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Research Paper

The social context of U.S. built landscapes

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ABSTRACT

In this paper, we present a quantified, GIS-based analysis of the relationship between urban morphological patterns and racial, ethnic, and household characteristics. We want to understand how the built landscapes of American cities differ in sociological terms—for example, are some more prone to racial concentration or prevalence of particular family types? Since many built landscape types are relatively recent and rapidly growing, this analysis can inform current debates about sprawl and inequality. We examined six diverse U.S. metropolitan regions: Boston, Atlanta, Chicago, Las Vegas, Portland, and Sacramento, joining census block data with built landscape patterns mapped in GIS through aerial imagery analysis. We find that a large portion of our six metropolitan regions consists of patterns that can be characterized as sprawl—patterns that are often manifestations of a desire for separation. This separation has significant equity implications because resources—services, amenities, schools, parks, tax base, etc.—are not evenly distributed. Further, two of our patterns (Rural Sprawl and Upscale Enclave), which are growing rapidly and most often occur on the urban fringe, have the least diverse demographics across all six metro areas. These landscapes are also by far the least dense, leading to a range of negative environmental impacts. Older built landscape types (Urban Grids, Rectangular Block Grids, and Degenerate Grids) are denser and relatively diverse. These have lower rates of occupancy in most urban areas, indicating an opportunity to house additional residents in relatively well-located, well-connected, and diverse central portions of metropolitan regions.

1. Introduction

The rapidly expanding postmodern metropolitan region features a variety of built landscape types—distinctive neighborhood-scale patterns of streets, blocks, buildings, parcel configurations, and balances of gray and green infrastructure. Human populations are not distributed evenly across these built landscapes, but vary in both density and demographic characteristics between them. The physical characteristics of particular landscape types as well as other factors such as job location, transportation options, housing cost, resident self-selection, and racial, ethnic, or economic discrimination determine both density and demographics.

In this paper we seek to understand how the built landscapes of American cities differ in sociological terms, and what this might mean for future efforts to manage sprawl and reduce social inequality. Are some built landscapes more prone to racial concentration or a prevalence of particular family types than others? Are some inhabited primarily by renters who would be at greater risk of displacement than other residents living in owner-dominated landscapes? Do social equity questions exist because of the nature of some built landscape types and who lives in them, for example arising from the frequent placement of garden apartment landscapes with disadvantaged residents next to freeways, railroad tracks, large commercial corridors, and industrial sites, land uses that might have negative impacts due to noise, traffic, or pollution?

Although there is variation worldwide, certain built landscape forms such as the gridded neighborhood and the organic pre-industrial village have been widely recognized by past generations of urban design theorists (e.g. Kostof, 1991; Mumford, 1961). Other built landscape types are more recent, enabled by the motor vehicle, twentieth-century development technologies, changing market preferences, and evolving urban design values. For example, suburban tract landscapes with curving streets and cul-de-sacs appeared in North America mainly after World War II, and New Urbanist landscapes with their more connected street patterns and neotraditional housing forms date with a couple of exceptions only to the 1990s.

Wheeler (2015) developed a global typology of 27 built landscape types present in metropolitan regions worldwide in the early twenty-first century. (Not all types occur in all regions.) Table 1 gives a brief description of the patterns. Fig. 1 shows some examples of what these

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Table 1
Built Landscapes of Metropolitan Regions Summary.

Airports	Large-scale landscapes for air travel, usually at edge of metro areas. Early 20th c on.
Allotment Gardens	Contiguous garden plots containing small dwelling structures. Found primarily in Northern Europe and Russia. 18th c. on.
Apartment Blocks	Relatively uniform landscapes of large residential buildings, often slab-like. Rare in North America. Post-WWII.
Campus	Large institutional sites often with formal or picturesque design of spaces. Many eras.
Civic	Large civic buildings and spaces, typically with formal design. Ancient times on.
Commercial Strip	Low-density, linear commercial development along highly trafficked streets. 1920s-on.
Country Roads	Incremental, linear, small-scale development along formerly rural roads. Many eras.
Degenerate Grid	Large-scale residential landscapes with rectilinear street patterns and poor connectivity. Mid-20th c. on.
Garden Apartments	Low-to-mid-rise residential buildings with a strong relationship to exterior green space and site amenities. Late 19th c. on.
Garden Suburb	Detached homes along curvilinear but well-connected streets with extensive greenery. Late 19th c. on.
Heavy Industry	Industrial uses on large parcels; large-footprint buildings, outdoor storage of materials, fuel tanks, and rail access. 19th c. onwards.
Hillside	Irregular winding streets shaped by steep terrain. Many eras.
Incremental/Mixed	Small-scale land subdivision and development, resulting in a non-uniform mix of forms and moderate-to-poor street connectivity.
Land of the Dead	Large areas for burial, often with formal or picturesque design. Many eras.
Long Blocks	Very long, rectilinear, residential blocks (> 1000′).
Loops & Lollipops[1]	Large-scale, mass-produced residential landscapes with regular, curvilinear street patterns and poor connectivity. Post-WWII.
Malls & Boxes	Large commercial buildings or a single large enclosed pavilion, usually with ample parking. Post-1950.
New Urbanist	Combines aspects of grid and garden suburb forms. High street connectivity; mixed-use centers. Post-1980.
Organic	Tightly woven street pattern with dense, fine-grained urban development. Many eras.
Quasi-Grid	Rectilinear, well-connected but irregular street patterns created by topography, design, or incremental development. Many eras.
Rectang. Block Grid	A regular, rectangular-block grid form with many potential land uses. In US and Europe typically < 1900.
Rural Sprawl	A semi-rural residential landscape with very large parcels (usually 1–10 acres per dwelling unit). Generally post-1950.
Superblocks	Large master-planned blocks, interior circulation. Building placement more varied than Apartment Blocks. Mid-20th c. on.
Trailer Parks	Mobile homes on small lots with narrow access roads. Exclusive to N. America. Mid-20th c. on.
Upscale Enclave	Affluent, insular residential landscape often with large houses, extensive plantings, and low street connectivity. Antiquity onwards.
Urban Grid	A grid of relatively small, squarish blocks with varied land use often found at the core of many cities. Mid-19th c. or before.
Workplace Boxes	Landscapes of boxy buildings serving industrial or commercial uses. Post-1950.

[1] (Southworth & Owens, 1993).

patterns look like.

Certain patterns exemplify suburban and exurban "sprawl." Sprawl can be identified by a constellation of factors: poorly connected street patterns, discontiguous development, homogeneous land uses, motor vehicle dependency, and often low density (although sprawl can consist of attached housing, apartments, and even high-rise buildings as well as single-family homes; see Ewing & Hamidi, 2017; Galster et al., 2001). Loops & Lollipops, Rural Sprawl, Upscale Enclaves, Degenerate Grids, Garden Apartments, Garden Suburbs are the core residential landscapes of sprawl, joined by non-residential built landscape types such as Heavy Industry, Airports, Trailer Parks, Land of the Dead, and Commercial Strips. Just three of our patterns—Organic, Urban Grids, and Rectangular Block Grids—can not be classified as sprawl, as these patterns consist of well-connected, contiguous, relatively mixed-use blocks that support pedestrianism. New Urbanist landscapes aim for these urban qualities as well but often have difficulty meeting these objectives. Outlying grids are urban as well (platted as a town centers in previous times), but they are typically remnant nineteenth-century settlements embedded in twentieth or twenty-first century sprawl.

This study represents an initial investigation into correlations between social variables and these built landscapes within six U.S. metropolitan regions for which GIS built landscape mapping is currently available: Boston, Atlanta, Chicago, Las Vegas, Portland OR, and Sacramento. These regions, a convenience sample intended to represent diverse parts of the country, all contain populations of at least 1.5 million with different social histories and demographic characteristics (see Fig. 2). The best correlations would of course come from address-level demographic data, but since this is not available we use the next-best level of the census block (as opposed to the larger block group or census tract). Although data at this scale is more limited, the U.S. census at the block level does provide an initial source of demographic information with which to analyze social dimensions of built landscapes.

Such correlations are of more than academic interest. Urban and regional planners have opportunities to shape future built landscapes both through policies affecting new development at the urban fringe or infill sites, and by promoting more incremental change within existing neighborhoods. We are interested, for example, to know whether certain current built landscape types hold opportunities for sustainability-improving retrofits, for example if high vacancy rates or small household size indicate opportunities to house more people. We also want to know whether certain built landscape types should be preferred over others for social reasons, for example if they consistently show an ability to accommodate a greater diversity of family types and renters as well as owners. Since limited data is available at the block level, the conclusions we can draw from this analyses are limited as well. But this initial step towards better understanding the social implications of built landscapes in US metropolitan regions may nonetheless yield valuable policy implications related to the challenges of managing sprawl and improving social equity.

2. Background

2.1. The sociospatial patterning of cities

Our empirical investigation seeks to identify associations between built landscapes and the demographic characteristics of residents within early twenty-first century American cities. As background, it is important to briefly summarize the historical trajectory of social and spatial divisions in cities, including the theoretical perspectives that have been proposed to explain them.

Different demographic groups have inhabited separate parts of the city for as long as cities have existed. But it was during the rise of the industrial city in the 19th century that social separation began to take on a more explicit spatial pattern. In the early industrial era this meant new gridded suburban districts outside of more organic central cities in Europe. As production left the home in favor of larger, specialized facilities, exclusively commercial and industrial landscapes emerged. Improving roads and carriages allowed the upper class to take up residence on the periphery, especially in nations such as the United Kingdom with a strong tradition of country estates.

Beginning in the nineteenth century designers began creating garden suburb neighborhoods for the new urban bourgeoisie. As industrial cities grew and created new built landscape forms, demographic groups were increasingly segregated by landscape type. The working class, streaming into cities from the countryside, typically

Fig. 1. Examples of built landscape types (aerial images 1000′ × 1000′).

settled in dense slums in the old organic center of European cities or, somewhat later, gridded or degenerate grid suburbs such as the "by law" blocks of attached housing in late-nineteenth century Britain. The advent of the streetcar enabled the exodus of the middle class from the central city to "streetcar suburbs"—rectangular block grids along streetcar lines (Hayden, 2003; Warner, 1962). Wealthy merchants inhabited more upscale districts with larger homes and lots, or else commuted into the city from surrounding exurban estates. Racial, ethnic, and religious minorities clustered or were actively segregated within some of these landscapes.

The early twentieth-century social ecologists—a group of urban sociologists clustered at the University of Chicago—sought to study

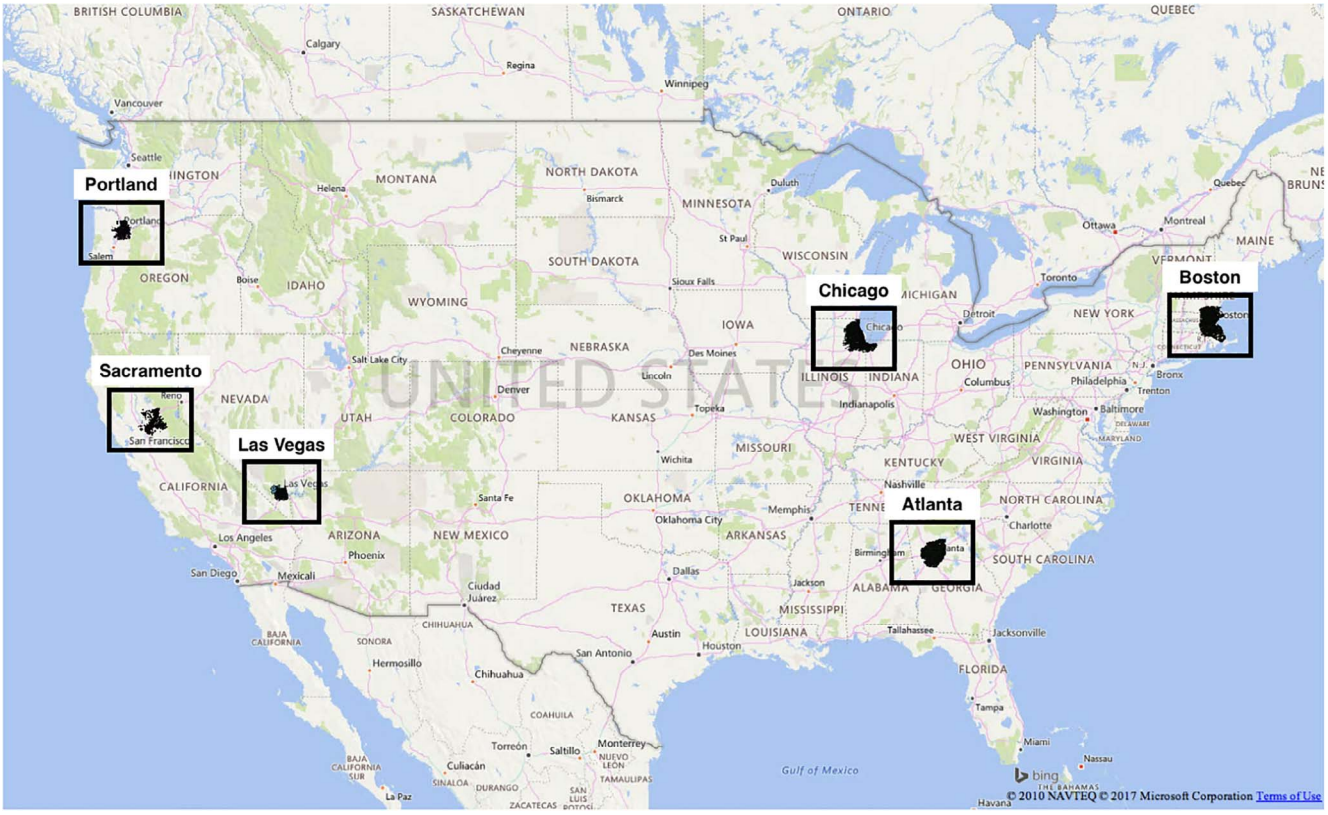

Fig. 2. Locations of six metropolitan regions.

evolving spatial patterns of demographic change within cities, considering built form in a very general way. Most famously, Roderick McKenzie, Robert Park, and Ernest Burgess developed a spatial model of urban growth and demographic change emphasizing a pattern of concentric rings of different socioeconomic character (McKenzie, Park, & Burgess, 1967). New immigrants clustered in an inner ring next to the central city, while a more established working class (often consisting of second-generation Americans) lived in the ring beyond that, and more affluent residents beyond that in detached single-family homes. Blacks were clustered in a vertical spine on Chicago's South Side cutting across these rings. The Chicago School employed ecological concepts such as invasion, succession, and evolution to describe spatial changes, a practice that was criticized for presuming that lower-income communities were disorganized (e.g. Zukin, 1980). Dear (2000) later argued the importance of analyzing the dispersed, polycentric, suburban world where social division, privatization, jurisdictional fragmentation, and appropriation of cultural forms presented a much different narrative than the monocentric model of the Chicago School.

Toward the latter half of the 20th century, such fragmented and dispersed urban patterns, defined as "sprawl," were increasingly blamed for a host of social, environmental and economic problems facing American society: global warming and environmental degradation (Ewing, Bartholomew, Winkelman, Walters, & Chen, 2008; Ewing & Hamidi, 2017), social inequity (Pendall, 2000; Squires, 2002; Talen, 2015), exorbitant energy spending, economic inefficiency and waste, job loss, and the decline of public health (Burchell, Downs, McCann, & Mukherji, 2005; Frumkin, 2004). Sprawl was also blamed for exacerbating the de-industrialization of American cities, leading to the decline of a once robust and growing middle-class (Chetty, Nathaniel Hendren, & Emmanuel Saez, 2013). It seems clear that the spatial arrangement of demographic groups within the metropolis matters a great deal, and that the association of these groups with particular built landscape types may also have profound implications for both social welfare and future paths of urban development.

2.2. Linking urban form and social variables

Also relevant is research related to the general topic of connecting built form to social variables. This literature tends to focus on cause or effect—i.e., how a built form was engendered (the question of agency in urban morphology research), or what the effects and outcomes of built form are. Our study correlating built form to social variables is a unique, large-scale quantitative approach that has the potential to inform both types of research.

The causes of particular urban forms are complex and can include the actions of individuals and the regulations of governments combined within broader social and economic forces that affect agency (Oliveira, 2016; Whitehand, 2009). Land subdivision, land use, building construction, infrastructure, connectivity and movement – these and other elements of human-built landscapes are analyzed to answer questions about how such elements came about, how they interrelate, and what their likely future course will be (McCartney, 2012). Some urban morphologists are interested not only in measuring form and understanding its causes, but in interpreting what these forms and patterns mean in terms of the underlying political economy. In that perspective, urban patterns can be viewed as an expression of the political and economic powers at play, such that the urban pattern is "a means by which the prevailing system of power and socio-economic relationships are maintained" (Knox, 1984, 107; Larkham & Conzen, 2014). Harvey (1985) similarly emphasized the organization of urban space by capital, operating through land markets and related institutions and creating a fragmented terrain "held down and together under all manner of forces of class, racial, and sexual domination" (Harvey, 1985, 178). Feminist critics such as Hayden (1984), Wekerle (1984), and Spain (1992) illuminated how women have been historically relegated to certain spaces and denied safe access to others, and Ellin (1996) highlighted the way motives such as fear and control shape urban landscapes. Davis (1990) traced the ways ideas, visions, and culture interacted with power to create "spatial apartheid" within Los Angeles, and later (2006)

Table 2
Census Block Variables, 2010.

Total population
% of total population
% White alone
% Black or African American alone
% Asian alone
% Two or More Races
% Other Race alone
% Hispanic or Latino
% Not Hispanic or Latino, White alone
% Not Hispanic or Latino, Black or African American alone
Housing units
% of total units
Population in occupied units
Occupied units
% occupied units
% Husband-wife family households
% female-headed households
% units owner-occupied
% units renter-occupied
% vacant units

Source: Minnesota Population Center. National Historical Geographic Information System: Version 11.0 [Database]. Minneapolis: University of Minnesota. 2016. http://doi.org/10.18128/D050.V11.0.

chronicled the rise of massive informal settlements worldwide inhabited almost exclusively by the poor.

Built landscapes have the potential to affect choice, access, opportunity, interaction, movement, identity, connection, mix, security, and stability (Talen, 2008). Environmental psychologists and public health experts have shown how the design of the built environment can have a profound impact on human behavior and feelings (Gallagher, 1994; Koohsari & Hannah Badland, 2013; Tuan, 1981). Talen and Koschinsky (2014) reviewed the literature on neighborhood effects and found that neighborhoods of a particular form (compact, walkable, diverse) have been linked to social interaction, sense of community, feelings of identity, and improved personal well-being in terms of health and safety. Within these studies, the characterization of the urban environment often entails an evaluation of street connectivity, housing density and compact building forms, housing type and mix, land use diversity, and locations and qualities of facilities and services.

This literature – on the measurement, causes, and effects of the built environment – forms an important backdrop to our study. While our analysis is not directed at uncovering the indicators of agency that can be found embedded in the American urban pattern, nor do we attempt to shed light on the effects of urban form, we take the relationship between urban form and social variable in a different, and broader, direction: what demographic groups are associated with particular urban forms, how do groups vary in terms of the built environment contexts, and how do these associations vary across metropolitan areas? Our study is unique in its scale (covering six large metropolitan regions), its quantitative approach, and its representation of the built environment on the basis of built landscapes.

3. Data and method

Our method involves the following four steps: 1) characterizing the built landscape through aerial image interpretation; 2) creating a polygon layer in GIS that identifies each landscape pattern; 3) creating a point layer of socio-demographic information; and 4) identifying the socio-demographic points that fall within each pattern type. The method extends Wheeler's (2015) typology of built landscapes by looking at the underlying social characteristics associated with each landscape type.

Methods for the creation and mapping of landscape typology are described and illustrated in Wheeler (2015), but can be summarized as follows. First the typology itself was created based on previous urban morphological literature and visual analysis of a large number of global urban regions. Particularly influential sources included Mumford (1961), Lynch (1981), Kostof (1991, 1992), Southworth and Owens (1993), Jacobs (1993), Calthorpe (1993), Moudon (1994), and Hayden (2003). Next, built landscape types were mapped in ArcGIS for each metropolitan area using Google Earth, