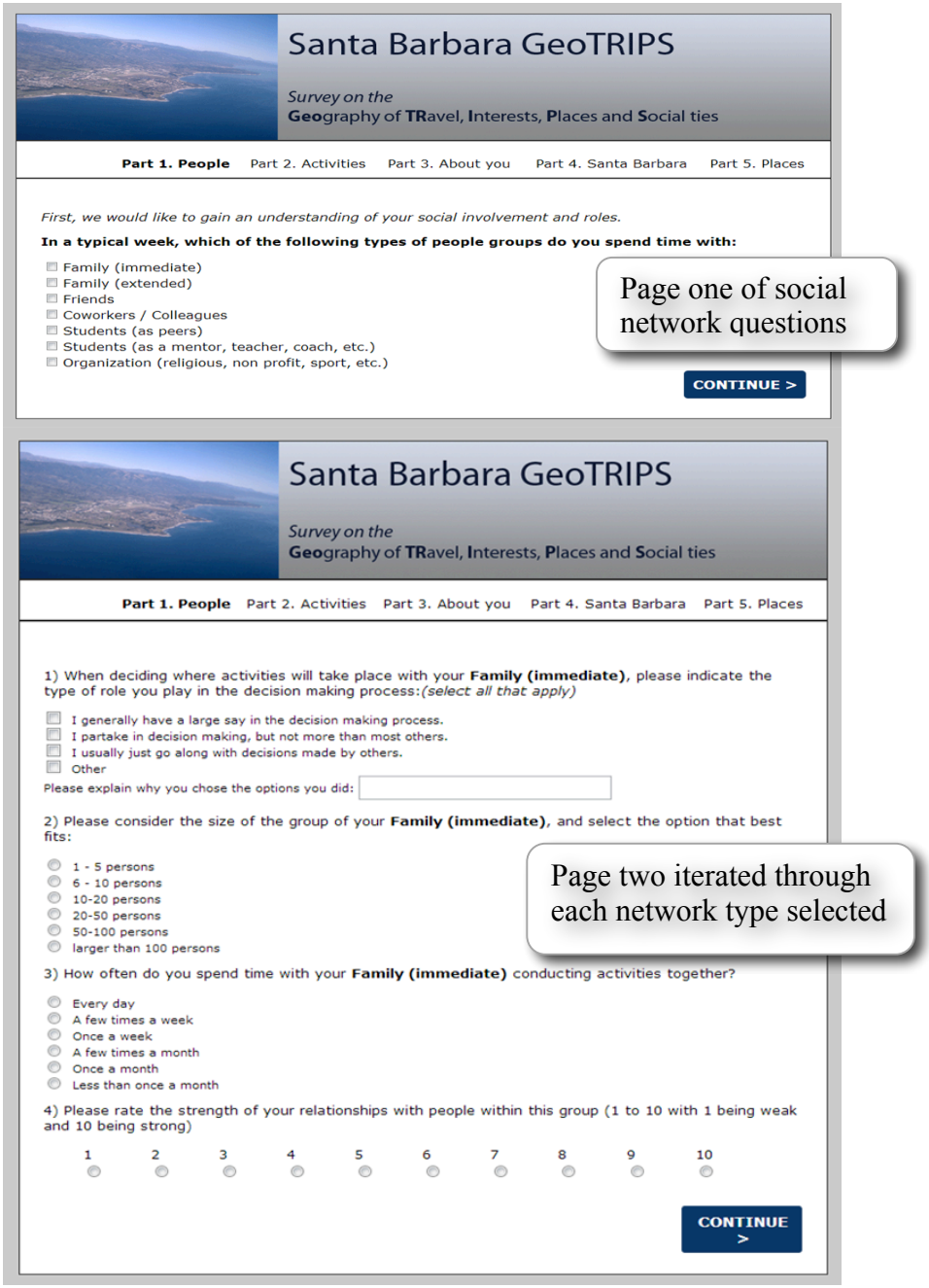
Table 5.1: Sample Descriptive Statistics

Variable	*Description*	
Gender	female	59%
	male	41%
Employment	employed full time	44%
	employed part time	14%
	student full time	6%
	student part time	1%
	self employed	7%
	home duties	4%
	unemployed	4%
	looking for work	1%
	retired	17%
	disabled	2%
Marital status	single, never married	23%
	married/ domestic partner	61%
	other	16%
Relation to household	live alone	13%
	live with immediate family	72%
	live with extended family	3%
	live with friends	5%
	live with acquaintances	2%
	live with significant other	3%
	other	2%
Age	mean	49 years
Household income	median	$60,000-$69,999
Number of children	mean	0.47
Number of household members	mean	2.6

Each respondent was asked to select from a list of seven different social network types the groups in which they interacted with in a typical week. The list of social network types was developed using research conducted by Carrasco and Miller (2006) and Goulias and Kim (2004). This list included immediate family, extended family, friends, coworkers, students (peers), students (as a mentor) and organization members (religious, sport, club, etc.). Following the selection of networks, four questions were asked for each of the social networks selected

regarding size, strength, frequency of contact and decision-making role. Figure 5.1 provides the questions from the survey.

Figure 5.1: Page one and two of social networks survey questions



5.3. Methods

In order to understand the way in which people are involved in different social networks, and the role that they play in the decisions involved in these groups, latent class cluster analysis was used. Latent clusters or groups developed from the statistical procedure were used to first classify aspects of social networks and their composition, and second understand social interaction roles.

Latent Class Cluster Analysis (LCCA) is a modeling technique within the latent class models in which probabilistic methods are employed to cluster or group objects (or in our case individuals) into classes. Although the basic form of the LC cluster model is one with continuous indicators, extensions have been developed to accommodate mixed indicator types (including nominal and ordinal) and covariates to be simultaneously modeled. The equation used for LCCA with mixed indicator types is provided in Equation 5.1.

$$f(y_i|\theta) = \sum_{k=1}^{K} \pi_k \prod_{j=1}^{J} f_k(y_{ij}|\theta_{jk}) \qquad \text{Equation 5.1}$$

where

y_i is the person's response (i=1,...,N) to the measured variables and $y_i|\theta$ is the distribution of y given the model parameter θ

N is the number of respondents

K is the number of clusters (k-1,...,K)

π_k is the prior probability of belonging to a latent class or cluster ***k***

j is the total number of indicators

And y_{ij} is each element of y_i used to individually specify each univariate distribution. These are the scores for each respondent's answers of the questions in Figure 1.

In addition to this specification, covariates can be used to predict class membership. When specifying these covariates, it is important to separate them as exogenous variables used only to predict membership, and not as endogenous variables used to inform the development of clusters. Equation 5.2 provides the formulation for the inclusion of these covariates.

$$f(y_i | z_{i,}\theta) = \sum_{k=1}^{K} \pi_{k|z_i} \prod_{j=1}^{J} f_k(y_{ij} | z_i, \theta_{jk}) \qquad \text{Equation 5.2}$$

where

$\mathbf{z_i}$ is the vector of the values of the covariates for individual i. In this model specification, the covariates are specified as having direct effects, avoiding the influence of the covariates effect on the class membership only going through the latent variable.

The analysis was conducted using Latent Gold 4.5. To estimate the parameters, Maximum Likelihood (ML) and Posterior Mode (PM) methods are traditionally used. PM methods account for the use of several priors (Dirichlet and Gamma) employed to avoid boundary solutions or non-existence of Maximum Likelihood estimates (Vermunt and Magidson, 2005). In order to converge to a solution, Latent Gold estimation procedures include a two-step use of algorithms, first using Expectation Maximization (EM) and turning to Newton-Raphson (NR) once a solution is near the Likelihood maximum. Models of different cluster

structures were estimated iteratively and compared. Model parsimony, fit statistics and cluster structure were all used to determine the appropriate number of clusters best describing the data and latent phenomenon.

5.4. Conceptual Framework

In order to understand both the composition of different social network types and the different roles that people have in those networks, a two stage cluster model was developed. The first step consisted of developing a classification of instances of respondents' social network involvements dependent on network composition. In the second step, these classifications of social network involvement types were used with decision making responses to understand differences in socializer types, or the role people play in different instances of social network interactions.

5.4.1. Social network composition

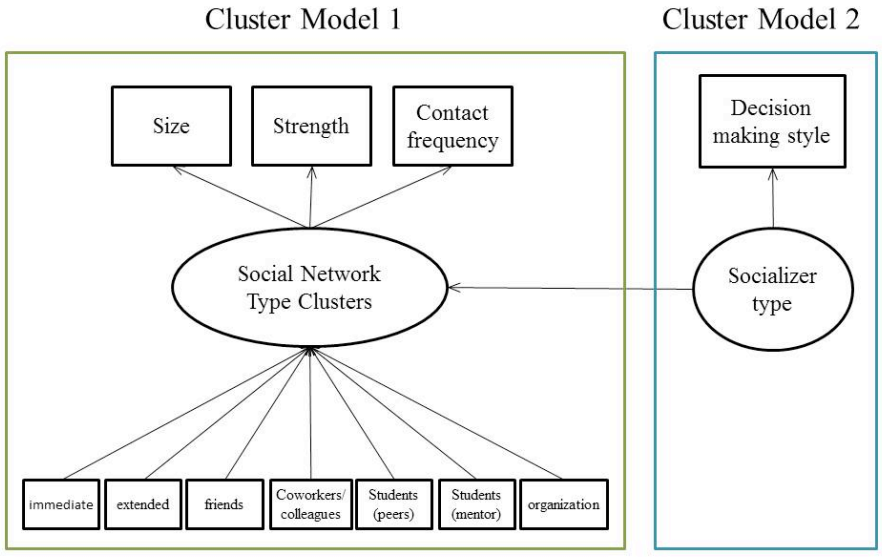
The analysis of social network composition included three measured attributes of the social network. The stated size of the social network, perceived strength of the relationships the respondent had with individuals in the specific network, and frequency of interaction (see Figure 1) with the social network were used to create clusters of social network composition types. Covariates of the type of social network were included to further drive the estimation of clusters and classifications. The conceptual model for this stage of estimation is labeled as "Model 1" in Figure 5.2. Development of this cluster model provided one classification for a number of social network attributes, which describe a specific

instance of social interaction type. Each social group for each individual was assigned a cluster class as a result of this first stage.

5.4.2. Social engagement types

Following model one, the cluster memberships were used to provide further insight into social aspects and roles. Model one classifications were used in combination with responses about the decision making role (who decides the location where activities take place) to develop socializer type clusters (represented as "Model 2" in Figure 5.2). These socializer clusters were again classes of specific instances of social network interaction for each respondent. Development of these clusters was used to investigate the possibility that differences in roles exist among different social group types.

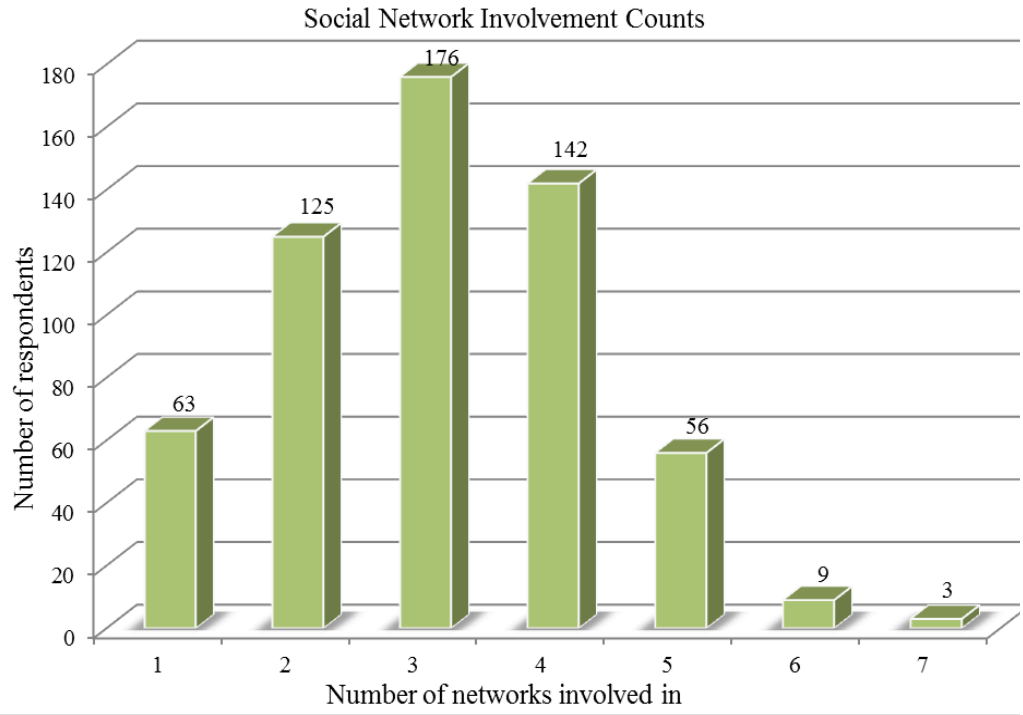
Figure 5.2: Conceptual Model

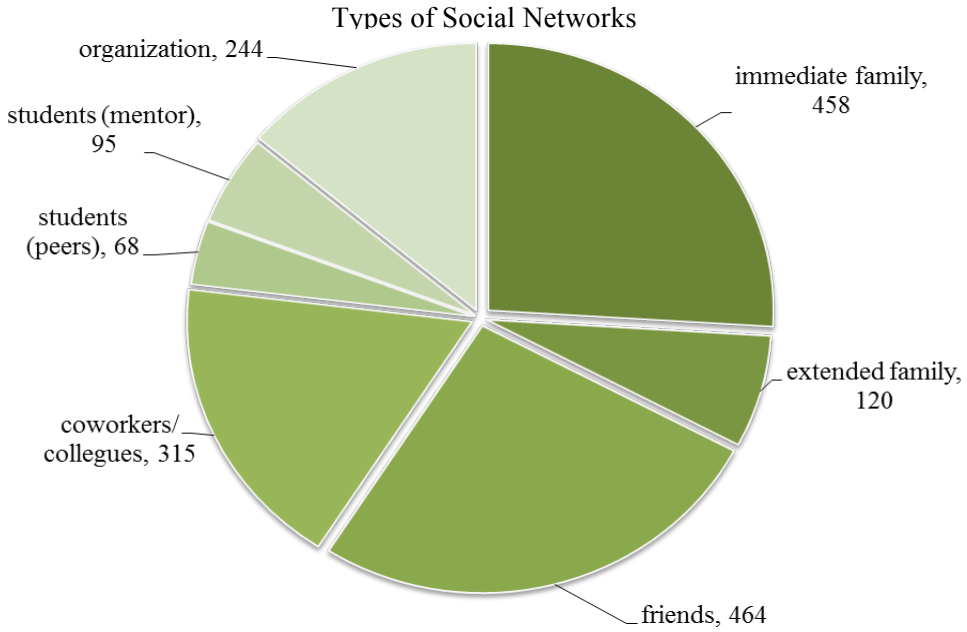


5.5. Analysis

In accordance with the conceptual framework provided in the previous section, two latent class cluster models were developed. The sample consisted of 1764 different instances of social network involvement from 574 respondents. Descriptions of the social network data is provided in Figure 5.3. Respondents recorded participation on average with three different types of social networks, with 98% of respondents falling between one and five different social network types.

Figure 5.3: Sample Social Network Statistics (N= 574, Mean: 3.07, Standard deviation: 1.231)





5.5.1. Cluster Model 1 (social network types)

An iterative procedure was used to develop a series of cluster models based on social network aspects provided both as exogenous and endogenous variables. Social network size, strength and frequency of interaction were used to inform the development of the latent clusters, while the types of network were used as binary covariates. For estimation purposes, one binary indicator (in this case Organizations) must be left out of the model specification. Each instance of social network involvement was treated as an individual object to be classified in the cluster model, therefore classifying instances of participation. It is therefore possible for most individuals to have memberships in different clusters, dependent on the social network involvement. The resulting model, a 5 cluster model was determined to be the best model representing the data based on fit statistics (provided in Table 5.2), model parsimony and cluster structure. The resulting profile of this five-cluster model is provided in Table 5.2, and the probability means are reported in Table 5.3. The five clusters developed are interpreted as shown in Figure 4 that shows the within each cluster relative value of three criteria variables (network size, strength of relationships, and contact frequency).

Figure 5.4: Cluster results of network attributes (note that for size s= small, l= large; for strength w= weak, s= strong; and for frequency d= daily, m= monthly)

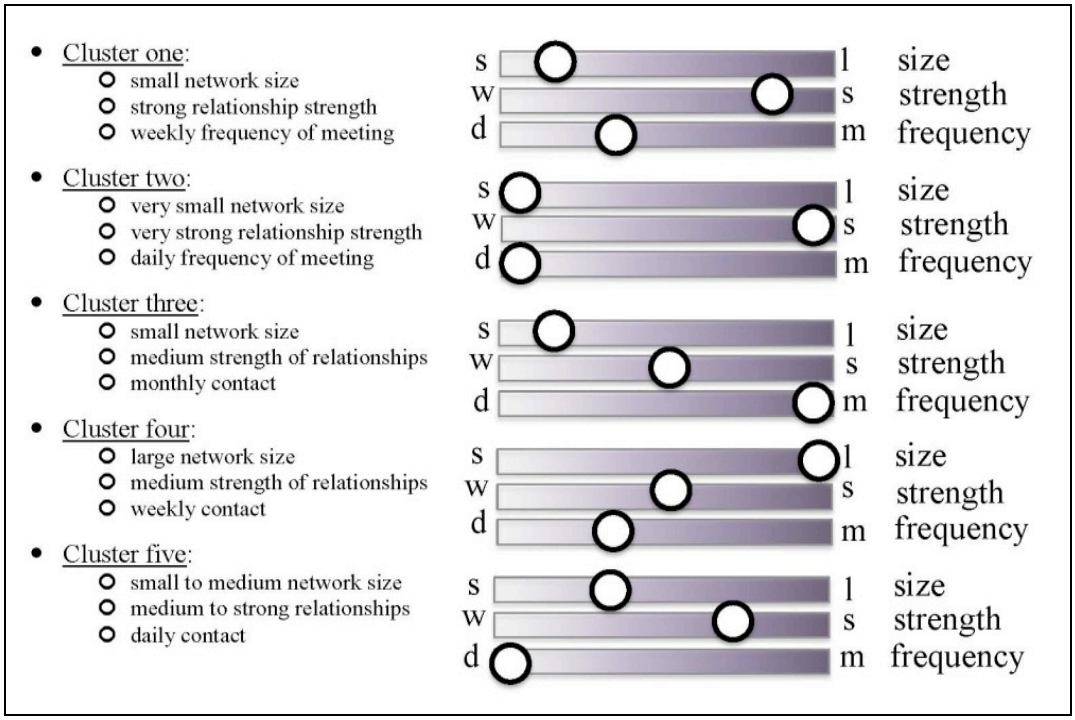


Table 5.2: Model One Profile

			Cluster1	*Cluster2*	*Cluster3*	*Cluster4*	*Cluster5*
		Cluster Size	0.3815	0.2209	0.1604	0.1544	0.0827
Indicator	size	1-5 persons	0.5074	0.9441	0.4452	0.0748	0.2698
		6-10 persons	0.2907	0.0533	0.2976	0.1376	0.2733
		11-20 persons	0.1421	0.0026	0.1697	0.2160	0.2362
		21-50 persons	0.0474	0.0001	0.0661	0.2314	0.1393
		51-100 persons	0.0083	0.0000	0.0135	0.1297	0.0430
		Over 100 persons	0.0042	0.0000	0.0079	0.2104	0.0384
		Mean	1.7709	1.0586	1.9287	3.8350	2.5274
	strength	1	0.0001	0.0000	0.0210	0.0094	0.0030
		2	0.0003	0.0000	0.0346	0.0181	0.0072
		3	0.0022	0.0000	0.0920	0.0568	0.0275
		4	0.0056	0.0000	0.0941	0.0684	0.0407
		5	0.0334	0.0001	0.2230	0.1909	0.1392
		6	0.0720	0.0009	0.1917	0.1934	0.1727
		7	0.1540	0.0081	0.1635	0.1943	0.2126
		8	0.3088	0.0652	0.1308	0.1831	0.2456
		9	0.2050	0.1746	0.0346	0.0571	0.0939
		10	0.2185	0.7511	0.0147	0.0286	0.0576
		Mean	8.2077	9.6665	5.6571	6.2290	6.8689
	contact	Everyday	0.0255	0.7264	0.0014	0.0178	0.4359
		A few times a week	0.3873	0.2689	0.0617	0.3213	0.5317
		Once a week	0.2744	0.0046	0.1254	0.2702	0.0303
		A few times a month	0.2316	0.0001	0.3039	0.2707	0.0021
		Once a month	0.0524	0.0000	0.1974	0.0727	0.0000
		Less than once a month	0.0287	0.0000	0.3102	0.0473	0.0000
		Mean	2.9843	1.2785	4.5649	3.2010	1.5986
Covariates	immediate	0	0.8462	0.1011	0.9889	1.0000	0.9919
		1	0.1538	0.8989	0.0111	0.0000	0.0081
		Mean	0.1538	0.8989	0.0111	0.0000	0.0081
	extended	0	0.8605	0.9596	0.9661	0.9974	0.9998
		1	0.1395	0.0404	0.0339	0.0026	0.0002
		Mean	0.1395	0.0404	0.0339	0.0026	0.0002
	friends	0	0.3807	0.9672	0.9138	0.9961	0.9388
		1	0.6193	0.0328	0.0862	0.0039	0.0612
		Mean	0.6193	0.0328	0.0862	0.0039	0.0612
	coworkers	0	0.9335	0.9894	0.3590	0.9934	0.4316
		1	0.0665	0.0106	0.6410	0.0066	0.5684
		Mean	0.0665	0.0106	0.6410	0.0066	0.5684
	peers	0	0.9942	0.9999	0.8874	0.9157	0.9367
		1	0.0058	0.0001	0.1126	0.0843	0.0633
		Mean	0.0058	0.0001	0.1126	0.0843	0.0633
	mentors	0	0.9975	1.0000	0.9083	0.9095	0.7072
		1	0.0025	0.0000	0.0917	0.0905	0.2928
		Mean	0.0025	0.0000	0.0917	0.0905	0.2928

BIC= 15529.1694, Classification Error= 0.1091

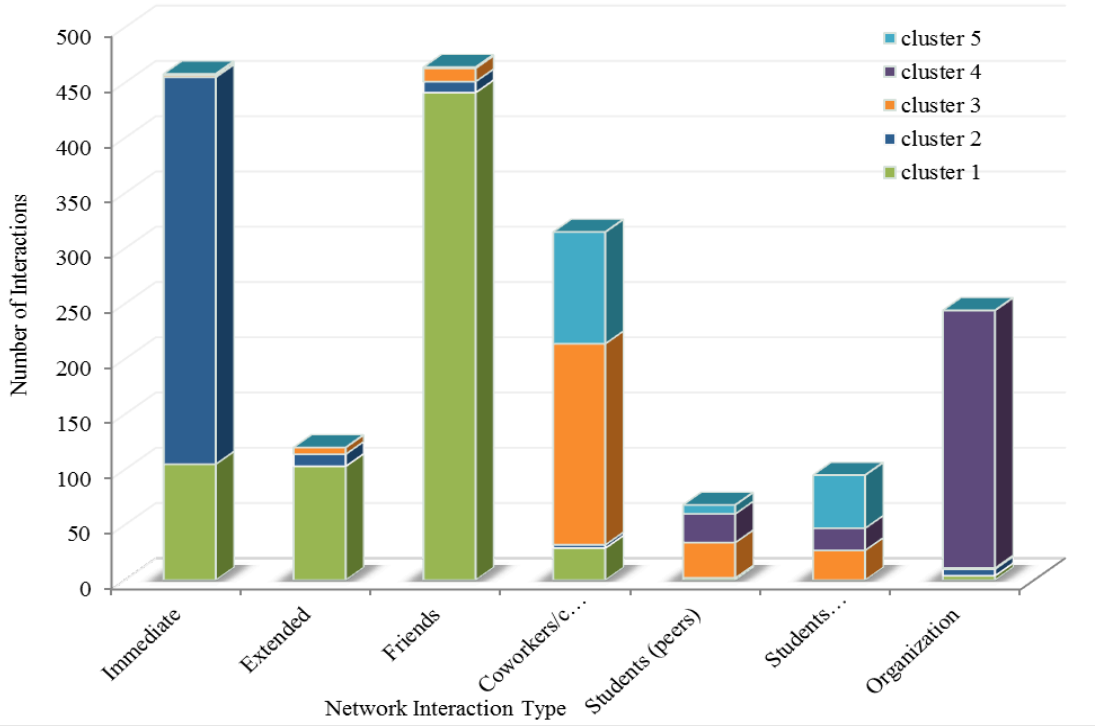
Table 5.3: Model 1 Probability Means

			Cluster1	*Cluster2*	*Cluster3*	*Cluster4*	*Cluster5*
		Overall	0.3815	0.2209	0.1604	0.1544	0.0827
Indicators	size	1-5 persons	0.3669	0.4112	0.1497	0.0205	0.0518
		6-10 persons	0.5623	0.0543	0.1991	0.0956	0.0888
		11-20 persons	0.4166	0.0045	0.1821	0.2749	0.1220
		21-50 persons	0.1980	0.0000	0.1698	0.4685	0.1638
		51-100 persons	0.0793	0.0000	0.1126	0.6188	0.1893
		Over 100 persons	0.0359	0.0000	0.0284	0.8564	0.0793
	strength	1	0.0206	0.0000	0.4998	0.2866	0.1929
		2	0.0063	0.0000	0.6069	0.2925	0.0942
		3	0.0278	0.0000	0.5250	0.3183	0.1289
		4	0.0336	0.0000	0.4233	0.4588	0.0843
		5	0.1590	0.0002	0.4144	0.3012	0.1253
		6	0.2487	0.0001	0.3647	0.2772	0.1094
		7	0.4720	0.0120	0.1813	0.2104	0.1242
		8	0.5681	0.0703	0.1013	0.1558	0.1044
		9	0.5625	0.2887	0.0262	0.0474	0.0751
		10	0.3208	0.6324	0.0084	0.0223	0.0161
	contact	Everyday	0.0438	0.7715	0.0012	0.0105	0.1730
		A few times a week	0.4877	0.1855	0.0343	0.1513	0.1412
		Once a week	0.5547	0.0105	0.1180	0.3022	0.0146
		A few times a month	0.5496	0.0003	0.2577	0.1914	0.0010
		Once a month	0.2980	0.0000	0.5350	0.1669	0.0000
		Less than once a month	0.1370	0.0000	0.7298	0.1333	0.0000
Covariates	Immediate	0	0.4361	0.0302	0.2143	0.2086	0.1108
		1	0.2259	0.7646	0.0069	0.0000	0.0026
	Extended	0	0.3523	0.2274	0.1663	0.1653	0.0888
		1	0.7826	0.1312	0.0799	0.0059	0.0003
	friends	0	0.1971	0.2899	0.1989	0.2087	0.1054
		1	0.8984	0.0275	0.0526	0.0023	0.0192
	coworkers	0	0.4336	0.2660	0.0701	0.1868	0.0435
		1	0.1421	0.0131	0.5758	0.0057	0.2633
	peers	0	0.3945	0.2297	0.1481	0.1471	0.0806
		1	0.0572	0.0004	0.4688	0.3379	0.1358
	mentors	0	0.4023	0.2334	0.1540	0.1485	0.0618
		1	0.0174	0.0002	0.2732	0.2595	0.4497

The covariates included in the model estimation provide insight into the types of social networks that are present in each cluster. Cluster one for example consists mainly of immediate and extended family, as well as friends. The probability means

indicate that instances of both extended family and friends have high probability of belonging to cluster one. This finding indicates that there is similarity among these three types of social networks in the composition of size, strength and frequency, especially in the case of extended family and friends. Cluster two is largely represented by immediate family social network instances. This cluster also includes a portion of the extended family and friend social network instances, but is mostly dominated by immediate family. This result is to be expected, as it shows that networks instances of immediate families have qualities of their composition (relationship strength, size and level of interaction) that are not as common to other network types. Clusters three, four and five are primarily composed of non-family or friend based social network types. Commonality is again noticed, this time between coworker social network types and students (either as mentors or peers) within both cluster three and cluster five. To further the explanation of cluster classification and social network type, a visualization of a cross-tabulation of cluster class and network type is provided in Figure 5. Notably, this graph illustrates the strong domination of organization social networks in cluster four. Cluster four primarily consists of large social networks, with strength of relationships in the middle to somewhat strong region on the spectrum. Cluster three appears to be dominated by professional colleagues and coworkers/students.

Figure 5.5: Social Network Cluster Membership by Type



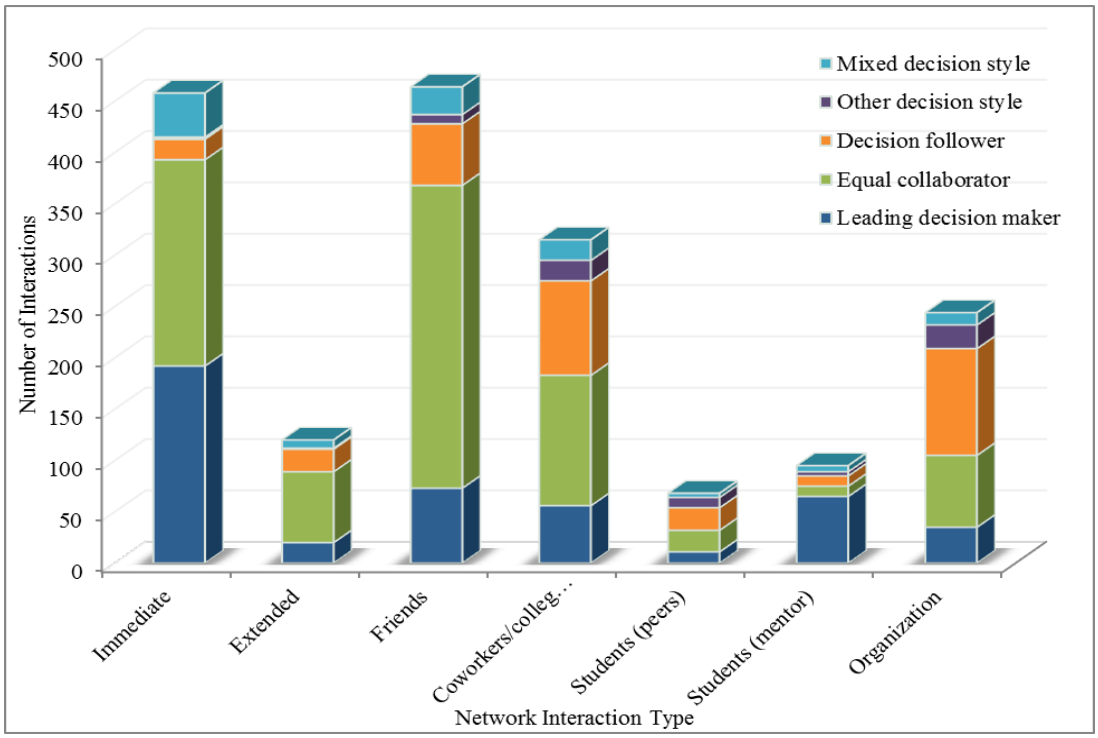
5.5.2. Cluster Model 2 (decision roles)

Following the development of a cluster model based on social network types and attributes, the decision roles of individuals with respect to the social network involved in were cross-tabulated. The results of this cross-tabulation were used to examine the commonalities and distributions of decision making roles when deciding where activities take place with others from a social network or role across social network types. Decision types were categorized into five groups as a result of responses from the survey. The first three decision types correspond to each of the response options of the survey, which have been shortened for ease of reference.

Responses of "I generally have a large say in the decision making process" were termed *leading decision maker*, "I partake in decision making, but not more than most others" were termed *equal collaborator*, and "I usually just go along with decisions made by others" were termed *decision follower*. Additionally, the survey form allowed for an "other" response, allowing respondents to explain their selection of "other." Many of these explanations indicated the fixed nature of activities with these social groups. For instance explanations like "usually fixed meeting places" or "The location of volunteer activities I participate in is already known" were given. Individuals selecting the "other" option for their role were categorized as *other decision-making role*. Lastly, due to the fact that respondents were allowed to select multiple response variables describing their decision making role in the network, a fifth categorization was created. The explanation respondents gave for selecting multiple roles consisted of statements such as "it depends on the decision" or "there are three of us, and we all at times feel what one wants to do is more important than others." These multiple response instances were collapsed into one variable, and were categorized as *mixed decision role*.

Results of the cross tabulation are provided in Figure 5.6. Of note, decision followers primarily manifest within colleagues/ coworker social networks, and organization instances. The "equal decision making" role is represented in each of the network types, although is small in the cases of interaction with students as a mentor. This social network type is predominately comprised of leading decision makers" who have the most influence in the decisions, which is an intuitive role of someone in a mentoring relationship.

Figure 5.6: Decision Making Types by Social Network Type



In addition to the cross-tabulation, a second latent class cluster analysis was conducted to examine the stated roles respondents have in decision-making processes among the clusters developed by network attributes. The membership classifications of the latent class cluster model previously discussed were used as an indicator in the estimation of the second model. In addition to classification results, the stated decision-making role variable was used in the development of clusters. An iterative procedure was again used in specifying the model structure. The fit statistics (provided in Table 5.4), cluster structure and classification error were used to guide the final acceptance of the four-cluster model. Results of this second model are provided in Table 5.4 (profile) and Table 5.5 (probability means). The results of

this cluster analysis provide some interesting insights on decision-making styles within different social contexts. Clusters can be described as:

Cluster one: This cluster is largely comprised of family and friends with small size, strong relationships and frequent interaction. The predominant decision role in this cluster is either leading decision maker having large influence, or equal collaborators in the decision.

Cluster two: This cluster is mainly comprised of non-family or friends social networks, and it is the cluster with the highest probability for organization instances. The decision-making role is mostly decision follower, with some equality of decision making with a collaborator.

Cluster three: This cluster is comprised mostly of the small size, strong relationships, weekly interaction cluster, which is largely based on social networks of friends. The decision making role for this cluster is mostly decision followers or mixed decision strategies.

Cluster four: This cluster is comprised mostly of organization, mentor and coworker social network types that are small, and medium relationship strength and everyday interaction. The decision-making role for this cluster is comprised primarily of leading decision makers, and some instances of equal collaboration.

Interestingly, cluster one and three exhibit many similarities in the composition of social network types, as do clusters two and four. The bifurcation of these cluster groups occurs due to the difference in roles of decision-making, with decision followers being clearly represented in clusters two and three. The manifestation of these different social roles within two sets of similar cluster

compositions indicates that there are both differences in decision-making roles across different types of social networks, as well as heterogeneity within similar social network types.

Table 5.4: Model 2 Profile

		Cluster1	*Cluster2*	*Cluster3*	*Cluster4*
	Cluster Size	0.5227	0.2395	0.1237	0.1141
Indicators					
Model 1 cluster classification	1	0.5523	0.0000	0.8007	0.0000
	2	0.3663	0.0044	0.1850	0.0001
	3	0.0811	0.4045	0.0143	0.0655
	4	0.0002	0.4701	0.0000	0.3982
	5	0.0000	0.1209	0.0000	0.5362
	Mean	1.5293	3.7075	1.2136	4.4704
Decision Type	Large decision maker	0.3537	0.0002	0.0001	0.6250
	Equal collaborator	0.6438	0.2355	0.1123	0.3745
	Decision follower	0.0025	0.5444	0.4474	0.0005
	Other decision style	0.0000	0.0943	0.1336	0.0000
	Mixed decision style	0.0000	0.1256	0.3067	0.0000
	Mean	1.6488	3.1097	3.6345	1.3754

BIC= 9783.132, Classification error= 0.0717

Table 5.5: Model 2 Probability Means

		Cluster1	*Cluster2*	*Cluster3*	*Cluster4*
Indicators	Overall	0.5227	0.2395	0.1237	0.1141
Model 1 cluster classification	1	0.7442	0.0000	0.2558	0.0000
	2	0.8908	0.0032	0.1059	0.0001
	3	0.2838	0.6525	0.0116	0.0521
	4	0.0007	0.7175	0.0000	0.2818
	5	0.0000	0.3152	0.0000	0.6848
Decision Type	Leading decision maker	0.7210	0.0002	0.0000	0.2788
	Equal collaborator	0.7494	0.1217	0.0341	0.0948
	Decision follower	0.0058	0.6865	0.3074	0.0003
	Other decision style	0.0000	0.8028	0.1971	0.0000
	Mixed decision style	0.0000	0.3658	0.6342	0.0000

5.6. Conclusions

It is widely accepted that the involvement in activities in different places is a driver of the need for travel. Often times, these activities have a social component, which influences either when or where the activity occurs. Many of these social interactions are difficult to capture in current survey methodologies. Household interactions are the exception to this statement, because many travel behavior surveys are collected at the unit of household level. As intrahousehold interactions become an important component of explaining travel behavior, it is important to realize that similar influences occur outside of the household unit. The ability to more accurately predict not only the spatial, but also the temporal attributes of an activity depends on the inclusion of important information. Although this research focuses primarily on the destination choice process, it is important to note that a further need and research direction is the expansion of this decision making analysis to additional attributes of activities such as temporal (daily activity agenda and scheduling of specific activities) or even the overall social composition of the activity (size, social network type, etc) and how these influence future activities.

To understand the roles of different social networks in the lives of individuals, we must first understand how they differ from each other. A latent class cluster analysis was conducted to examine differences and similarities among different social network types, with respect to the size, strength of relationships and the frequency of interaction. Results show similarities with these attributes among family (immediate and extended) and friends, as well as organizations, coworkers/ colleagues, students (as both peer and mentor). In addition to finding similarities,

differences stood out as well. For instance, many of the very strong, small family relationships were preserved in a specific cluster.

In addition to the differences and similarities of network composition and type, the decision-making process among these social networks exhibits similar trends. The decision-making role of an individual can differ vastly across different social engagement types. For instance, a parent has a much different role as a member of a family for which he or she is the head; versus the role he or she plays as a member of a company, or friend. The results of the second cluster analysis revealed different groups of decision-making strategies within similar social network types, as well as similarities in decision making strategies across different social network types. This is particularly important for all facets of activity and travel behavior models that aim at describing the decision process followed by individuals and their groups. The research here shows we can identify decision-making roles (leaders vs. followers) and context (family vs. friends social network). It is also possible these roles change with the type of activity or other circumstances. Knowing all this will increase our ability to predict where people will go to participate in activities and also who should be influenced to motivate a group of people in adapting behaviors that are aligned with policies (e.g., sustainability).

In addition to social influences to behavior adoption, the investigation of social networks can provide insight into the spatial distribution of joint activities. An important next step of this research is to determine the patterns of destination choice with respect to the location of individuals prior to a joint meeting. Future data collection and analysis will involve examining activity diaries of individuals

and exploring the convergence of time-space prisms of members of different social network types in destination choices. This will allow for investigation as to whether there is correlation between the proximity (closer, equidistant or further) of destinations to a specific individual and the decision-making role. It is quite possible that destination choices for joint activities have a spatial bias towards a more vocal decision maker due to the cognitive processing of alternatives and mental map representations of space. This however must be explored empirically, and requires unique data for the investigation. An enhanced understanding of the process of decision making in this vein as well as a more general knowledge of the joint decision making process will no doubt enhance current modeling efforts. In addition, increasing our understanding of social behavior will provide a richer theoretical basis for the assumptions implicit in the activity based modeling paradigm.

This research was focused specifically on the social network composition and decision making strategies apparent in different networks. Of equal importance however is an understanding of the individual and his or her membership in different social networks as well as decision-making types. Future work includes conducting a person-based analysis, similar to the one presented in this paper, to determine whether it is feasible to predict or model social engagement types with respect to known socio-demographic indicators and membership in different life cycle stages. It should be noted here that this data collection and the investigation into different types of roles was not exhaustive. While we did explore small differences such as the role of an individual with students as peers and as a mentor, we did not explore

other roles (such as the role of an individual as a parent or as a child in the immediate family). While these are important distinctions within the immediate family, this research was meant to focus more on the relationships outside of the immediate family. These interfamily relationships could be an area for future research and addition to this survey. In addition, this data will be combined with a second phase of data collection consisting of an activity diary and smartphone based activity log. Decision making processes occurring for specific observed activities will be compared to the social engagement types and roles provided by the individual during the first phase of the data collection.

6. Conclusions and Future Research

6.1. Summary

The work presented in this dissertation is a compilation of a series of investigations on latent factors that are involved in decision-making. The choice of a destination involves a complex lattice of attributes of the decision maker, those in his or her social network, the built environment and the psychological middle ground between all of these. The understanding of how these factors influence the decision making process, and the extent to which they do influence decisions is integral in the pursuit of higher accuracy in behavioral models. It is of increasing importance that models of human behavior used for policy analysis and planning decisions have high level of detail to ensure this higher accuracy. Improvements in computational resources and theoretical developments have contributed to a mass of techniques to incorporate smaller details of daily activities, and differences that exist among individuals.

The predominant method for representing human decision making within computational travel demand models is by utilizing the discrete choice framework. 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. Proper 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 place attitudes in the choice set formation and/or probability of alternative choices (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. It should however be noted, as illustrated in chapter two, that measurement methods and assumptions of transferability of questions should be tested. As observed in the model comparison, factor structures can differ greatly 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. This concept is first illustrated in chapter two, and expanded in chapter three with the exploration of sense of place using qualitative analysis. The use of qualitative analysis for comparison to quantitative analysis methods can provide insights into the attributes of sense of place that cannot or have not been sufficiently captured using quantitative survey questions. The theoretical framework of sense of place has been developed over decades, but has predominantly been qualitative in nature. As such, it is difficult to encompass the ideas of sense of place into one theory and test it mathematically. The lack of consensus on exactly what sense of place is, and how it is developed is a

testament that the phenomenon is highly individualized and personal. However, this work contributes to an amassing literature that is, in part, attempting to create some quantitative foundation to capture some of the broader, or more basic elements of these place attitudes. The research presented through these chapters attempts not to create one all encompassing theoretical framework of quantifying and validating sense of place, the focus is rather to explore which parts can and can not be measured and quantified in a meaningful way. The work presented in chapters two and three is then used to develop a second survey, GeoTRIPS, to measure place attitudes, decision-making and social network involvement in destination choice. Chapter four uses the data collected from the GeoTRIPS survey to address the challenges of enumerating all possible alternatives, and incorporating all of the considered attributes into the utility representing the choice process. This chapter is the first step in comparing subjective attraction to places with the more commonly used objective measures comprising accessibility indicators. This chapter also introduces the concept of geographic aggregation and place meaning, and explores (small) regions rather than places.

In addition, it is recognized that the decision maker in an instance of destination choice might not be the only influence on the outcome of the destination. Other individuals may have influence (to a variety of degrees) on the decision that is manifested. Chapter five is an exploration of social network involvement and the role of decision making within these networks. Chapter five extends work that focuses more specifically on time use and social networks. It combines aspects of social networks from graph theory (concerning the number of nodes, or number of

individuals within a network, and the strength of ties, which was measured by perceived strength and frequency of meeting), with inquiries into the perceived role that an individual plays in destination choices. Although it has been recognized within the activity-based approach that interactions with others impact time use and activity patterns, the role of decision-making has never been examined.

Although this research and discussion was flavored with an obvious motivation of destination choice model improvement, it is important to address the applicability of many of the findings to other areas within the transportation domain. Destination choice models aim at predicting behavior of people and decisions that are made, but this is a viewpoint of destinations from a modeling perspective. Equally important to travel behavior is the reasoning for the selection of destinations from a planning perspective. Sustainable planning objectives aim at reducing vehicle miles traveled, and increasing the amount of active modes of travel (bike, walk, etc.) used. Creating attractive destinations with opportunities to use active modes is of high importance. The work presented here on sense of place, and more broadly place meaning can be insightful for planners and architects who are attempting to cultivate sustainable travel through destination choice. Reaching a deeper understanding of the aspects of place that individuals value and consider for different travel decisions can aid in decision making and the planning process. The built environment greatly impacts the way in which people experience place. Lynch discusses the manner in which a human translates aspects of the built environment and interprets them in his book *Image of the City*. These interpretations of the built environment aid in understanding how the place or aspects of the place should be used (for instance a

park bench is for sitting), but the design elements also elicit emotional associations (for instance litter and graffiti might project feeling unsafe and a dislike for an area).

In addition to destination choice, the incorporation of sense of place and the role of social networks on travel decisions can be viewed in a much larger scope. Both social and psychological aspects of places can influence a variety of aspects of time use and activity planning. Sense of place, and the influence of social networks can aid in the prediction of these activity and time use details as well. For instance, sense of place can be used to help predict the timing of an activity, or even the duration of an activity. This deserves further research, but perhaps people are more likely to stay at a specific destination for a longer time if the location is associated with a positive sense of place. Or perhaps activities can be prioritized with respect to the importance of sense of place, and lower priority activity destinations should be influenced by the sense of place association of higher priority activities when included in a trip chain. The interconnection between time use, mode choice and destination choice is high, and should be recognized as such when examining the role of sense of place. For instance, if a destination is sought after due to the high level of place identity associated with it, it might be natural that the mode chosen for the trip to that destination also has a high level of "mode identity."

While all of the findings discussed at the end of each chapter (and more broadly as the conclusion in this chapter), individually contribute to the body of scientific knowledge in both geography and more specifically to travel behavior/ travel demand modeling, it is useful to provide a proposed framework for which this discussion can be consolidated for incorporation into models of decision making.

6.2. Theoretical framework

6.2.1. Incorporation of place meaning

There are several areas in which implementation of place attitudes can enhance the development of choice models. First, subjective attributes 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. The development of the choice set can be combined with the concept of person based time-space accessibilities to create a smaller number of alternatives, which will be discussed further below.

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.

Specification of attribute importance is an additional way in which place attitudes can be incorporated. It is likely that the criteria used in decision making vary across different activity types. Further investigation into what attributes matter when selecting a choice among all alternatives is needed. For instance, knowing when or if distance is less important than aesthetic quality or safety can further refine estimations. Weights can be applied to attributes in the utility depending on the circumstances of the activity type and decision maker.

6.2.2. Incorporating social networks and decision roles

Understanding who activities are conducted with and the potential role of the individual in the decision-making process can provide further enhancements to current models. Knowing how much control a decision maker has over a decision can allow researchers to weight the influence of the individual's preferences. Distilling the decision making process to include considerations of when or if a persons attitudes and preferences and other choice criteria influence the decision more is an important step in enhancing models. In addition to this, research currently recognizes the act of bargaining in terms of time use, but this negotiation between individuals can be broadened to consider decision making as a whole. Negotiation protocols can be established with the information of decision-making roles, and modeled by assigning relative weights to the individuals involved in the decision. This accommodates decisions made between two individuals (dyads of decision making), or larger groups such as triads or tetrads of decision makers or even more individuals.

6.2.3. Other behavioral facets to consider in destination choice

There are many aspects of activities that are recognized as important in destination choice. The activity type, chaining of activities and scheduling (such as duration and time of day) all play a role in the physical location in which an activity takes place. In addition, the social nature of activities has been explored and recognized as influential in both activity type and destination choice, such as whether the party is comprised of family members, friends, acquaintances, coworkers or others, and the size of these parties. One overarching aspect of destination choice that closely links the activity and behavior to sustainable travel and therefore planning is the mode of arrival to the destination. The considerations of destination choice are a combination of human agency, and the built environment resulting from planning and policy decisions. Incorporating more details about the meaning of places that is in part a product of the planning decisions, and the social nature of the activities in people's schedules will undoubtedly improve our understanding and ability to model human actions.

In order to do this successfully, we must explore the possible methods that can be used to enhance out decision-making models. One way would be to develop a household utility function that includes place meaning as a variable defining latent clusters and decision-making role as a weight of individual utilities to represent the "power" of each person. This idea can be expanded beyond households, as some activities involve social networks outside of the family, but a household level incorporation is a first step in improving existing methods.

6.3. Limitations

There are several limitations of the work presented in these studies. Several biases in the data might limit the findings of the research in the ability to generalize behavior. First, the sample of both data collections was not a random sample. Although the second data collection (GeoTRIPS) was a random recruitment, the response was biased due to the web-based nature of data retrieval, among other standard survey biases (like self selection and underrepresentation of specific demographics). It must be noted therefore, that while this research is motivated by the desire to predict and simulate the daily lives of people in order to plan more effectively, this research is only in the primitive stages of this pursuit. The data collected and presented in this dissertation is not appropriate for simulation, and is meant to explore and open discussion into the possibilities. Although biased samples can be accommodated by use of sampling weights, with the small sample size and small geographic representation any weighting to overcome the bias due to data collection method would still likely lead to biased results. In this research, we are able to examine the internal validity of the findings though fit statistics and indices indicating the appropriateness of the latent variables. However, external validity would be necessary if this research is extended into the realm of predictive modeling. To accomplish this, it would be necessary to split the sample into two parts when for instance conducting a factor analysis. The first portion of the sample in this case, would be used to derive the latent variables, and the second portion would be used to confirm this structure.

In addition to this, studies of residents' attitudes of Santa Barbara are likely to exhibit differences than studies of residents' attitudes of other cities. Important future research could involve conducting this survey in additional cities, and examining the impact of environment, size and other differences on the outcome of the place attitudes. It is important to note the potential role of Volunteer Geographic Information (VGI) in this endeavor. Although VGI has similar issues of bias due to the participants being only those with access to a computer, who additionally have to be willing to participate out of pure interest (perhaps making this bias even more exacerbated), creating an online evaluation of cities (by residents or also separately by non residents) to gain an idea of sense of place could be an interesting way to collect this data to compare places.

Another obvious limitation relates to the specific methodology of data collection for a portion of the survey. The hexagonal analysis suffers from the possibility of arriving at different results depending on the size (a common geographic problem known as the Modifiable Areal Unit Problem), or orientation of boundary placement of the hexagons. As previously stated, the size of the hexagons was chosen as a tradeoff between geographic detail and respondent burden. It would be interesting to explore the impact of the geographic aggregation of the hexagon regions, and the placement of the hexagons in deriving these attitudinal maps. Additionally, the hexagons were used in order to tessellate, as the goal was to have both a regular shape and continuous division of the study area. Using irregular shapes with either natural boundaries or mental map regions derived from a pilot study group where fuzzy logic was used to define the boundaries was a possibility for this research but

would not meet our objectives, and therefore was not used. This however could be an interesting area for future research.

6.4. Future Research

As mentioned above, one area of future research could involve investigating differences across different cities and even countries, in order to better understand the impacts of the built environment, as well as social and cultural differences. This area of research would shed light on how transferable ideas are from one place to another.

In addition to this, 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 (e.g., grocery shopping may be heavily influenced by variety of goods and prices instead of aesthetics). Both sense of place research and choice research could benefit immensely from these endeavors. A portion of the data collected through the GeoTRIPS survey will be used to investigate the differences that exist in criteria importance across activity types, that has not been included in the work presented here.

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). Jane Jacobs, champion of urbanization and ideas that form the foundation of smart growth discusses many of these aspects in her book *The Death of Great American Cities*, in a much more implicit way. Jacob presents ideas such as the fact that people don't enjoy looking out onto streets in a city that are empty and thus void of activity, and the idea that buildings should be oriented toward the street, welcoming the pedestrians that are walking into them. Ideas such as these describe the way in which humans translate these design elements and social aspects of places into meaning (also discussed by Lynch and presented in the introduction of this dissertation). Considering that planners are implementing principles of sense of place to cultivate specific behaviors and attract people to "greener" behaviors, the environmental design and planning community should make efforts to introduce these principles and practices in models attempting to explain behavior, thus enabling the testing of the effectiveness of these principles in changing behavior and to perform policy analysis. Current data collection is being conducted throughout the study area of the GeoTRIPS survey to collect attributes of the physical environment. These attributes will then be explored to investigate correlation between place attitudes, attraction indices, and physical aspects of the built environment.

The exploration of roles in social networks and the influence of others on decision making is still in its infancy. As mentioned in chapter five, a disaggregate analysis is necessary in order to better understand how individuals differ in the roles that they play in social settings.

The role of time in these measurements and aspects of decision-making should not pass by without noting. The landscape of place attitudes, as would be expected, should change from the present views. This change could be brought by a change in demographics, a change in the built environment, or another initiator that could impact the emotional connection to place. Stores moving into or out of an area, or even an individual's biography (length of residence in the study region, social habits, etc.) might change, leading to a change in the perception and attitudes of place. Similarly, the role that an individual plays in decision-making could change (though not as drastically perhaps) with time, as the social and cultural dimensions of person-to-person interactions change. It is very likely that this study would yield different results if it were repeated in the exact same way ten years from now. Capturing, mapping and even predicting the changing attitudes is another area for potential future work. In addition to this, it is likely that there are seasonal effects in the evaluation of places, which might be more pronounced in regions where seasons are more extreme.

In addition to these points for future work, several additional areas of further research have been addressed in the conclusions of each of the chapters, which relate more specifically to that study.

One overarching area for future research is the inclusion of these aspects in a model of destination choice, as discussed in section 6.2. This requires the collection of data through an activity diary and the modeling of the observed destinations in a full choice model. Although this research is out of the scope of the work presented in this dissertation, this data collection has been an ongoing research interest.

Current development of a smartphone based activity diary utilizing the sensors of Android phones is occurring. Upon completion of this software, a subset of the sample of the second data collection (GeoTRIPS) will be selected to participate in the activity diary. This data will allow for further investigation in the choices that individuals make.

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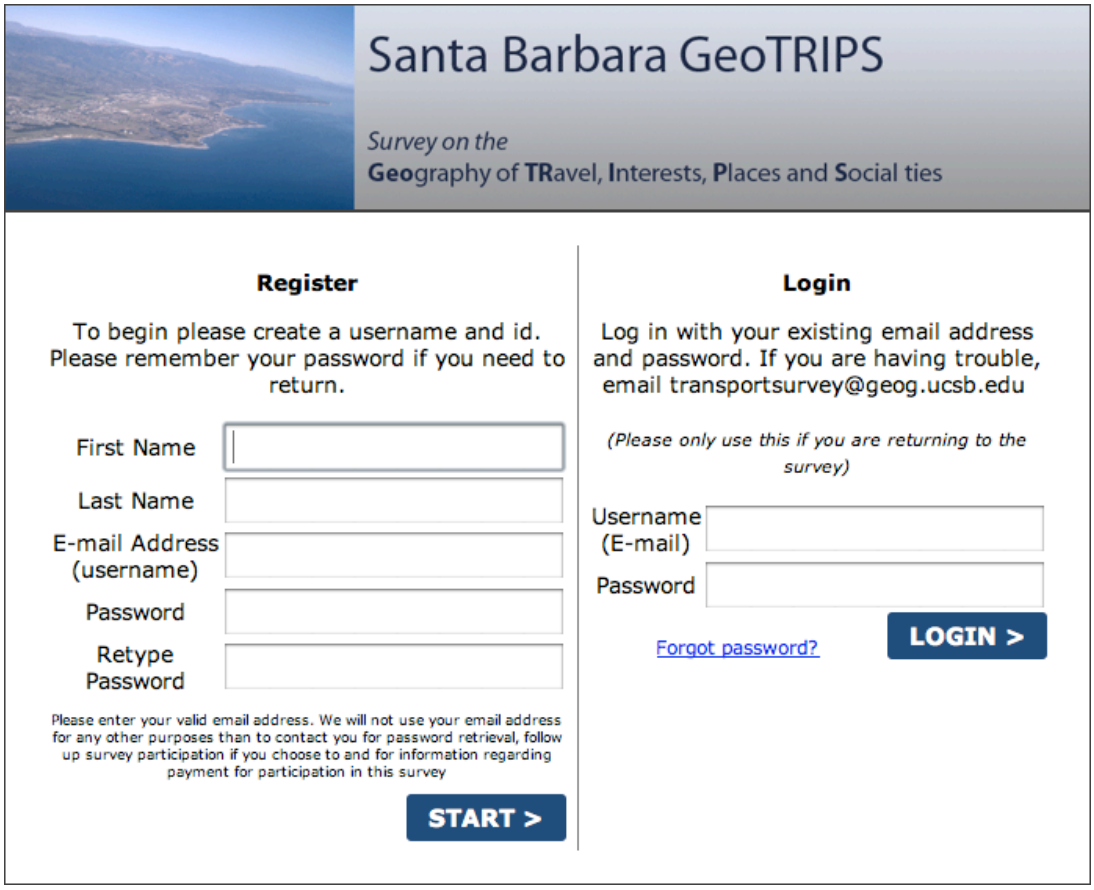
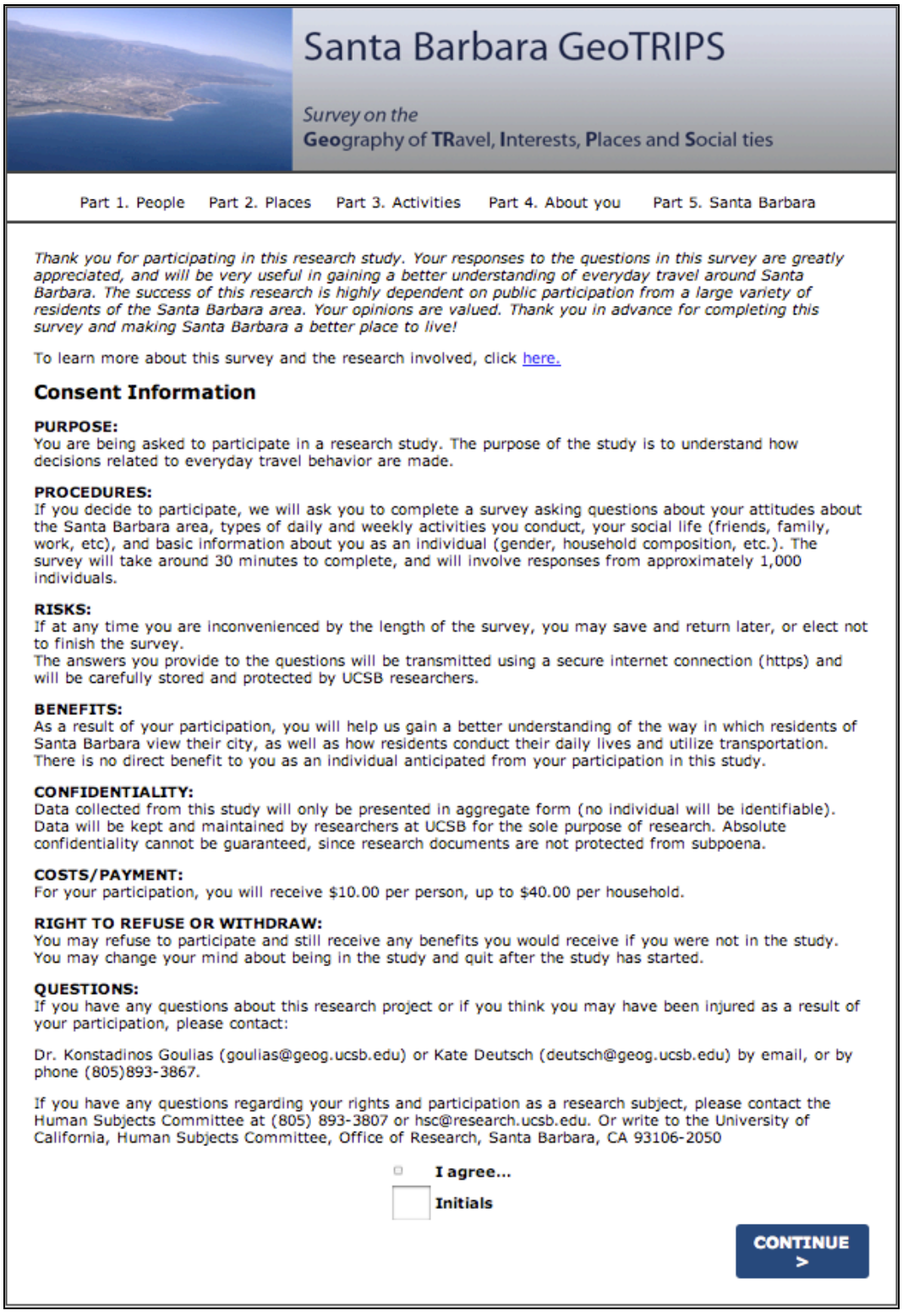
Appendix

GeoTrIPS Survey

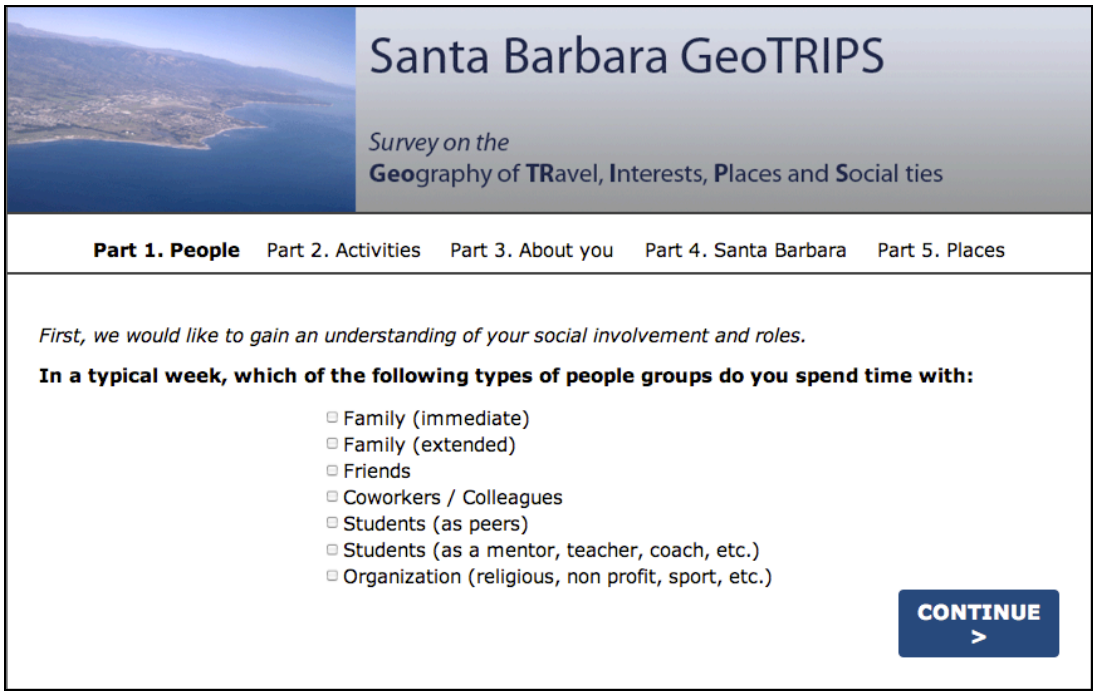
Page one: Sign-up and login page



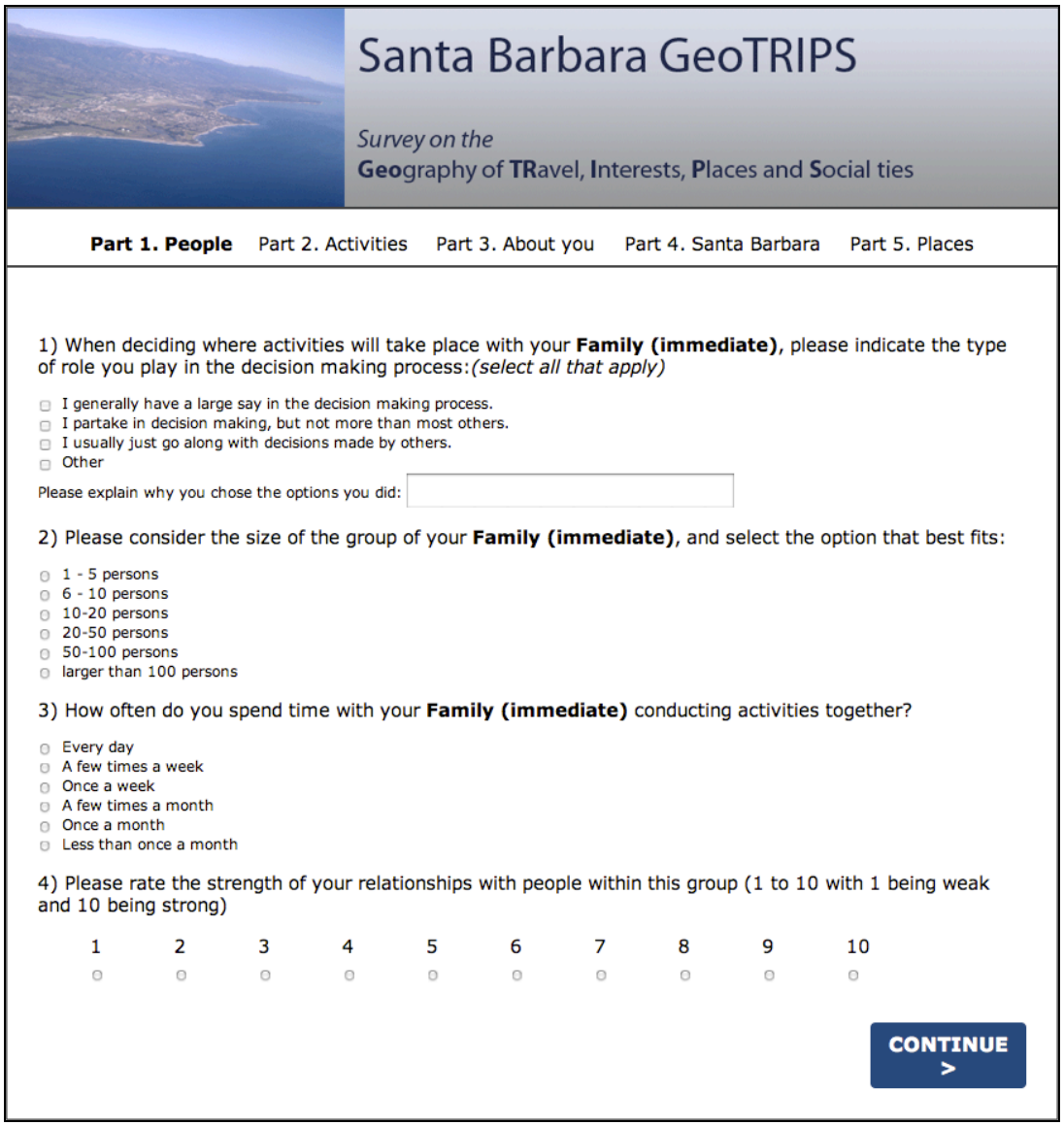
Page two: Consent form



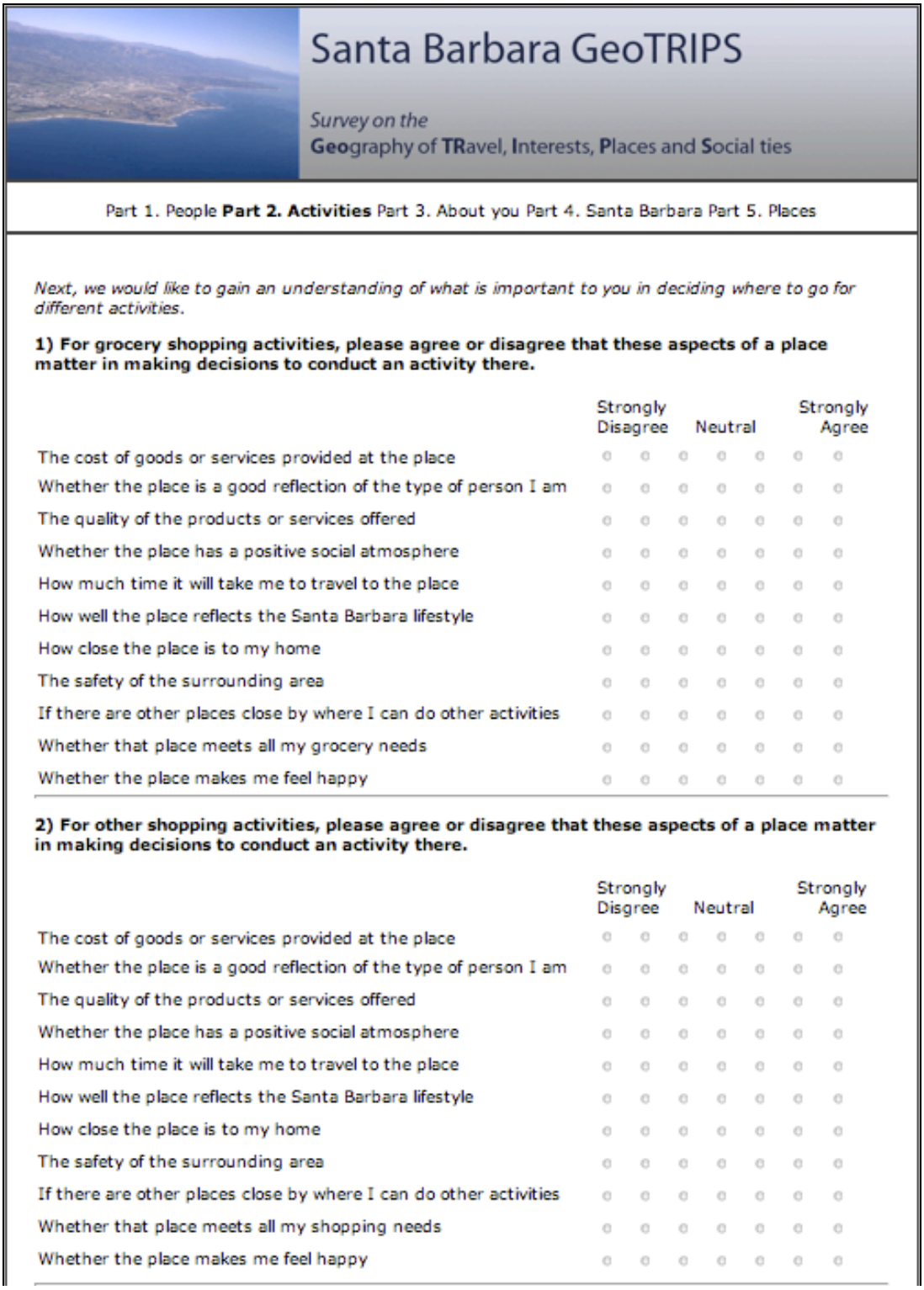
Page three: Social network involvement



Page four (iterated through all social networks selected): Network attributes



Page five: Criteria in destination choice for different activity types



Santa Barbara GeoTRIPS

Survey on the
Geography of **TR**avel, **I**nterests, **P**laces and **S**ocial ties

Part 1. People **Part 2. Activities** Part 3. About you Part 4. Santa Barbara Part 5. Places

Next, we would like to gain an understanding of what is important to you in deciding where to go for different activities.

1) For grocery shopping activities, please agree or disagree that these aspects of a place matter in making decisions to conduct an activity there.

	Strongly Disagree			Neutral			Strongly Agree
The cost of goods or services provided at the place	o	o	o	o	o	o	o
Whether the place is a good reflection of the type of person I am	o	o	o	o	o	o	o
The quality of the products or services offered	o	o	o	o	o	o	o
Whether the place has a positive social atmosphere	o	o	o	o	o	o	o
How much time it will take me to travel to the place	o	o	o	o	o	o	o
How well the place reflects the Santa Barbara lifestyle	o	o	o	o	o	o	o
How close the place is to my home	o	o	o	o	o	o	o
The safety of the surrounding area	o	o	o	o	o	o	o
If there are other places close by where I can do other activities	o	o	o	o	o	o	o
Whether that place meets all my grocery needs	o	o	o	o	o	o	o
Whether the place makes me feel happy	o	o	o	o	o	o	o

2) For other shopping activities, please agree or disagree that these aspects of a place matter in making decisions to conduct an activity there.

	Strongly Disgree			Neutral			Strongly Agree
The cost of goods or services provided at the place	o	o	o	o	o	o	o
Whether the place is a good reflection of the type of person I am	o	o	o	o	o	o	o
The quality of the products or services offered	o	o	o	o	o	o	o
Whether the place has a positive social atmosphere	o	o	o	o	o	o	o
How much time it will take me to travel to the place	o	o	o	o	o	o	o
How well the place reflects the Santa Barbara lifestyle	o	o	o	o	o	o	o
How close the place is to my home	o	o	o	o	o	o	o
The safety of the surrounding area	o	o	o	o	o	o	o
If there are other places close by where I can do other activities	o	o	o	o	o	o	o
Whether that place meets all my shopping needs	o	o	o	o	o	o	o
Whether the place makes me feel happy	o	o	o	o	o	o	o

3) For spending time with family, please agree or disagree that these aspects of a place matter in making decisions to conduct an activity there.

☐ I do not participate in any activities with family in Santa Barbara

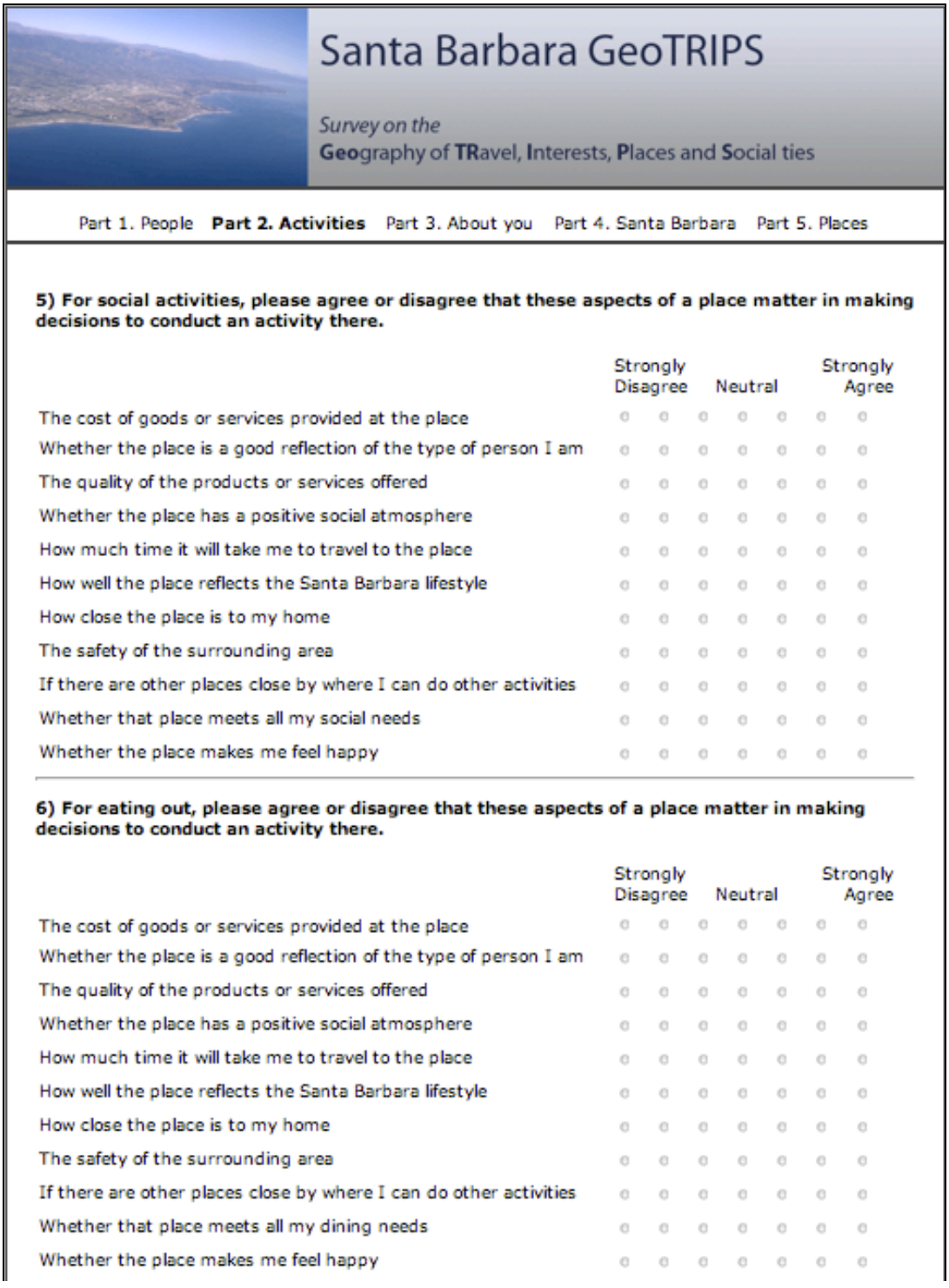
	Strongly Disagree			Neutral			Strongly Agree
The cost of goods or services provided at the place	o	o	o	o	o	o	o
Whether the place is a good reflection of the type of person I am	o	o	o	o	o	o	o
The quality of the products or services offered	o	o	o	o	o	o	o
Whether the place has a positive social atmosphere	o	o	o	o	o	o	o
How much time it will take me to travel to the place	o	o	o	o	o	o	o
How well the place reflects the Santa Barbara lifestyle	o	o	o	o	o	o	o
How close the place is to my home	o	o	o	o	o	o	o
The safety of the surrounding area	o	o	o	o	o	o	o
If there are other places close by where I can do other activities	o	o	o	o	o	o	o
Whether that place meets all my needs	o	o	o	o	o	o	o
Whether the place makes me feel happy	o	o	o	o	o	o	o

4) For outdoor recreation activities, please agree or disagree that these aspects of a place matter in making decisions to conduct an activity there.

	Strongly Disagree			Neutral			Strongly Agree
The cost of goods or services provided at the place	o	o	o	o	o	o	o
Whether the place is a good reflection of the type of person I am	o	o	o	o	o	o	o
The quality of the products or services offered	o	o	o	o	o	o	o
Whether the place has a positive social atmosphere	o	o	o	o	o	o	o
How much time it will take me to travel to the place	o	o	o	o	o	o	o
How well the place reflects the Santa Barbara lifestyle	o	o	o	o	o	o	o
How close the place is to my home	o	o	o	o	o	o	o
The safety of the surrounding area	o	o	o	o	o	o	o
If there are other places close by where I can do other activities	o	o	o	o	o	o	o
Whether that place meets all my recreation needs	o	o	o	o	o	o	o
Whether the place makes me feel happy	o	o	o	o	o	o	o

CONTINUE >

Page six: Criteria in destination choice for different activity types (continued)



Santa Barbara GeoTRIPS

Survey on the
Geography of **TR**avel, **I**nterests, **P**laces and **S**ocial ties

Part 1. People **Part 2. Activities** Part 3. About you Part 4. Santa Barbara Part 5. Places

5) For social activities, please agree or disagree that these aspects of a place matter in making decisions to conduct an activity there.

	Strongly Disagree			Neutral			Strongly Agree
The cost of goods or services provided at the place	o	o	o	o	o	o	o
Whether the place is a good reflection of the type of person I am	o	o	o	o	o	o	o
The quality of the products or services offered	o	o	o	o	o	o	o
Whether the place has a positive social atmosphere	o	o	o	o	o	o	o
How much time it will take me to travel to the place	o	o	o	o	o	o	o
How well the place reflects the Santa Barbara lifestyle	o	o	o	o	o	o	o
How close the place is to my home	o	o	o	o	o	o	o
The safety of the surrounding area	o	o	o	o	o	o	o
If there are other places close by where I can do other activities	o	o	o	o	o	o	o
Whether that place meets all my social needs	o	o	o	o	o	o	o
Whether the place makes me feel happy	o	o	o	o	o	o	o

6) For eating out, please agree or disagree that these aspects of a place matter in making decisions to conduct an activity there.

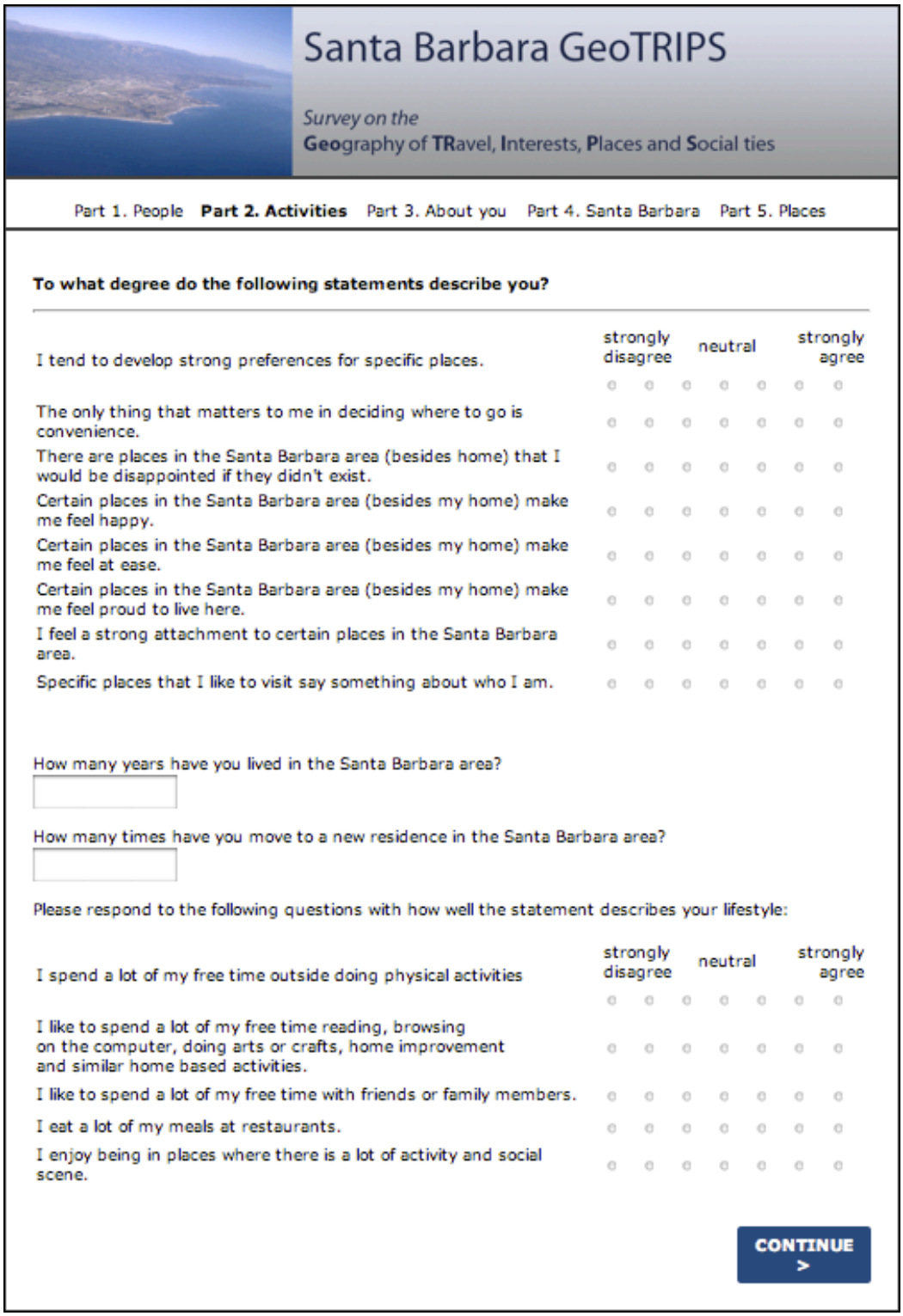
	Strongly Disagree			Neutral			Strongly Agree
The cost of goods or services provided at the place	o	o	o	o	o	o	o
Whether the place is a good reflection of the type of person I am	o	o	o	o	o	o	o
The quality of the products or services offered	o	o	o	o	o	o	o
Whether the place has a positive social atmosphere	o	o	o	o	o	o	o
How much time it will take me to travel to the place	o	o	o	o	o	o	o
How well the place reflects the Santa Barbara lifestyle	o	o	o	o	o	o	o
How close the place is to my home	o	o	o	o	o	o	o
The safety of the surrounding area	o	o	o	o	o	o	o
If there are other places close by where I can do other activities	o	o	o	o	o	o	o
Whether that place meets all my dining needs	o	o	o	o	o	o	o
Whether the place makes me feel happy	o	o	o	o	o	o	o

7) For entertainment activities, please agree or disagree that these aspects of a place matter in making decisions to conduct an activity there.

	Strongly Disagree			Neutral			Strongly Agree
The cost of goods or services provided at the place	o	o	o	o	o	o	o
Whether the place is a good reflection of the type of person I am	o	o	o	o	o	o	o
The quality of the products or services offered	o	o	o	o	o	o	o
Whether the place has a positive social atmosphere	o	o	o	o	o	o	o
How much time it will take me to travel to the place	o	o	o	o	o	o	o
How well the place reflects the Santa Barbara lifestyle	o	o	o	o	o	o	o
How close the place is to my home	o	o	o	o	o	o	o
The safety of the surrounding area	o	o	o	o	o	o	o
If there are other places close by where I can do other activities	o	o	o	o	o	o	o
Whether that place meets all my entertainment needs	o	o	o	o	o	o	o
Whether the place makes me feel happy	o	o	o	o	o	o	o

CONTINUE >

Page seven: Person history and preferences



Santa Barbara GeoTRIPS

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Part 1. People **Part 2. Activities** Part 3. About you Part 4. Santa Barbara Part 5. Places

To what degree do the following statements describe you?

	strongly disagree			neutral			strongly agree
I tend to develop strong preferences for specific places.	o	o	o	o	o	o	o
The only thing that matters to me in deciding where to go is convenience.	o	o	o	o	o	o	o
There are places in the Santa Barbara area (besides home) that I would be disappointed if they didn't exist.	o	o	o	o	o	o	o
Certain places in the Santa Barbara area (besides my home) make me feel happy.	o	o	o	o	o	o	o
Certain places in the Santa Barbara area (besides my home) make me feel at ease.	o	o	o	o	o	o	o
Certain places in the Santa Barbara area (besides my home) make me feel proud to live here.	o	o	o	o	o	o	o
I feel a strong attachment to certain places in the Santa Barbara area.	o	o	o	o	o	o	o
Specific places that I like to visit say something about who I am.	o	o	o	o	o	o	o

How many years have you lived in the Santa Barbara area?

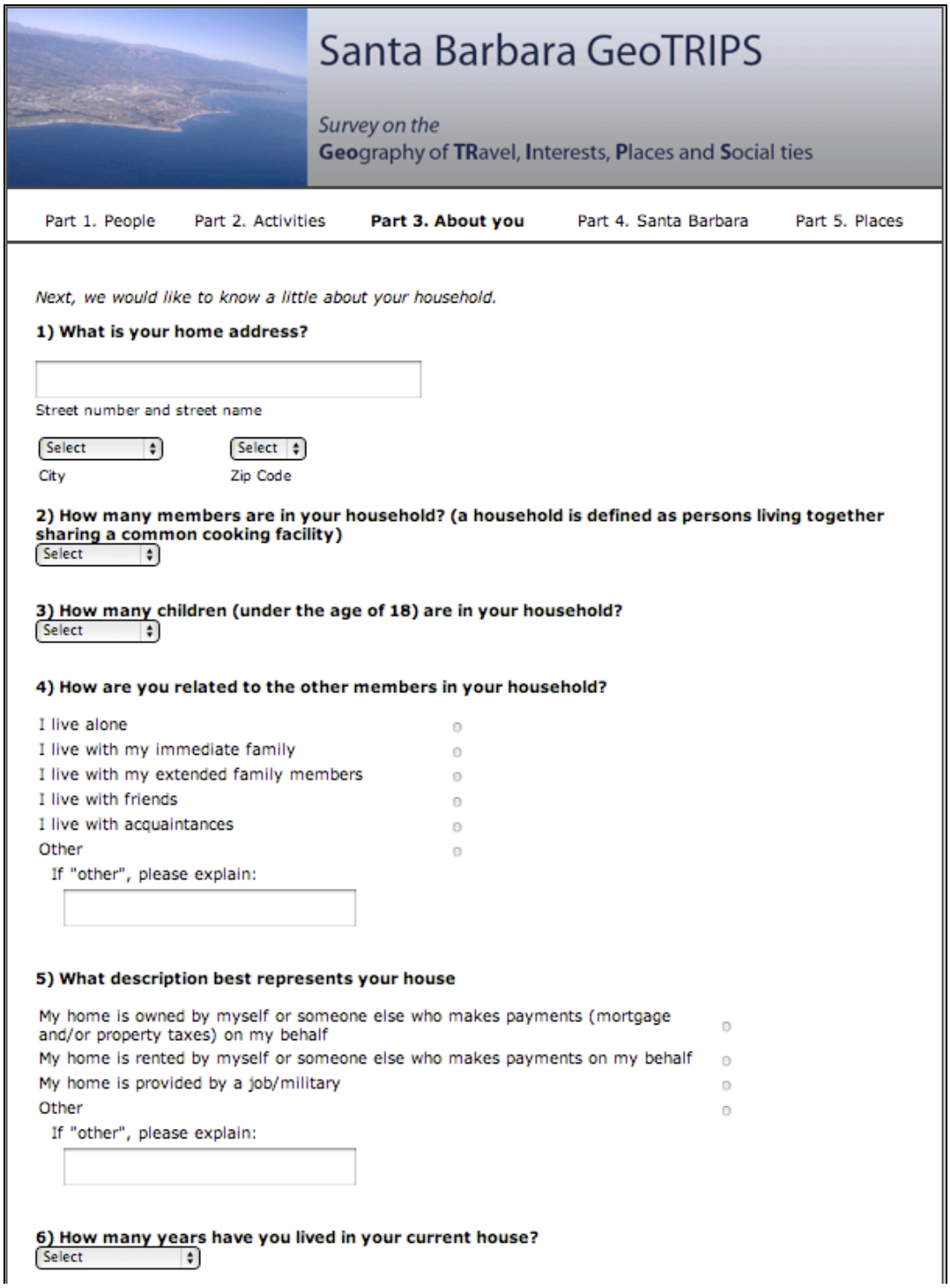
How many times have you move to a new residence in the Santa Barbara area?

Please respond to the following questions with how well the statement describes your lifestyle:

	strongly disagree			neutral			strongly agree
I spend a lot of my free time outside doing physical activities	o	o	o	o	o	o	o
I like to spend a lot of my free time reading, browsing on the computer, doing arts or crafts, home improvement and similar home based activities.	o	o	o	o	o	o	o
I like to spend a lot of my free time with friends or family members.	o	o	o	o	o	o	o
I eat a lot of my meals at restaurants.	o	o	o	o	o	o	o
I enjoy being in places where there is a lot of activity and social scene.	o	o	o	o	o	o	o

CONTINUE >

Page eight: Household level socio-demographics



Santa Barbara GeoTRIPS

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Part 1. People | Part 2. Activities | **Part 3. About you** | Part 4. Santa Barbara | Part 5. Places

Next, we would like to know a little about your household.

1) What is your home address?

Street number and street name

Select — City

Select — Zip Code

2) How many members are in your household? (a household is defined as persons living together sharing a common cooking facility)

Select

3) How many children (under the age of 18) are in your household?

Select

4) How are you related to the other members in your household?

- I live alone
- I live with my immediate family
- I live with my extended family members
- I live with friends
- I live with acquaintances
- Other

If "other", please explain:

5) What description best represents your house

- My home is owned by myself or someone else who makes payments (mortgage and/or property taxes) on my behalf
- My home is rented by myself or someone else who makes payments on my behalf
- My home is provided by a job/military
- Other

If "other", please explain:

6) How many years have you lived in your current house?

Select

7) What is your annual household income?

Less than $10,000	○	$80,000 - $89,999	○
$10,000 - $19,999	○	$90,000 - $99,999	○
$20,000 - $29,999	○	$100,000 - $109,999	○
$30,000 - $39,999	○	$110,000 - $119,999	○
$40,000 - $49,999	○	$120,000 - $129,999	○
$50,000 - $59,999	○	$130,000 - $139,999	○
$60,000 - $69,999	○	$140,000 - $149,999	○
$70,000 - $79,999	○	$150,000 or more	○

8) How many vehicles does your household own?

Select

9) How many licensed drivers are there in your household?

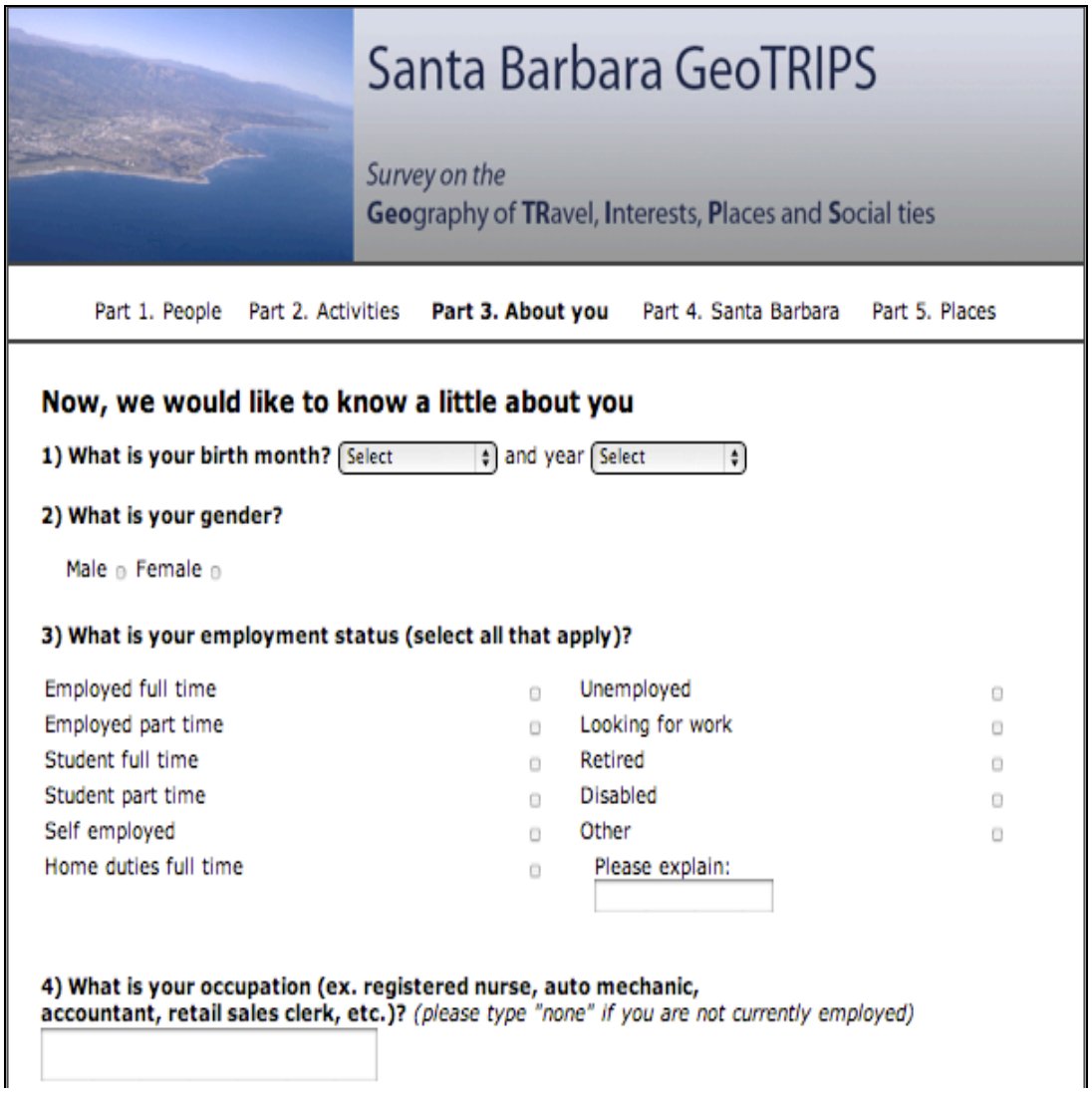
Select

10) How many bicycles does your household own?

Select

CONTINUE >

Page nine: Individual level socio-demographics



Santa Barbara GeoTRIPS

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Part 1. People | Part 2. Activities | **Part 3. About you** | Part 4. Santa Barbara | Part 5. Places

Now, we would like to know a little about you

1) What is your birth month? Select and year Select

2) What is your gender?

Male ○ Female ○

3) What is your employment status (select all that apply)?

Employed full time	☐	Unemployed	☐
Employed part time	☐	Looking for work	☐
Student full time	☐	Retired	☐
Student part time	☐	Disabled	☐
Self employed	☐	Other	☐
Home duties full time	☐	Please explain:	

4) What is your occupation (ex. registered nurse, auto mechanic, accountant, retail sales clerk, etc.)? *(please type "none" if you are not currently employed)*

5) Are you of Hispanic, Latino or Spanish origin?

- No, not of Hispanic, Latino or Spanish origin
- Yes, Mexican, Mexican American, Chicano
- Yes, Puerto Rican
- Yes, Cuban
- Yes, another Hispanic, Latino or Spanish origin

Please explain:

6) What is your race (select all that apply)?

- White
- American Indian or Alaska Native
- Guamanian or Chamorro
- Filipino
- Vietnamese
- Samoan
- Other Asian or other Pacific Islander

Please explain:

- Black or African American
- Asian Indian
- Japanese
- Native Hawaiian
- Chinese
- Korean
- Other race not listed

Please explain:

7) Do you have a drivers license?

Yes No

8) What is the highest education level completed?

- No school completed
- Elementary school
- Less than high school graduate
- High school graduate
- Associate degree in college
- Some college- no degree
- Bachelors degree
- Master's degree
- Professional school degree
- Doctoral degree

9) What is your marital status?

- Single, never married
- Currently married / domestic partner
- Separated
- Divorced
- Widowed

10) What is your work address?

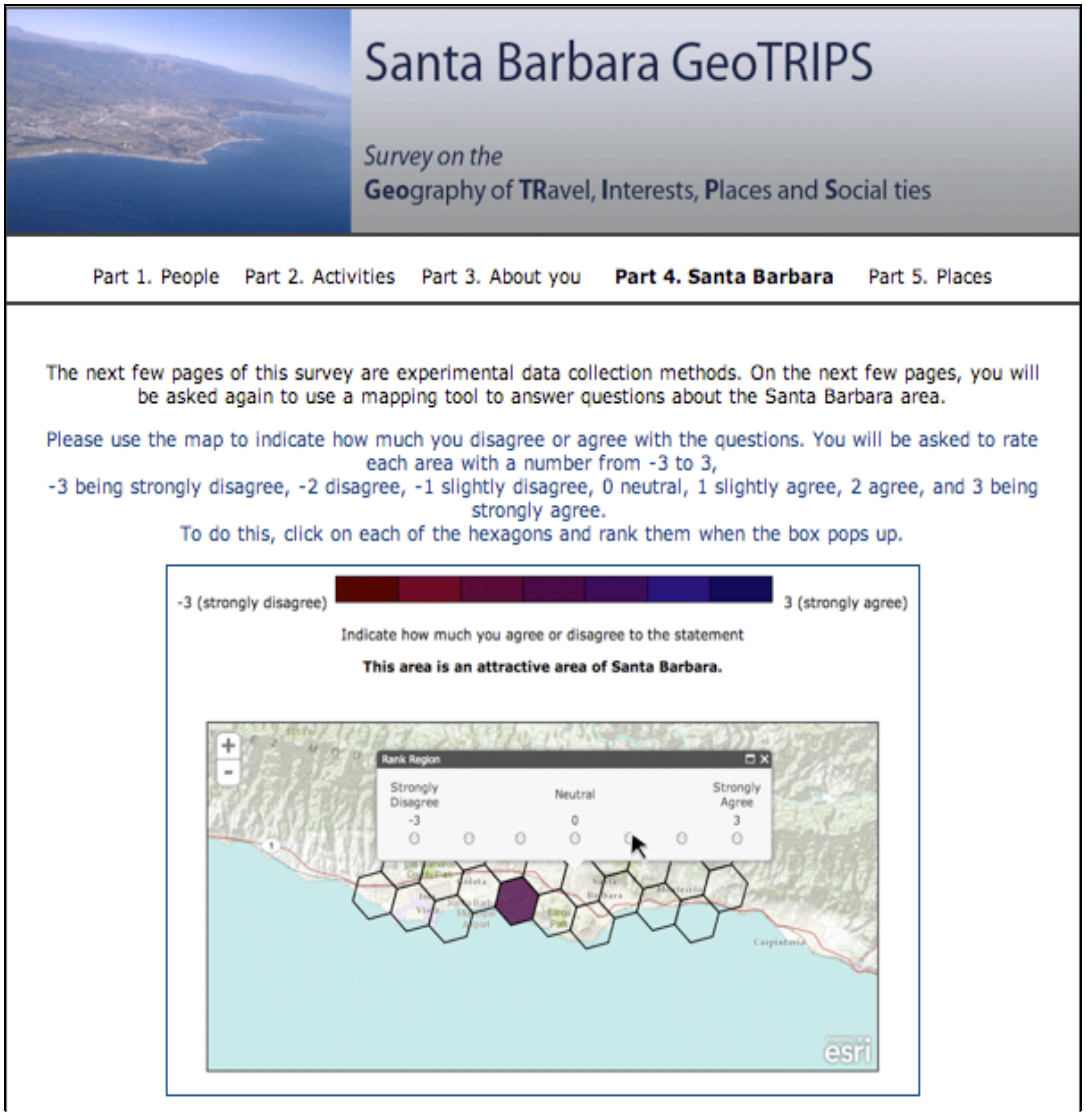
Street number and street name

City

Zip Code

CONTINUE >

Page ten: Hexagon mapping instructions



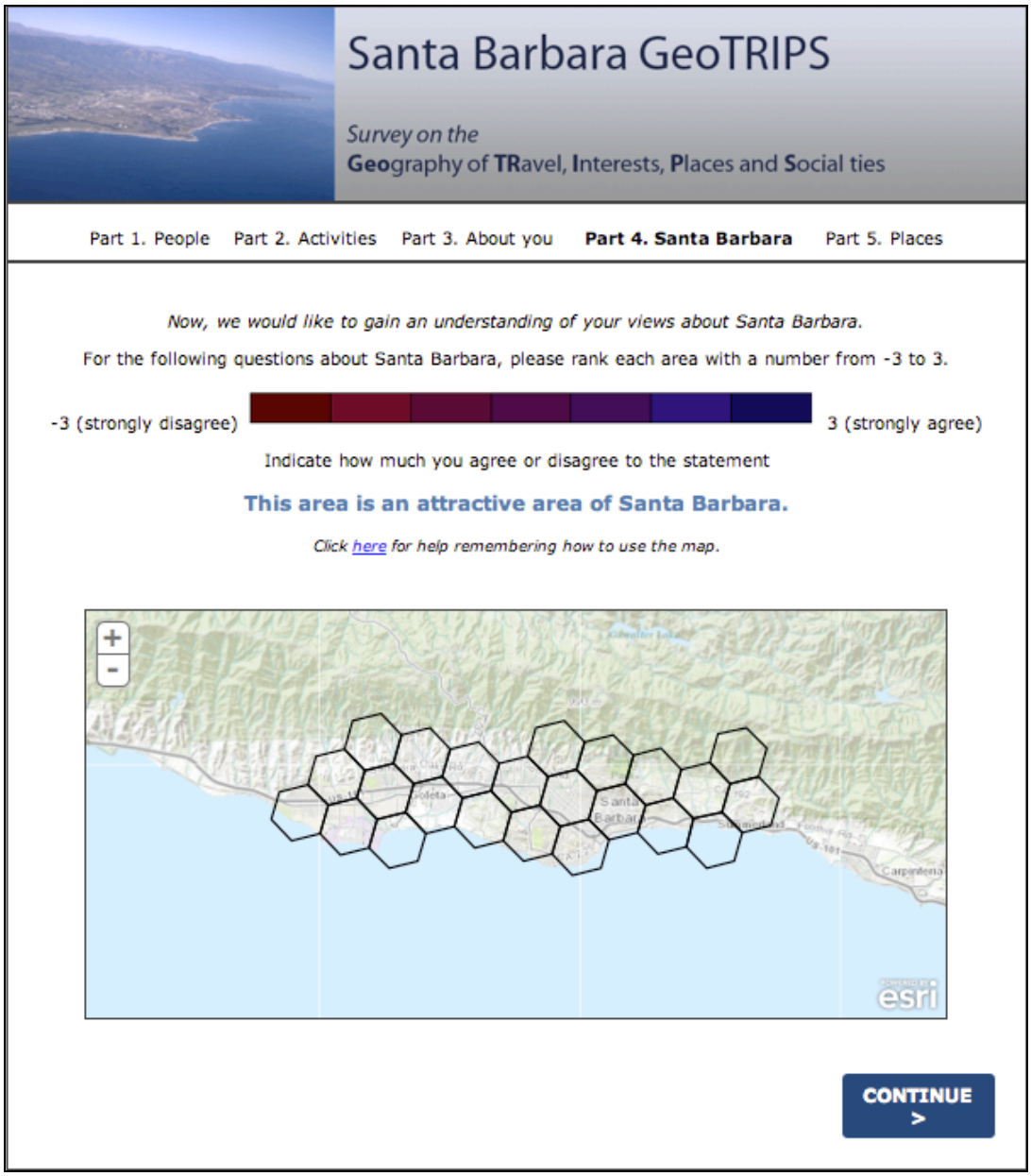
Navigation:

1) To zoom in and out, use either the plus and minus symbols on the map, or use your mouse scroll button
2) To move the map view, press and hold the left mouse button and move the mouse to drag the map in the desired direction.

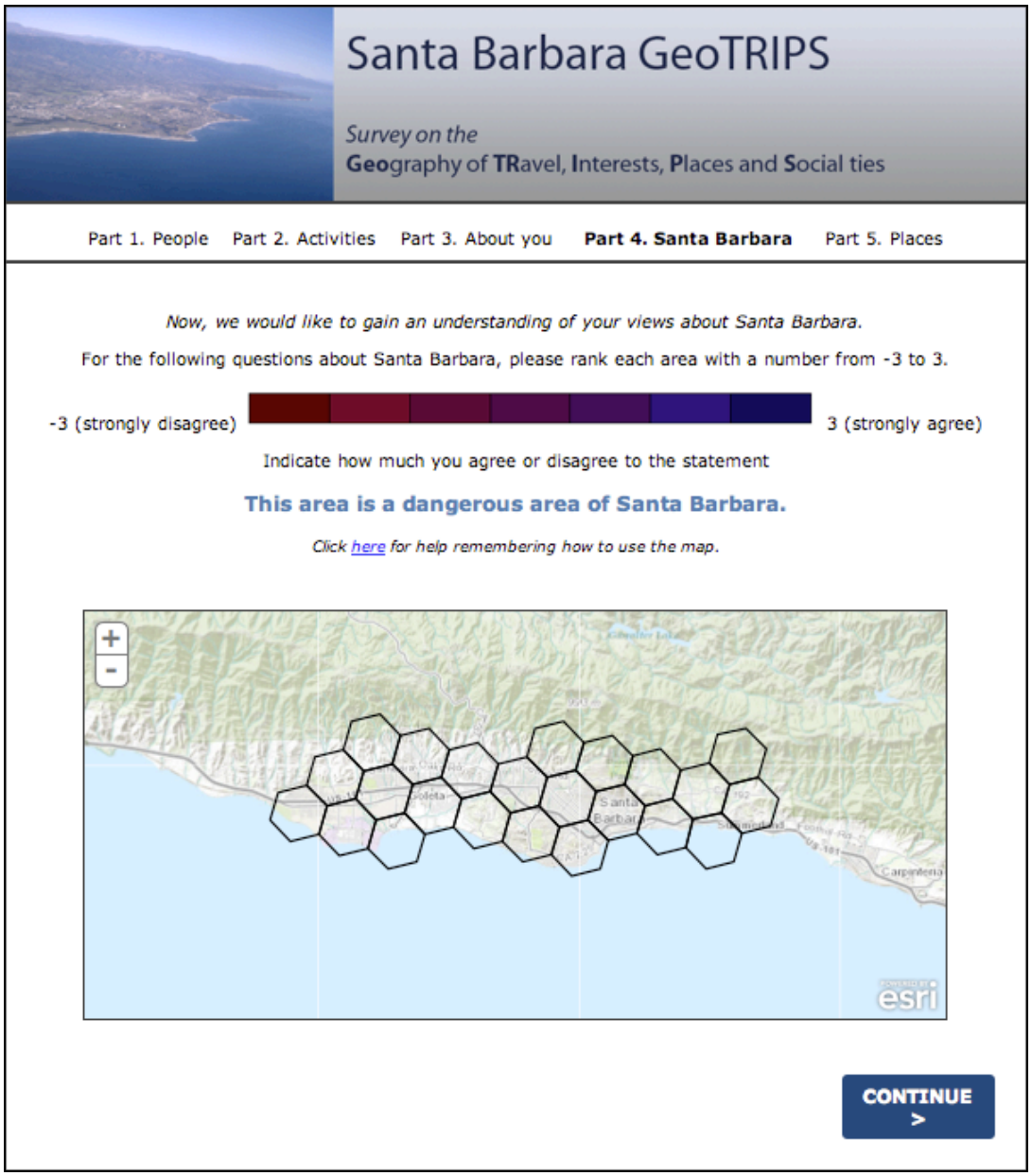
If you have trouble viewing the maps, you may need to verify that the content is safe in order to enable your browser to load properly. To do this, check that you have given permission for the content to be displayed (at the top of the page in your browser.) You may also need to reload your page by clicking on the reload arrow in your browser window.

CONTINUE >

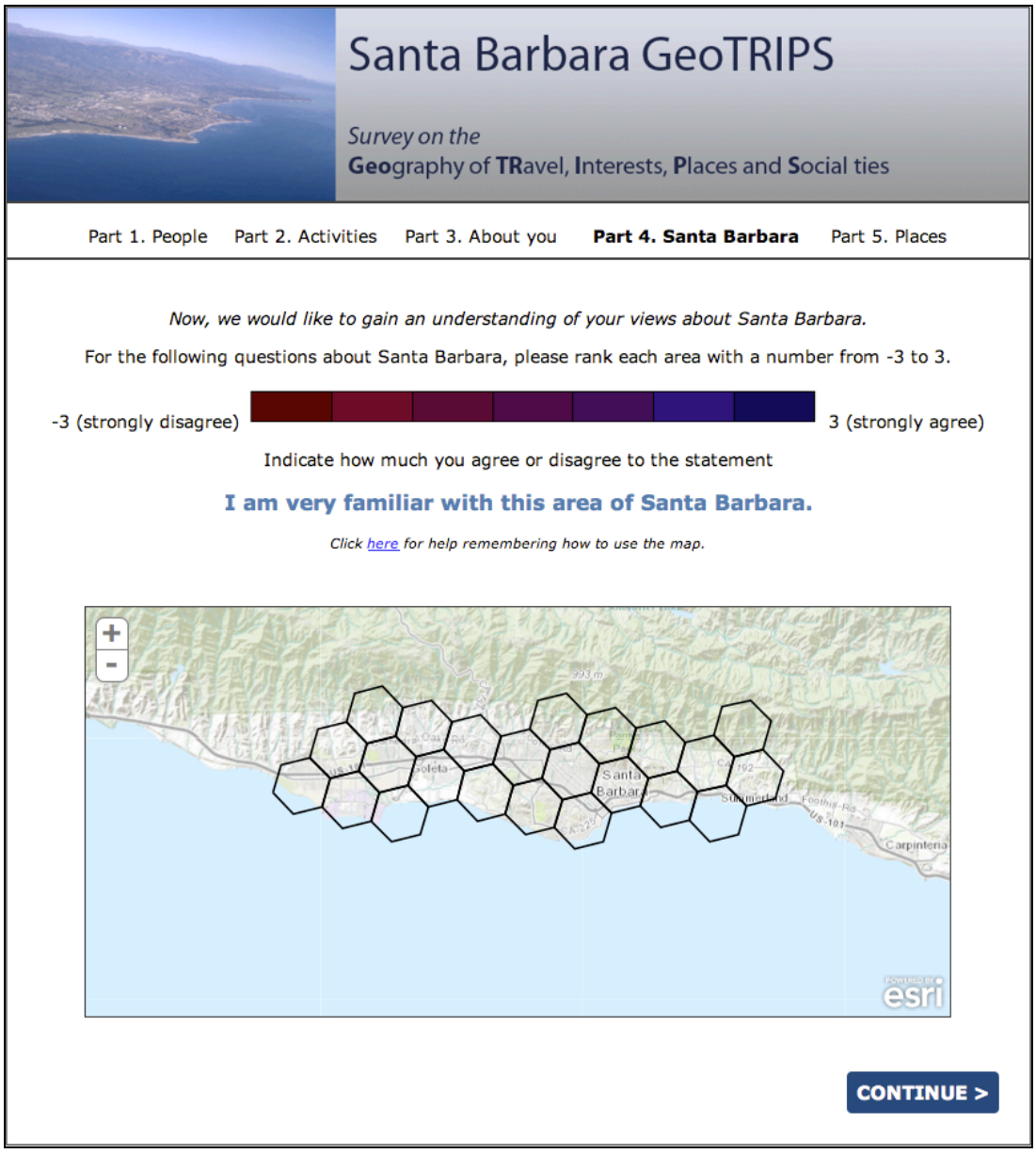
Page eleven: Hexagon mapping- attractive



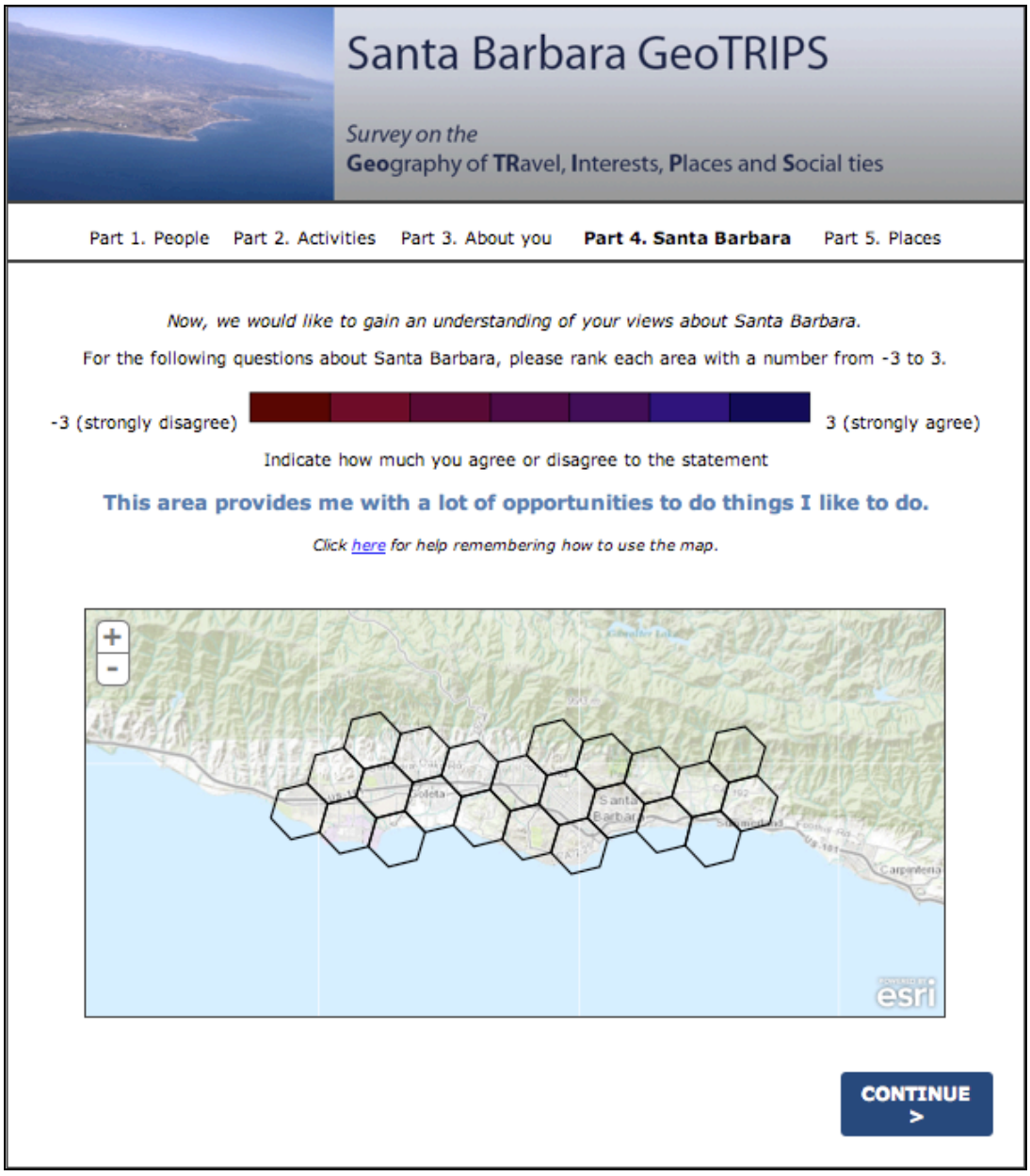
Page twelve: Hexagon mapping- danger



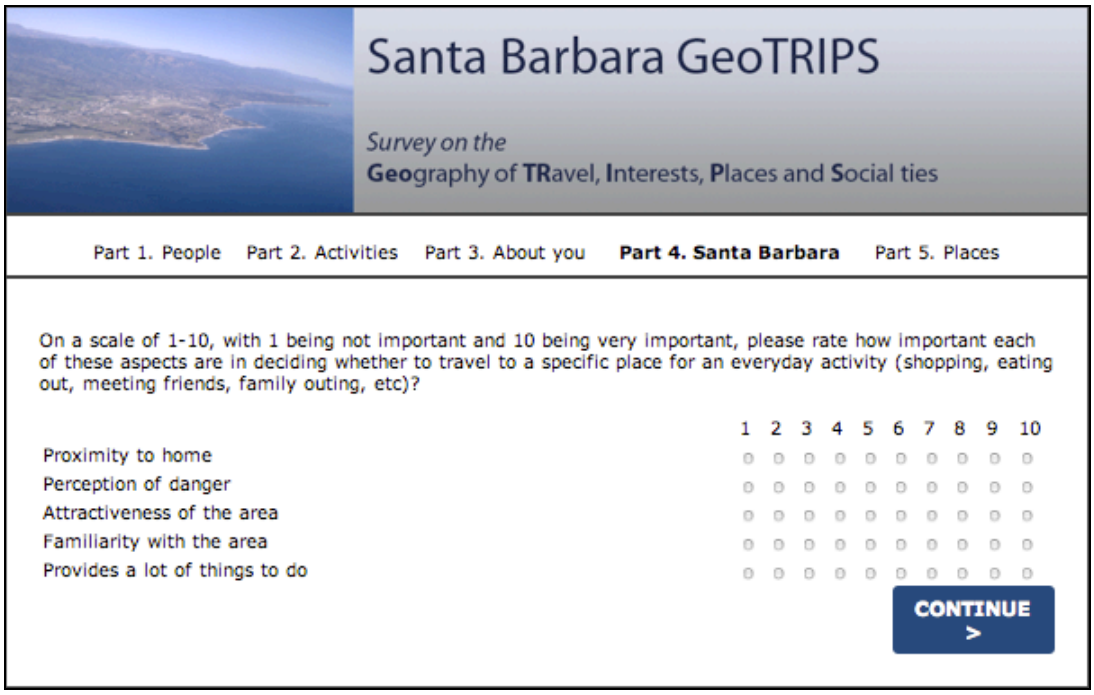
Page thirteen: Hexagon mapping- familiarity



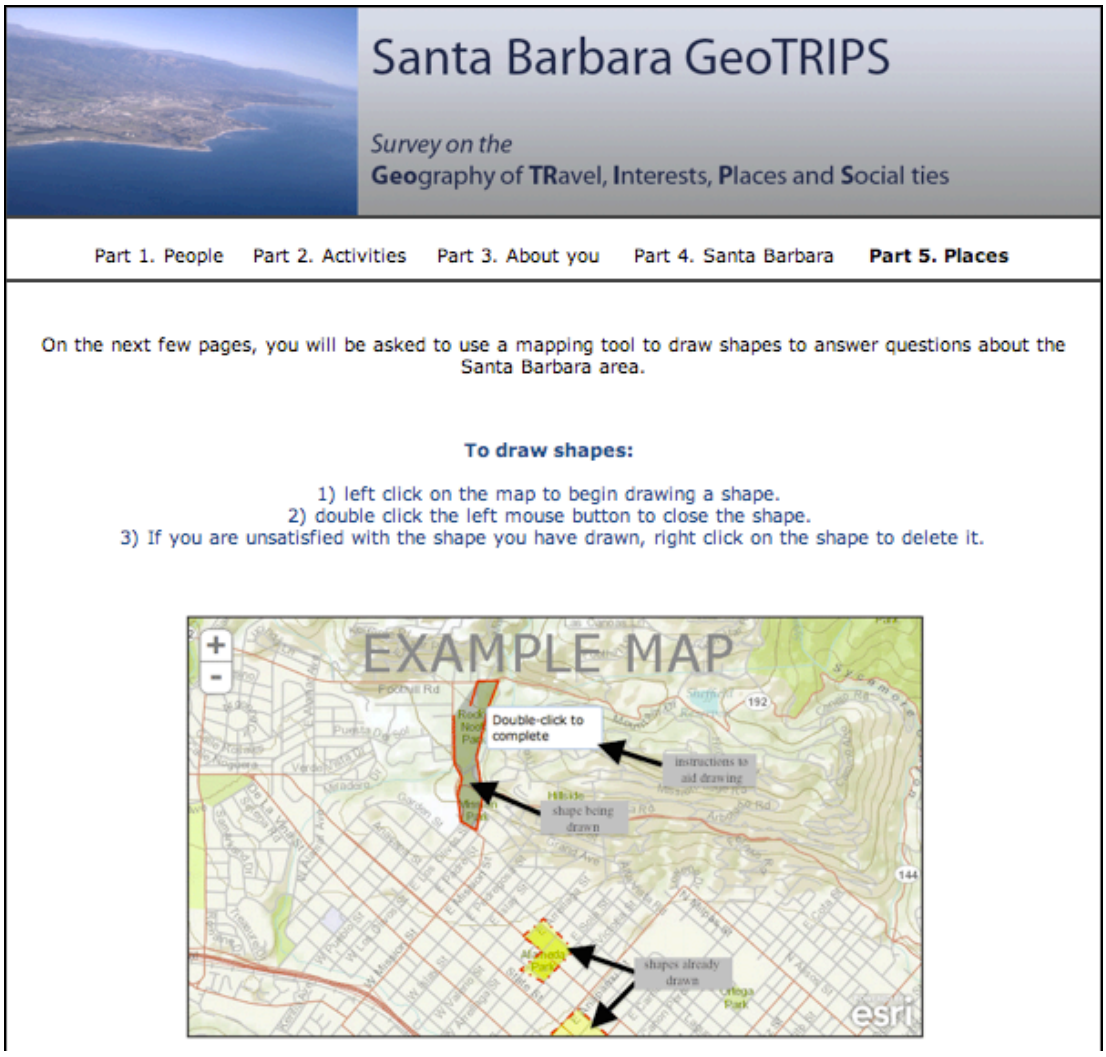
Page fourteen: Hexagon mapping- opportunities



Page fifteen: Importance rating



Page sixteen: Polygon mapping instructions



Navigation:

1) To zoom in and out, use either the plus and minus symbols on the map, or use your mouse scroll button
2) To move the map view, press and hold the left mouse button and move the mouse to drag the map in the desired direction.

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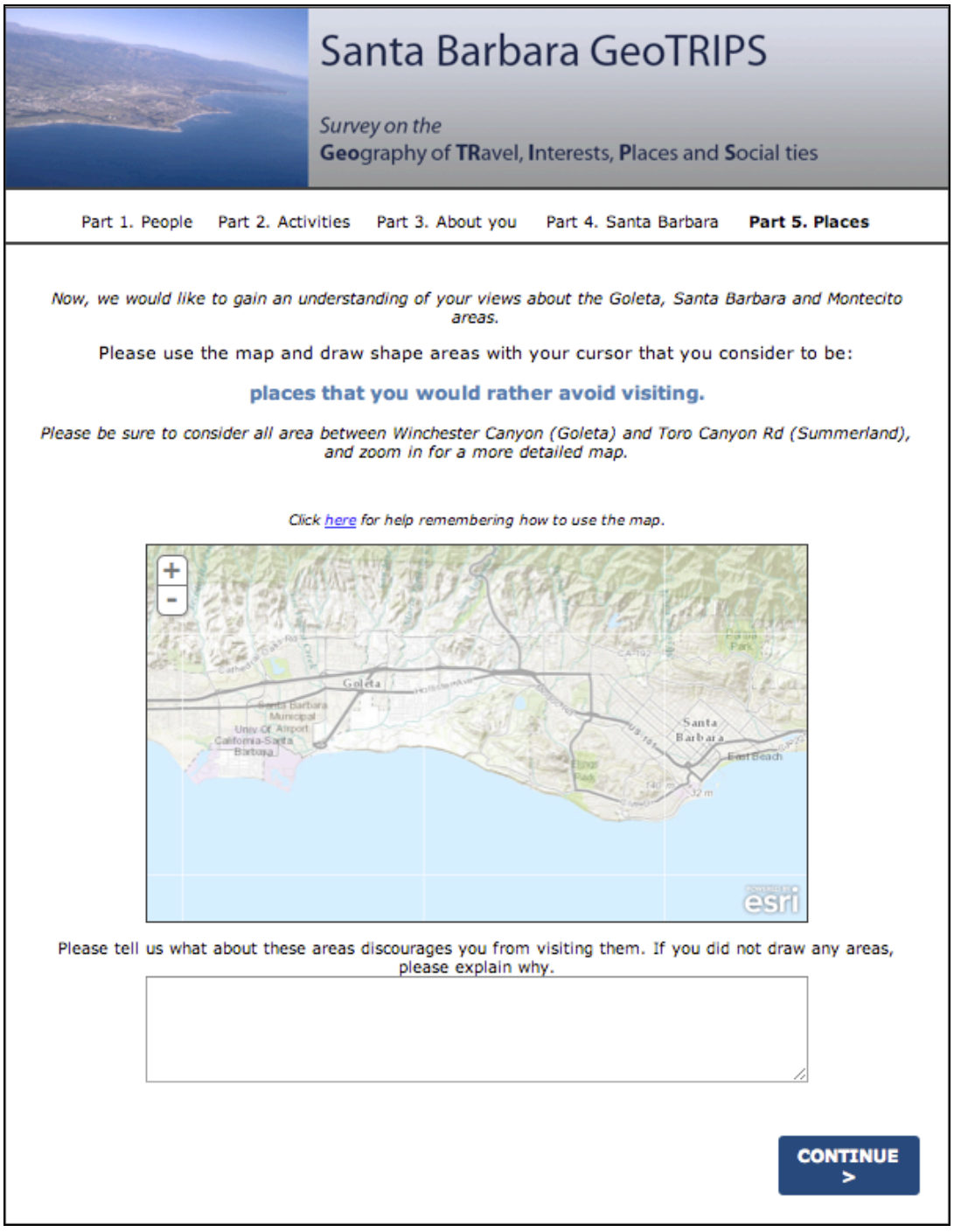
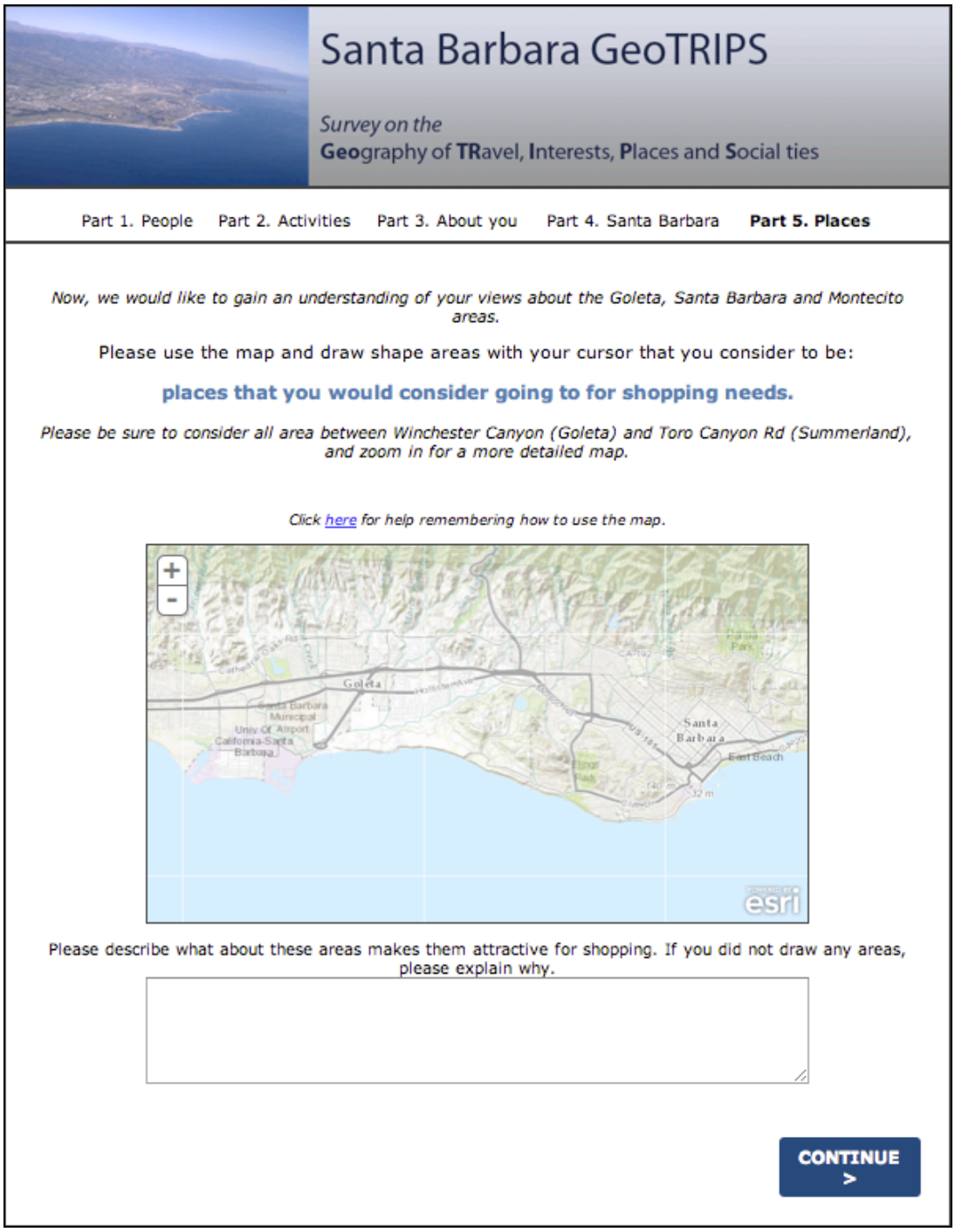
Please be sure to consider all area between Winchester Canyon (Goleta) and Toro Canyon Rd (Summerland).

CONTINUE >

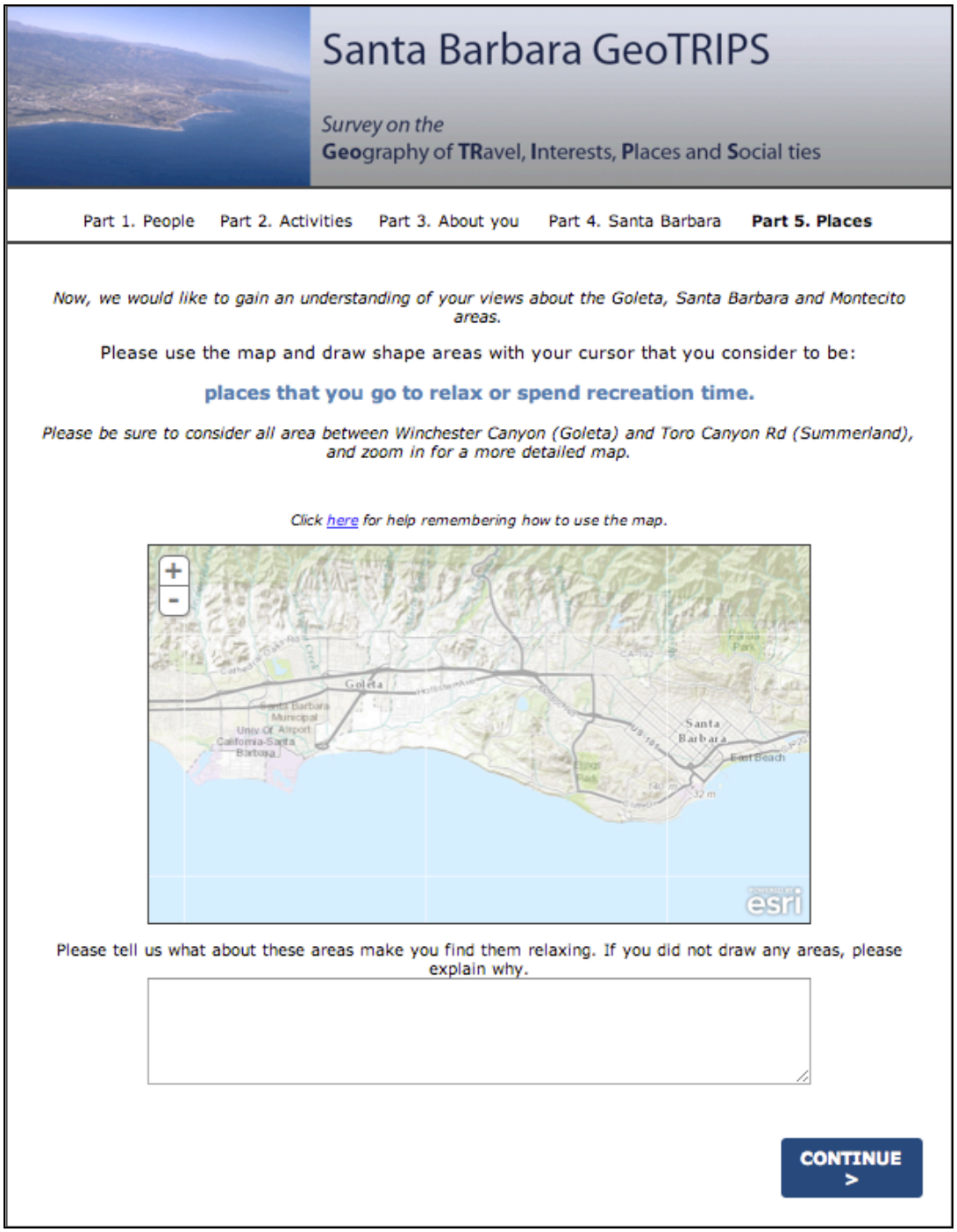
Page seventeen: polygon mapping- avoidances



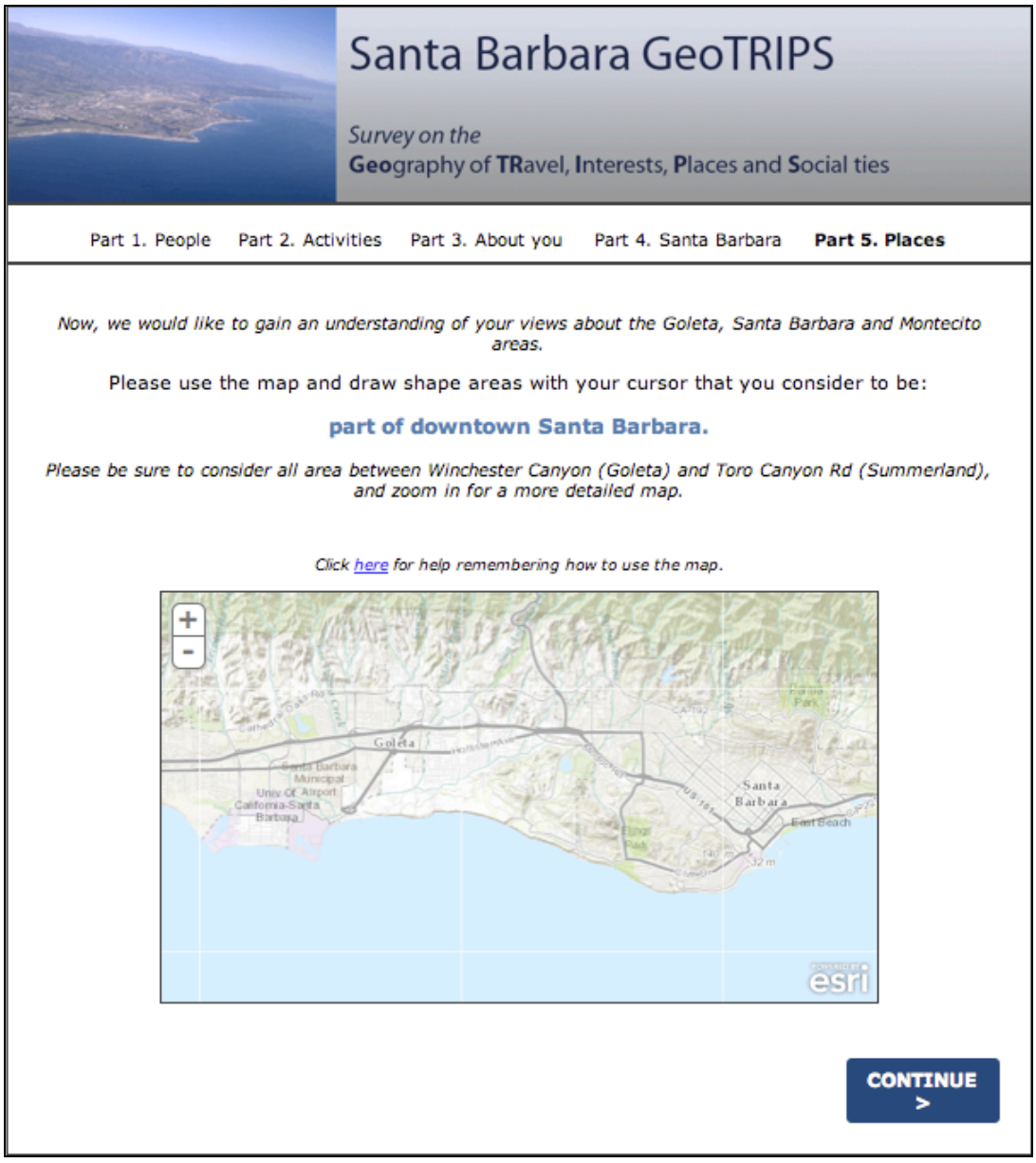
Page eighteen: polygon mapping- shopping



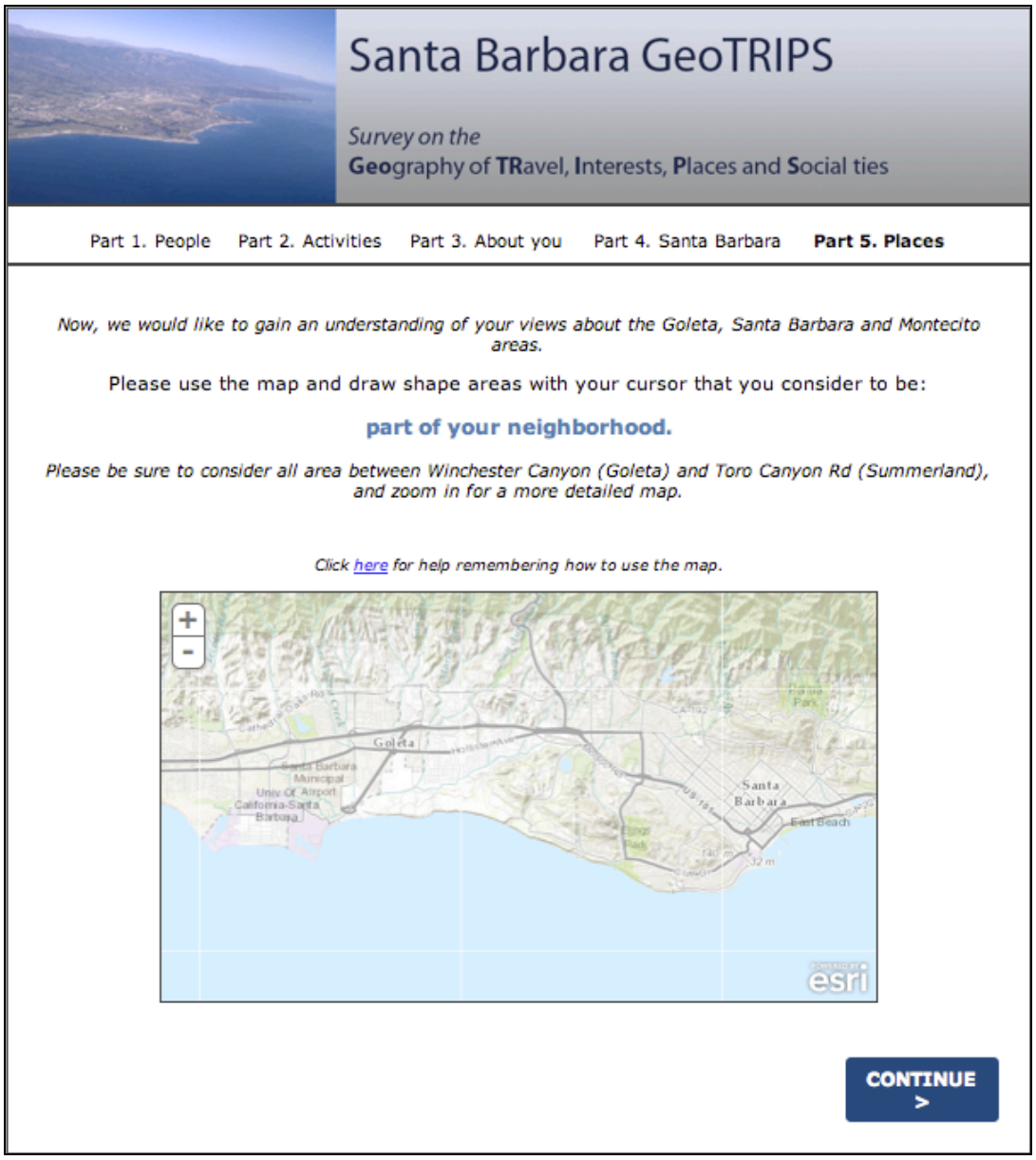
Page nineteen: polygon mapping- recreation



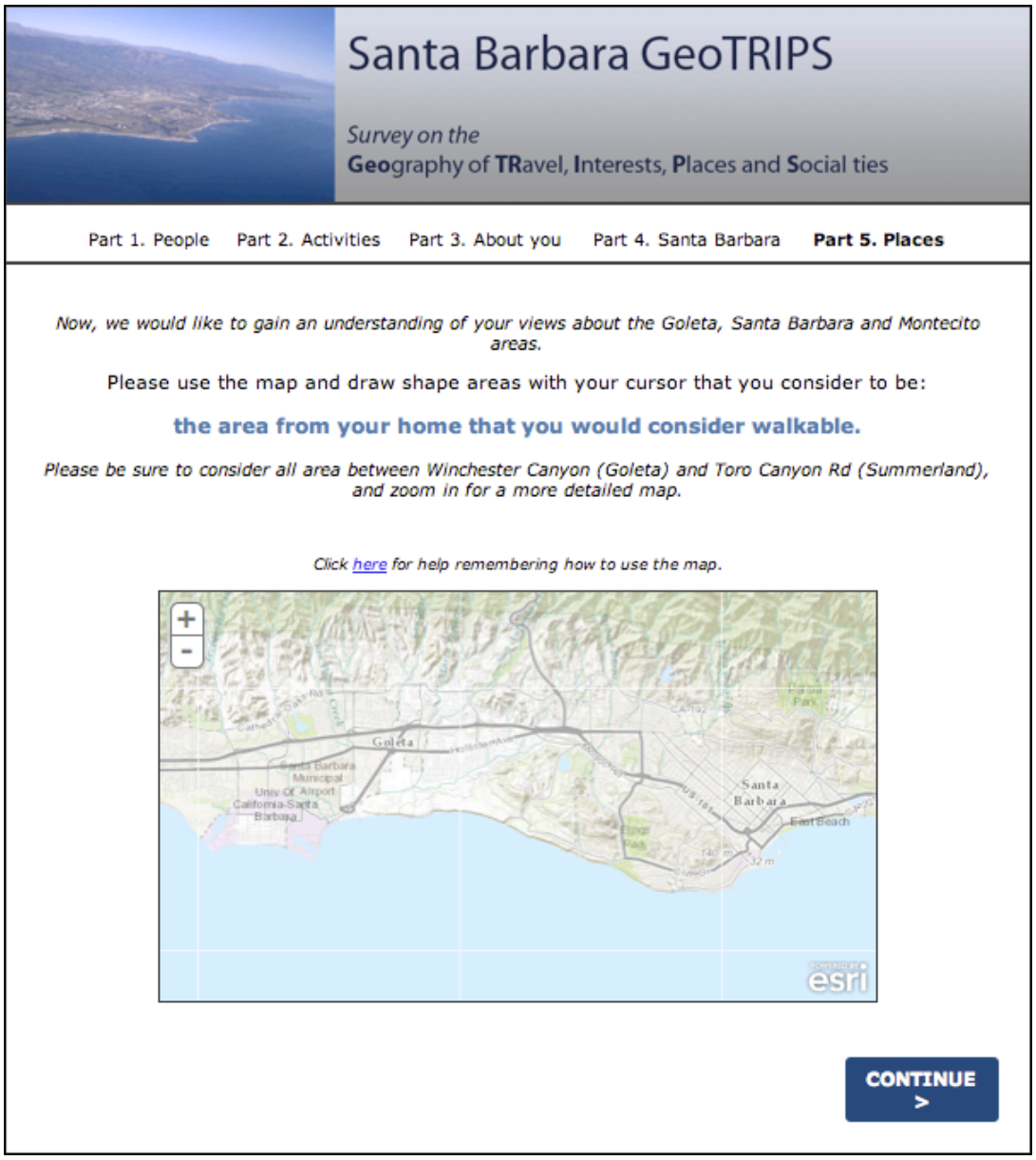
Page twenty: polygon mapping- downtown



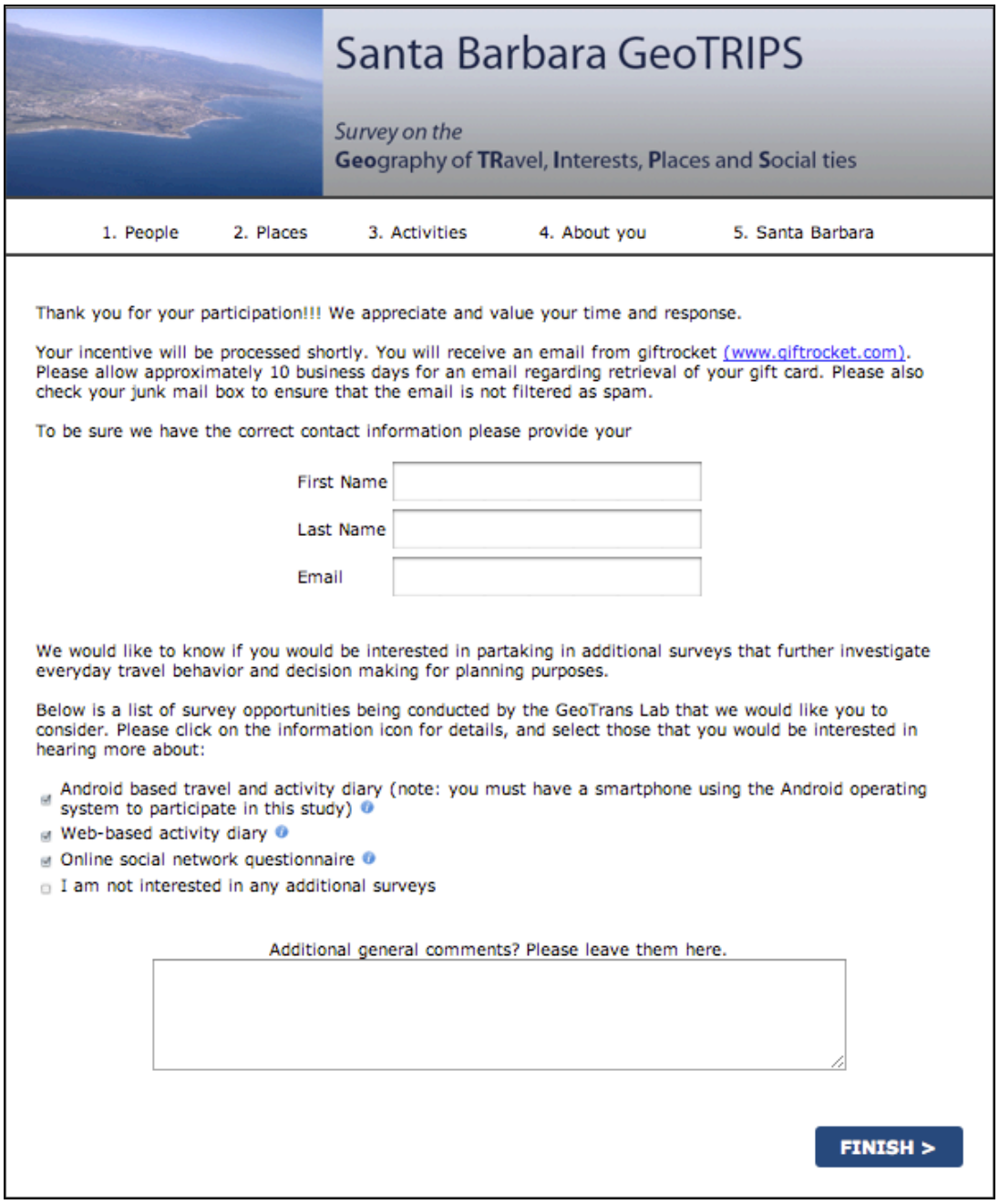
Page twenty one: polygon mapping- neighborhood



Page twenty two:- polygon mapping- walkable



Page twenty three: end page



Page twenty four: close