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Representations of an Urban Neighborhood: Residents' Cognitive Boundaries of Koreatown, Los Angeles

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by

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ABSTRACT

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by

Crystal Ji-Hye Bae

The neighborhood has long been studied in such fields as geography, sociology, political science, and urban planning as a meaningful unit of analysis, with deep connections for residents and an ever-shifting form. This study expands on foundational research about geographic regions (particularly informal or vague cognitive regions), sense of place, and environmental and travel perception, and takes as its focal area the neighborhood of Koreatown in Los Angeles. By collecting information about residents' individual attributes, their concepts of this neighborhood region, and their travel activity within the city, I elucidate how ideas about the neighborhood fit into theories about sense of place. My work additionally demonstrates the value of surveying residents about vague concepts of local regions, and ways in which to measure and express these ideas.

I conducted in-person surveys to explore the connection between residents' cognitive boundaries of Koreatown, through drawn boundaries and explanations, and their behavior within the city of LA, represented by activity space measures. In doing so, I find ways in which respondents' cognitive boundaries of the Koreatown neighborhood align with and differ from otherwise established definitions of Koreatown, presenting two methods of evaluating individual boundaries of a region. One of these ways of comparing polygons, the

radial intersect method, is originally extended to the summary of multiple polygons. Collected temporary travel behavior of respondents provides a way of depicting respondents' activity spaces in the LA region for comparison with their cognitive regions. Survey data is supplemented with socio-demographic data from the Census and field observations to contextualize these findings by looking at residential clustering and ethnic composition in the neighborhood and the greater Los Angeles region. My research makes an important contribution to our understanding of the urban neighborhood through an extensive analysis of a unique ethnic enclave from the perspective of local residents in one of the nation's largest metropolises.

TABLE OF CONTENTS

Introduction and Background 1

Significance and Research Questions 1

Geographic Regions 3

Sense of Place 4

Urban Neighborhoods 7

Ethnic enclaves and segregation 11

Measures of residential segregation 13

Travel Behavior 15

Theory of activity spaces 17

Measurement of activity spaces 19

Study Area: Koreatown, Los Angeles 21

Historical and Geographical Context of Koreatown 23

Extent of Study Area 25

Methodology 27

Pilot Study of the Lower East Side, Santa Barbara 27

Main Study in Koreatown, Los Angeles: Respondents 30

Main Study in Koreatown, Los Angeles: Procedure 33

Demographic questionnaire 33

Boundary-drawing map task 34

Open-ended description of boundary location 34

Perceived ethnic composition of Koreatown 35

Identification with and interaction within Koreatown 35
Activity spaces 35
Neighborhood field assessment 36
Census data review 37
Results 37
Measurement of Cognitive Boundaries 37
Radial intersect method for average polygon 38
Raster overlay method for areas of agreement 41
Comparison with official and crowd-sourced definitions 42
Coding Salient Features in Descriptions of Cognitive Boundaries 45
Physical features 47
Social or cultural features 48
Other features 49
Respondent Estimates of Residential Ethnic Composition 50
Overall characterization 50
Comparison of ethnicity estimates with Census counts 52
Daily Activity Spaces 52
Extent, orientation, and location of respondent activity spaces 54
Role of travel mode 54
Comparison of activity spaces with drawn boundaries 56
Clustering of Ethnic Groups in the Greater LA Region 56
Discussion 57
Boundary Agreement and Disagreement 58

Visual Indicators of "Koreanness" 62

Ideas about Who Lives in Koreatown 67

Respondent Temporary Travel Behavior 68

References 72

Appendix and Figures 84

Introduction and Background

Urban areas are promising for study because the dense physical and social landscapes of cities form a rich platform for understanding how people influence and are influenced by their built environment. My research addresses the measurement of urban residents' sense of place, particularly at the neighborhood scale. How residents define the boundaries of a neighborhood may reflect their connection to the community and their activities within it, and these boundaries may in turn affect residents' identification with and behavior within the neighborhood. My research falls into subfields of cognitive and behavioral geography, as well as urban geography more generally. Not limited to geography, this research is greatly open to collaboration with scholars in other disciplines, such as psychology, urban planning, transportation, and architecture.

Significance and Research Questions

As our cognition of the world shapes our behavior in it, it is important to understand how beliefs about our environment interact with how we attach personal meaning to place. As we interact in the world, we carve out our own place in it, adopting certain regions as our own while feeling disconnected from others. Administrative borders attempt to delineate where one region ends and another begins, yet these lines are drawn artificially sharp in contrast to how people understand them, where concepts such as "downtown" are fuzzy (Montello, Goodchild, Gottsegen, & Fohl, 2003), and disputes arise over the name or limits of one's neighborhood, as with Koreatown's boundaries in Los Angeles. Though there has been ongoing study of cognitive mapping in the fields of spatial cognition and behavioral geography, examining features in specific environments and their role in the formation of cognitive boundaries further illuminate ideas about lived experience and place identity.

This study makes an important contribution by exploring the connection between residents' concepts of neighborhoods and official neighborhood designations, elucidating how ideas about neighborhood fit into theories about sense of place, and gauging how well formal administrative designations fit with residents' informal conceptions. It additionally demonstrates the usefulness of surveying residents about vague concepts of local regions and ways in which to measure and express these ideas. By comparing the neighborhood as perceived by residents with residents' distribution and activities within the area, I also show the importance of these spatial and behavioral factors in our understanding of cognitive regions. In order to compare the region boundaries drawn by respondents of my study, I use a novel method of summarizing polygons and compare it to an existing raster overlay method to examine the relative merits of each method. This particular study area, the Koreatown neighborhood of Los Angeles, California, also allows for preliminary exploration of how the concept of an ethnic enclave, where residents of a shared ethnic background are more clustered in an urban neighborhood, plays into the individual and social understanding about a place.

My research questions are the following:

Primary: Where do residents in and near the officially designated neighborhood of Koreatown, Los Angeles locate the boundaries of "Koreatown"? How are these boundaries similar or different from the official designated boundaries, and why?

Secondary: Which physical and social factors relate to their understanding of these boundaries? How are cognitive neighborhood boundaries related to residents' ethnic identity, their activities within this space, and their level of identification with Koreatown?

Geographic Regions

Regionalization has an important role in geographic thought, as this process organizes our knowledge about the world around us. As described by Montello (2003), people broadly use categories as a method of organizing their knowledge. The cognitive method of categorization has important utility for people, simplifying complex concepts into a series of general rules (although not necessarily represented mentally as rules) rather than attempting to precisely represent all available information. Regionalization can be understood as spatial categorization. Montello establishes a taxonomy of four types of geographic regions: administrative, thematic, functional, and cognitive regions. *Administrative regions* have boundaries that are either sharply-defined or can be made precise as needed, and in addition, everything contained within an administrative region is considered as much a member of the region as every other thing contained within it (uniform membership). The administrative region of a local 'county', for example, has defined boundaries within which all sub-areas and entities are considered equally a member of that county. In contrast, those types of regions defined as *thematic*, *functional*, and *cognitive regions* have boundary vagueness and non-uniform membership properties: These are regions with disputable borders and more internal variation.

The challenge of defining cognitive, functional, and thematic regions is due to the fact that their boundaries can be intrinsically and fundamentally vague. There may be, for example, more representative areas within a cognitive region, or cognitive regions that are shared by certain groups of people. With these types of regions, there may be elements in our physical environment used by people as landmarks or cognitive reference points to "ground" these shared regions (Tversky, 1992). My particular motive for studying Koreatown is related

to the boundaries of this cognitive region, as understood by residents living in and near this part of Los Angeles; as a secondary motive, I take into account the Koreatown neighborhood from thematic and functional perspectives, based on observable properties of the built environment and residents' patterns of activity. Finally, I consider Koreatown as an administrative region, examining the precise boundaries of the neighborhood as defined by the city of L.A. and how they compare to the other boundary definitions.

Building off ideas presented by Couclelis, Golledge, Gale, and Tobler (1987) in their exploration of the anchor-point theory, I expect that respondents will mention a number of smaller scale, idiosyncratic locations that serve to "anchor" their knowledge, thoughts, and activities and which may be personally experienced but not widely shared across respondents. These locations may be expressed both in respondents' activities within the area and in their ideas about Koreatown, by either focusing their activities around home, work, or retail places, or by focusing their concept of the Koreatown neighborhood in relation to where they live, work, or shop. Respondents may also mention more important anchors at a neighborhood or community level than at the city level, signaling greater familiarity with their environment at a local scale of interaction.

Sense of Place

The concept of *place* includes more than just location, spatial properties, or material setting. It also includes those intangible, subjective properties such as meaning and emotion. How the place is subjectively experienced is commonly referred to as "sense of place". Sense of place has been identified by geographers and other social scientists to describe the connection between people and their surrounding environment, and has been qualitatively

and quantitatively assessed by many (Cresswell, 2004; Jorgensten & Stedman, 2001; Tuan, 1974).

A "place" is a type of cognitive region, which exists at different levels of understanding. Accordingly, sense of place is not only personal or individually held but also varies by geographic scale, as shown by Shamai (1991) in the differences between residents' sense of place for Toronto (city level), Ontario (province level), and Canada (national level). His study demonstrates what has been shown across the literature as an important consideration in regards to sense of place: the scale of analysis. Prior studies of sense of place have attempted to quantify aspects of sense of place at different scales, such as at the level of an individual street, a neighborhood, or a broader region, as reviewed by Cresswell (2004).

At the city scale, Lynch (1960) explored physical elements in the environment that shape residents' perception of the city. Certain cities, Lynch claimed, have a greater sense of imageability, which is a quality of the environment that makes it distinct, memorable, and allows the observer to form a mental 'image' of it. Depending on the layout and structure of the city, it may also be more or less legible to an observer. From interviewing residents across three large cities, Lynch found many commonalities in those elements of the city which stood out to people, identifying five main types of elements that contribute to an individual's mental representation of the city:

- *paths*, along which an observer may move,
- *edges*, which are linear features that act as barriers (physical or not),
- *districts*, areas in which an observer can mentally or physically enter,
- *nodes*, points of interaction which the observer can enter into,

- and *landmarks*, which are points of reference visible to the observer but into which the observer does not enter.

Lynch focused on the collective image of the city; however, he understood at the same time that collective sense of place was constructed of many individuals' experiences of the city. He showed that these images are strongly connected to the physical environment and that residents are able to identify these city elements.

I posit that it will be useful to expand on those aspects of the local environment that contribute to residents' sense of place at the neighborhood scale. Lynch's typology of elements will also serve as a useful basis for identifying features to include in the assessment of the environment. Some of the work that builds upon this includes Orleans' 1973 study of differences between cognitive maps of the city among Los Angeles residents of different social groups. He found that these mental representations differed not only by physical location, but also along the lines of group characteristics like socioeconomic class and ethnicity. This is an important argument for the consideration of ethnicity and social class in understanding variation in both cognition and behavior at the group and individual levels.

Two frequently identified dimensions of sense of place in the literature include place identity and place attachment, although various additional dimensions have also been named. Place identity is the relation of self-identity to place, defined by Proshansky as "those dimensions of self that define the individual's personal identity in relation to the physical environment by means of a complex pattern of conscious and unconscious ideas, beliefs, preferences, feelings, values, goals, and behavioral tendencies and skills relevant to this environment" (1978, p. 155). This highlights the link between one's experience of the physical environment and one's personal identity, showing that the meanings associated with

a place is rooted in its physical aspects but also shape one's behavior within it. Place attachment is the bond established between a person and a place, especially its emotional dimension – such as the sense of dependence on a place. The study by Shamai mentioned above deals with measuring place attachment. Altman and Low (1992) described place attachment as accompanied by cognition and practice, which reiterates that both cognitive processes and behavior need to be considered.

Urban Neighborhoods

Neighborhoods are an important sub-region under the superordinate heading of region. The term "neighborhood" has come to hold a wide range of meanings, from a colloquial understanding of the collection of those people and homes that constitute a local community near oneself to the formal mathematical definition of points falling within a certain spatial range. When discussing residential neighborhoods, it is commonly understood that a neighborhood consists not only of a spatial region but includes its residents and the social properties that tie them together (Bell & Boat, 1957). The concept of neighborhood is further complicated because neighborhoods emerge from a variety of historical, political, economic, and cultural processes. Of interest to this study is the urban neighborhood, and in particular the concept of the residential ethnic enclave, in which residents of a shared ethnic background are spatially concentrated within the city.

Identification with one's neighborhood serves the purpose of forging a sense of community among urban residents. Clarence Perry (1939) first used the concept of the neighborhood in the city planning context to design residential neighborhoods that were closed, self-contained units, which he claimed would promote social life in residential communities and would together make up the basic units of a city system. Perry's planned

neighborhood units would promote social cohesion and were to be specifically bound by larger arterial streets, which would allow others to pass *by* the neighborhood without having to pass *through* it. Since then, the idea of the neighborhood unit has influenced many planning and development programs, mostly applied in the planning of "new towns" (Banerjee & Baer, 1984). Broadly, neighborhoods have important functions for residents, promoting social life, providing public surveillance, and forging links to outside resources as well as the exchange of resources within them (Schoenberg & Rosenbaum, 1980, p. 33). It is understood that urban residents identify strongly with their neighborhoods, with local identity shaping their interactions with the city and its people (Ahlbrandt, 1984). Barton et al. (2010) state that neighborhoods are effective when they are specifically designed to encourage social activity, sustainability, and economic vitality, and promote well-being by improving residents' health and quality of life.

The neighborhood has also been used as a unit of analysis in addition to a unit for planning. Outside of the planning context, a neighborhood may be defined in a number of ways, including by its social or physical attributes, thematic descriptions, activities, visual features, or other characteristics (Galster, 2001; Barton, Grant, & Guise, 2010). Galster (2001) defined neighborhoods as "the bundle of spatially based attributes associated with clusters of residences, sometimes in conjunction with other land uses" (p. 2112), referring not only to physical characteristics such as building structure and proximity to employment, services and transportation, but also to social, political, demographic, and "sentimental" (such as related to place identity) characteristics. Other definitions of neighborhood center on the place of residence and include a rough area containing nearby places accessible on foot or through other means.

However, there is little consensus about the kinds of neighborhoods that exist, which characteristics identify them, or their spatial scale, and neighborhood is commonly equated with the arbitrary areal units most readily available. The Modifiable Areal Unit Problem (MAUP) describes this difficulty in analysis, as geographic research often experiences a disconnect between the scale of analysis and the scale at which the real-world phenomenon actually occurs (Openshaw & Taylor, 1979; Hipp, 2007). This is often a limitation on the side of data availability, as the scale of available data – such as in the form of Census population tables – cannot often be reliably refined without increasing uncertainty. This study examines population data at the aggregated Census tract-level and the block-level (which closely tracks with actual city block scale), as well as collected survey data from residents at the individual scale.

Dubin (1992) suggests that an individual's cognition of the location of his or her neighborhood is dependent upon where he or she lives, noting that the neighborhood shifts to center upon the individual location within it, citing Strange's (1991) theory of 'sliding neighborhoods.' This theory suggests that it is impossible to define an accurate and fixed boundary of a neighborhood, since its residents will each hold a different concept of the neighborhood depending on their home locations within it. However, this theory may be confounding the concept of the shared neighborhood and the home neighborhood. An individual's home neighborhood is personal to each individual and the localized area within which he or she lives. We should therefore acknowledge the difference between a home neighborhood and a broader, culturally-shared idea of neighborhood which is often shared and understood by many. For the purposes of this study, respondents were asked to comment on the borders of Koreatown, which may or may not correspond to the idea of their "home"

neighborhood. However, even while a person is describing a shared or commonly-held idea of a neighborhood, we may witness a similar 'sliding' effect, based on one's home location and tied to the individual's personal identification with the neighborhood.

The neighborhood is an essential social unit for its residents, visible especially in the example of the ethnic enclave, historically identified by the clustering of residents sharing a common ancestry and culture (Chaskin, 1997). As a social system, the neighborhood – and especially the ethnic neighborhood – provides economic, communicative, and emotional links to broader outside systems. To varying levels of success, the existence and value of neighborhoods are established through the efforts of organizations such as neighborhood councils. When neighborhoods are given official names and boundaries to mark their status, this can bring about more outside recognition, better planning, and increased investment in the local economy, as well as encouraging residents to engage in more civic participation as part of these community groups (Chaskin, 1998; Jun, 2007). Chaskin also reviews definitions of neighborhood proposed by these groups and finds a wide range of ways in which neighborhoods have been defined, building off of school catchment areas, other existing administrative units, residents' cognitive maps, and neighborhood characteristics (1998).

