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Defining the community of interest as thematic and cognitive regions

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ABSTRACT

When deciding where to draw the boundaries for electoral districts, officials often strive to ensure that communities of interest are not split up but kept wholly within those boundaries. But what constitutes a community of interest is vague, with legal and academic sources describing either a thematic region with shared demographic and land-use traits, or a cognitive region that is meaningful to people and commonly agreed upon. This study, conducted in the city of Santa Barbara, California, seeks to identify communities of interest at the sub-city level as both thematic regions—by clustering Census tracts and land parcels according to classes of relevant variables—and cognitive regions—by surveying residents about the size and locational extent of their community and finding areas of agreement. We then assess the degree to which the two types of regions overlap as a way to evaluate how well the two meanings correspond. We also examine the amount of overlap between the two sets of regions and the city council electoral districts that were recently created in Santa Barbara. Our study finds that the two types of regions correspond relatively well to each other in this test city, but that the electoral districts correspond more to the thematic regions, understandable given that the district creation made no attempt to survey residents about their beliefs.

1. Introduction

Many democracies elect their representatives from carefully crafted districts, but the methods that governments use to draw their boundaries vary substantially (Handley & Grofman, 2008). While many jurisdictions allow their public officials to tweak the lines to serve partisan interests, others opt to use a set of nonpartisan criteria to create districts that are more representative (Mann & Cain, 2005). One such criterion, referred to as "respecting the community of interest," is the degree to which district boundaries unite—rather than separate—a *community of interest*, defined as a group of people with shared values, concerns, and cultural traits (Grofman, 1985). The fact that dozens of polities utilize this criterion (Handley, 2008) demonstrates the wide belief that respecting communities of interest is critical to ensuring effective and fair representation for members of these groups. When these individuals are kept together in a single district, it is thought, the resulting homogeneity enables its representative to better focus on advocating for and catering to that group's interests (Morrill, 1987).

While a general consensus exists on the importance of ensuring that electoral districts respect the community of interest, there is little agreement on any of the specific traits that characterize such a community (Cain, Mac Donald, & McDonald, 2005). If this criterion is not precisely defined, officials can draw district boundaries in various ways that do not end up fulfilling the intent behind the community criterion. Members of those communities will find themselves more poorly represented as a result. In this paper, we explore defining a community of interest as a thematic region, according to demographic and land-use attributes, and as a cognitive region, according to people's beliefs about their community ascertained from surveys we administer. Then we analyze how communities of interest defined as these two regions correspond with one another and with existing electoral districts (Fig. 1). This will tell us about the degree to which thematically defining communities of interest reflects the distribution of particular demographic and land-use variables in the city, and conversely, the degree to which cognitively defining communities of interest captures residents' conceptions of their community.

2. The community of interest as used in (re)districting

Four specific criteria stand out for their frequent appearances as stated goals in district boundary drawing around the world:

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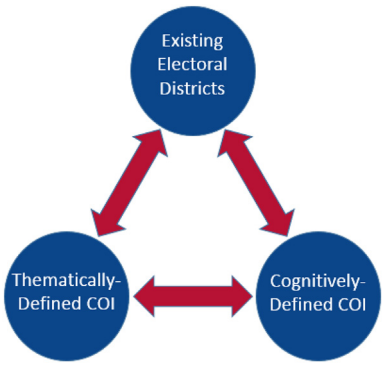


Fig. 1. Conceptual diagram of the aim of this research—to investigate the relationships between the three types of regions (COI = community of interest).

consideration of existing local administrative boundaries, contiguity of shape, compactness of shape, and respect for communities of interest (Handley, 2008; Mann, 2005). Most of these are defined easily enough: The first criterion involves making district lines correspond to administrative boundaries such as county and city lines as closely as possible; the second refers to keeping a district as a single coterminous shape instead of unconnected pieces; and the third concerns ensuring that a district has a rounded, sensible shape instead of a sinuous, convoluted one. A consensus definition has eluded the fourth goal of respecting communities of interest, however, as what exactly constitutes one has remained very nebulous (Cain et al., 2005; Courtney, 2008; Medew, 2008). Whatever the definition may be, the objective with this criterion is to respect these communities by ensuring as much as possible that district boundaries keep them together, rather than split them apart.

Despite the lack of agreement on the exact nature of a community of interest, certain common threads appear across various definitions. One is that there is a geographic element to the concept. Morrill (1987) called the community of interest "the most geographic criterion, in the sense that a major concern of geography is to identify the regional structure of a society … the territories with which citizens strongly identify, and whose integrity they want to maintain" (p. 251). Stephanopoulos (2012a) concurred, arguing that people who live nearby tend to have common interests and values and also feel more connected to each other. From the very beginning of California's use of the criterion for redistricting, the state very clearly defined it as a territorial concept—a particular area with certain interests (Mac Donald & Cain, 2013). This remains the case today, as the California Constitution defines communities of interest as "*contiguous* populations" (Stephanopoulos, 2012b, pp. 287–288). In light of these findings, it makes sense to think of a community of interest as a type of region.

Another common thread is the objective or thematic aspect of the definition. This aspect is particularly emphasized in the (re) districting law of various jurisdictions. Australian law, for instance, defines a community of interest in sociological terms by referring to "economic, social, and regional interests," as well as accessibility of communication and travel (Medew, 2008, p. 103). The state of Colorado mentions "ethnic, cultural, economic, trade area, geographic, and demographic factors" (Cain et al., 2005, p. 18). The most detailed objective traits come from California law, which references "common social and economic interests" such as those common to urban, rural, industrial, or agricultural areas, "and those common to areas in which the people share similar living standards, use the same transportation facilities, have similar work opportunities, or have access to the same media of communication relevant to the election process" (California State Constitution, Article XXI, Section 2-d-4).

The last important thread evident across the definitions for the community of interest is the subjective or cognitive element. Besides focusing on thematic attributes that come from observing *outward* characteristics of the people making up these communities, there may be another way to understand the concept that comes from observing *inward* cognitive attributes of those same people. Montello (2003) discussed this thematic versus cognitive distinction in the context of regions, describing the former as being "formed by the measurement and mapping of one or more observable content variables or themes" and the latter as being "produced by people's informal perceptions and conceptions" (p. 177). Some scholars have suggested that a human cognitive element should come into play when considering communities of interest. Chambers (1999) held that such communities are defined subjectively. Mac Donald and Cain (2013) maintained that their residents "have to perceive and acknowledge that a social, cultural, or economic interest is politically relevant" (p. 612). Perceptions of such interests do not always correlate with socioeconomic attributes, but may instead reflect environmental and cultural concerns, or even things such as attachment to places of recreation. Stephanopoulos (2012a) likewise argued that these communities have a subjective element, and that that element "does not always coincide with objective interests" (p. 1435). These conclusions lend support to the idea that one can define a community of interest subjectively as well as objectively.

Even authors who were not addressing communities of interest per se have recognized the importance of citizens living in a district with which they can identify. Prescott (1965) recommended that "boundar[ies] should be drawn to cater for local sentiment and regional patriotism" (p. 173). Morrill (1990) contended that districts should be meaningful entities with which constituents can identify. Grofman (1993) introduced an idea that he called the "cognizability principle," which refers to the ability of residents to cognize their district by being aware of the general configuration of the boundaries, thereby facilitating their "identification of and with the district" (pp. 1262–1263). These calls to consider individuals' impressions about and attachments to their local community during the process of (re)districting represent a potentially informative way to understand what communities of interest are apart from thematic aspects. They also raise the interesting theoretical question of how well cognitively-defined communities of interest will correspond to thematically-defined ones.

What rationale lies behind requiring respect for communities of interest in (re)districting? Handley (2008) explained how many authorities and citizens believe that "electoral districts should be cohesive units with common interests related to representation" so as to make the representative's job easier (p. 275). That way the representative can advocate for his or her constituents more effectively. If that is not the case, the representative may have to choose between the interests of people in disparate parts of the district, and whoever loses out will feel unrepresented as their interests go unattended (Morrill, 1987). Furthermore, more homogenous districts that respect communities of interest, while less competitive, tend to lead to representatives who are ideologically closer to the typical voter (Brunell, 2008; Buchler, 2005). If more competitive districts are desired, it is possible for such a district to include ideologically opposed communities while still wholly containing them. That way, communities can still be united in their grassroots efforts (Mac Donald & Cain, 2013, p. 613); also, few will be separated by district boundaries from their community and thereby suffer a "distinct informational disadvantage" about the election (Winburn & Wagner, 2010, p. 374). For these reasons among others, bringing clarity to the vague idea of communities of

interest stands to benefit representative democracy in important ways.

Still, the task of measuring communities of interest remains challenging. Stephanopoulos (2012a) identified two ways to measure the objective component: directly, by combing through socioeconomic and survey data, and indirectly, by using political units or media markets as proxies. The more direct method has been utilized by Stephanopoulos himself (2012b), as well as Spielman and Singleton (2015a) in the context of neighborhoods. Stephanopoulos took the approach of defining a community of interest as a geographic area that is spatially homogeneous in terms of its demographic and political characteristics. Thus he employed factor analysis to identify the factors that most differentiate California Census tracts in terms of those characteristics; adjacent tracts with similar loadings on a certain factor were considered to be members of the same community of interest. Spielman and Singleton classified Census tracts into one of 55 categories based on a host of demographic variables; similar to Stephanopoulos, tracts of the same class can be viewed as spatially homogeneous and clustered together into communities of interest.