Spielman and Logan (2013) used 19th century historical city data to categorize neighborhoods based entirely upon detailed residential composition, focusing on physical areas defined by the dimensions of ethnicity and socioeconomic status. In their analysis, the authors used a spatial clustering method to assign specific buildings to neighborhoods, and also noted the coincidence of neighborhood edges with major thoroughfares or clusters of buildings. The authors provide a method of using data to identify neighborhood regions of a city through ethnicity and socioeconomic factors, thus demonstrating the potential of

defining neighborhoods through the attributes of its residents, without directly assessing people's subjective conceptualizations of the locations of neighborhood.

Ethnic enclaves and segregation. I use a working definition of the ethnic enclave as a region of the city within which there exists a concentration of residents who either identify as sharing a common ethnic background or are largely identified by others as constituting the same ethnic group. The segregation of residents in cities has many causes and impacts, and though residential segregation is often thought of as an entirely negative effect of racial discrimination or economic inequality which restricts peoples' housing opportunities, some urban segregation is voluntary and ethnic enclaves can provide social and economic benefits to its inhabitants. Ethnicity is strongly tied to individual identity and persists across geographic areas, which helps to explain the importance of ethnic communities for immigrants. Ethnicity and its implications for urban segregation have been studied from many perspectives. One example is from the field of cultural ecology, which views ethnic groups occupying the same or nearby spaces as acting in competition with one another for limited resources, as described by Barth (1969). Kaplan and Holloway describe other consequences of segregation, including isolation from employment opportunities, ethnically-based economic enclaves, cohesion of ethnic groups and political power, and the spatial concentration of poverty. These both result from and help cause greater identification with the ethnic group and an increased maintenance of the boundary between the group and others. Theories about the causes of segregation discuss direct and indirect racial discrimination, economic inequality due to minority groups earning less income, and ethnic group preferences toward living within close proximity of those in one's own group (1998, pp. 69–94).

Early theories of urban assimilation state that immigrant enclaves may serve as stepping stones for new immigrants to the U.S., who become familiar with the English language and with American culture before eventually transitioning out of the enclave, or as isolating traps from which immigrants do not have the means to leave. These urban residential enclaves are not considered permanent places of settlement. Zhou (2009) argues, however, that the enclaves of today's cities do not easily fit the model of either functioning as a springboard or a trap for immigrants, and approaches the issue from the perspective of forming resources and social capital within these neighborhoods.

Ethnic enclaves can be differentiated on both a functional economic level and on an aesthetic level. For example, such businesses as *carnicerías*, *panaderías*, and *discotecas* are visual indicators of the presence of an ethnically Hispanic community (Oberle, 2006). *Carnicerías*, small grocery stores with butcher services, are the most visible instances of Hispanic retail in these communities and play an important role in the creation of sense of place for residents and visitors. Among the distinct visual features that Oberle notes are "nostalgic" use of names, symbols, decor, and shop layout meant to echo those of Mexico (2006, p. 150). These examples of businesses serve as important gathering places within the neighborhood, providing economic and social benefits as well as strengthening residents' sense of place. Zhou and Cho call this type of ethnic economy that is dependent upon co-ethnic relationships and institutions an "enclave economy," which has important economic as well as noneconomic effects. It creates social spaces for individuals, attracts the return of middle-class residents to the inner city, and helps individuals build social capital (2010).

I expect that the physical features of the built environment will be important factors in residents' construction of their boundary ideas, and – particularly for this ethnic enclave –

that boundaries drawn may relate more to the visual presence of Korean businesses and landmarks than to the actual spatial distribution of Korean residents in the area.

Measures of residential segregation. Residential segregation in cities is often on the basis of ethnicity and/or social class, though there are many causes as well as many impacts of residential segregation (Massey, 2001). This segregation itself can be considered both a state and a process, since it is created in different ways and is also a state of experience for residents. Though outright housing discrimination is an illegal practice, segregation still exists in U.S. cities because of the effects of historical segregation practices that impact equal access to housing today, and also because of voluntary self-segregatory residential decisions. As stated above, clustering of residential groups in the city can provide a number of benefits to residents who share a common ethnicity.

Massey and Denton (1988) compare several methods of measuring segregation beyond the dissimilarity index[1], a measure of residential *evenness*, which had been the most commonly used measure since Duncan and Duncan (1955) championed it as the standard measure of segregation. Since Massey and Denton's 1988 paper, more work has been done with these other measures of segregation. One category of these, measures of residential *clustering*, are most useful to this study, because they assess how segregated residents of different ethnic groups are within an area. One of these measures of clustering, the spatial proximity index—first proposed by White, 1983; also described by Massey & Denton, 1988; Kaplan & Holloway, 1998; and Grannis, 2002—describes how closely members of minority

[1] Index of dissimilarity: $D = \frac{1}{2}\sum_{i=1}^{I}\left|\frac{x_i}{X} - \frac{y_i}{Y}\right|$ "where x and y are the populations of group X and group Y in subarea I, and X and Y are the populations of group X and Y in the city as a whole" (Kaplan & Holloway, 1998, p. 11).

groups live near one another, often creating what can be considered ethnic or racial enclaves. The average spatial proximity between members of a given group X is represented as:

$$P_{xx} = \frac{\sum i \sum j \, x_i x_j c_{ij}}{x^2}$$

where:

$$c_{ij} = e^{-d_{ij}}$$

The spatial proximity index is then calculated by weighting the average intragroup proximities by the fraction of each group in the population (Massey & Denton, 1988; Iceland & Weinberg, 2002).

$$SP = \frac{XP_{xx} + YP_{xx}}{TP_{tt}}$$

When SP = 1.0, there is no differential clustering between ethnic or racial groups, and when SP > 1.0, members of the same group tend to live in closer proximity (White, 1983). Unlike the index of dissimilarity, the index of spatial proximity takes into its calculation physical distance between the subunits of the city.

By calculating the physical proximity of where residents of different ethnic groups live, this clustering measure provides information that could help inform political decisions such as designations of neighborhoods within the city, especially where an attempt is made to identify groups of residents based on characteristics that connect them socially. This kind of grouping is already done, for example, by government entities such as the U.S. Census Bureau, whose establishment of census tracts (geographic units containing around 2,500–8,000 residents) is based on population size, population characteristics, economic status, and living conditions (U.S. Census Bureau, “Census Tracks and Block Numbering Areas”).

Schnell and Benjamini (2001) propose an index of segregation that measures the sociospatial isolation of individual residents from other ethnic groups. The measure looks at the spaces in which a person conducts their daily activities (termed "life spaces") and focuses on their level of isolation or exposure to others' life spaces. Their measure gives indices that focus on the individual's experience of isolation, unique in that it does not consider only group aggregates. The authors state that within groups, individuals have differences in lifestyle—and therefore different life spaces (related to the idea of *activity spaces* described by others and summarized below)—that importantly contribute to the segregation experienced as a result of isolation. The approach by Schnell and Benjamini to measuring segregation includes both spatial and social aspects by taking into account measures of territorial scale and interactive spheres, suggesting that activity behavior of residents is a necessary consideration in understanding the effects of segregation. For the purpose of this study, however, a traditional measure of segregation, the spatial proximity index originally proposed by White (1983), will be used with available Census data at the tract level, and compared with cognitive definitions of ethnic neighborhoods and with activity space representations of individual behavior discussed in the following section.

Travel Behavior

The field of travel behavior has taken up the question of the link between everyday human behavior and the physical built environment. One prominent study was conducted by Jan Gehl in his *Life Between Buildings* (1987). Gehl made urban design and planning recommendations based on his extensive observation of how people interact in the public built environment, including places such as plazas, corridors, and streets. In his study of the use of public space, he identified different degrees of social interaction moderated by

different types of physical spaces, environments that promote or dissuade peoples' movement or communication, and where people choose to gather in these places. He compared traffic patterns across several world cities to the types of activity that they supported, and notably cited Los Angeles' street patterning as a prime example of a system that allows vehicular traffic but is "unusable" for any other kind of travel, particularly pedestrian traffic.

Some examinations of human behavior and the built environment have measured design qualities in the urban environment, and looked and their relationship to environmental cognition, and active living behavior through analysis of walkability and bicycle commuting (Ewing, Handy, Brownson, Clemente, Winston, 2006; Ewing & Handy, 2009; Handy & Xing, 2011). Many of the direct relations between the built environment and travel activity are reviewed by Ewing and Cervero in their 2010 meta-analysis, in which the authors track the progression of this field of research. They note that in comparison to studies conducted before 2001, more recent studies have "estimated effects of more environmental variables simultaneously (expanding beyond density, diversity, design, and destinations, to include distance to transit), controlled for more confounding influences (including traveler attitudes and residential self-selection), and used more sophisticated statistical methods" (266).

Space syntax, originally applied to architecture, is another area of research with potential to extend our knowledge about the link between the physical environment and human behavior. Space syntax techniques analyze the topological configuration of architectural designs or urban street patterns to quantify the relationship between the physical structure of the building or street space and human social activity (Hillier & Hanson, 1984; Jiang, 2008; Montello, 2007). These approaches allow for systematic evaluations of urban structures and have been used to look at differences in travel behavior, such as walking behavior (Baran,

Rodríguez, & Khattak, 2008). Some have even investigated space syntax measures in relation to spatial knowledge (Meilinger, Franz, & Bülthoff, 2012).

The subject of travel in urban and transportation planning has been increasingly explored from behavioral viewpoints, but these studies often focus on expressed changes in behavior and neglect to explicitly examine aspects of cognition. However, others have recognized this important relationship between cognitive maps and travel behavior. Golledge and Gärling (2004) reviewed several components of travel decision-making and the role of the cognitive map, such as in how people select paths, learn routes, and react to changes in their schedules or in traffic conditions. Differences in travel mode may also impact the spatial knowledge acquired about one's environment, and in turn, the travel decisions people make are based on this spatial knowledge. Mondschein, Blumenberg, and Taylor (2010) showed that individual and group differences in travel behavior can be partially attributed to differences in the mode of prior travel experience. The association between sense of place and travel behavior has also been shown (Deutsch & Goulias, 2009), and therefore specific attitudes about a place such as those that relate to place identity should be considered as well.

Theory of activity spaces. There have been numerous efforts to represent and model the activities of people following the contribution of the temporal aspect of behavior from time geography. A central idea of the time-space geography described by Hägerstrand (1970) is that our activities are situated in space and in time. Being held to limitations of space and time imposes certain constraints (capability, coupling, and authority constraints) on our possible actions. Time-space paths and time-space prisms, proposed by Hägerstrand, are ways in which an individual's daily activities and his or her temporal, spatial, and other constraints on activity can be graphically depicted. Behavior is also bound by cognition: the

knowledge or awareness of what can be done, as well as where and when these activities can be performed (Golledge and Stimson, 1987; Miller, 1991; Kwan, 1998). Human behavior reflects and shapes acts of cognition such as learning, thinking, habit, motivation, feelings, and planning, so it is important to consider observable behavior to better understand cognitive regions, and in return, learning about cognition helps us understand behavior.

Activity spaces reflect the usual behavior of urban residents and have been used in the travel behavior literature to study extent of daily travel. Golledge and Stimson (1987, p. 109) describe an activity space as "the subset of all locations within which an individual has direct contact as a result of his/her day-to-day activities." This includes not only the locations directly visited, but also those routes taken and the secondary areas that the individual was exposed to as a result of his or her journeys. Jakle, Brunn, and Roseman (1976) discuss the formation of an activity space to include the "process through which we gain information about and attach meaning to our environment" (93). This is not only the part of the environment that a person occupies in his or her activities, but the potential places of activity as well.

Activity spaces include the different spaces inhabited by individuals in the city, often with focal points at the home and workplace. Golledge and Stimson (1997, pp. 283–284) further state that individual activity spaces consist of a hierarchy of movements, with movements between home and work at the top of the hierarchy and secondary trips closer to either the home or the workplace. Home-based trips, those trips that either begin or end at the individual's residence, make up the large majority of city residents' habitual travel behavior. This supports the notion that the home is an important personal anchor point, serving as a focal point of the majority of one's activities (167-168).

Activity spaces are not only a factor of time-space constraints or knowledge about the physical environment. Differences in activity spaces have also been tied to factors such as demographics, life cycle stage, social networks, and mode of transportation (Kwan, 1998; Axhausen, 2005; Carrasco, Miller, & Wellman, 2006; Silm & Ahas, 2014). For instance, Kwan (1998) has explored the idea of accessibility at the individual level to understand gender- and ethnicity-based differences in activity patterns. Silm and Ahas (2014) studied ethnic differences as well, looking at the relationships between ethnicity and the location and extent of residents' leisure and socialization activities. Activity spaces are useful representations of where people go, especially when examined in conjunction with boundaries of cognitive regions and with residential segregation. In this study, I assess activity spaces of residents specifically in relation to their concepts about cognitive region boundaries.

Measurement of activity spaces. Various methods have been proposed as to how to measure and portray these activity spaces, including use of travel diaries or GPS logs to collect individuals' activity data, and methods such as convex hulls and standard deviational ellipses to summarize this data. Traditional ways of collecting travel data are recall or travel diary methods, in which activities are either recalled for a specific period of time after the fact, or are recorded by the respondent approximately as they happen and collected by the surveyor on a return visit (Golledge & Stimson, 1997, pp. 304–308). Recently, travel data has also been more commonly collected through Global Positioning System (GPS) data provided by mobile cellular phones or other GPS devices (Shareck, Kestens, & Gauvin, 2013). These methods have the potential for ensuring better data coverage and quality

through methods such as collection of GPS tracks or mobile prompted recall, which prompts the respondent to input activity data at specific locations or times.

There are a number of ways to visualize and measure activity spaces based on collected travel data. Jakle et al. (1976) depicted activity spaces as route-based, similar to a simplified map or schematic map representing the places visited and the routes taken between them (see Figure 1 for an example). This type of display requires routing information between locations visited which is not collected with all types of activity logs or travel diaries, but may be inferenced using techniques such as a minimum spanning tree (Schönfelder & Axhausen, 2003). An alternative method that summarizes point patterns of travel activity as areal information is the convex hull or minimum convex polygon. The convex hull connects the outermost activity locations as the vertices of a polygon to create the smallest possible convex polygon that encompasses all included locations (Burgman & Fox, 2003), adapted from ecological description of animal home ranges to the description of human activity spaces (Fan & Khattak, 2008; Shareck et al., 2013). Other methods such as the concave hull have been suggested, which is computed in much the same way except it allows for concave sides when connecting the outermost points. However, the concave hull may not sufficiently represent an activity space, as it does not include in-between areas within which the individual is likely to move or which may at least be familiar to the individual (Zhang & Krause, 2013). Both the minimum convex and concave polygon methods also suffer from the influence of sample size on area and are highly influenced by outliers.

Travel behavior researchers have proposed the standard deviational ellipse method (as described by Raine, 1978) as an activity space measure of observed travel behavior in urban environments (Newsome, Walcott, & Smith, 1998; Schönfelder & Axhausen, 2003). The

ellipse is drawn around the activity space to capture the locations of observed activities within one standard deviation (about 68% of all activities, assuming a normal distribution) or two standard deviations (95% of activities, assuming a normal distribution) from the mean center of all activities. See Figure 1 for an example of a standard deviational ellipse summarizing locations visited by a person throughout the course of a day, including a home location and five other visited locations. This method may better quantify the extent of individual activity spaces when dealing with only a sample of all activities. The standard deviational ellipse also allows for the comparison of area and orientation across individuals, giving insight into the differences between the spaces that people occupy on a temporary basis throughout their typical day, week, or other temporal cycle.

Study Area: Koreatown, Los Angeles

The Koreatown neighborhood of Los Angeles, California holds the distinction of being one of the highest density and highest diversity areas of the city, a multiethnic area with large concentrations of Korean, Mexican, Salvadoran, and other residents (Zhou & Cho, 2010). The Koreatown study area, only 5 square miles in size, contains over a fifth of the entire Korean population in all of Los Angeles County (21.8%), meaning it is an important residential concentration of Korean residents in the area. Approximately 20% of the residents within the study area list their ethnicity as Korean, according to the American Community Survey (ACS) 2013 5-year estimate[2] (U.S. Census Bureau, 2013a), which is higher than the proportion of Koreans in all of the Los Angeles urban area (2.3%).

[2] The ACS 5-year estimate is used here rather than the 1- or 2-year estimate because it provides estimates for country origin (such as Korean), rather than only race or ethnic identification (like Asian

However, Koreatown is home to many more non-Koreans. Kim (2011) reported more than half of all residents in the Koreatown neighborhood are Hispanic, which I confirmed with ACS 2013 5-year estimates to be 52.9% in my study area. The proportion of Hispanic residents in the study area is higher than the proportion of Hispanic residents in the entire Los Angeles area: 48.7% of all residents of the Los Angeles urban area identified as Hispanic or Latino in the Census ACS estimate. Of the Hispanic population of the study area, 45.6% were Mexican, 23.6% Salvadoran, 20.0% Guatemalan, and 5.1% other Central American, with the remaining population in small proportions from South American, Spanish, and other origins (U.S. Census Bureau, 2013b). Overall, Koreatown is ethnically more Korean and also more Hispanic than the rest of the Los Angeles area.

The commonly referenced and popularly understood name *Koreatown* identifies the neighborhood as an ethnic enclave, and is also marked by street signage such as the Koreatown sign at the Normandie Avenue exit on the Santa Monica Freeway, first erected in 1982, and the two traditional Korean gates on Olympic Boulevard at Vermont Avenue and at Western Avenue (Kim, 2011). There are additionally a number of blue neighborhood street signs posted by the City of Los Angeles (2015), intended to mark the boundaries of the neighborhoods of Los Angeles (see Figure 2). However, one issue with the posted street signs is the lack of consistency between these street signs, the highway signs, neighborhood landmarks such as the stylized Korean gates, and popular understanding of the neighborhood's location.

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more generally). However, the smallest-level geographic units provided for ACS estimates are Census tracts. The study area referred to is defined below.

Streets in the Koreatown area are laid out as a grid pattern oriented relative to the cardinal directions, generally running north–south and east–west with small internal divergences from the grid. However, the street pattern of Koreatown is not orthogonal to the street pattern of the historic core of downtown LA to the east, which diverges by an approximately 30 degree clockwise rotation. This rotation in the downtown core street grid is due to historical adherence to the Spanish Laws of the Indies (Waldie, 2010). The two street grid patterns meet at Hoover Street, close to the eastern edge of the study area (see Figure 3).

The architecture and general appearance of buildings in Koreatown does not significantly differ from that of the surrounding area. However, there has been at least one serious attempt in the past to "Koreanize" the visual appearance of the neighborhood by replicating traditional Korean architectural design (Quinones, 2001; Hawthorne, 2014).

Historical and Geographical Context of Koreatown

Los Angeles has historically served as a significant port of entry for Koreans to the United States of America. The location of the Korean community has moved since its original founding and has since expanded to encompass a much larger physical extent. Its initial location near the Bunker Hill neighborhood of LA was an arrival place for early Korean immigrants in the late 19th and early 20th century, though before the 1960s, the Korean population in Los Angeles totaled under a thousand people (Yu, 1985). The Immigration and Nationality Act of 1965 (also known as the Hart-Celler Act) substantially increased the flow of Korean immigrants to the United States, with families largely settling in Los Angeles (Kim, 2011). This most recent movement is referred to as the "Third Wave" of Korean immigration to the U.S., following the earlier waves of migration in 1885-1924 and 1950 to 1965. Today's Koreatown in Los Angeles is home not only to many first- and

second-generation Korean-Americans, but also to many other ethnic groups. According to Yu (1985), "Koreatown" Los Angeles as it is understood in today's context was referred to as such as early as the 1970s, corresponding with the Third Wave of Korean immigration to the area. Following much discussion by community leaders and city officials, Koreatown was given formal boundaries by the Los Angeles City Council in August 2010 (Villacorte, 2010), though signage proclaiming the existence of "Koreatown" had been posted by the city of Los Angeles prior to then (Yu, 1985).

Koreatown has long held importance for the Korean community in Los Angeles and has had an eventful history. The neighborhood was the main area of focus for media attention during the LA riots of 1992, though the turmoil of this time extended further into South LA as well. This critical event in LA's history, as it occurred in contemporary times, certainly still resonates with long-term residents of Koreatown and the greater Los Angeles region. Interviews with residents, retailers, and others in the area both at the time of the 1992 riots and in retrospective accounts show strong emotional responses tied to the place where the events occurred (Jones, 1992; Kim, 2012). In more recent years, however, the Koreatown area has expanded rapidly in terms of its population and urban development, some of which has resulted from increased South Korean economic investment in the region since the easing of U.S. foreign investment restrictions in 2006 (Southern California Association of Governments, 2008).

Korean enclaves have also emerged and grown in importance in Los Angeles's suburbs, following the rise of what Li has coined the "ethnoburb" – the significant concentration of an ethnic community living in a suburban area (1998). Notable differences between an ethnoburb and an ethnic enclave (specifically between the Chinese ethnoburbs and the

Chinatowns studied by Li) include their location: the ethnic enclaves of the 20th century and even earlier have been traditionally located in urban centers, while ethnoburbs are further out from the city center in the suburbs; and their residential composition: typically ethnoburbs serve and house residents from a broader range of socioeconomic backgrounds than do traditional ethnic enclaves.

Zhou and Cho (2010) state that in Los Angeles, "Koreatown owes its name to the dominance of Korean-owned businesses and ethnic social structures, not the number of Koreans living there" (91). It is an open question as to whether this is echoed in the thoughts of its residents.

Extent of Study Area

An appropriate extent for my study area is defined using a buffered overlay of two regions: one captured by the crowd-sourced estimate of Koreatown boundaries published by *The Los Angeles Times* "Mapping LA" project, and the other marked by the boundaries of Koreatown designated by the Los Angeles City Council (LACC). The study area includes an approximately quarter-mile, one- to two-block buffer around the overlaid areas in order to potentially reach local residents who do not live within these defined areas. This helps include more residents who may consider themselves living outside of or on the edge of the neighborhood, and thereby allow for contrast with residents inside of Koreatown in order to better focus the location of these boundaries. The area of this resulting study region is 5 square miles. See Figure 3 for a map of the study area, and Figure 4 for a broader context of the study area within the greater LA region.

The Mapping LA boundaries of Koreatown include a greater spatial extent than those boundaries defined by the LA City Council, with the Mapping LA definition drawing upon

locals' popular knowledge of Los Angeles. Though this definition was created through the collective contributions of residents from across the greater Los Angeles region, it has the potential to be more inclusive of residents who may live further afield yet still identify with the Koreatown neighborhood. The definitions of each of the neighborhood areas in this project were determined by a team at *The Los Angeles Times* called "the Data Desk" who created a first proposal of neighborhood boundaries in Los Angeles by merging together Census tracts, then expanded and revised the definitions based on input from Los Angeles residents and other readers of *The LA Times*. The method of placing these boundaries were based on several principles determined by the Data Desk team, including: qualitative and quantitative coherence, based on visual characteristics and population statistics; compactness and minimization of enclaves, gaps, overlaps or ambiguities; and the preservation of "schools and other landmarks in the communities bearing their names" ("About Mapping LA," 2010). The Mapping LA project as of the June 2010 revision contained more than 272 neighborhoods in the Los Angeles region. For the purposes of this project only the definition of the Koreatown neighborhood was used, though immediately adjacent neighborhoods were examined.

The Los Angeles City Council approved a designation of the Koreatown community's boundaries in 2010.[3] This definition resulted from City Council meetings with input from stakeholders such as Korean business owners, local government representatives, and other

[3] From an LA City Council communication adopted August 2010: "Members from the community and the applicant informed the Committee that after extensive discussions, a compromise was reached, and requested that the Committee approve the revised boundaries for the Koreatown community to be as follows: Olympic Boulevard from Western Avenue to Vermont Avenue on the south, Vermont Avenue from Olympic Boulevard to Third Street on the east, Third Street from Vermont Avenue to Western Avenue on the north, Western Avenue from Third Street to Olympic Boulevard, including a business corridor along Western Avenue from Third Street to Rosewood Avenue situated inside the East Hollywood area on the west" (Krekorian, 2010).

public participants. It is reasonable to include these official LACC boundaries in the definition of the study area, as the act of naming this area may have helped influence residents' understanding and is an important consideration. It includes a smaller northern stretch of Western Avenue established as part of the "business corridor" (presumably for both political and economic reasons) and additional area to the south and that is not already included in the Mapping LA definition. It is also of theoretical interest to my research to investigate how the officially designated boundaries do or do not match the boundaries in the minds of residents.

The Los Angeles Department of City Planning describes the Koreatown area more conservatively to be: "generally bounded by Eighth Street on the north, Twelfth Street on the south, Western Avenue on the west, and continues east towards Vermont Avenue" (Los Angeles Department of City Planning, September 19, 2001, p. III-6) This defined area is smaller than and lies entirely within the LACC border of Koreatown, and will be referenced briefly in later comparisons.

Methodology

Pilot Study of the Lower East Side, Santa Barbara

Prior to the main study in Koreatown, Los Angeles, a pilot study of ten respondents was conducted in July 2014 in the Lower Eastside neighborhood in downtown Santa Barbara, California. This allowed me to determine modifications to the survey instrument, such as in the introduction of the study to potential respondents, specific wording of questions, and total length of the survey. Though downtown Santa Barbara does not match the urban density of downtown Los Angeles, its streets are similarly set up in a rectilinear grid pattern (not

aligned to the cardinal directions) and it has the presence of several neighborhoods within its downtown area (City of Santa Barbara, 2014).

The pilot study was conducted in both English and Spanish in the Lower Eastside area of Santa Barbara, California, during the month of July 2014 with a Spanish-speaking undergraduate research assistant. The survey was administered to ten respondents who were asked afterward to give open-ended feedback on their comprehension of the survey itself. Comparison with U.S. Census data shows that the sample of respondents was not representative of the areas covered, due in large part to the convenience sampling method used for the pilot. In the main survey, however, a systematic spatial sample with more even coverage of the entire study area was used.

The stages of the pilot study were as follows: (1) a basic demographic questionnaire collecting age, gender, ethnicity, primary language spoken at home, and work status; (2) the task of drawing the boundary of the Lower Eastside when presented with a base map of downtown Santa Barbara; (3) an open-ended explanation of the placement of the boundary; (4) estimation of the ethnic composition of the residents of the Lower Eastside; (5) questions about habitual travel in the Lower Eastside; (6) a one-day travel log; (7) and concluding questions about any particularly confusing or unclear parts of the survey.

The task in the survey that posed the most difficulty to respondents appeared to be the estimation of neighborhood residents' race and ethnicity, with several respondents giving only a partial answer (such as a range of estimates) or declining to answer. There were also minor challenges expressed by residents when attempting to recall all visited locations for the one-day travel log, though this was not expected to be a significant issue in the main study. Asking for two or more days of travel information would increase respondent burden and

survey administration time, and potentially introduce further concerns with reliability of recalled locations; therefore the travel log task was limited to one day (the previous day) only.

Preliminary data analysis of pilot survey results verified that the methods proposed below for the main study are feasible and appropriate for the type and extent of information collected. Boundaries drawn on the provided paper base maps were scanned, georeferenced to the base map, and digitized using GIS software. The digitized boundaries allow for comparison of locations of drawn boundaries and their centroids, shared areas of agreement, lengths along any axis, and areas of the contained regions. The drawn boundaries can also be compared to attributes of the calculated activity-space ellipses, which include location of the ellipses and their centroids, length along the major and minor axes, and area of the contained region. Both the drawn boundaries and the activity spaces can be compared with attributes of the residents and their home locations as well.

For the open-ended question about why respondents drew the boundaries on the base map where they did, all responses were coded based on both the expected sets of features and attributes, and from what emerged from this observed data. This was an iterative process, working from both a bottom-up and a top-down approach to create and modify the coding guide for this question. The topics that resulted include physical barriers such as streets and the highway, landmarks such as the local high school, areas of ethnic and class differences, official planning regions including school districts, and adjacent neighborhoods. This process helped inform the development of the coding system for the full study.

As a result of this pilot test, edits were made to the survey format and administration of the survey. The survey, which typically ran ten to fifteen minutes long, was determined to be

of appropriate length to gather the information needed for the proposed analysis. Most of the respondents were not deterred by the time required, and their feedback reflected this as well.

A formal neighborhood assessment of physical features was not conducted with the administration of this pilot survey, but was added to the main study. However, informal observations during the pilot showed that there were visible differences in housing style between the Lower East Side and other neighborhoods, as well as a strong sense of State Street acting as a marked east-west divide in Santa Barbara. The Pacific Ocean creates a clear barrier to the south, though the highway and the railroad are other potential southern barriers, since movement past those edges is either difficult or impossible.

Respondent interest in the topic of the pilot survey was generally high, though I expect residents of Los Angeles have overall higher engagement with the topic of neighborhood identification than do residents of Santa Barbara. Community groups in Koreatown are active in promoting the identity of the neighborhood, and there are high levels of investment in the local neighborhood economy by transnational companies, mainly those based out of South Korea.

Main Study in Koreatown, Los Angeles: Respondents

For the main study, the population of interest can be described as including all urban residents of a city in which there are neighborhoods with notable ethnic residential concentrations, as it is the case that ethnic enclaves exist in many urban areas worldwide. The sampling frame includes all residents living in and around the Koreatown neighborhood in Los Angeles, using the study area specified above, recognizing that the boundary of 'Koreatown' differs both by administrative definition and in popular understanding. A total of 50 respondents were selected from the study area using a systematic spatial sampling

method, in which households were selected by a process of systematically placing points along a road-based grid within the study area, followed by on-the-ground estimation of the nearest residential dwelling to each point. One adult resident, the first person of at least 18 years of age that was available and willing to respond, from each of the selected households was identified and asked to respond to the in-person survey. In cases when appropriate respondents were not available on initial visits, attempts were made to follow-up at those residences. This sampling method ensures more regular spatial coverage of the entire study site, which includes officially and informally designated definitions of Koreatown as well as a buffer around those areas. To increase the response rate among those not comfortable understanding or answering the survey in English, a Spanish or Korean version of the survey was administered as needed, either by myself (I speak Korean) or by a Spanish-speaking research assistant. Interviews were conducted in the months of September through December 2014.

An in-person surveying method enabled collection of information that would be more difficult and less reliable to collect through phone or online methods. The estimated response rate to the surveys conducted for this study was approximately 40-50% overall. The response rate is often higher for door-to-door surveys administered in-person versus remotely administered mail or online surveys. Door to door surveying additionally allows for more thorough and thought-out responses compared with the method of surveying on the street (Singleton & Straits, 2010). In this study, an additional consideration was the need to have respondents draw boundaries on a given base map to represent their ideas about the extent of Koreatown without referring to additional external sources, such as online references or other maps. Exact locations and addresses of the chosen households were recorded only for the

purpose of the sample selection and data analysis phases, and are not communicated in the results, in order to protect the privacy of respondents. Likewise, addresses or locations of respondents' activities were only used for the purpose of data analysis and not published in a personally identifiable fashion.

The 50 survey respondents ranged in age from 19–82 (mean = 49.6) and 56% (n = 28) were female. The average length of residence in the current neighborhood—whether or not the respondent identified as a resident of "Koreatown"—was 16.7 years. Respondents' racial or ethnic identification is presented in Table 1, and work status is summarized in Table 2.

Table 1. Respondent Ethnic/Racial Identification

	Frequency	Percent
Hispanic or Latino/a	24	48%
Caucasian or White	14	28%
Asian	9	18%
African-American or Black	2	4%
Not Provided	1	2%

Table 2. Respondent Work Status

	Frequency	Percent
Full-time employed	15	30%
Unemployed	9	18%
Retired	9	18%
Part-time employed	7	14%
Self-employed	5	10%
Disabled	3	6%
Student	1	2%
Other	1	2%

Main Study in Koreatown, Los Angeles: Procedure

The Koreatown, Los Angeles study consisted of an in-person survey with several parts, including the boundary-drawing task and the one-day activity log. It also included an environmental assessment of the neighborhood by the researcher to qualitatively determine physical features in the neighborhood such as signage and the appearance of buildings. Finally, it included an analysis of block-level Census data for comparison with collected survey data. The data collection phase consisted of multiple trips to Los Angeles to conduct surveys and fieldwork, spanning a time period of approximately three months, from early September to early December 2014.

Description of the stages of the study follows, including the survey tasks in the order in which they were presented to respondents. The in-person survey tasks consisted of: (1) the demographic questionnaire; (2) a boundary-drawing map task of Koreatown; (3) open-ended description of the drawn boundary; (4) an estimate of the proportion of different ethnic groups in Koreatown; (5) respondent identification and interaction within Koreatown; and (6) an activity log to calculate activity spaces. Stages (7) and (8), the neighborhood assessment and the measurement of spatial proximity, respectively, were conducted both concurrent to and following the survey data collection.

Demographic questionnaire. After granting permission to participate in the research study, respondents were asked a series of demographic questions. These questions asked for each respondent's address, year of birth (age), gender, self-identified race or ethnicity, primary language spoken at home, and occupational status. The objectives of the study suggest that these attributes of resident identity will be important for analysis of the cognitive boundaries of Koreatown.

Boundary-drawing map task. For the boundary-drawing task, respondents were provided a printed base map of the area, showing a street map of the study area and the surrounding area of approximately two miles added on each side (see Figure 5). The same areal extent was shown on the base map for each respondent, regardless of the respondent's residential location. Streets and highways obtained from the U.S. Census Bureau's TIGER/Line® Shapefiles were displayed on this base map, labeled with their names.

Respondents were instructed that they were to be shown a map and asked to indicate on the map where they believed the Koreatown neighborhood was located, by drawing a line containing the neighborhood in any shape they deemed appropriate. Respondents were allowed, but not prompted, to revise their boundaries by changing their original drawing before continuing the survey. In one or two cases, the respondent expressed that the base map did not include the entirety of the area they wished to indicate, and was asked to describe the intended extent of their drawing (this was noted and included in the digitization of the paper maps). Assistance was provided when the respondent expressed difficulty locating on the base map a specific feature such as a street. Two examples of boundaries drawn by respondents which differ in shape, size, and location are shown in Figure 6.

Open-ended description of boundary location. Following the boundary-drawing map task, respondents were asked to give a report of their reasoning behind the placement of the boundary. They were not cued as to what kind of explanations to provide, rather to discuss why they considered the area they indicated on the map in the previous task to be "Koreatown." This was an open-ended question, potentially allowing respondents to name features in the environment and other physical elements, cultural elements, signage, or official designations.

Perceived ethnic composition of Koreatown. The next task had residents estimate the percentage of Koreatown residents that belong to each of the following ethnic or racial categories: 'Hispanic', 'White', 'Black', 'Korean', and 'Other Asian'. Responses were checked at the time of administration to confirm they totaled 100%, and respondents were allowed to change their estimates if desired; in a few cases, the recorded percentages did not total 100% and were recalculated on a 100-point scale post-survey to allow for comparison.

Identification with and interaction within Koreatown. Additional survey questions had respondents provide length of residence in their current neighborhood, whether they identified themselves as living within "Koreatown" (if not, the name of the neighborhood they identified as living in), whether they currently work in Koreatown (if not, the name of the neighborhood they currently work in), the approximate number of times they shop in Koreatown per week, and whether they visited places in Koreatown in their free time (if so, for what purposes).

These questions are targeted towards understanding respondents' level of identification with "Koreatown" and their general level of interaction within the neighborhood. The specifics of their activities, expanded on in the following task, may also aid in understanding respondents' beliefs about the ethnic composition of neighborhood. As barriers to movement or activity are strongly tied to cognitive boundaries, I expect the similarity between respondents' drawn boundaries of Koreatown and their activity spaces will increase with the level of identification with the Koreatown neighborhood.

Activity spaces. Finally, respondents were asked to provide information about their activities in space and time (the locations they visited and when). To make this task more reasonable for respondents to perform, as well as to improve recall, respondents reported a

single day of activity: the locations they visited on the previous day. The activity log included for each trip the time of day, location visited (street address, or cross-streets if address was unknown), purpose of trip, whether the trip was undertaken by the respondent alone or with others, and mode of transportation used. If a specific location was named, the exact address was added post-survey to facilitate geocoding of activity locations. The activity log was created based on guidelines from previous travel surveys, with consideration for the completeness of needed information and accuracy of recall. Guidelines referenced include those by Chapin (1974), Kenyon (2006), and Tourangeau, Rips, and Rasinski (2000). A multi-day activity log left behind with the respondent was not practical for the administration of this survey, which involved a single, in-person visit with each respondent.

I predict that residents who live closer to the collective 'edges' or borders of Koreatown may have activity spaces that extend further in some direction away from the center of Koreatown, while the activities of those living closer to the center may concentrate more within the neighborhood. Residents' activities largely center on important anchor points of home and work, and activity spaces would therefore be expected to encompass peoples' residence and workplace locations. Examining the extent, directionality, and location of these activity spaces from the vantage point of Koreatown will indicate how far out respondents' activities reach from the commonly-shared home activity node in or near Koreatown.

Neighborhood field assessment. Along with the stages of the in-person survey as described above, I conducted a neighborhood observation to create a basic inventory of elements in the surrounding environment, noting street and building signage, blocks of primarily retail or residential units, landmarks and vistas, appearance and usage of streets and open spaces, and so on. This field assessment, conducted concurrent to and following survey

administration, helped create an inventory of elements to inform later analysis, especially in the coding of respondents' boundary descriptions.

Census data review. Complete count data from the 2010 Decennial Census for the Los Angeles region was used for socio-demographic analysis of residents within the study area using measures of segregation. The spatial proximity index, a measure of residential clustering, expresses how population is spatially distributed within the study area and can point to the presence of ethnic enclaves. White's 1983 index of spatial proximity was calculated at the Census tract level using the open source Geo-Segregation Analyzer application (Apparicio, Martori, Pearson, Fournier, & Apparicio, 2014).

In addition, block-level data from the 2010 Decennial Census Summary File 1 (U.S. Census Bureau, 2010) was used for the summary of resident ethnic and racial composition. This complete count data was compared to respondent estimates of Koreatown's population composition for a broad measure of the accuracy of these estimates.

Results

Measurement of Cognitive Boundaries

The individual boundaries of Koreatown, Los Angeles drawn by survey respondents were used to examine respondents' understanding of the location, extent, and shape of the neighborhood. A total of 48 of the 50 respondents drew a boundary for this task. Drawn boundaries were imported from the paper maps into an ArcGIS geodatabase by scanning, georeferencing, and digitizing each boundary. Each boundary was digitally traced by hand in ArcMap 10.2. The digitization and import of the drawings into GIS software allows for area, location, direction, and distance calculations, as well as comparisons between all drawings

and with official designations of the neighborhood's boundaries. Drawn boundaries were compared using the two methods described: (1) averaging boundary polygons through a radial intersect method, and (2) calculating shared areas by raster overlay. The first method analyzes the drawn boundaries as borders or bounding lines, and is a new approach to averaging cognitive neighborhood areas by the extent of each boundary as measured from its center. The second method, raster overlay, is a well-established approach to obtaining an 'area of agreement' using multiple input polygon areas (described, for example, in Sullivan & Unwin, 2010). The two methods are expected to act well in complement, treating the drawn regions both as bounding lines and as filled areas.

Radial intersect method for average polygon. The first method for summarizing the boundaries drawn in the survey is a novel approach to aggregating data from multiple polygons to generate one averaged polygon representing the shape, location, and extent of all the included polygons. This method, that I introduce as the "radial intersect method," is inspired by a similar process briefly described in Dalton (2007, p. 8) in which the author generates an average boundary from a single common center. However, in this case there exists no single common center; in fact, some of the region centers are entirely outside other regions. This radial intersect method for averaging many regions of varying shapes, some of which contain areas wholly separate from other regions, instead selects the centroid of each of the individual input polygons as the center for each radial calculation. This results in a different process that aims at a similar end goal.

The basic steps of this method are as follows. The radial intersect method requires taking the centroid (spatial center) of each drawn boundary polygon using the average x-value and the average y-value of the polygon, then drawing radial lines from the centroid to intersect

with the boundary line of each polygon in 16 different, evenly divided directions. The number of directions was chosen to be 16 because it is a multiple of 4 (respecting the likely applicability of cardinal directionality on this flat surface) that would have sufficiently high resolution but not unnecessarily so. The point location of the intersection of the radius line with the drawn boundary was recorded, resulting in 16 intersection points for each respondent's boundary. All of the respondents' intersection points corresponding to the same angle from the centroid—for example, all points that intersected each respective 270° line from the centroid for all of the included respondents' polygons—were then averaged. This resulted in the average intersection location for all of the 0° lines, all of the 22.5° lines, all of the 45° lines, and so on for all 16 angle directions. These averaged points were finally connected by a line to approximate an 'average boundary' for all respondents. See Figure 7 for a visual diagram of the workflow for this process. The script for this process was written in Python using the ArcPy package for integration with ArcGIS functionality.

To ensure that this method appropriately maintained the shape, size, and location of the input polygons when averaged, a simulation was run to check that the radial method did not over-simplify the polygons. A grid of 4 x 4 polygons of various regular shapes was generated and the process described above was run for each of the scenarios (all triangles, all squares, or a mix of shapes). These simulations produced the expected results, which were that the output shapes, averaged over many polygons, would preserve the shape and size properties of the input polygons. This confirmed that the radial intersect method seems to properly maintain the shape, size, and location of these input polygons, indeed producing what we may consider an 'average polygon' output from the individual polygons. For instance, the simulation of this method using an input of 16 regular triangles of the same size, oriented in

the same direction, and arranged in a 4 x 4 grid, resulted in an 'average' polygon shape resembling a triangle, located in the center of the grid, with the same size and orientation of the original input triangles. A mix of different shapes, such as in the simulation of squares and triangles together, returned a shape with rounder sides, with however a narrower 'top' when all triangles were oriented with one point to the same 'north' direction. When considering this radial intersect process as an averaging method, this is consistent with expected results: an averaging of different shapes should somewhat "soften" the rigid edges of the input polygons when they are of different shapes.

The resulting shape of my average region polygons after applying this radial intersect method is generally circular, though it appears flatter on the north, east, south, and west sides. Figure 8 illustrates the result of this radial intersect process. This flattening is probably an effect of respondents tending to draw along the street grid and thus drawing a rectangular shape for their boundary. Of the individual boundaries drawn by respondents, 28 could be characterized as mostly rectangular, 8 appear circular, and 12 cannot readily be characterized as either circular or rectangular. The overall average boundary is quite symmetric north–south and east–west, with a 'width' of 1.75 miles (east to west) and a 'height' of 1.74 miles (north to south).

The variability across all respondents' boundaries was also considered. The standard deviation along the east–west and north–south directions for each of the 16 averaged angular intersections was calculated. The most variability occurred in the east–west direction (x-direction) along the western boundary of the neighborhood, with the most uncertainty in the southwest part of the boundary and more certainty moving north, in an ordered pattern. The average standard deviation in the east–west direction (x-direction) of these averaged angular

intersection points was 0.39 miles. The average standard deviation in the north–south direction (y-direction) was 0.41 miles. Figure 9 shows a representation of the variability around each of the average intersection with each of the 16 angles, shown as 95% confidence intervals around each point in the x- and the y-directions. These show a fairly even variation around the perimeter of the polygon, with some differences between average intersection points.

Raster overlay method for areas of agreement. The second method, raster overlay, focuses on the areas within the regions rather than their boundaries; it lends itself well to the computation of areas of agreement between all respondents. This method first converts the digitized boundaries into polygon areas, overlaying a raster grid of cell size 10 x 10 feet and representing each individual's drawn boundary as a separate layer, then overlays the raster layers and assigns a value of 1 for each grid cell contained within each of the areas and 0 for each cell not within the area. For example, a cell that is contained within 20 respondents' drawn boundaries would be assigned a value of 20. Cells of size 10 x 10 feet were considered to be adequately high resolution, assuming the collected data is not nearly that precise (meaning no expected loss of additional information at this cell resolution because respondent drawings of boundaries and their boundary concepts are much grainier, or less precise, than that level of resolution). All raster layers are overlaid to compute areas of agreement. For this analysis, areas of less than 50% agreement, 50%–75% agreement, and more than 75% agreement were created. Figure 11 shows these aggregated areas of agreement.

The area of highest agreement among respondents (75% or more) for the Koreatown region is approximately bounded by West 3rd Street on the north, Vermont Avenue on the

east, Olympic Boulevard on the south, and Western Avenue on the west. This is an approximately rectangular shape except where it includes a small portion of the area west of Western Avenue in the southern part of the area of agreement. The total contained area of the 75%+ agreement region is about 1.2 square miles. The area of at least 50% agreement is approximately bound by West 1st Street on the north, Vermont Avenue on the east, Pico Boulevard on the south, and South Wilton Place on the west, and has an area of 2.6 square miles. The 50%+ agreement area has rougher edges than the 75%+ agreement area, suggesting more dispute between respondents about the outer reaches of the Koreatown neighborhood. The fact that these areas are different itself indicates uncertainty about the extent of Koreatown.

Comparison with official and crowd-sourced definitions. The averaged regions resulting from the two methods described above were also compared with the official definition of Koreatown by the LA City Council (LACC) as well as the crowd-sourced definition from the "Mapping LA" project of *The LA Times*.

First, the boundaries set forth in each of the two definitions (official LACC definition and Mapping LA 'popular' definition) were compared to the average polygon created using the radial intersect method. Figure 10 overlays the definitions of Koreatown by the LACC and the Mapping LA project onto the average polygon created with the radial intersect method.

When compared to the LA City Council definition, the average boundary clearly stretches further beyond the sides of the rectangular LACC region, excepting only the narrow arm of the business corridor that extends along the part of Western Avenue contained by the LACC region. The size of the area contained within the average boundary (approximately 2.6 mi^2) is larger than the LACC region (approximately 1.4 mi^2) by about 1.2 mi^2. The difference

in shape between the boundary averaged from respondents' drawings and the boundary defined by the LACC is also notable, as several individual respondents had defined a circular region in their drawings, contributing to the roundness of the overall boundary created by averaging the individual boundaries. These two bounded areas have a similar location—as judged by comparing their centroids—centered on a point less than a third of a mile (about one or two city blocks) apart, near the intersection of South Kingsley Drive and 7th Street.

The polygon averaged with the radial intersect method appears to be more similar in size to the Mapping LA boundary than to the LACC boundary, but there is more difference when examining shape and location of these two boundaries. When compared to the Mapping LA definition of Koreatown, there is only a minor difference in area (about a tenth of a square mile) measured between the average boundary computed from respondents' drawn boundaries and the slightly larger crowd-sourced boundary from the Mapping LA project (measured as 2.7 mi^2). The shape of the Mapping LA boundary, however, is a fairly irregular polygon, showing a mostly rectangular shape with an extra protrusion in its southwestern portion and some irregularity along the edges to follow places where the street grid shows variation. As for the relative locations of these boundaries, the average boundary calculated above is further to the south than the Mapping LA boundary of Koreatown, with its north–south placement nearer to the LACC definition than the Mapping LA definition. The two areas appear to cover a similar east–west extent, with the centroid of the Mapping LA definition also located approximately at South Kingsley Drive.

The raster overlay areas of common agreement across study respondents were also compared to the official and popular definitions of Koreatown previously mentioned. See

Figure 12 for the areas of agreement with an overlay of the LA City Council definition and the Mapping LA definition.

When compared with the official definition of Koreatown from the LA City Council, the area of highest agreement (75% or more) closely matched the LACC definition on the western, northern, and eastern sides. However, this agreement area did not include any overlap with the protruding arm of the business corridor further north along Western Avenue in the LACC definition. This agreement area also did not stretch as far south as the LACC definition, which goes all the way to include 12th Street rather than stopping at Olympic Boulevard. Also noteworthy is that the 75%+ agreement area (and to a lesser extent the 50–75% agreement area) nearly share the same eastern extent as the LACC definition, stopping at Vermont Avenue as a visible edge to the neighborhood. The 50–75% agreement area extends symmetrically approximately 0.3 to 0.4 miles beyond the edges of the 75%+ area except for on this eastern side, where it appears there is more reliable agreement about Vermont Avenue as that edge.

When the raster overlay areas were compared to the crowd-sourced "Mapping LA" definition by readers of *The LA Times*, there are places where the Mapping LA definition extends beyond the over 50% agreement areas of the survey respondents. The Mapping LA definition includes a protrusion on the southwestern part of the area that is not depicted in my respondents' boundaries, though perhaps hinted at by the small stretch of the southwestern part of the over 75% agreement area. The northeastern part of the Mapping LA definition also captures more area than my respondents depicted in their drawn boundaries of Koreatown. However, the 50-75% area of agreement among the respondents of this study

does extend as far south as Pico Boulevard, which is further south than either the Mapping LA or the LACC definitions reach.

Neither of the boundaries computed by these methods closely resemble the LA Department of City Planning's more conservative definition of Koreatown, which, again, is defined as "generally bounded by Eighth Street on the north, Twelfth Street on the south, Western Avenue on the west, and continues east towards Vermont Avenue" (Los Angeles Department of City Planning, September 19, 2001). Though it overlaps with both the average boundary from the radial intersect method and the agreement areas from the raster overlay, it is contained almost completely within the bounds of each and confined to its southern portion. Though this could be another source of information that influences people's concepts of Koreatown's boundaries, this definition is less prominent or publicly-referenced than the LACC or Mapping LA definitions and will be disregarded in the rest of the analysis.

Coding Salient Features in Descriptions of Cognitive Boundaries

Responses to the open-ended prompt, "Please explain why you drew your boundary line of Koreatown where you did," were coded and analyzed to identify salient features in respondents' ideas about the boundaries of Koreatown. Survey respondents expressed a wide variety of reasons for the placement of their boundary. Responses to this question were typically only a few sentences long and transcribed in real time by the researcher or research assistant during survey administration. Of the 50 survey respondents, one respondent declined to respond to this survey question. Of the 49 responses to this question, 48 were coded and one was determined not to contain useful content. The transcribed explanations were segmented into semantic units ranging from a single word (for example, a street name) to a short phrase in length (a descriptive comment).

These explanations of the drawn boundaries were coded into one of three main categories: physical features, social or cultural features, or other features. Again, as with the coding of the pilot study results, the coding system was the result of an iterative process incorporating both top-down and bottom-up approaches. The three categories proposed were based on the research questions and prior work on cognitive regions. The identified categories were used to generate topic items to expect in the responses, starting with potential features identified during the in-person environmental assessment of the area, including features such as streets and highways, businesses, signage, and the ethnicity of residents.

After several iterations of the categories, the final coding system consisted of the following features within the three categories. Items categorized as "physical features" included visible paths, barriers, or landmarks, particularly street names, businesses, and signage (such as street, neighborhood, or store signs). "Social or cultural features" were mentions of a particular group of people, such as by ethnicity or language, or social characteristics of people in the neighborhood. "Other features" included residents' description of adjacent neighborhoods, memories or events they link with the neighborhood, or sense of identity and community connection. These three main categories were further subdivided into eight sub-categories.

From the 48 coded responses, a total of 150 semantic units were placed mutually exclusively into one main category and one sub-category. These categorized units are summarized in Table 3 below, including the number of respondents whose explanation mentioned at least one of the feature types listed in each of the categories and sub-categories, as well as the number of total mentions of each of the feature categories and sub-categories.

Table 3. Features Mentioned by Respondents in Open-Ended Descriptions

Feature Type	Number of Respondents	Number of Mentions
Physical	**39**	**66**
Presence of businesses, such as stores, restaurants, offices	21	28
Streets mentioned by name	16	26
Presence of signage	12	12
Social or Cultural	**30**	**61**
Presence of groups of people, named by race or ethnicity	24	42
Social characteristics of people or groups of people	12	19
Other	**12**	**23**
Events or memories related to the Koreatown neighborhood	8	10
Other neighborhoods, mentioned by name	6	10
Use of external aids, such as maps or online sources	3	3

Physical features. Physical features were most commonly mentioned in these open-ended explanations, with a total of 39 respondents mentioning at least one physical feature. Of the physical features, many respondents (n = 21) mentioned the presence of Korean businesses or other establishments as one reason for their placement of the Koreatown boundary. Others named specific streets (n = 16) and signage (n = 12).

Commonly referenced streets in the open-ended explanations were Olympic Boulevard (mentioned by 9 of the 16 respondents who mentioned at least one street by name), Western Avenue (mentioned by 5), and Vermont Avenue (mentioned by 3). When compared with the analysis of drawn boundaries in the previous section, in which both the radial intersect average boundary and the raster overlay of shared areas help identify prominent streets in respondents' boundary drawings, these streets clearly stand out as important features for the

basis of many peoples' cognitive maps of Koreatown. Olympic Boulevard is a large thoroughfare running east–west and is visible in many respondents' drawn boundaries as the southern extent of Koreatown (especially in the 75% agreement area of the raster overlay). The north–south running Western Avenue is notable as a common western boundary of Koreatown, and the north–south running Vermont Avenue is shared by most respondents as the eastern boundary.

Social or cultural features. Social or cultural features were also important in these explanations. These responses reflect an understanding of Koreatown's location based on the presence of a Korean population, reinforcing the concept of Koreatown as a Korean ethnic enclave within the city. A total of 30 respondents mentioned these social or cultural features, which included both mentions of social groups ($n = 24$) or of the characteristics of groups or individuals ($n = 12$). The mention of a social group may be, for example, the naming of an ethnic or racial group in the area (such as Koreans, Filipinos, or Guatemalans). The mention of social characteristics includes statements such as "Koreans at the market are super respectful to their own, but very cold to others" and "Koreans congregate and loan money for starting businesses."

As expected, the presence of Koreans in Koreatown was strongly felt by respondents. Korean people were mentioned by all of the 24 respondents who made mention of at least one ethnic group in their explanation. But respondents also mentioned a variety of other ethnic or racial groups, often using generic terms like "other Asians" or "Hispanics" to name these groups. The mention of other ethnic groups reflects the recognition of the neighborhood as a non-homogenous social space shared by other people. Ethnic or racial categories

mentioned included Korean, Filipino, Salvadoran, Guatemalan, Bengali, Thai, African-American, Caucasian, and other groups of people.

By including statements about characteristics of groups of people or individuals, respondents also attributed personal meaning to what the presence of certain people might mean to the community. These statements included contrasting themes: One view depicting Koreans as community members who improve the neighborhood financially and aesthetically through economic growth, and an opposing view of Koreans as isolated, exclusive business people who mainly look out for their own. Several responses also touched on the theme of Koreatown's shifting nature, recognizing the diversity and changing demographics of the area's residents. One respondent specifically noted social differences between first-generation and second-generation Korean immigrant neighbors, suggesting that patterns of immigration shape the social character of the neighborhood.

Other features. Other features were not mentioned by as many respondents as were physical or sociocultural features, but these and other features were still present in several responses categorized as 'other.' The types of memories of events that stood out to respondents in relation to Koreatown's neighborhood extent were those that reflected a sense of 'ownership' or community involvement, such as the occasion of a local Korean cultural festival. When respondents mentioned neighborhoods other than Koreatown, they spoke of these in the context of bounding the edges of Koreatown. For instance, one person stated, "Outside of this area [the area indicated on the base map by the respondent], it is not really Koreatown anymore. North of 3rd Street, you're getting closer to Hollywood. South of Olympic Blvd, more Pico-Union." This statement recognizes the wide boundary between one neighborhood to the next, a type of transition zone between neighborhoods where a person

may not be entirely inside only one place. The use of external aids to understand the boundaries of Koreatown included a few mentions of the knowledge of demographic data, maps, and online sources to locate Koreatown's boundaries.

Respondent Estimates of Residential Ethnic Composition

Overall characterization. Respondent estimates of the residential composition of Koreatown, Los Angeles ranged widely. A total of 48 respondents answered this part of the study, and 2 declined to answer. Consistent with what was observed in the pilot study, this was the most difficult task for survey respondents, sometimes requiring multiple prompts before the respondent both understood the task and was willing to give an estimate. The difficulty observed in completing this task suggests that this type of question requires significantly more effort on the part of respondents or that it causes much more uncertainty than other aspects of the survey, and may be in part because it is an unfamiliar kind of request. Though most people have some tendency to mentally group others into ethnic or racial categories, they may not be accustomed to making an overall estimate of population, and especially of residential population (which may look different from the daytime population of an area).

The range of estimates and averaged respondent estimates of Koreatown's ethnic composition based on the categories of "Hispanic," "Asian," "White or Caucasian," and "Black or African-American" are presented below in Table 5. These categories are based on the ethnic categories presented in the survey, but for the purposes of comparison summarize "Korean" and "other Asian" together to match the 2010 Decennial Census race and ethnicity categories available at the block level. For the comparison of perceived versus 'actual' residential composition (recognizing that the actual composition is continuously-changing),

Table 6 displays the residential composition calculated using block-level data from the 2010 Decennial Census (U.S. Census Bureau, 2010) for both the LA Times "Mapping LA" definition and the LA City Council definition of Koreatown, as well as the difference between these numbers and the averaged estimates from survey respondents.

Table 5. Respondent Estimates of Ethnic Composition in Koreatown

	Mean	Minimum	Maximum	Std. Deviation
Hispanic	**37%**	15%	78%	16%
Asian	**46%**	10%	80%	19%
White / Caucasian	**11%**	0%	33%	9%
Black / African American	**7%**	0%	30%	7%

Note: Percentages are rounded to the nearest whole number, and therefore may not sum to 100%.

Table 6. Comparison with Census Report of Ethnic Composition

	Mapping LA Percentage	Mapping LA Difference	**LACC Percentage**	LACC Difference
Hispanic	**47%**	-10%	**48%**	-11%
Asian	**39%**	7%	**40%**	6%
White / Caucasian	**7%**	4%	**6%**	5%
Black / African American	**5%**	2%	**5%**	2%
Other	**2%**		**2%**	

Note: Percentages here divide total count of residents identifying with each ethnic/racial category on the Census for the blocks included in each boundary definition (Mapping LA or LACC) by the total count of all residents within that boundary definition. Difference is calculated by subtracting the Census-reported percentage for each ethnic category listed from the mean respondent estimate for that category.

Comparison of ethnicity estimates with Census counts. Comparisons of the survey respondents' estimates of the Koreatown ethnic composition are displayed in Table 6 above. The differences between the percentages calculated from the Census counts of residents who identify with each of the ethnic categories and the mean percentages for the estimates by respondents for each of the ethnic categories is calculated for each of the boundary definitions (columns with the headings "Mapping LA Difference" and "LACC Difference"). Looking at the difference between the mean estimates and the Census counts for the region bounded by the Mapping LA definition, there is a 10% underestimate for Hispanic residents, a 7% overestimate for Asian residents, and a weaker overestimate for each of the other ethnic groups. If we instead consider the difference between the mean estimates and the Census counts for the LACC region, there is an 11% underestimate of Hispanic residents, a 6% overestimate of Asian residents, a 5% overestimate of white (Caucasian) residents, and a 2% overestimate of black (African-American) residents. Though some of these appear to be very minor overestimates, the overestimate of Asian residents and the underestimate of Hispanic residents may explain some of the estimation error for the other ethnic/race categories.

Daily Activity Spaces

Activities reported in the one-day activity logs were cleaned and entered into the GIS geodatabase, with information about activity type or purpose, location, time of day, mode of travel, and who participated. Addresses were geocoded from their street addresses, or nearest cross-streets when exact addresses were not available. A total of 98 locations visited outside the home were recorded for all 50 respondents who provided a response to this question, an average of 1.96 locations visited outside the home per person. Table 7 below displays the frequencies of locations visited for respondents. Of these visits, 30.6% were made for the

purpose of shopping, 22.4% for work, 13.3% for visiting or attending family, and 12.2% for dining, with the remaining visits categorized as errand (8.2%), leisure (8.2%), religious (2.0%), or uncategorized (3.1%) activities.

Table 7. Number of Reported Locations Visited by Respondents in Activity Logs

	Frequency	Percent
0 locations	4	8%
1 location	19	38%
2 locations	14	28%
3 locations	6	12%
4 locations	4	8%
5 locations	2	4%
6 locations	0	0%
7 locations	1	2%

Activity space ellipses were only computed for those respondents who visited at least two locations outside the home, as a minimum of three points are required for this calculation. Each respondent's home location was used as another reference point in the activity space calculations. Activity spaces for 27 respondents were computed, consisting of 79 total recorded locations (not including home locations).

Activity space ellipses were calculated using the "Directional Distribution" tool in the Spatial Statistics toolbox in ArcGIS 10.2. Using the given x- and y-coordinates of each of the visited locations, this tool calculates the standard distances for the x- and y-directions from the mean center location, then outputs the standard deviational ellipse that will be used to represent each respondent's activity space. In this analysis, one standard deviation was represented, covering about 68% of visited locations for each respondent, assuming peoples'

activities have a spatially normal distribution. Alternatively, two standard deviations would represent 95% of locations, and three standard deviations would increase that to 99%.

Extent, orientation, and location of respondent activity spaces. The extent of respondents' activity spaces was analyzed by comparing the areas of the standard deviational ellipses. The average size of respondents' activity spaces was 12.6 square miles ($n = 27$), with a minimum size of 0.1 square miles and a maximum size of 83.4 square miles.

The orientation of the activity spaces was examined to determine whether there was apparent directionality in respondents' activities around the Los Angeles area. The average orientation of the summarized activities was 77.1°, with 0° corresponding to an ellipse oriented north–south and 90° corresponding to an ellipse oriented east–west. An orientation of 77.1° is approximately southwest–northeast, and is consistent with the relative location of the mean center of the ellipses reported above. The ratios of the minor axis to the major axis for these activity space ellipses are also on average very small, with the average minor axis only 22% as long as the major axis, indicating ellipses that are quite narrow.

The average location (mean center) of all of the activity space ellipse centers is located in the southwest portion of the study area, showing that as an overall trend, respondents' activity spaces are pulled to the west away from Koreatown. This is to be expected considering nearly half of these respondents reported activities in areas to the west of the study area, including in the cities of Malibu, Santa Monica, and Beverly Hills. There were some activities located to the south, there were notably fewer activities included to the north and to the east of the study area.

Role of travel mode. For each of the locations recorded in respondents' travel logs, the mode of travel was also recorded. This was collected to help explain the difference in extent

of activity spaces, as primary mode of travel may reflect access to modes of transport such as a personal vehicle or public transit systems. Those residents of the study area who did not have regular access to a car or to other vehicular travel modes may have more limited activity spaces, as those who for instance travel mainly on foot would not be expected to regularly visit locations more than a few blocks away from their homes.

More than half (62%) of respondents primarily traveled by car for the activities captured in the one-day log. The next largest modeshare was a tie between walking and taking the bus or another form of transit (each 14%). Primary mode of travel appeared to relate to the size of the drawn boundary in the earlier task, but was only marginally significant ($r(44) = .29$, $p = .059$). This reflects only the primary mode taken by respondents on a single day and is not fully representative of their regular travel. The questions following the activity log asked respondents to comment on how 'typical' their activities of that collected day were, in an attempt to collect additional information about how representative they thought their activities on that one day may have been. For the most part, the activities listed by respondents in the one-day log were at least similar to the day of the week that the data was collected: for example, a respondent who provided her log of activities for a Friday noted that this was typical of her Friday travels. Other respondents used this opportunity to list other places they normally visit but did not visit on that specific day.

Of those 27 respondents for whom activity spaces were calculated, those who primarily drove their own vehicle had the largest activity spaces on average ($n = 19$, $M = 16.4$ mi^2) followed by those who primarily rode the bus or took another form of transit ($n = 5$, $M = 4.8$ mi^2). This corresponds with what is expected based on resident access to travel mode (especially car ownership), which is that those who have the option of traveling by private

vehicle will travel more miles on average than those who are restricted only to other modes of transportation.

Comparison of activity spaces with drawn boundaries. On average, the activity space ellipse for those respondents with at least 3 recorded locations (n = 27) was 9.8 square miles larger in area than their drawn neighborhood boundary of Koreatown. Approximately 63% of these respondents had individual activity spaces that were larger than their drawing of the Koreatown boundary. There was more variation in the activity space areas (SD = 22.3 mi^2) than in the drawn areas (SD = 1.8 mi^2), and no significant correlation was found between respondents' activity space areas and their drawn boundary areas. A visual comparison of activity spaces and drawn boundaries confirms that activity spaces stretch much further, across the city of Los Angeles and even beyond to neighboring cities, than do the definitions of a single neighborhood.

Clustering of Ethnic Groups in the Greater LA Region

Clustering was measured by computing White's spatial proximity index for different ethnic and racial groups using Census 2010 tract-level data for the Los Angeles urbanized area. When examining the two main groups of interest in my study area, Hispanic and Korean residents, there are slight differences in the amount of overall clustering present in the residential locations of these groups in the LA region. Korean residents show evidence of spatial clustering: The index of spatial proximity (SP) for Koreans in the region is equal to 1.16 when compared to white residents, where a value of SP greater than 1.0 indicates differential clustering. Hispanic residents show differential clustering to an even higher degree (SP = 1.21) when compared with non-Hispanic residents, suggesting that they are more residentially-clustered.

Discussion

This comprehensive study of residents' cognitive boundaries of Koreatown in Los Angeles has taken a deep look at where people locate the boundaries of the neighborhood, what people think and know about the neighborhood and its extent, and how they move around within it. This study has also explored the uncertain connection between the neighborhood as officially designated and the neighborhood as understood by its residents, which is itself an interconnected process. Comparison of the boundaries drawn by survey respondents living in the study area with boundaries set forth by the city council and by a more general audience exposes differences in the concept of Koreatown, emphasizing the neighborhood as a rich and varied social environment. It also shows similarities between these boundary definitions, supporting the idea of the neighborhood having shared mental representations among its residents and visitors, with common themes emerging from the urban landscape, either through its visual or other sensory attributes, or through other features such as verbal labels or political designations. There are a multitude of processes that shape people's relations to and comprehension of the urban 'neighborhood' as a cognitive region and certainly also many ways in which we may learn about these representations. This work extends our understanding of how people think about vague cognitive regions more generally, and about the particularities they associate with ethnic enclaves more specifically.

The sample of respondents included in this study is more representative of the population of Koreatown as measured by the Census, which differs from the population of Los Angeles more broadly. However, Asian residents were underrepresented in the survey, which can be attributed to an observation in the field that many Korean residents lived in gated apartment

buildings or larger complexes, to which the door to door sampling method did not allow the researcher adequate access (block-level Census data from 2010 confirms that most of the blocks with the highest concentration of Asian residents were indeed those largely consisting of controlled-access apartments). Caucasian residents were overrepresented in the sample relative to Caucasian population in the study area, potentially because of greater willingness to participate in the survey. Unemployed and retired residents may also have been overrepresented in the sample due to a greater likelihood of being home at survey times, which were largely during the afternoon and early evening.

Boundary Agreement and Disagreement

Koreatown is a particularly interesting study area because it is a prominent ethnic enclave in the city, recognized for its residential and commercial concentration of Koreans while being shared as a home by many other groups of people. Respondents living in the local area drew boundaries of the neighborhood and showed significant individual variation in how they represented Koreatown's boundaries. They provided drawings with a large range of locations, extents, shapes, and other properties, yet there were notable levels of agreement amongst most of these. Using two different methods of averaging the Koreatown boundaries drawn by respondents, the radial intersect method and the raster overlay method, I was able to demonstrate the outcome of applying different methods of analysis to understanding the uncertainty around a cognitive region. In this case, a common center area emerged from both of the calculation methods, which shared some commonalities with each other and could also be related to the two Koreatown boundary definitions used for comparison from the LA City Council (LACC) and *The Los Angeles Times* Mapping LA project.

There are important differences in the purpose, methodology, and communication of the definitions of Koreatown by the LA City Council members, *The Los Angeles Times* readers, and the respondents in this survey. The two definitions used for comparison differ in terms of who is represented: While the LACC definition includes opinions from elected representatives, stakeholders, and other politically-involved community members in attendance at the council meetings about Koreatown and its adjacent regions, the *LA Times* Mapping LA project aims to reach their entire LA-based readership, who were invited to share their thoughts on where the boundary stood for all of the neighborhoods of Los Angeles. Both the LACC and the Mapping LA boundary for Koreatown were reached by compromise. The LACC reached a compromise about Koreatown's boundaries after several discussions and revisions in a formal process with opportunity for public input (Krekorian, 2010). The Mapping LA boundary of Koreatown was instead created by a team of staffers at *The LA Times* and revised after receiving over 650 user-drawn maps and many comments from readers ("About Mapping LA," 2010). Notably, the Koreatown boundary presented in the Mapping LA project was created concurrently with many other neighborhood boundaries in Los Angeles rather than by considering Koreatown in isolation. This suggests that bordering neighborhoods could well have influenced the placement of Koreatown's boundary, which may also partially explain its irregular shape in this project (see Figure 3). Although I expect that people do consider the presence of nearby neighborhoods when defining an individual neighborhood, requiring them to explicitly think of the placement of surrounding areas may involve more consideration about which areas along the boundaries may be "more" representative of one neighborhood or the other. For instance, an area of higher uncertainty which may be included when asked about Koreatown may not be included

if it more clearly 'fits' another neighborhood. Compared to the respondents who contributed to the crowd-sourced Mapping LA project by *The Los Angeles Times*, which included anyone from their readership who wished to contribute to the neighborhood definitions, the sample of respondents in this survey were likely more representative of residents of Koreatown.

In this study, I have applied a radial intersect method of summarizing polygons in a novel way, comparing it to a raster overlay method and making a methodological contribution to this type of analysis. The two methods used to summarize these boundaries from survey responses produced somewhat different results. The radial intersect method was potentially a better aggregate estimate of the shape of the drawn boundaries, averaging the boundary locations of the areas drawn by respondents and the directional extent in sixteen directions from the spatial centers of each of these areas. The area created by the radial intersect method was located with its center at West 7th Street and South Kingsley Drive, the furthest northern extent between 1st and 3rd Streets, the eastern extent between Vermont Avenue and Virgil Avenue, the southern extent between 12th Street and Pico Boulevard, and the western extent between Irving Boulevard and Van Ness Avenue (see Figure 8). The averaged area appeared quite circular, though there was a visible flattening of the 'sides' corresponding to the north, east, south, and west cardinal directions. Displaying the confidence intervals in the x- and y-directions around each of the average intersection points around the perimeter of the polygon (Figure 9) shows that there is more variability in the western part of the perimeter, indicating less certainty among respondents about how far west the boundary of Koreatown reaches.

When overlaid with the definitions of Koreatown from the Los Angeles City Council and *The LA Times* Mapping LA project, as shown in Figure 10, the similarity in size between the polygon resulting from this radial intersect method and the Mapping LA boundary suggests

that these two definitions which take into account the perspectives of residents and local community members are more generous estimates of the area included in the region of "Koreatown" than the city's definition presented by the LACC. The LACC boundary of Koreatown, which necessarily reflects a push and pull from elected representatives and community stakeholders invested in the economic and social success of their neighborhoods, may be a condensed version because of the political influence of surrounding neighborhoods. This is clearly shown by some of the compromises reached by the Council, such as allowing for the inclusion of the business corridor of Koreatown which runs along Western Avenue, "from Third Street to Rosewood Avenue situated *inside the East Hollywood area* [emphasis added] on the west" (Krekorian, 2010).

The raster overlay method (Figure 10), on the other hand, paints a picture of which areas are commonly included by respondents, the areas shared by specific proportions of the survey respondents. Montello et al. (2003) found that when respondents were first asked for the "default" downtown region (without specifying level of certainty), it corresponded closely to the region they drew when instructed to indicate their 50% confidence downtown region. In my study, it seems to follow that the 50% agreement between respondents may also be a better measure of an 'average' boundary of Koreatown. The 50% or more agreement area is larger in area than the 75% or more agreement area by about 1.4 square miles (> 50% region = 2.6 mi^2; > 75% region = 1.2 mi^2). Though the boundaries specified by the two analysis methods are quite different in shape and appearance, the total area contained within the 50%+ confidence region from the raster overlay matches the areal size of the 'average' polygon generated by the radial intersect method (2.6 mi^2).

It is interesting to consider not only that the survey responses showed variation around Koreatown's extent, but also that this is supported by individual expressions of uncertainty in respondents' open-ended descriptions of the reasons for their boundary location. The variation shown in respondents' boundary placements can also be partially attributed to the variation in respondent attributes, such as ethnicity, work status, length of time living in the neighborhood, and so on. A larger sample would allow us to explore whether there are significant differences between groups of people in the locations of these boundaries.

Visual Indicators of "Koreanness"

Respondents' open-ended explanations for their placement of Koreatown's boundaries is a compelling aspect of the study because they provide evidence for an answer to the question of why people believe the boundaries of this cognitive region lie where they do. Examining the results of the coded explanations, it is clear that Korean business establishments and Korean-language signage are both salient in peoples' mental images of Koreatown. Both businesses and signage are highly related in this context, as the recognition of businesses as Korean was often attributed to the Korean-language signs outside of them, although the clientele or ownership of the business may too have played a role in this recognition. Businesses that are recognized by residents and visitors as "ethnic" or "ethnic-serving" are signals to the presence of that ethnic community within the area, and therefore the spatial extent of visually-marked Korean institutions should relate to the spatial extent of residents' cognitive boundaries as well. The use of a separate language (and in the case of the Korean language, even a separate script, called *Hangul*), meant to facilitate communication and cohesion amongst those who share it, sets a group of people apart when viewed from outside. Interestingly, the economy of Koreatown is not tied solely to its local clientele but reaches

into the surrounding suburbs, where there is a large presence of Korean residents and smaller concentrations of Korean communities, and has global links as well. Serving as a node to the larger and more extensive community, Koreatown's area of influence may be much broader symbolically than its spatial area, which can generally be agreed upon. Additionally looking at ethnic Korean business ownership in the area would further supplement this investigation.

In addition to business signage, respondents pointed to other signage, most notably the "Koreatown" neighborhood signs present in the area. These small blue signs, shown in Figure 2, are mainly mounted on traffic light poles or lamp posts at the intersection of two streets, and are meant to delineate the entrance into a certain neighborhood. They may send the message to observers that the neighborhood is an official political designation, though this is not the case in Los Angeles. Other than Koreatown, the neighborhoods of Historic Filipinotown, Country Club Park, Little Armenia, Wilshire Center, and others are present in the surrounding area's signage. These are mostly adjacent neighborhoods and districts, but some are even partially or wholly contained within the borders of 'Koreatown'. However, there is no mandated nor consistent basis for determining the placement of these neighborhood signs: Requests for posting new neighborhood signs are reviewed on a case-by-case basis, often not coordinated with other efforts by city officials or organizations to define the boundaries of the neighborhoods. It is not surprising that the existence of the signs, which proclaim the existence and location of a neighborhood, would so influence respondents' ideas about the neighborhood's boundaries. However, several survey respondents expressed their own disagreement about the placement and even the names posted on these signs, and neighborhood signs are only one piece of the puzzle. These signs, though explicitly naming neighborhoods, were less salient to people than the Korean-

language business signs—most likely due to the overwhelming imbalance in quantity, with small blue neighborhood signs posted at the occasional street intersection versus a multitude of storefront signs written in Hangul script.

The importance of streets to cognitive boundaries of the Koreatown neighborhood was also clear in these survey responses, as they served as both a physical barrier to activity and as a mental dividing line between regions. For instance, Olympic Boulevard is a major, high-traffic road, and at seven lanes across, it is difficult to cross from a smaller arterial street on foot because of the infrequently marked crosswalks, and even nearly impossible to cross by car except at signaled intersections. In a very real sense of the word, it acts as a barrier to north-south movement across. This impedance of activity contributes to its role as a commonly shared boundary, though it is unclear from the scale of the drawn boundaries whether residents mostly thought of the region as *including* Olympic or merely going up to Olympic. One reason Olympic Boulevard may be included as part of the region is because it serves as a business corridor, with many large retail stores, fast food restaurants, and smaller businesses. From the neighborhood observation, Olympic Boulevard is noted as a major commercial corridor, and has numerous buildings and plazas with a significant presence of Korean businesses with signs written in the Hangul script. It may be representative of the commercial face of Koreatown, but it is an open question as to whether people think of Koreatown as more of a residential or retail area, or as both to some extent. Would the definitions of Koreatown as a residential enclave be much different from the definitions of Koreatown as a business district?

Though sufficient for the purposes of interpreting respondents' answers to the question about why they located their Koreatown boundary where they did, a more extensive and

systematic environmental field assessment would be a useful attempt to quantify the number of visibly "Korean" features in Koreatown, to generate areas within Koreatown that seem to be more physically marked as Korean. This system could be based off of examples of environmental audit instruments, such as that described by Ewing & Handy (2009) for accessing neighborhood walkability, counting numbers of certain features on both sides of every block: Korean- and Spanish-language signs or businesses, for instance. Business databases could be used to classify and count potentially Korean-owned businesses in the region by name, as in the classic example using telephone directories (Reed, 1976; Zelinsky, 1980) which has been updated in more recent examples using Internet business databases or by automatically extracting data from other online sources, such as retrieving place names from web pages (Jones, Purves, Clough, & Joho, 2008) or from geotagged images (Rattenbury, Good, & Naaman, 2007; Hollenstein & Purves, 2010). However, these methods leave open the question of *why* a certain spatial location is considered a "place" in the minds of the people who are calling it one in their business names or tagging it as such in their shared photographs. There is a limited amount of prior research on quantitatively identifying the physical and social elements that relate to the cognition of a place as an ethnic enclave, and this study proposes several types of salient features that people recognize and agree upon. The precise relationship between salient features within the built environment and individuals' reasons for what defines a "place" such as Koreatown is yet to be determined.

Physical cues such as foreign-language signage in the neighborhood seem to be more salient indicators of an ethnic enclave than the actual demographic makeup of the neighborhood, though it is clear that people use the presence of Koreans as an indicator of place as well. As survey respondents were all local residents of the area, it can be assumed

that enough time is spent in the area to form an idea of who lives, works, shops, and dines around Koreatown. Additionally, these social and cultural attributes mentioned by respondents were not limited to those describing the residential population, as the visibility of Korean shopkeepers and the daytime population of Koreatown played a role in their boundary ideas as well. Therefore work schedule and time of day may be important influences on respondents' ideas of Koreatown: Those who reside in Koreatown and spend all day working outside of Koreatown will almost certainly have a different idea of Koreatown's population than those who live elsewhere and spend their working hours in Koreatown. The activity space analysis confirms that some Koreatown residents indeed spend much of their day away from their home in an entirely different part of the city.

However, a point to remember is that explicit reports, such as the open-ended question posed here, are self-reported and have important limitations. The survey question, which asked respondents to "explain why you drew your boundary line of Koreatown where you did," may be improved by more precisely asking for specific reasons that they believe the boundary of Koreatown is there in the real world, as it may have been misinterpreted as asking for why they drew the boundary there on the map. For the most part, these responses are peoples' theories about why they believe Koreatown has the location and extent they specify. But people do not have full and complete access to their own beliefs or the process they use to construct those beliefs, and in this case they need not only to access these ideas, but also to externalize their ideas to the researcher by verbally expressing their thoughts (Montello & Sutton, 2013). A respondent may be unsure about why they believe the boundary of Koreatown is located where they indicate, and nonetheless provide an answer to the question. People may intentionally change how they present their thoughts, editing them

to avoid embarrassment or to tailor to the interviewer out of politeness, for instance (Tourangeau, Rips, & Rasinski, 2000).

Ideas about Who Lives in Koreatown

Survey results from the respondent estimates of resident ethnic composition hinted at the accuracy of peoples' estimates based on established social terms for categorizing race and ethnicity. Respondents' percentage estimates at this scale were generally fairly accurate, with average combined error for any one ethnic category under 10 percent. There are only a few instances in which this type of ethnic group estimation has been used in surveys, one being the General Social Survey (GSS) in 2000, the only year this ethnicity estimation task was included. Wong (2007) analyzed Americans' estimates of the ethnic composition of the entire United States as reported in the 2000 GSS, and suggested that respondents' nationwide estimates were based on what they know and observe from their local surroundings. Though the posing of the questions on this module of the GSS and in my own survey differs, the results of my survey seem to support the claim that residents have surprisingly good sense of their local residential context and may base it off of specific knowledge such as the race or ethnicity of their own neighbors. However, these survey results also show an overestimate of Asian residents relative to recent Census counts of the actual Asian population in the area, and a relative underestimate of Hispanic residents.

The popular, shared naming of this neighborhood as "Koreatown," a name that necessarily indicates the presence of an ethnic enclave, apparently does contribute to peoples' ideas of who inhabits the neighborhood. This may be the reason for the overestimation of Asian residents and the underestimation of Hispanic residents (of whom there are relatively more living in Koreatown than in the greater LA region, as stated

previously). Respondents' estimates of residential ethnicity composition may also indicate that the changing nature of Koreatown's boundaries and its residential makeup are a challenge to residents' cognition of where the neighborhood is. Several people observed in the survey's open-ended description that the neighborhood was "expanding" in spatial extent over time or that the type of people living in Koreatown had been changing as the neighborhood grew in popularity. Additionally, the visual dominance of Korean-language signage and Korean businesses in the area are another likely factor for this overestimation of Asian residents, as people may overly conflate the presence of Korean residents with the existence or visibility of Korean-owned stores, restaurants, banks, and other businesses.

A further refinement to this analysis would be to compare ethnicity percentage estimates along the lines of individual respondent attributes and the residence location of each respondent. By using Census block counts that correspond to each person's drawn boundaries of the area identified as Koreatown, it would be possible to measure how much discrepancy exists between each individual's ethnicity estimates and the 2010 Census block-level ethnicity reports for the population in the approximate area that the respondent considers to be Koreatown. Perceived ethnic composition of Koreatown as reported by each respondent is expected to depend upon each individual's idea of where the boundaries of Koreatown are located. One caveat, however, is that resident proportions will have shifted in the time between when this last Census count was taken and the time when this survey was administered.

Respondent Temporary Travel Behavior

The relationship between concepts of the spatial properties of the Koreatown region and the extent and orientation of the activity spaces of surveyed residents is of interest as well.

The wide range of extents shown in the one-day activity spaces clearly demonstrates that residents' spaces of interaction are not bound by their local area. People travel much further than the extent of a single urban neighborhood, even leaving out purely work-based trips. Without specific information about the routes taken between visited locations, the standard deviational ellipse is a good representation of a person's activity space, generalizing the extent, location, and directionality of the summarized travel data.

The orientation measures of the activity space calculation suggest that there is greater spatial similarity and/or greater social intersection between Koreatown and those areas to the south and west than between Koreatown and the areas to the north or east. When observing the ratio of the minor axes to the major axes of each ellipse, it is clear that most of these observed activity spaces are very narrow. This may not only reflect deviation from the 'main' route (between the two furthest away locations), but may also reflect the willingness to make trips to locations further away. Mode of travel—of which driving was the most common—would certainly affect this shape, as those who primarily drive would be expected to make longer and further trips.

A potential limiting factor in this activity space analysis was the sample size of respondents who provided enough travel information in their one-day logs to calculate a standard deviational ellipse of activity locations. Only slightly more than half of all respondents reported at least two activity locations other than the home. In fact, the most frequent number of locations visited by respondents in the surveyed day was one (38% of respondents reported only 1 location). A focused study of activity behavior should ideally take into account more days of travel activity. This could be achieved by visiting each respondent on two occasions (once to leave a travel log or diary and administer directions,

and another time to collect the recorded travel information), or by using a mail-in survey. However, the lower retention rate through repeated visits or the lower response rate of mail-in surveys may cancel out the added benefit of collecting enough locations for more respondents. Another alternative which has been made possible through more recent technology is to have respondents carry a digital device such as a smartphone or Global Positioning System (GPS) unit to track their location, perhaps even with prompted recall methods to aid in entering their activities (Auld, Williams, Mohammadian, & Nelson, 2009; Shareck, Kestens, & Gauvin, 2013). When looking at activity spaces, it would be interesting to compare other factors that may relate to extent, location, or directionality of activity spaces, such as access to travel mode, socioeconomic status, ethnicity, and employment status. For instance, life-cycle considerations could be taken into account, as the difference in respondents' life cycle stages may account for significant differences in sizes of their activity spaces (Carrasco et al., 2006).

Additionally, it is worth considering that respondents' activities do not only take place in physical space but include their interactions in social space as well (Carrasco et al., 2006). The use of social network data, such as locations of family members and friends, to include 'social activity spaces,' would be a valuable supplementary source of data for this type of study. Those who reside in Koreatown, as compared to those who visit Koreatown for social or other activities, may define its extent differently, see different functional purposes in it, have different emotional ties to it, and travel to different locations within it.

The results of the spatial proximity calculation suggest that Korean residents in the Los Angeles region are spatially clustered, and Hispanic residents even more so when analyzing tract-level population data. This means that Hispanic residents are more likely to live in

Census tracts that are close to other tracts with high proportions of Hispanic residents. However, segregation measures such as the spatial proximity index are highly dependent on the spatial units of analysis and all reduce the complexities of residential segregation into a single number, which hides the actual distribution of groups within the overall analysis area and completely ignores the distribution of groups within each spatial unit of analysis.

Taken all together, the comparison of drawn boundaries to other boundary definitions, the exploration of respondents' explanations for why the region was conceptualized as "Koreatown," the estimates of resident ethnic composition, and the activity space analysis demonstrate that a neighborhood is a multifaceted concept that people think about and act within in complex, interwoven ways. This study provides insight into ways in which we can measure and understand vague cognitive regions, the physical and social features that people associate with an ethnic enclave, what we can learn about cognitive boundaries from daily travel behavior, and the link between cognitive, crowd-sourced, and official boundary definitions. This study of residents' cognitive boundaries of the Koreatown neighborhood in Los Angeles has demonstrated the value and the challenge of defining a neighborhood region, particularly this widely recognized, economically and socially influential, and culturally heterogenous ethnic enclave.

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Appendix.
Survey instrument administered to respondents. Formatting differs slightly from version used for the survey. (Spanish- and Korean-language survey instruments also used).

Demographics

Address:

_____

_____

Year of Birth:

_____

Ethnicity:

_____

Primary Language Spoken at Home:

☐ English

☐ Spanish

☐ Korean

☐ Other _____

Gender: ☐ M ☐ F

Work Status:

☐ Part-time employed

☐ Full-time employed

☐ Unemployed

☐ Student

☐ Freelancer

☐ Business owner

☐ Other _____

Mapping Task

Now I will ask you what you consider to be the "Koreatown" neighborhood in Los Angeles.

1. On this map, please draw what you consider to be the boundaries of "Koreatown". Draw a single boundary line all the way around the area of Koreatown as any shape you think is appropriate.

2. Please explain why you drew your boundary line of Koreatown where you did. (Anything else?)

_____

_____

_____

_____

_____

3. What do you believe is the ethnic or racial mix of residents in Koreatown? I will read off a list of ethnic groups, and I would like you to estimate the % of residents of Koreatown that belong to each group.

% Hispanic	
% White	
% Black	
% Korean	
% other Asian	
= 100%?	

Go over to = 100%; allow respondent to change answers (show them answers).

Habitual Travel

4. Would you say you live within Koreatown? ☐ Yes ☐ No

If *yes*: How long have you lived in Koreatown? ____ years, ___ months

If *no*: What neighborhood do you live in? _____

How long have you lived in this neighborhood? ____ years, ___ months

5. Do you work in Koreatown? ☐ Yes ☐ No

If *no*: What neighborhood do you work in? _____

6. How many times per week do you shop in Koreatown? ____ times per week

7. In your free time, do you visit any places in Koreatown? ☐ Yes ☐ No

If *yes*: For what purpose?

_____

Travel Log

Now I want to ask you about the places you normally go during the week.

8. To begin, please tell me all of the places you visited yesterday, not only in your own neighborhood but anywhere in Los Angeles. Start in the morning by telling me what time you left your home and the first place you visited. Tell me where it's located and how long you were there. Then tell me the next place you visited and for how long. Please go on throughout the entire day.

Yesterday was:

☐ Sunday ☐ Monday ☐ Tuesday ☐ Wednesday ☐ Thursday ☐ Friday ☐ Saturday

Time	Location visited (address, street, etc)	Purpose	With whom?	Mode of travel?

9. Are there any locations you visited yesterday that you would not normally visit? Please describe.

Circle locations above which were not usual; take notes on descriptions below.

10. Are there any locations you did not visit yesterday that you would normally visit? Please describe.

Conclusion

Thank you for your time.

If you have further questions, please contact Crystal Bae at cbae@geog.ucsb.edu.

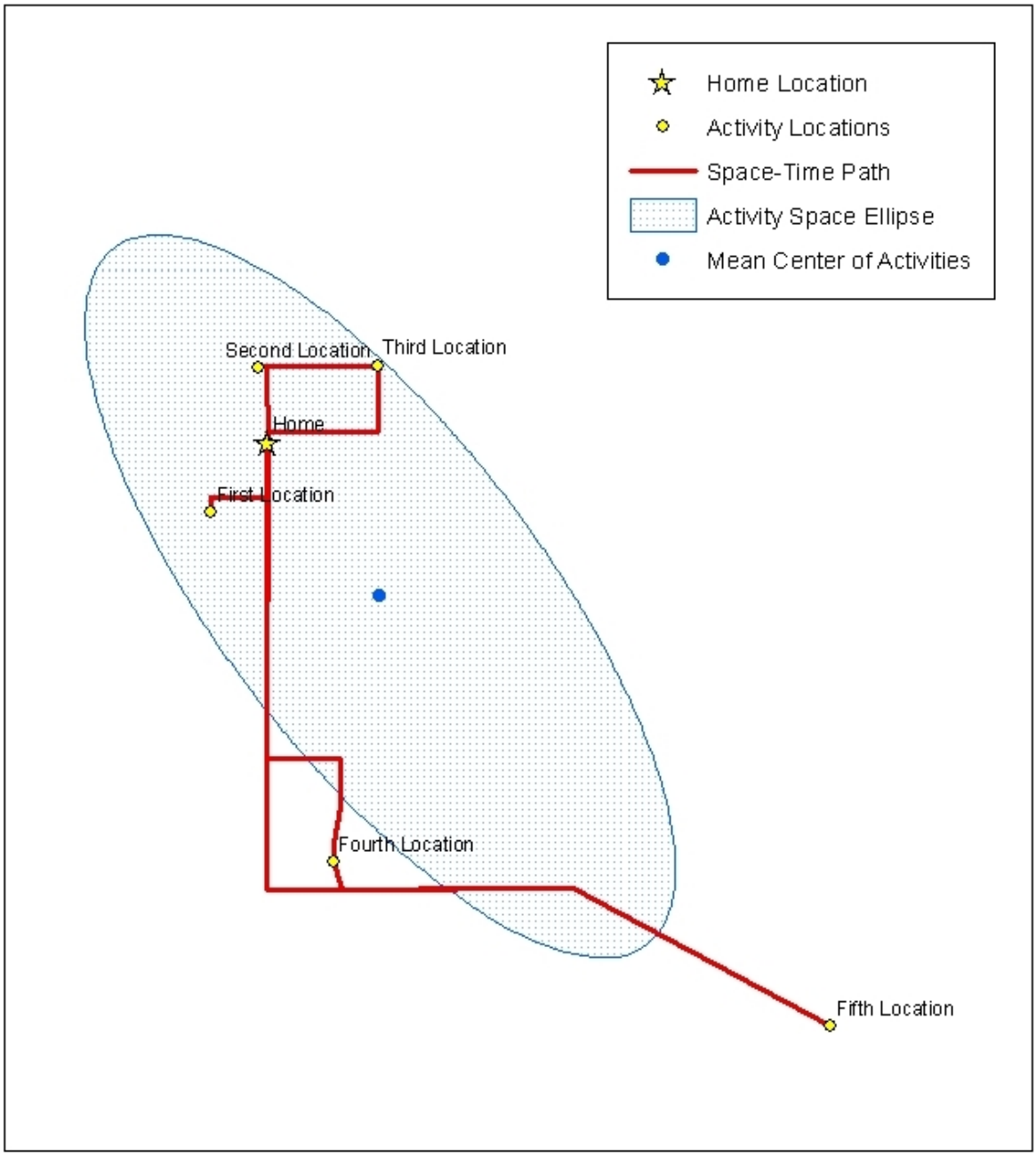

Figure 1. Example of an activity space, with home and other activity locations visited by an imaginary individual. Here the activity space is visualized in two ways: by the paths traveled in order along a street network, shown as a space-time path; and by the activity space ellipse calculation based on home and visited locations.

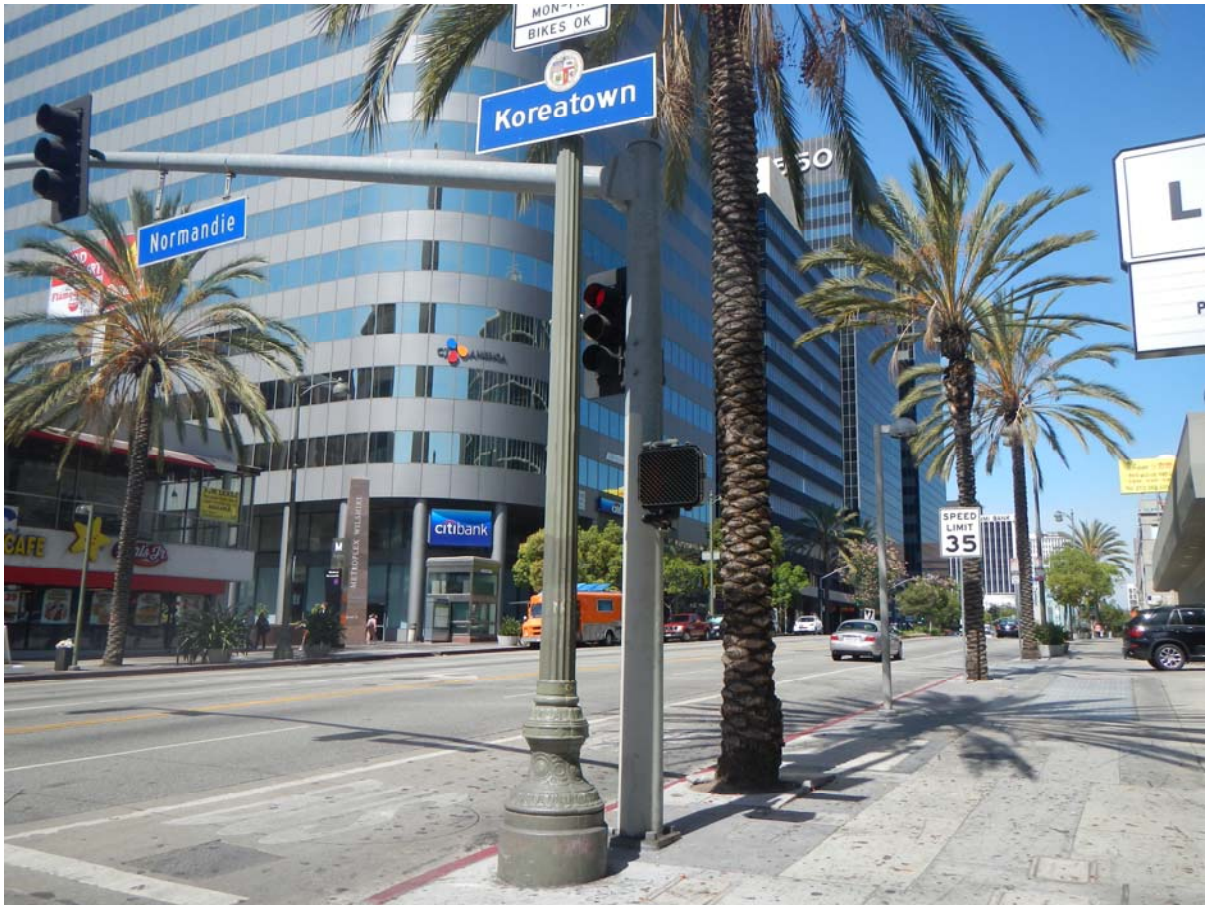

Figure 2. Photograph by the author of blue "Koreatown" neighborhood sign posted at Normandie Avenue and Wilshire Boulevard.

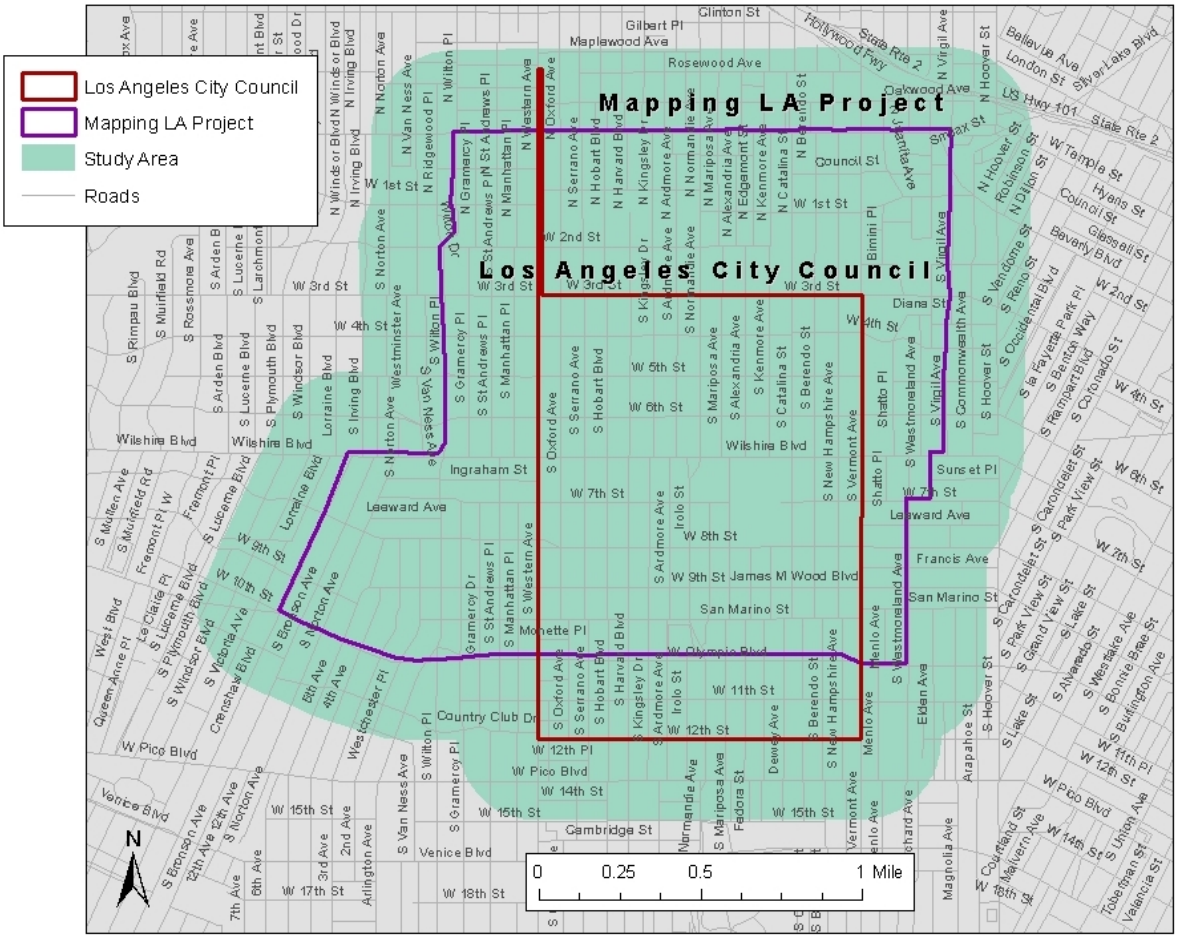

Figure 3. Map of study area overlaid on two sets of Koreatown boundaries, as published in *The Los Angeles Times* Mapping LA project ("Mapping LA: Koreatown," 2009) and as defined by the LA City Council. The study area is approximately 5 square miles in size.

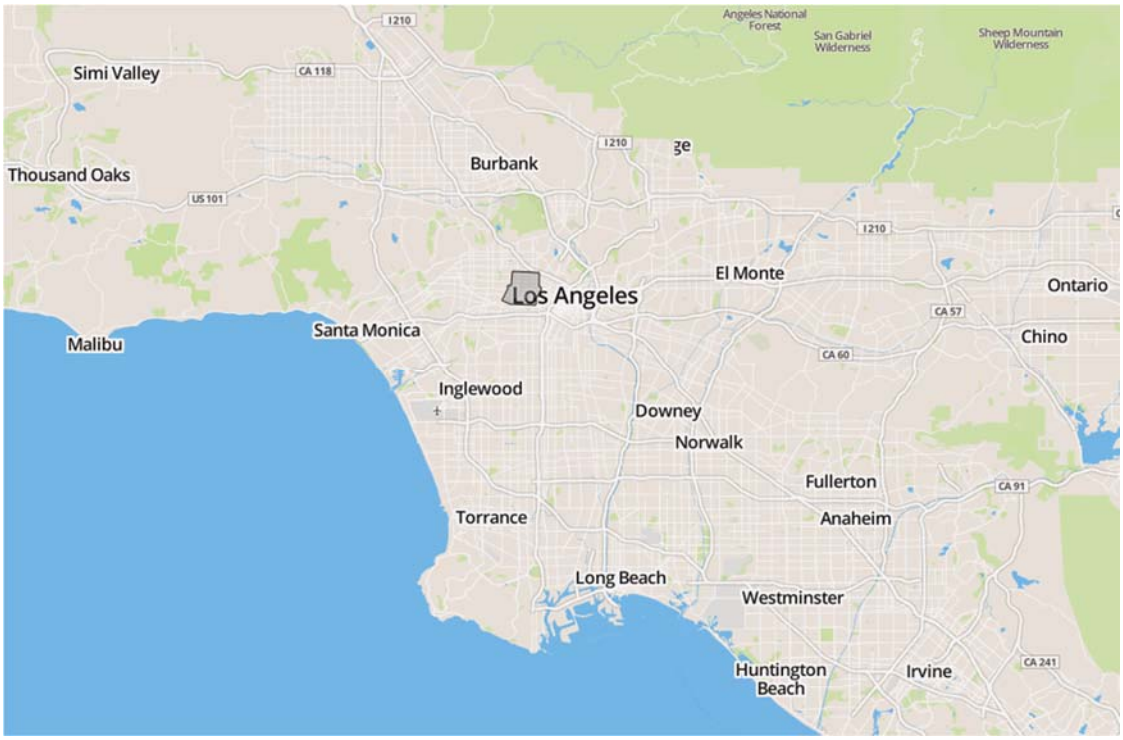

Figure 4. Map of the study area location within the greater Los Angeles region. The approximate study area is indicated here with a grey polygon. Base map from Mapbox and OpenStreetMap.

Figure 5. Sample map showing the extent of the base map presented to respondents in the boundary drawing task. This base map displays street and highway labels. Image quality as shown here is a reduced version of the base map presented to respondents, due to space constraints.

Figure 6. Example of boundaries drawn by two different respondents in the study, shown in different colors on the map. These drawn boundaries clearly differ in shape, size, and location.

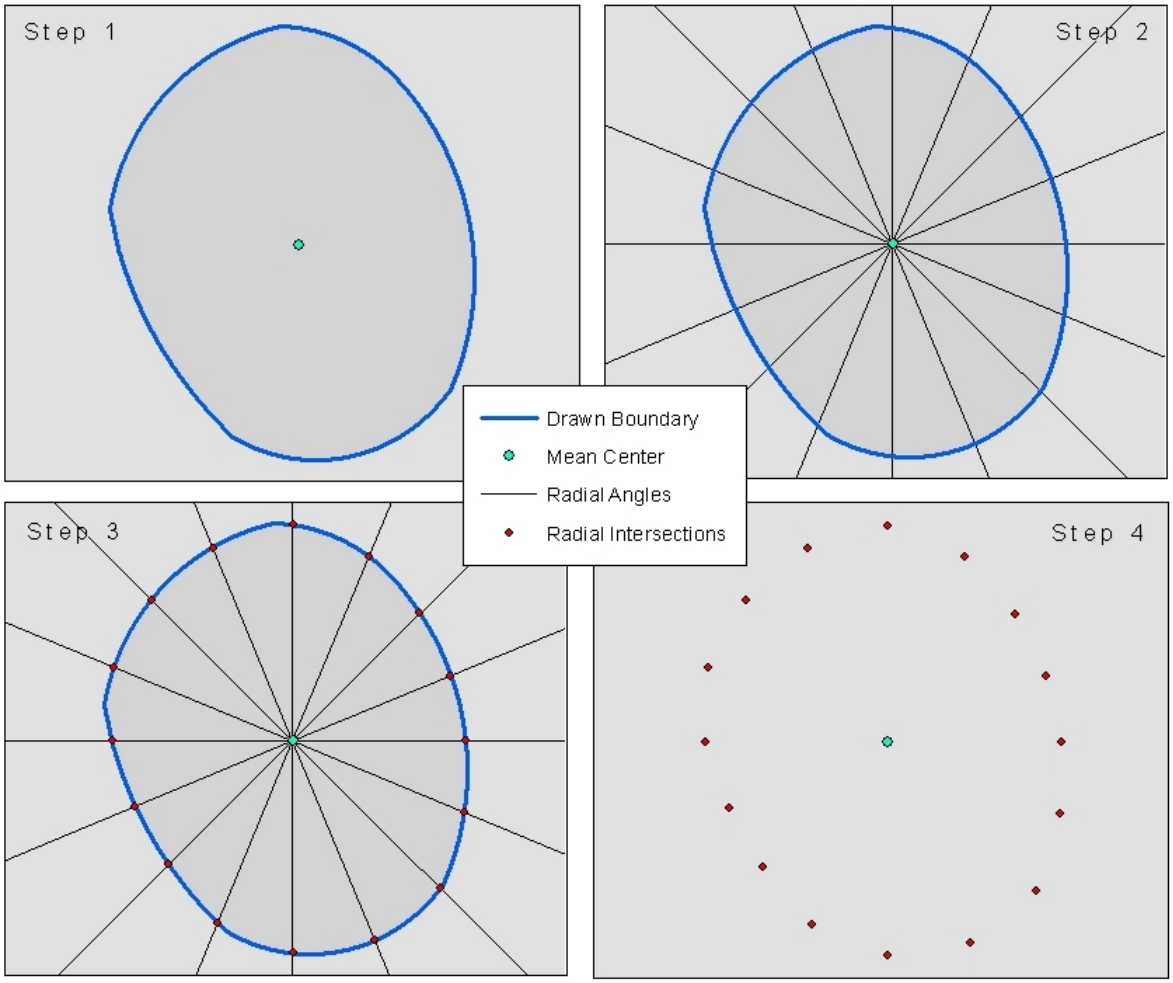

Figure 7. Visual depiction of the workflow involved with the radial intersect method. Step 1 shows the digitized polygon, represented as a line, and the mean center (centroid or spatial center) of the polygon. In Step 2, sixteen radial lines at evenly spaced angles are drawn outward from the mean center point. Step 3 shows the intersection points of the polygon boundary line with the radial lines. Step 4 displays the radial intersection points for this polygon, which are then used for averaging over all other polygons.

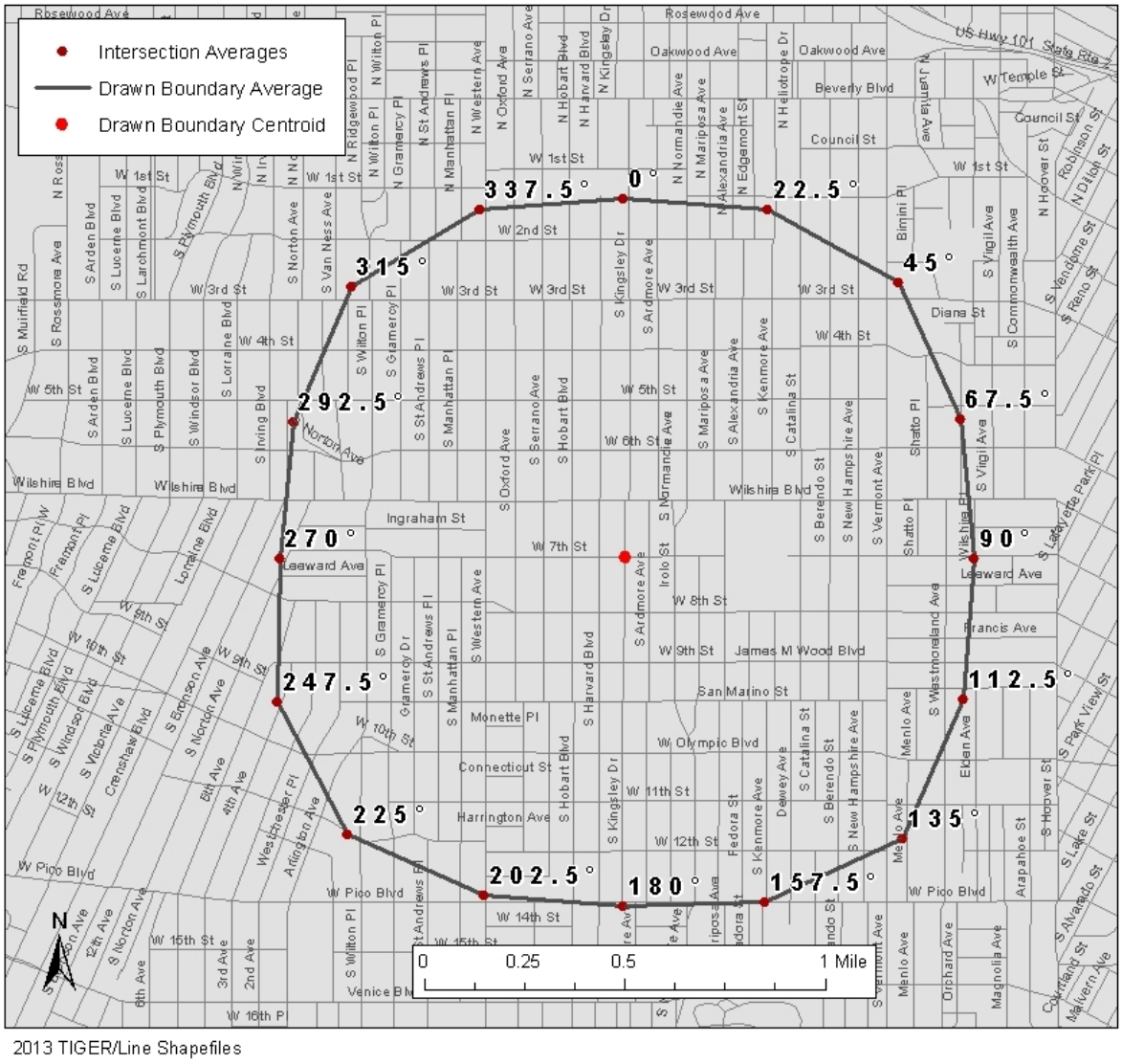

Figure 8. Average of drawn boundaries resulting from the radial intersect method. The average of each of the intersection points that meet the specific radial angle (labeled in degrees) is shown, starting with 0° at north and moving clockwise in 22.5° steps for a total of 16 different intersection points.

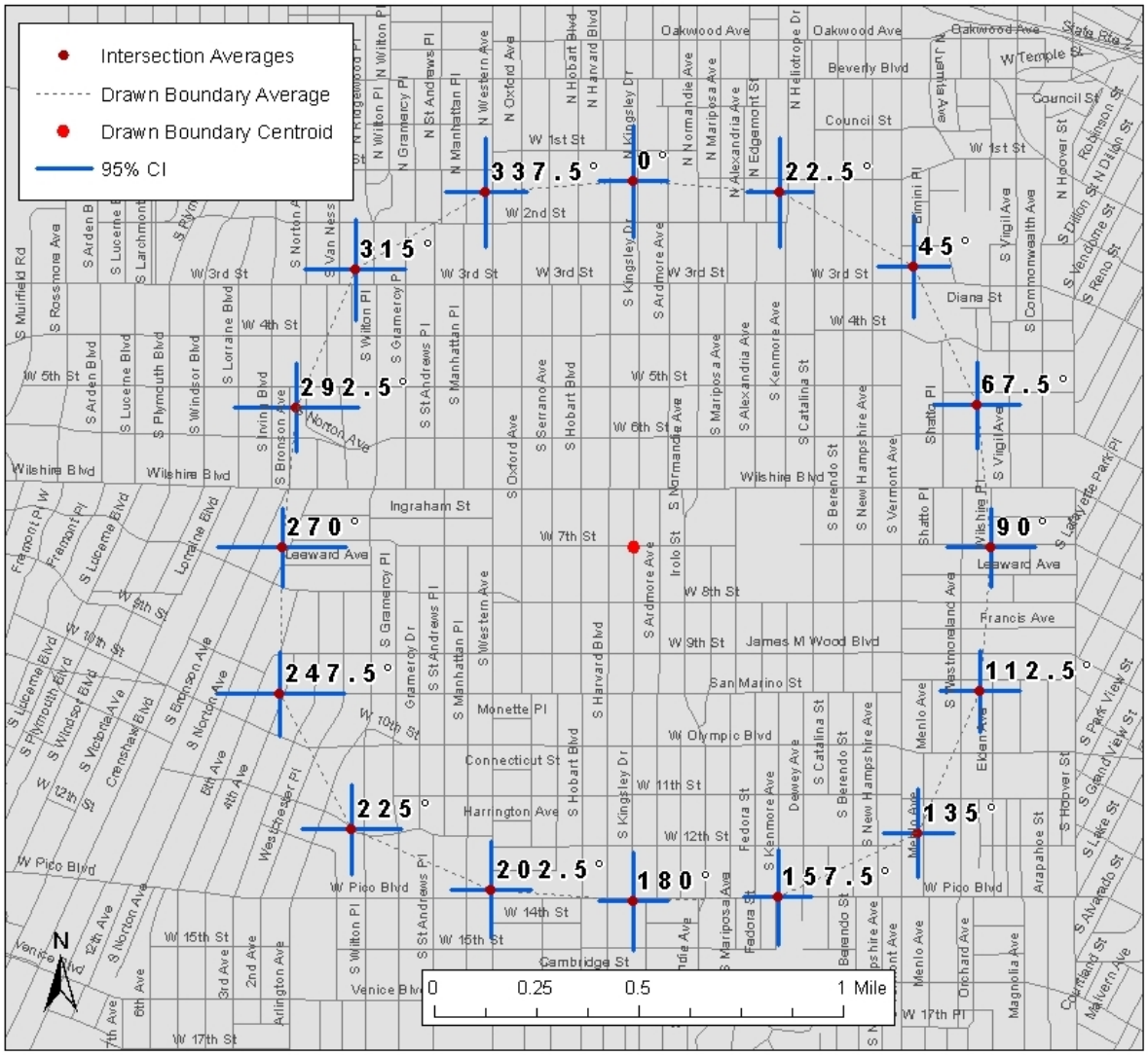

Figure 9. A display of the variability around the 16 different intersection points resulting from the radial intersect method, represented as the 95% confidence region around each point, in the x- and y-directions.

Figure 10. Average of drawn boundaries from the radial intersect method with overlaid definitions of Koreatown. Same as Figure 8 above, with the overlaid definitions of Koreatown from the Los Angeles City Council (LACC) and *The Los Angeles Times* "Mapping LA" project.

Figure 11. Areas of agreement among respondents about the boundary of Koreatown, as calculated using the raster overlay method. The central region, colored white on the map, is the area of greatest agreement (75% agreement or more). The gray-colored area indicates at least 50% but less than 75% agreement. The black-colored area indicates less than 50% agreement between respondents' drawn boundaries.

Figure 12. Areas of agreement among respondents, with overlaid definitions of Koreatown. Same as Figure 11 above, with the overlaid definitions of Koreatown from the Los Angeles City Council (LACC) and *The Los Angeles Times* "Mapping LA" project.