However, Mac Donald and Cain (2013) pushed back on the idea of relying on such indicators when measuring communities of interest, arguing that "purely quantitative measures … cannot supplant qualitative public testimony" (p. 611). They pointed out several flaws in the demographic data source used by Stephanopolous and Spielman and Singleton, the US Census Bureau's American Community Survey (ACS). While extremely useful because it provides the most comprehensive and detailed demographic survey data for communities across the country, it is not collected for political purposes, its unit of analysis (the Census tract) is fairly large, its information quickly becomes outdated, and demographic data "do not necessarily translate into the perceived collective interests of a group, community, or neighborhood" (Mac Donald & Cain, 2013, p. 622). Moreover, they felt that supposedly objectively measures aren't really objective—someone still has to decide what those measures should be and how they should be weighted. While granting that such measures can be useful supplements, they emphasized the importance of public testimony in providing information that cannot be gleaned from census variables. There is also the problem of using officially designated boundaries like those of Census tracts to differentiate neighborhoods, which tend to "not reflect sociological realities" (Cain & Hopkins, 2002, p. 528). It therefore appears that collecting input from the public about the scope of their community of interest provides a crucial alternative—if not paramount—data source for measuring the region.

Certain governments will from time to time solicit public testimony on proposed boundaries for electoral districts. Most prominently, California's new redistricting commission opted to rely on public input instead of census variables when delineating communities of interest, receiving testimony from citizens during dozens of hearings across the state (Kogan & Kousser, 2011; Kogan & McGhee, 2012; Stephanopoulos, 2012b). Mac Donald and Cain (2013) agreed with that approach, contending that "public testimony gives a better snapshot of what matters to voters, residents, and communities at a given time and place" (p. 611). Since the goal of the effort was to identify the interests of communities, what better way to obtain that than by asking them? Community groups could also inform the commission about where administrative boundaries did not reflect the perceived extent of their particular community of interest (Mac Donald & Cain, 2013, p. 624). Public testimony had the greatest impact in revealing "affinities between neighboring communities, related population growth outside the boundaries of an incorporated city, discrepancies between neighborhoods and census designations, and interests not covered by data like the ACS" (p. 628). Public testimony thus proved to be very valuable in this case.

Public input has its limitations, however. Mac Donald and Cain (2013) conceded that "determining [communities of interest] through public testimony can be expensive and raises questions about selectivity bias" (p. 615). The logistics of such an effort can be daunting, especially in a large state like California, but a greater theoretical concern is the danger of selectivity bias. The people who show up to these hearings are not very representative of the public at large, as they are typically more politically informed and engaged than, and better organized than, the average citizen. Oftentimes the meetings will be dominated by certain interest groups who have the most stake in the outcome (Cain & Hopkins, 2002, p. 521). Such groups may exert social influence on nonaligned attendees, further biasing the testimony received by the authorities present. In general, any open expression of beliefs and attitudes in public group settings is likely to provide an optimal opportunity for the biasing effects of social influence mechanisms (Forgas & Williams, 2001). In sum, public input is a necessary source of information for measuring communities of interest, but that obtained at hearings cannot be trusted to reveal the true and full opinion of the public at large.

In light of these considerations, we resolve to measure all three aspects of communities of interest—geographic, objective, and subjective—by defining such communities as both thematic and cognitive regions. The thematic region will capture the objective element, the cognitive region will capture the subjective element, and the fact that they are both regions will satisfy the geographic element. We measure the objective component directly, by defining thematic regions using ACS variables that Spielman and Singleton (2015a) identified as important in differentiating neighborhoods. Fully aware of the limitations in ACS data laid out by Mac Donald and Cain (2013), we balance this approach by measuring the subjective component as well. However, we collect public input not from people attending hearings but from those at their homes in the context of their daily lives. By randomly surveying residents, we hope to obtain a sample of respondents that is representative of everyone and as free of bias as possible. That way we can define cognitive regions by assessing agreement among respondents, and then compare those regions with the thematic ones as well as the existing electoral districts.

3. Data and methods

3.1. Study area

Our study seeks to delineate communities of interest as both thematic and cognitive regions within the city of Santa Barbara, California. This city was convenient for us, but it was also appropriate because it had recently instituted district elections for its city council members after decades of having them elected at-large across the city; one of the criteria the city used when drawing the new electoral districts was respect for perceived communities of interest (Johnson, 2015). Santa Barbara was forced to make the change after being sued in July 2014 by a group of Hispanic voting rights advocates, who argued that the at-large system had failed to adequately represent Hispanics, since so few of their number had been elected to the office. On February 24, 2015, the city settled the lawsuit by agreeing to switch its city council elections to a district system, initiating a quick month-long process to create six single-member districts in time for that November's elections (Potthoff, 2015; the districts are shown in Fig. 2).

For several reasons, we considered Santa Barbara to be an informative and timely place to explore thematic and cognitive communities of interest. First, we believe the results from this city can be effectively generalized to other urban areas, at least those of

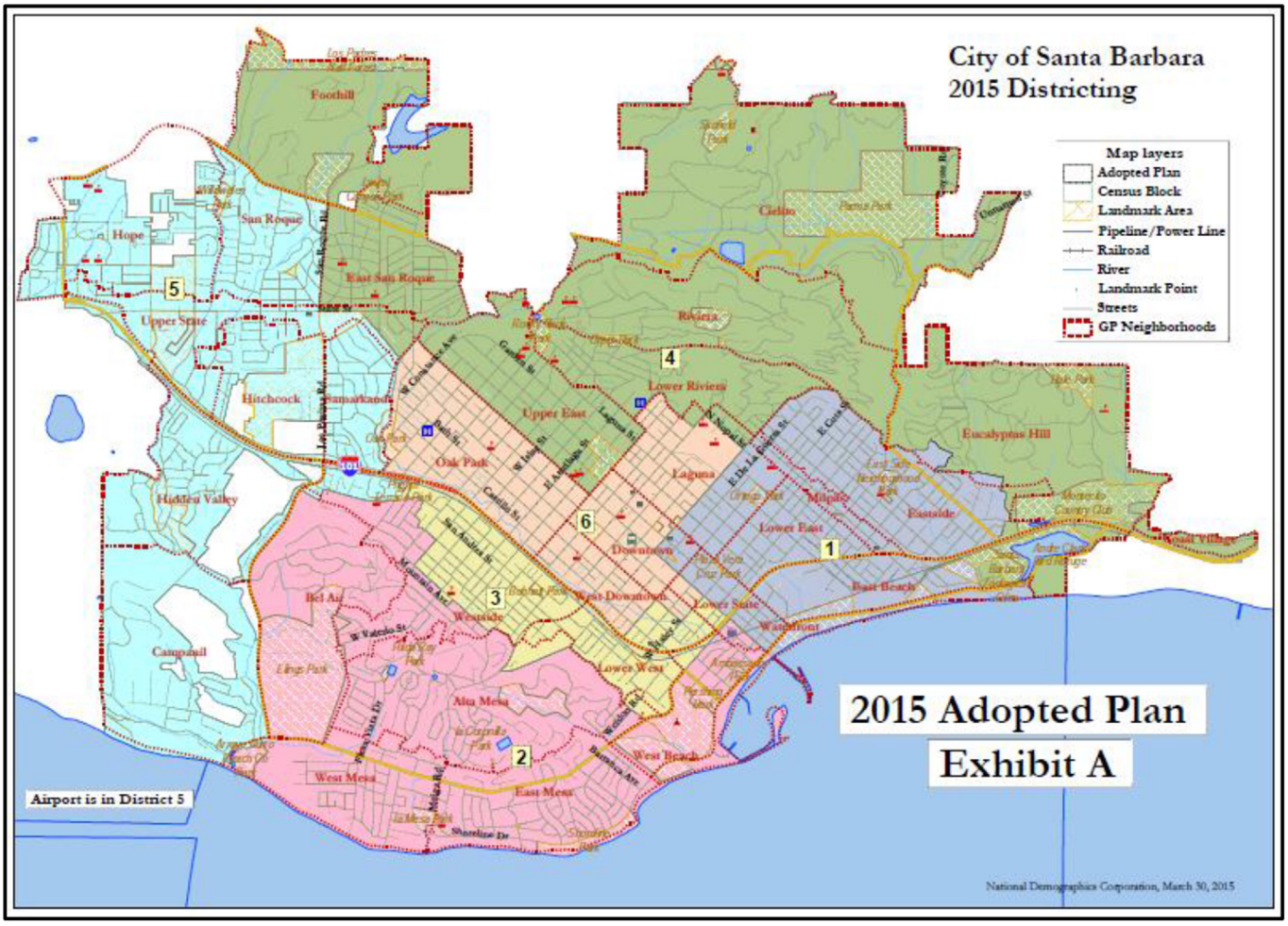


Fig. 2. Map of Santa Barbara city council districts as of 2015. Source: http://www.santabarbaraca.gov/gov/vote/district_elections.asp.

similar size, due to the diversity of many of its thematic attributes that may distinguish communities of interest, such as ethnicity, income, education, land use, etc. For example, Santa Barbara can serve as an example for cities with much disparity in education among their communities of interest, but it can also serve as an example for cities whose communities are differentiated by land use. Second, the fact that these districts are brand new means that few residents are aware of their existence, let alone have informed opinions about them, so cognitive communities of interest would likely be conceived apart from the influence of authorities' boundary decisions. Finally, our research can assess how well the city carried out its hurried districting project vis-à-vis the community of interest criterion, and thereby inform other municipalities charged with the same task, whether because of litigation or otherwise.

3.2. Communities of Interest as Thematic Regions

In order to identify clusters of Census and land-use variables, we first needed to acquire the appropriate data for those variables in Santa Barbara. Obtaining Census data presented a challenge because the ACS has several limitations. Aside from those mentioned already, one key drawback is that the ACS is not a census but a large sample, which means that a fair amount of uncertainty about the data is unavoidable. In some areas, the level of uncertainty for estimating a certain variable, as measured by the margin of error, can exceed the entire estimate. There are methods to deal with this uncertainty, however. One such technique proposed by Spielman and Singleton (2015a) is especially promising. They advocated taking a multivariate approach in which a large number of different variables for a given area are evaluated together in order to classify that area into a certain group. The benefit in doing what they termed a *geodemographic classification* is that the errors for these largely independent variable-specific estimates tend to cancel each other out, thereby mitigating the overall uncertainty effect. Nevertheless, the uncertainty involved is still substantial enough that this method only works well at the Census tract level, meaning that these units are the smallest level of resolution at which to reasonably conduct this type of analysis.

Spielman and Singleton (2015a) took on the task of classifying each tract in the conterminous United States, based on a geodemographic analysis of 136 variables from the ACS, a full list of which is available at their online Github page (Spielman & Singleton, 2015b). They selected variables that best reflected several "domains" which they believed to best differentiate Census tracts, such as age, race, and education. After selecting the variables, they classified them using Ward's hierarchical cluster analysis, resulting in a dendrogram that they partitioned at the 55-class level. This means that they could classify every tract into one of 55 categories. One caveat to using Spielman and Singleton's data is that they selected their variables for the purpose of differentiating neighborhoods, not communities of interest. Yet the two concepts

do not differ very much. The fact that they used "community" as a synonym for "neighborhood" several times in their paper suggests the near-interchangeability between the two. A neighborhood is usually considered to be a small-scale community. Though larger communities may exist, they are not a consideration for this intra-city analysis, so we did not need to distinguish the concepts much. Furthermore, the variables selected by Spielman and Singleton are appropriate indicators for thematic communities. We therefore incorporate Spielman and Singleton's comprehensive, detailed, and validated dataset into our study as the demographic component of our analysis.

We also included land-use data because the California Constitution cites common types of land use, such as industrial or agricultural, as a marker of a community of interest. The value of employing land use to define communities is validated by the Supreme Court case of *Karcher v. Daggett*, where Justice Stevens condemned one New Jersey district that merged "New York *suburbs* [and] the *rural* upper reaches of the Delaware River" and another that linked "*industrial* Elizabeth; liberal, academic Princeton; and largely Jewish Marlboro" (Stephanopoulos, 2012a, p. 1422; emphasis ours). We obtained land-use data from a city government website showing the general plan. This general plan apportions all of the parcels in the city into land-use classes, such as high-density residential and industrial (City of Santa Barbara, 2013). Obviously the parcel is at a much smaller scale than the Census tract, but we went on to group these parcels into larger units more closely approximating the scale of tracts and electoral districts, as described below.

The main task of the thematic analysis consisted of grouping both the Census tracts from Spielman and Singleton (2015a) and the land-use parcels from the city into meaningful clusters, in order to further group those clusters into thematic regions that we could compare to cognitive regions as well as the electoral districts. Grouping the Census tracts was straightforward because Spielman and Singleton had already developed a classification scheme; we just grouped tracts of the same class into clusters based on their contiguity. For example, if a tract of a certain class shares a border with a tract of the same class, they form a cluster of that particular class. The end result was a total of 13 clusters of Census tracts in Santa Barbara, representing 8 classes (Fig. 3). There are 3 clusters of (using the labels of Spielman and Singleton) "Old Wealthy Whites" (OWW), 3 of "White Nuclear Family - Outer City" (WNF-OC), 2 of "White Nuclear Family - Inner City" (WNF-IC), and 1 each of "Hispanic & Kids" (H&K), "Low Income Diverse" (LID), "Middle Income Single Family Households" (MISFH), "Residential Institutions & Young People" (RI&YP), and "Wealthy Urbanites" (WU).

Grouping the land-use parcels denoted by the city followed the same process as that for the Census tracts: the parcels were classified, and any contiguous parcels of the same class were linked into clusters. We classified each parcel into five broad categories: low density residential, medium density commercial and residential, high density commercial and residential, industrial/harbor, and open space/other uses (there is no land that is low density commercial). This scheme keeps industrial land use as a distinct type while dividing the rest of the urban land use, both residential and commercial, according to density. This yielded 11 clusters of low-density (LD) land use, 21 of medium-density (MD), 19 of high-density (HD), 3 of industrial/harbor (IH), and 58 of open space/other uses (mostly small parks and schools) (O) (Fig. 4).

Having clustered the demographic and land-use classes, we could then cross the two types of clusters to produce comprehensive thematic clusters reflecting both aspects. We did so by taking the large demographic clusters (e.g., H&K) and subdividing them based on the medium-sized land-use clusters (e.g., MD) to create new, smaller thematic clusters (e.g., H&K/MD), 177 in all. Fig. 5 gives a map of all the thematic clusters in the city. With this new series of thematic clusters in hand, we could then group the clusters together to form a thematic region associated with each district. In order to decide whether a given cluster should be grouped into the thematic region linked with a certain district, we followed a simple rule: If the majority of a cluster's area fell within the boundaries of a district, that entire cluster was grouped into the region. This rule ensured that a particular thematic region was kept whole, just as the district to which it would be compared is retained whole. Following this procedure resulted in a contiguous thematic region identified with each district.

3.3. Communities of interest as cognitive regions

In order to obtain people's perspectives on the extent of their community of interest, we surveyed residents of the first, second, and third city council districts of Santa Barbara (henceforth referred to as Districts 1, 2, and 3). We restricted our sampling to just these three of the six new districts primarily for efficiency, but also because elections for city council were about to take place just for these three districts—presumably our survey would hold more immediate relevance for these residents. Districts 1 and 3 are the two majority-Hispanic districts that were the main intended outcome of initiating district elections in the city in the first place, with a 69% proportion of Hispanics in each district (NDC 2015). District 2 differs greatly from 1 and 3, especially in its high share of non-Hispanic Whites at 73% and lower population density; it therefore provided a nice contrast to the other two. Geographical cluster sampling was used to select houses to approach for an interview at regular intervals throughout each district, in the hope of removing biases particular to certain neighborhoods. Overall, 275 residences were approached for a response for this survey; of those, 188 had someone come to the door and 114 agreed to participate, for a total response rate of 60.6%. This is substantially higher than mail or phone surveys usually elicit (Groves, 2006), and it means that most people we contacted agreed to respond. More information is given in Table 1.

The cognitive survey was administered both orally and in pencil. The oral part asked the following open-ended question: "What criteria do you think are important in defining a community?" We did not use the term "community of interest," which we assumed is not widely familiar. We asked this to discover which traits of the concept people most commonly agree on, so that we might learn about people's understanding of what defines a community. This adds to our basic understanding of the community as a cognitive region that is relevant to geography and political science. It will also help with the practical task of identifying communities for purposes such as redistricting. The pencil part involved participants drawing and filling in bubbles on a double-sided sheet of paper, the instructions of which were printed in both English and Spanish. The front side of the sheet featured a street map of the city with major streets labeled. As Fig. 6 shows, we defined community of interest for respondents and asked them to draw the boundaries of what they saw as their community of interest. We also suggested a spatial scale for the drawings, by suggesting that respondents "consider a community of interest to be about the size of a city district or large neighborhood." We included this to prompt respondents to draw communities that were similar in size to those of other respondents as well as to the city council electoral districts, so as to facilitate comparison between the different types of regions. The back side of the sheet had the same street map as the front side but with superimposed city council district boundaries (Fig. 7). Instructions printed below the map identified the regions as city council districts. Respondents were asked to assess how well the "boundaries of the district in which you live reflect what you believe to be the

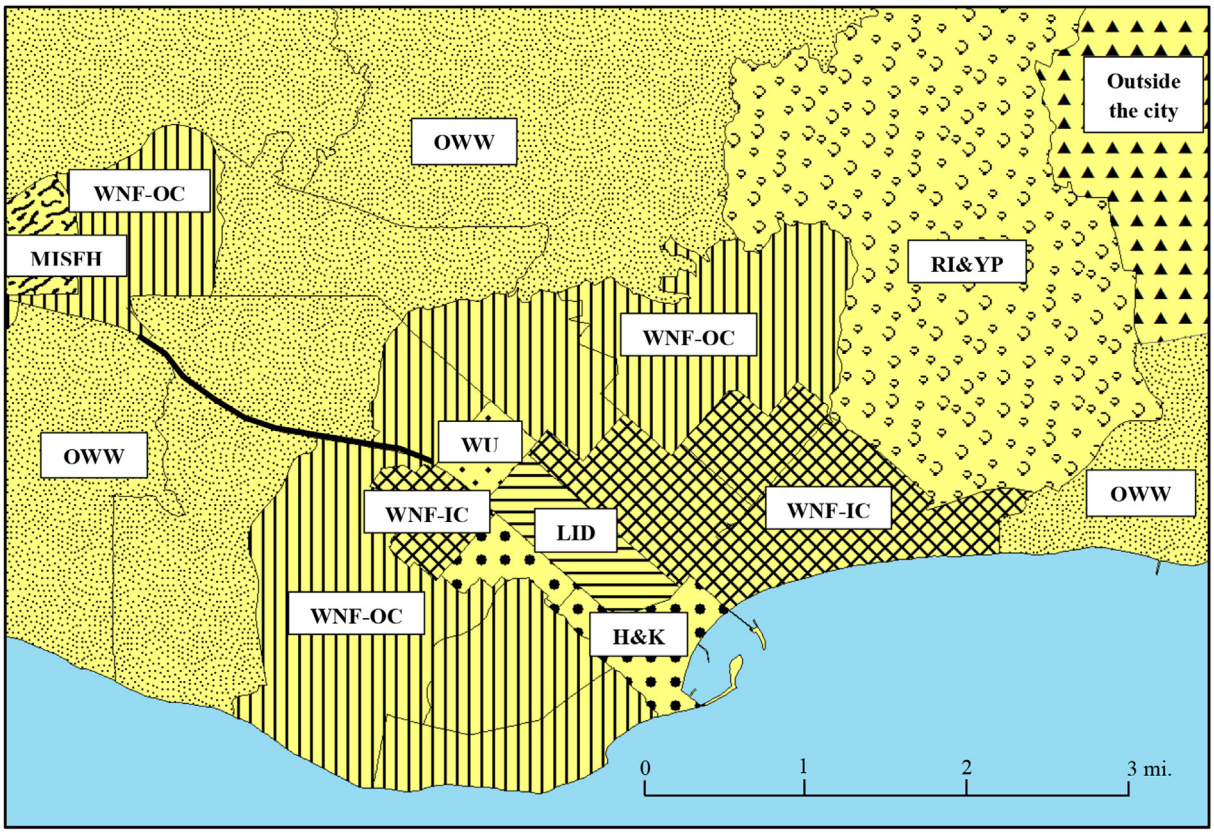


Fig. 3. Map of the demographic clusters in Santa Barbara. There are 13 tract clusters (each marked by a label) representing 8 classes (differentiated by pattern). The bold line at center-left indicates that the 101 Freeway separates otherwise contiguous tracts of the same class (OWW and WNF-OC) into different clusters.

Fig. 4. Map of the land-use clusters in Santa Barbara, differentiated by grayscale.

Fig. 5. Map of the thematic clusters in Santa Barbara, with pattern indicating each cluster's parent demographic cluster and grayscale its parent land-use cluster.

Table 1a
Demographic summary of district residents (2010 census and 2009–2013 ACS data; NDC 2015).

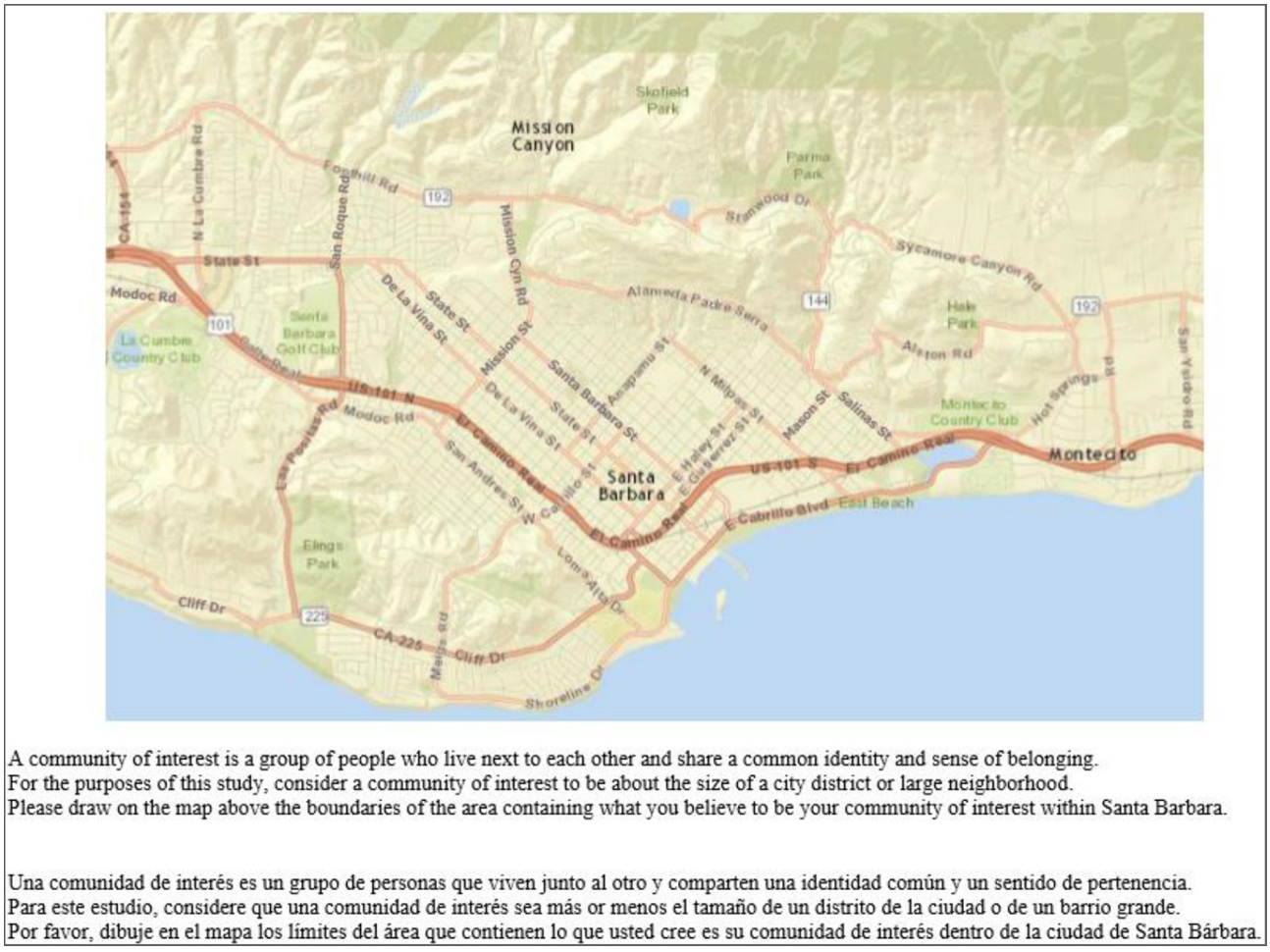
	District 1	District 2	District 3	Mean
Residents	14,865	14,924	14,324	14,704
Age in Years	26% 0–19, 58% 20–60, 16% 60+	23% 0–19, 57% 20–60, 20% 60+	28% 0–19, 61% 20–60, 10% 60+	26% 0–19, 59% 20–60, 15% 60+
Race/Ethnicity (Voting Age)	63% Hispanic, 30% NH White, 5% Other	16% Hispanic, 75% NH White, 7% Other	62% Hispanic, 32% NH White, 4% Other	47% Hispanic, 46% NH White, 5% Other

Table 1b
Demographic summary of survey respondents.

	District 1	District 2	District 3	Total/Mean
Potential Respondents	60	68	60	188
Participating Respondents	35	40	39	114
Mean Age in Years	46.5	51.5	45.0	47.8
Mean Years in SB	26.9	28.8	21.1	25.6
Race/ Ethnicity	51.4% Hispanic, 40.0% NH White, 8.6% Others	10.0% Hispanic, 90.0% NH White, 0.0% Others	41.0% Hispanic, 56.4% NH White, 2.6% Others	33.3% Hispanic, 63.2% NH White, 3.5% Others
Sex	60.0% Female	52.5% Female	59.0% Female	57.0% Female

boundaries of your community of interest" by marking one of five bubbles ranging from "Very well" to "Very poorly."

Since many native Spanish speakers live in Santa Barbara, we enlisted the service of a Spanish-speaking research assistant during survey administration. We surveyed residents over a span of six weeks in the summer, collecting responses during the late afternoon and early evening hours of weeknights (except for one midday Saturday outing). These times seemed to be the best opportunities to catch residents at home but not yet having dinner. When a resident agreed to participate, we first asked the open-ended question about their definition of a community, recording their answer with an application on a smartphone. We then presented respondents with the plain street map, on which they drew the boundaries of their cognitive community of interest. We did not tell them that communities of interest had a role in the creation of the city council districts, as we did not want to prompt them to think about the districts at all, in case someone with knowledge of them might be influenced when drawing their boundaries; our goal was to study such communities as social realities existing prior to and apart from any local (re)districting. After turning over the map



A community of interest is a group of people who live next to each other and share a common identity and sense of belonging.
For the purposes of this study, consider a community of interest to be about the size of a city district or large neighborhood.
Please draw on the map above the boundaries of the area containing what you believe to be your community of interest within Santa Barbara.

Una comunidad de interés es un grupo de personas que viven junto al otro y comparten una identidad común y un sentido de pertenencia.
Para este estudio, considere que una comunidad de interés sea más or menos el tamaño de un distrito de la ciudad o de un barrio grande.
Por favor, dibuje en el mapa los límites del área que contienen lo que usted cree es su comunidad de interés dentro de la ciudad de Santa Bárbara.

Fig. 6. Front side of the sheet of paper given to survey respondents.

sheet, we requested respondents to examine the city council districts and rate the degree to which their district reflected what they believed to be their community of interest on the five-point scale. We finished by asking respondents their age and how long they had been living in Santa Barbara; we noted their address and race or ethnicity as we left the house.

The cognitive analysis involved three tasks: coding the open-ended responses for the community definition, digitizing the drawn figures and determining their areas, and calculating degree of agreement among the figures. When coding responses to the question asking participants to define a community, we looked for common words or phrases given among all the respondents and grouped them into categories. For example, the mention or allusion to interaction among people, including use of the word "together," led to the creation of an "Interaction" category. Once a category was determined, we then tallied up the number of respondents whose definitions fell into that category. The most popular categories represented the criteria that people most often took into account when considering what community means to them. Altogether, we created twelve categories (Table 3).

Next, the boundary lines drawn by respondents were analyzed to determine the area of each figure they formed. This was done by first scanning all the drawings and then digitizing the lines in a GIS to create a series of overlapping figures for each district. In addition to one case thrown out due to an error made when administering the survey, anomalies found in people's drawings led to the exclusion of six more cases. Three individuals chose not to draw any figures, while two drew so many figures with so much overlap among them that their drawings were incomprehensible. Finally, one person drew a figure with an opening on one of its sides that prevented a confident determination of its area. This winnowing left 107 cases for areal analysis. The figures drawn by respondents living in District 1 are presented in Fig. 8.

As a thematic region could be identified for each electoral district based on which thematic clusters overlapped with a given district, so too could a cognitive region be identified for each district based on the figures drawn by its residents. These communities were determined by the degree to which residents of a given district agreed about the size and locational extent of their community of interest. Rather than generating a monolithic average figure, we produced for each electoral district a graded cognitive region that showed the range from a lesser-agreed-upon periphery to a greater-agreed-upon core. To determine level of agreement, we computed a count of the overlapping figures at each point in space. Second, we used that count to produce an output raster with 25×25 m cells (deemed to be adequate resolution). This output raster was then classified based on degree of agreement across points in space. Agreement could range from 0% at points in space contained by no respondent's figure to 100% at points contained by all respondents' figures (Woodruff, 2012). This process resulted in maps of the cognitive regions salient within each district, with light to dark shading showing lesser to greater agreement.

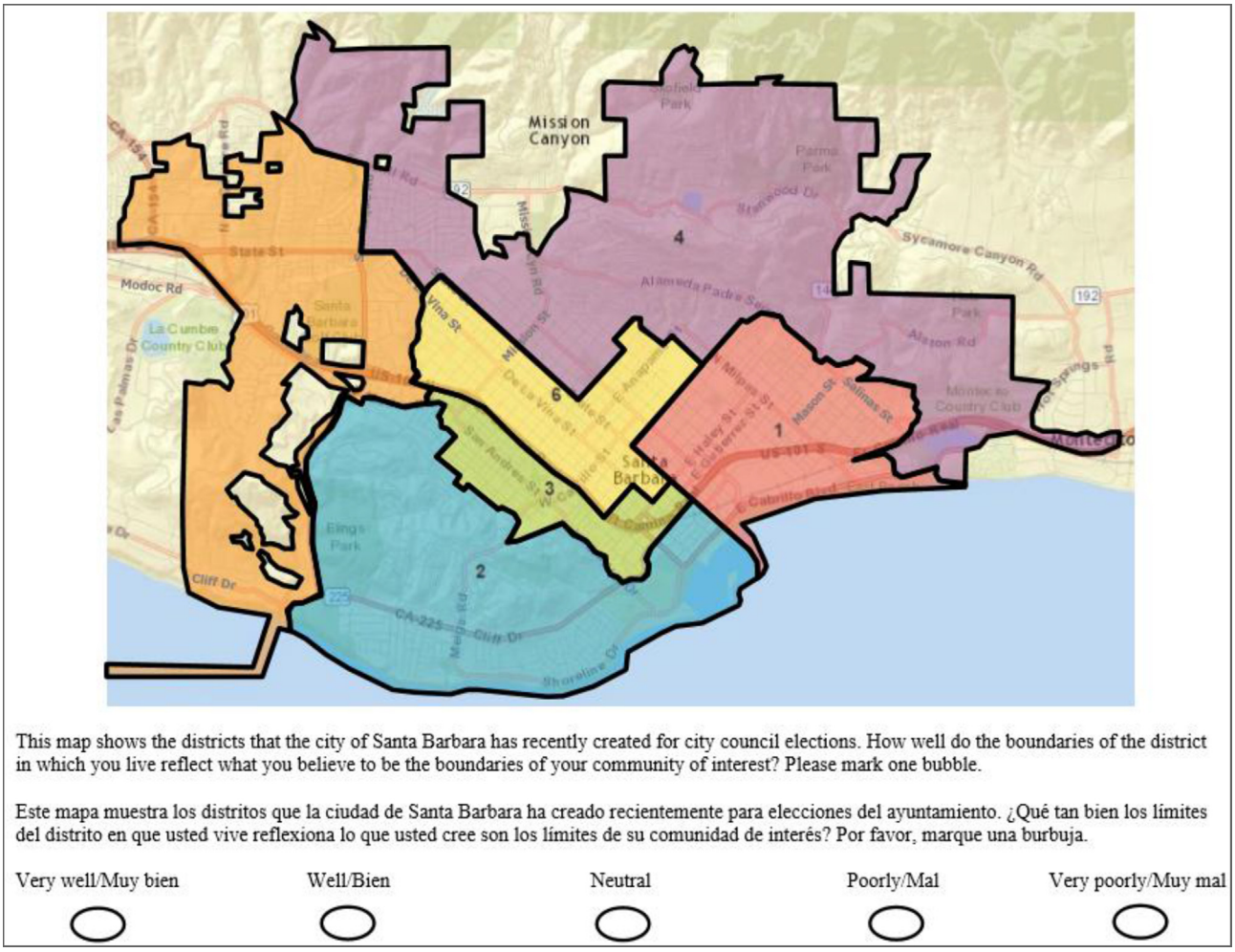


Fig. 7. Back side of the sheet of paper given to survey respondents.

Fig. 8. Drawn figures from respondents living in District 1, overlaid on the city street network.

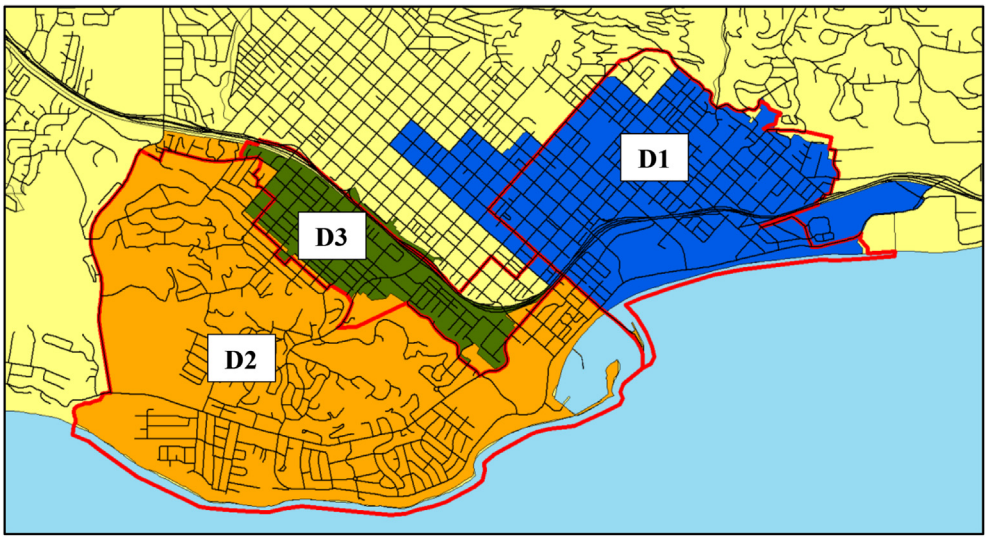


Fig. 9. Thematic communities of interest associated with each district (symbolized by shade), as compared to the districts themselves (marked by bold boundaries).

4. Results

4.1. Communities of interest as thematic regions

We first examine and profile communities of interest defined as thematic regions. One such region was fashioned for each of the three districts under study (Fig. 9). The region centered on District 1 is chiefly formed by the WNF-IC demographic cluster, and has an area of 5.65 km^2 (compared to 4.96 for the district itself). That associated with District 2 is largely defined by WNF-IC/LD and WNF-IC/O; together these two classes make up 83.7% of the community's 9.62 km^2 area (compared to 10.16 for the district itself). Finally, the region connected to District 3 consists largely of medium density uses in the H&K or WNF-IC classes; when combined with the LID/O cluster containing the freeway and adjoining land, these take up 85.3% of the 1.73 km^2 area of the region (compared to 2.21 for the district itself). These three thematic regions represent what the Santa Barbara city council districts might look like if boundary drawers only paid attention to a community of interest criterion defined solely by demographic and land use attributes.

4.2. Communities of interest as cognitive regions

Next we examine the communities of interest defined as cognitive regions. Figures drawn by respondents residing in Districts 1, 2, and 3, had means of 6.94, 13.80, and 7.62 km^2, respectively. That these numbers are well above the areas of each electoral district—4.96, 10.16, and 2.21 km^2, respectively—reflects the fact that some of the figures were drawn much larger than the district. In spite of the instructions to "consider a community of interest to be about the size of a city district or large neighborhood," a few people insisted on drawing a figure encompassing almost the entire map area, which pulled the means upward. This is borne out by the huge standard deviations of 13.55, 20.51, and 12.74 km^2. Because of the undue influence exerted by these outliers, we believe it is informative to examine the figure areas after excluding them. We thus excluded figures more than 2 standard deviations larger than the mean area of the figures drawn by each district's residents, of which there was 1 in District 1, there were 3 in District 2, and there were 2 in District 3; that left 101 for analysis. As a result, figures drawn by residents of the three districts had their means drop to 4.77, 9.28, and 5.18 km^2, with much smaller standard deviations of 6.15, 13.06, and 7.16. These numbers more closely approximate those of the district areas and offer a clearer picture of how the communities conceived by most participants compare with those districts.

Residents of the three electoral districts agree only modestly about the size and locational extent of their community of interest; in no district is even a single point in space contained in the figures of 70% or more of its residents. Within District 1, the area shared by the most respondents is done so by 68% of them; it is 2.1% of the total district area. For District 2, that area is shared by 60% of respondents and represents a scant 0.2% of the district area. For District 3, that area is shared by 68% of respondents and totals an even smaller 0.1% of the district area. Given these levels of agreement, we decided to examine agreement at three levels: 40%+, 50%+, or 60%+ (Table 2). For example, an area at the 50%+ level is contained in the figures drawn by at least 50% of the respondents. Of course, the areas of agreement within each class decline in size as one moves toward greater agreement. (For this analysis we included the six outlier figures we had excluded for the areal analysis—their large sizes had no skewing effect here since only their innermost parts overlapping with other figures are taken into account—for a total of 107 figures.)

The majority of residents in Districts 1 and 3 agree to the existence of a single community of interest situated almost entirely within the boundaries of their respective electoral districts. In District 1 the 50%+ agreement region spans most of the inhabited part of the district, with a 60%+ core region centered along the main street of the area. The 40%+ region spills northwest into areas outside the district but remains firmly bounded on the south by the 101 Freeway; very few people live on the other side of this prominent edge feature (Fig. 10). Taking the centroids of the individual drawn figures (again excluding the large outliers) reveals that most of them concentrate in the 40%+ agreement region. However, a good number are located to the west in the downtown area (perhaps reflecting people's workplaces); this pulls the mean centroid westward so that it falls to the west of the 60%+ core, while still barely remaining in the 50%+ region. The standard deviational ellipse of the centroids reflects this westward shift by covering a fair amount of land outside the boundary, much of it in downtown.

Similar to District 1, in District 3 the 50%+ agreement region includes much of the inhabited part, and its 60%+ core region

Table 2
Areas of individual drawn figures vs. areas of cognitive regions (in km^2).

	Electoral District Area	Mean Area of Drawn Figures	40%+ Agreement Area	50%+ Agreement Area	60%+ Agreement Area
District 1	4.96	6.94	3.04	1.43	0.35
District 2	10.16	13.80	8.91	3.53	0.02
District 3	2.21	7.62	2.52	0.97	0.22

Table 3
Traits of a community, based on phrases used in definitions (114 respondents).

Name	Every mention of …	Percent Included
Group of People	A group of people	75.4%
Interaction	The interaction among people, including "together"	52.6%
Geography	Spatial/geographic area/proximity	40.4%
Residence	People residing	35.1%
Support	Giving and receiving of support among people	19.3%
Benefit	Activities benefiting/serving many people/greater good	18.4%
Unity	"Unity" or a related phrase	13.2%
Commonality	Shared traits or commonalities	12.3%
Neighborhood	"Neighborhood" or "neighbors"	10.5%
Economy	Occupations, jobs, or anything related to the economy	8.8%
Diversity	"Diversity" or a related phrase	2.6%
Culture	Cultural characteristics	1.8%

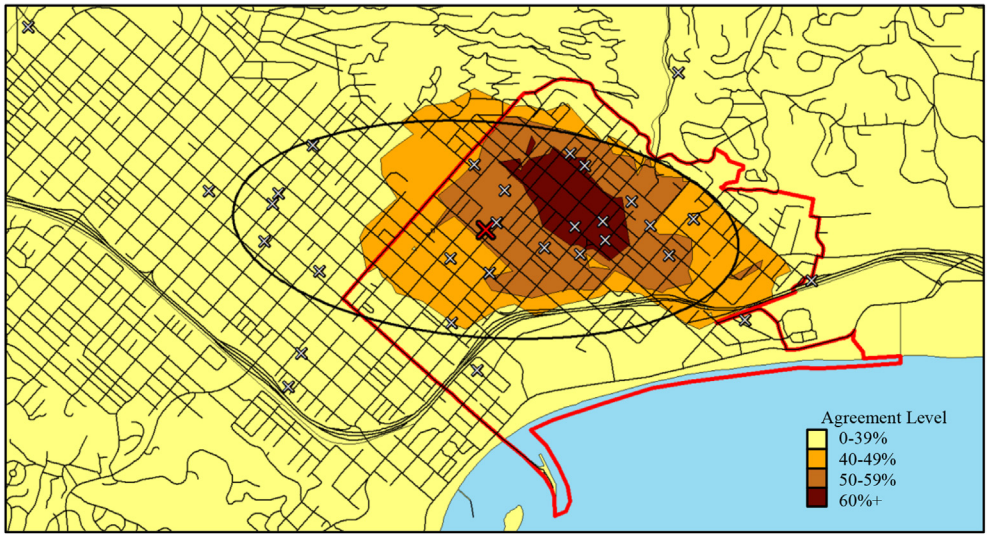


Fig. 10. Cognitive community of interest associated with District 1 (district boundary in bold). The centroids of the individual drawn figures are marked by small X's, the mean centroid by the large X, and the standard deviational ellipse of the centroids by the oval line.

stretches along the main street of that area (Fig. 11). Again there is a pattern of centroids mostly lying within the 40%+ region but several scattered in the downtown area. In this case, the result is the mean centroid drifting from the core toward the east, landing right on the edge of the area of majority agreement. As such, the standard deviational ellipse also extends eastward to envelop many of these downtown locations. Despite both being somewhat pulled toward downtown, the cognitive communities of interest in Districts 1 and 3 can be viewed as relatively compact, cohesive, and unitary.

In contrast to Districts 1 and 3, the majority of residents in District 2 do not agree to the existence of a single community of interest largely contained by the district boundaries Rather, they acknowledge the presence of two separate communities, one of which extends well outside the district. This pattern suggests that District 2 residents identify more with subsections of the district rather than the area as a whole. Even so, the 40%+ agreement region encompasses almost all of the district, so at some level there is an idea of a larger community of interest (Fig. 12). The centroid locations give further credence to this dichotomy between a single large community and two smaller ones. While the mean centroid as well as five individual centroids (each representing a single figure) are right between these smaller areas, indicating some belief in a single community encompassing the Mesa, most are found in and around the smaller areas. (A number are well outside the district in the downtown area, which pulls the standard deviational ellipse to the northeast, again possibly reflecting residents' places of work). Therefore it is clear that many residents of District 2 do not believe that there is a single community of interest taking up the whole district but rather two separate ones, which in fact occupy adjacent hills.

Next, we consider how well respondents felt the city's electoral districts represent their communities. In all three districts, respondents indicated that the city's electoral districts represent

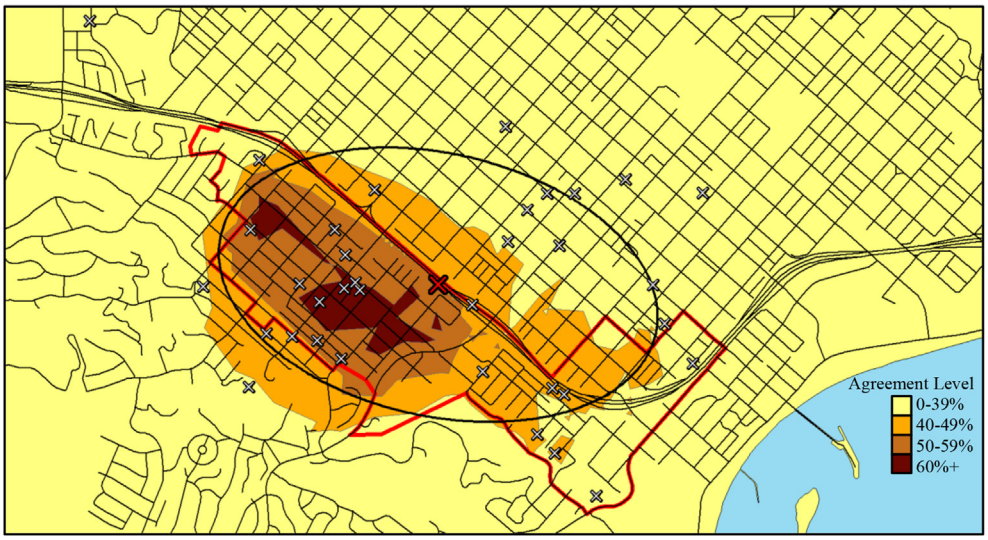


Fig. 11. Cognitive community of interest associated with District 3.

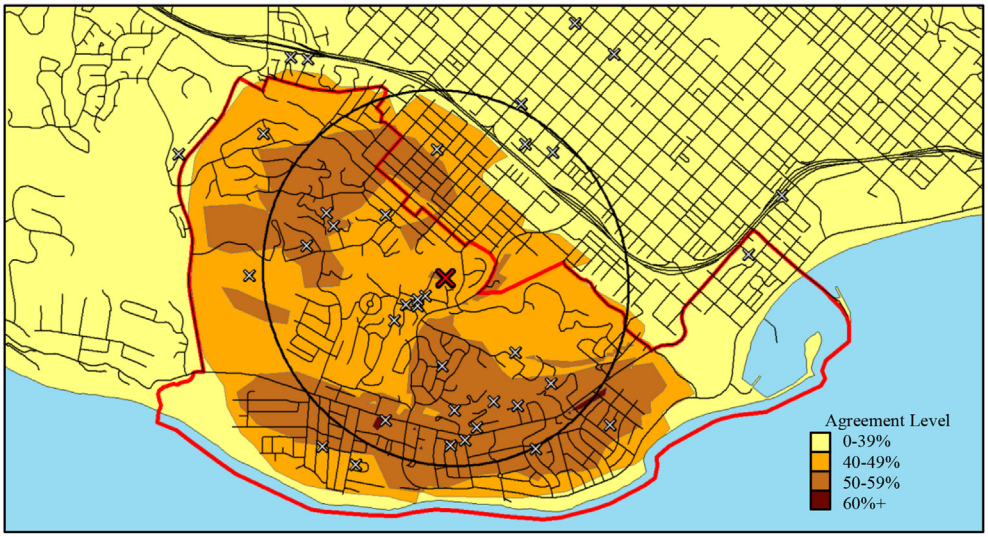


Fig. 12. Cognitive community of interest associated with District 2.

their communities moderately well. The mean of the ratings given by respondents for how well the districts matched their communities (1 = "Very poorly" and 5 = "Very well") is 4.0, 3.6, and 3.5, for residents of Districts 1–3 respectively. These averages are between "Neutral" and "Well." The small differences between the districts are not statistically significant ($F[2, 107] = 2.03$, $p > 0.05$). Nor does the ethnicity of the respondent, whether he or she is Hispanic or non-Hispanic, have a significant effect on rating ($F[1, 107] = 3.06$, $p > 0.05$). Finally, the interaction between a respondent's district and ethnicity also has no significant effect on one's rating ($F[2, 107] = 0.06$, $p > 0.05$). In short, we find no evidence that residents of one district believe that their community is better or more poorly represented by the city's electoral districts.

We also examine responses to the open-ended question about one's definition of a community. We coded these into one of twelve traits (Table 3). More than three quarters of participants made reference to a group of people of some kind, so this is definitely an important aspect of the definition of a community; this was the most common response in each of the three districts. A slim majority also alluded to the interaction among people, which included any sense of "togetherness" or comradery; this was the second most common response in each district. Explicit references to geography and residence were the other two traits found in over a third of people's definitions. Taken together, these responses lead us to a summary statement of the traits of a community according to Santa Barbara residents, with decreasing confidence towards the end of it: *A group of people who interact with each other in close geographic proximity, living together and supporting one another for their mutual benefit.*

4.3. Correspondence between types of regions

Using demographic, land use, and survey data to define communities of interest as two types of regions—thematic and cognitive—allows us to directly compare them. It also allows us to compare them to a third type of region, the recently created city council electoral districts, which can be considered administrative regions (Montello, 2003). Here, we make quantitative comparisons

between pairs of these three types of regions. We do so by overlaying one region on another in order to determine their overlap. Given these overlaps, we then examine how similar the regions are to each other using a spatial similarity index that assesses the degree of overlap. The degree of overlap depends on the regions' relative locations, sizes, and (to some extent) shapes. Several such indices have been proposed, each with its unique formula for computing spatial similarity (Frontiera, Larson, & Radke, 2008). However, a number of these have difficulties that make them less useful, such as taking a different form depending on the case or situation. For example, one measure takes a particular form if a region is completely contained by another and a different form if not. A simple and intuitive index with only one form in all cases was proposed by Hill (1990):

$$\text{Spatial Similarity} = 2 \times O/(Q + D)$$

where Q and D are the areas of the two regions in question and O is the area of their overlap. Hill's index ranges from 0, meaning the regions are not similar at all because they do not overlap at all, to 1, where they are exactly the same location, size, and shape. (Note that the index does not much reflect shape similarity unless the overlap is very high. It cannot equal 1.0 unless the two shapes are identical, but a square and a hexagon of the same size and centroid location will result in an index near 1.)

As before with the ratings, we next assess whether the district and ethnicity of the respondents had an effect on the spatial similarity between the figures they drew and their own districts, as measured by Hill's index. We find that the district in which the respondent lives has no significant effect on the spatial similarity ($F[2, 101] = 1.83$, $p > 0.05$). The respondent's ethnicity likewise has no significant effect on this correspondence ($F[1, 101] = 0.04$, $p > 0.05$). Lastly, the interaction between district and ethnicity does not significantly affect spatial similarity ($F[2, 101] = 0.47$, $p > 0.05$). In sum, we have no evidence to support a claim that residents of a given district drew figures whose spatial properties reflect that of their district any better or worse than residents of another district.

Comparing communities of interest defined as thematic and cognitive regions (the latter at the 40%+ agreement level) reveals a relatively high degree of spatial similarity between those regions associated with all three electoral districts, with each of the three pairs overlapping at 0.60 or better. While the similarity measures in Districts 1 and 3 are 0.60 and 0.67, respectively, that in District 2 is quite high at 0.87. The lower values for Districts 1 and 3 chiefly reflect the disparity in size between the thematic regions and their cognitive counterparts; in District 1 the thematic largely engulfs the cognitive, and vice versa in District 3. Respondents living in District 1 appear to have a narrower view of their community of interest than the corresponding thematic region would indicate; they may not be inclined to include those areas where fewer people live, and industrial and tourism use predominates. Respondents in District 3 seem to be more willing to view areas outside the thematic region as being included in their community. In District 2, on the other hand, the two types of regions correspond closely in their size and, to a lesser degree, their locational extent.

Comparing the thematic and cognitive regions to the administrative regions—their associated electoral districts—reveals that the thematic ones are more similar to their associated administrative regions than the cognitive ones are, with the overlap index between the administrative and thematic regions averaging about 0.15 greater than that between the administrative and cognitive regions. The spatial similarity ratings are quite high for the administrative-thematic comparison; they are 0.85 for District 1, 0.93 for District 2, and 0.83 for District 3. In contrast, the administrative and cognitive regions correspond less well; they are 0.65 for District 1, 0.82 for District 2, and 0.68 for District 3.

5. Discussion

This study finds that even on a small, intra-city scale, communities of interest defined as thematic regions correspond with those defined as cognitive regions reasonably well. This is notable especially when one considers how much of the thematic regions are uninhabited or sparsely inhabited and thus less likely to play a part in the areas residents identify with as their communities. Still, the thematic regions correspond with the electoral districts much more than the cognitive regions. Three reasons seem to account for this disparity. First, Santa Barbara intentionally designed districts that reflect certain thematic attributes. The city paid explicit attention to demographic characteristics of residents in having an outside company draw up the districts, especially since their first priority was to ensure the creation of two majority-Hispanic districts. In contrast, although public fora addressing the creation of these districts (attended by the first author) solicited informal claims about residential feelings and perceptions, no systematic surveying was carried out by the city to determine cognitive communities of interest.

Second, electoral districts must comprehensively cover the entire city region, and thematic regions achieve this as well. There is no requirement for cognitive regions to comprehensively cover the city, and in fact, figures drawn by respondents tend to leave out areas where very few or no people live or work. To some degree, our methodology brings this about. We implemented thematic regions by looking at characteristics of residents and land use organized according to existing administrative regions—census tracts and land parcels. This means that our thematic regions can also be considered administrative regions, just like the electoral districts; they therefore take the properties of that type of region, such as precise boundaries and comprehensive coverage (Montello, 2003). In contrast, the drawing task we used did not restrict the cognitive regions to any administrative regions and thus should not be expected to correspond as well to administrative regions like electoral districts. If we started with demographic and land-use data at higher resolution, we could loosen this administrative constraint on defining thematic communities. That would be valuable from a basic research perspective but perhaps not for the applied task of actually devising electoral districts.

Third, the way we defined thematic regions did not differentiate among places within each region as to their strength of membership. Our method for establishing cognitive regions did; places with higher agreement across individuals are stronger or clearer parts of a particular cognitive community of interest. Therefore, we needed to select some level of agreement at which to define a cognitive region and compare that region to the other types of regions, which was 40%+. However, since cognitive regions of higher agreement are necessarily smaller, cognitive regions at any substantial levels of agreement tend to be smaller than both the electoral districts and thematic regions (Table 2). This disparity in size further accounts for the greater correspondence between the latter two types of regions.

Our approach to assessing variability of region membership, however, had the weakness of not allowing respondents to directly express personal variations in their beliefs about community membership for places all considered to be within a given community. Our method required respondents to draw a single line around what they believed to be their community of interest, meaning that all places within that line—even just within—were considered 100% part of the community; all places outside—even just outside—were considered 0% part of it. Yet, of course, people do not have such a monolithic conception of their cognitive regions

but rather recognize gradation within them (Montello et al., 2003; Montello, Friedman, & Phillips, 2014). Future studies could have people draw lines around regions to directly express their variable degrees of confidence that the area is part of the community, or have them directly rate small areas as to their degree of membership in the community. Such approaches would provide rich and explicit data on the community of interest as a graded cognitive region, including pointing convincingly to "core" places of strongest/most consensual membership. The ability to assign a more graded status to each place as to its membership in a particular community of interest would certainly contribute to our basic understanding of research issues concerning political regions. It would also probably be useful to the task of creating electoral districts, for example, by identifying places that can more flexibly be attached to other districts if other districting criteria call for it (Gardner, 2002).

In fact, we found that our respondents disagreed substantially about the location, size, and shape of their communities, even though the majority did agree on a common core area. We believe that if we had asked participants to draw a boundary around particular neighborhoods by name (such as the "Westside" or the "Mesa"), we would have obtained more agreement among them. Studies that have asked respondents to define specific named neighborhoods like "Downtown" or "Koreatown" certainly suggest this (Bae, 2015; Montello et al., 2003). Those neighborhoods have an identity that is firmly attached to a certain place. People differ somewhat on the details of the boundaries, but everyone concurs that there is a unique, distinct Downtown Santa Barbara centered on State Street and, likewise, a unique, distinct Koreatown in Los Angeles straddling Wilshire Boulevard between the 10 and 101 Freeways. In contrast, "community" (let alone "community of interest") is a vaguer concept. It likely depends on a person's particular activity space and which portion thereof a person decides to include. Does one incorporate just the area where he or she lives and interacts with neighbors, or also those areas where he or she works or shops? We conclude that communities of interest defined as cognitive regions are real but somewhat idiosyncratic. Methodologically, their spatial nature will depend greatly on the instructions given to elicit them.

The spatial extent of a community of interest depends on spatial scale—how large a person considers a community of interest to be. The issue of scale is especially important because in California and elsewhere the community of interest criterion is employed for districting at various levels, including federal, state, and local government. Is it viable to define a community of interest as a basis for making a district both as large as California's 8th congressional district (about 85,000 km^2) and as small as Santa Barbara's 3rd city council district (a little more than 2 km^2)? Does the concept include any scale constraints, as so many geographic concepts do (e.g., Mark, 1993)? It should be remembered that the scale of a community of interest need not be as large as the district itself. The California Constitution places "community of interest" in a list of other geographic entities that are generally smaller than a federal- or state-level district: cities, counties, and neighborhoods (Article XXI, Section 2-d-4). This stipulation mandates that efforts be taken to keep these entities whole, but that does not imply that a particular district be restricted to just a single community, etc. That is, there may be a *collection* of neighborhoods or communities of interest that falls within each district. It requires only that care is taken not to split those at the periphery between different districts.

That said, we do believe it would be interesting and useful to investigate the existence of coherent communities of interest at different scales. Pursuing this would lead even more to the problem we had in the present study of getting respondents to draw communities at the "proper" scale. An approach to this might be having participants break up a given region into the number of cognitive subregions that a particular districting situation calls for at a particular level of government: U.S. House of Representatives, State Senate, State Assembly, etc. We could have used this method for our study of Santa Barbara's six city council districts, avoiding the need to specify their sizes by reference to neighborhoods and avoiding eccentric responses such as the whole city being circled. This would call for sampling respondents from all six districts, however, which was beyond the scope of our study.

These considerations do stimulate the question of whether the concept of community of interest has a natural scale or scale range. We believe it is a very interesting and important research question to ask about the scale properties of various ways of defining a community of interest, including at the scales of congressional and state legislative districts. We prodded respondents to draw communities of a certain scale to facilitate comparisons to the electoral districts. While we do not believe that the entire city or a couple of blocks constitute reasonable expressions of the concept of community of interest within the context of intra-city districts, we do believe that literature from geography and related disciplines (e.g., Tuan, 1974) is consistent with the notion that regions of identity and attachment exist at multiple scales, even up to that of a country or larger region (as in nationalism). A future study could explicitly ask participants to define the extent of a single community of interest, giving them the freedom to make it as small or as large as they want. Such a study would investigate the range of scales that people believe communities of interest can encompass, without necessarily referring to any particular scale or political context. This effort would benefit from using a digital mapping platform allowing users to pan and zoom to whatever scale or extent they choose, which would give them maximum latitude to show what a community of interest looks like to them.

6. Conclusion

By defining communities of interest as both thematic and cognitive regions, this research shows that both definitions compare reasonably well with each other and have unique and important contributions to make to our understanding of what a community of interest actually is. These findings demonstrate that the concept of the community of interest does indeed gain precision in its definition by incorporating both some key thematic indices as well as the perspectives of individual residents. The thematic region represents the land uses that should be included when drawing district boundaries but are often discounted by the perspectives of individual residents. On the other hand, the cognitive region depicts the area most people agree upon and should represent the core or center of whatever district is being crafted. The fact that both types of regions cohere rather well with existing districts shows that it makes sense to consider communities of interest when drawing borders even at this small scale.

If state or city officials wish to give communities of interest proper consideration, they would serve their citizens well by identifying those areas where people most agree is in their community of interest. Each time they need to redistrict (usually every ten years after a census), they could hire survey researchers to administer appropriate surveys to residents, using one or more of the methods we demonstrate and otherwise discuss in this paper. We believe that future assessments of communities as cognitive regions might well be collected via the Internet. This does run the risk of skewing toward those respondents who use the Internet more, but that is increasingly less of a threat to sampling representativeness (Fink, 2010). We expect that the traditional method, while more costly, offers a larger and more representative sample since virtually all registered voters have a residence. Such surveying

would also provide more systematic and comprehensive, and less biased, feedback than could be gained from a public forum. Once areas of strong agreement are identified, officials can make these areas the cores around which they form the rest of the districts. They can then utilize the thematic clustering method to ensure that the districts comprehensively cover the city. They would link such clusters according to how similar their attributes are to those of clusters at the core, while also considering population equality, contiguity, and compactness. Such an exercise would be feasible for most authorities, and the benefits to citizens' sense of representation would likely outweigh costs. Hopefully, more attention directed to both types of communities of interest will result in districts that are more representative and responsive to the needs and preferences of their citizens.

Conflict of interest

no conflicts of interest.

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References

Bae, C. J. (2015). *Representations of an urban neighborhood: Residents' cognitive boundaries of Koreatown, Los Angeles*. Santa Barbara: University of California. Master's thesis.

Brunell, T. L. (2008). *Redistricting and representation*. New York: Routledge.

Buchler, J. (2005). Competition, representation, and redistricting. *Journal of Theoretical Politics, 17*(4), 431–463.

Cain, B. E., & Hopkins, D. A. (2002). Mapmaking at the grassroots: The legal and political issues of local redistricting. *Election Law Journal: Rules, Politics, and Policy, 1*(4), 515–530.

Cain, B. E., Mac Donald, K., & McDonald, M. (2005). From equality to fairness: The path of political reform since *Baker v. Carr*. In T. E. Mann, & B. E. Cain (Eds.), *Party lines: Competition, partisanship, and congressional redistricting* (pp. 6–30). Washington, D.C: Brookings Institution Press.

Chambers, H. (1999). Enclave districting. *William & Mary Bill of Rights Journal, 8*(1), 135–182.

City of Santa Barbara. (2013). *City of Santa Barbara general plan*. Adopted 25 June 2013 http://www.santabarbaraca.gov/civicax/filebank/blobdload.aspx?BlobID=16899.

Constitution of California, Article XXI. http://www.leginfo.ca.gov/.const/.article_21.

Courtney, J. C. (2008). From gerrymanders to independence: District boundary readjustments in Canada. In L. Handley, & B. Grofman (Eds.), *Redistricting in comparative perspective* (pp. 11–26). Oxford, New York: Oxford University Press.

Fink, A. (2010). *Conducting research literature reviews: From the Internet to paper* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Forgas, J. P., & Williams, K. D. (2001). *Social influence: Direct and indirect processes*. Philadelphia: Psychology Press.

Frontiera, P., Larson, R., & Radke, J. (2008). A comparison of geometric approaches to assessing spatial similarity for GIR. *International Journal of Geographical Information Science, 22*(3), 337–360.

Gardner, J. A. (2002). One person, one vote and the possibility of political community. *North Carolina Law Review, 80*(4), 1237–1268.

Grofman, B. (1985). Criteria for districting: A social science perspective. *UCLA Law Review, 33*, 77–184.

Grofman, B. (1993). Would vince lombardi have been right if he had said: "When it comes to redistricting, race isn't everything, it's the only thing?". *Cardozo Law Review, 14*, 1237–1276.

Groves, R. M. (2006). Nonresponse rates and nonresponse bias in household surveys. *Public Opinion Quarterly, 70*(5), 646–675.

Handley, L. (2008). A comparative survey of structures and criteria for boundary delimitation. In L. Handley, & B. Grofman (Eds.), *Redistricting in comparative perspective* (pp. 265–284). Oxford, New York: Oxford University Press.

Handley, L., & Grofman, B. (2008). *Redistricting in comparative perspective*. Oxford, New York: Oxford University Press.

Hill, L. L. (1990). *Access to geographic concepts in online bibliographic files: Effectiveness of current practices and the potential of a graphic interface*. University of Pittsburgh. PhD thesis.

Johnson, D. (2015). *City of Santa Barbara: Drawing the lines*. National Demographics Corporation. Published on 18 Mar. 2015 http://www.santabarbaraca.gov/civicax/filebank/blobdload.aspx?BlobID=50303.

Kogan, V., & Kousser, T. (2011). Great expectations and the California citizens redistricting commission. In G. Moncrief (Ed.), *Reapportionment and redistricting in the west* (pp. 219–245). Lanham, MD: Lexington Books.

Kogan, V., & McGhee, E. (2012). Redistricting California: An evaluation of the Citizens Commission final plans. *California Journal of Politics and Policy, 4*(1), 1–22.

Mac Donald, K., & Cain, B. E. (2013). Community of interest methodology and public testimony. *UC Irvine Law Review, 3*(3), 609–636.

Mann, T. E. (2005). Redistricting reform: What is desirable? possible? In T. E. Mann, & B. E. Cain (Eds.), *Party lines: Competition, partisanship, and congressional redistricting* (pp. 92–114). Washington, D.C: Brookings Institution Press.

Mann, T. E., & Cain, B. E. (2005). *Party lines: Competition, partisanship, and congressional redistricting*. Washington, D.C: Brookings Institution Press.

Mark, D. M. (1993). Toward a theoretical framework for geographic entity types. In A. U. Frank, & I. Campari (Eds.), *Spatial information theory: A theoretical basis for GIS* (pp. 270–283). Berlin: Springer-Verlag.

Medew, R. (2008). Redistribution in Australia: The importance of one vote, one value. In L. Handley, & B. Grofman (Eds.), *Redistricting in comparative perspective* (pp. 97–105). Oxford, New York: Oxford University Press.

Montello, D. R. (2003). Regions in geography: Process and content. In M. Duckham, M. F. Goodchild, & M. F. Worboys (Eds.), *Foundations of geographic information science* (pp. 173–189). London: Taylor & Francis.

Montello, D. R., Friedman, A., & Phillips, D. W. (2014). Vague cognitive regions in geography and geographic information science. *International Journal of Geographical Information Science, 28*(9), 1802–1820.

Montello, D. R., Goodchild, M. F., Gottsegen, J., & Fohl, P. (2003). Where's downtown?: Behavioral methods for determining referents of vague spatial queries. *Spatial Cognition & Computation, 3*(2–3), 185–204.

Morrill, R. L. (1987). Redistricting, region and representation. *Political Geography Quarterly, 6*(3), 241–260.

Morrill, R. L. (1990). A geographer's perspective. In B. Grofman (Ed.), *Political gerrymandering and the courts* (pp. 212–239). New York: Agathon Press.

National Demographics Corporation. (2015). *Draft plan 3B*. Published on 26 Mar. 2015 http://www.santabarbaraca.gov/civicax/filebank/blobdload.aspx?BlobID=50821.

Potthoff, G. (2015). Santa Barbara agrees to settle district elections lawsuit. *Noozhawk*. Published on 15 Feb. 2015 www.noozhawk.com/article/santa_barbara_agrees_to_settle_district_elections_lawsuit.

Prescott, J. R. V. (1965). *The geography of frontiers and boundaries*. Chicago: Aldine Publishing Company.

Spielman, S. E., & Singleton, A. (2015a). Studying neighborhoods using uncertain data from the American community survey: A contextual approach. *Annals of the Association of American Geographers, 105*(5), 1003–1025.

Spielman, S. E., & Singleton, A. (2015b). Studying neighborhoods with uncertain census data. *Github*. Published on 22 July 2015 https://github.com/geoss/acs_demographic_clusters.

Stephanopoulos, N. O. (2012a). Redistricting and the territorial community. *University of Pennsylvania Law Review, 160*(5), 1379–1477.

Stephanopoulos, N. O. (2012b). Communities and the California commission. *Stanford Law & Policy Review, 23*(2), 281–334.

Tuan, Y.-F. (1974). *Topophilia: A study of environmental perception, attitudes, and values*. Englewood Cliffs, NJ: Prentice-Hall.

Winburn, J., & Wagner, M. W. (2010). Carving voters out: Redistricting's influence on political information, turnout, and voting behavior. *Political Research Quarterly, 63*(2), 373–386.

Woodruff, A. (2012). Crowdsourced neighborhood boundaries, part one: Consensus. *Bostonography*. Published on 2 July 2012 http://bostonography.com/2012/crowdsourced-neighborhood-boundaries-part-one-consensus/.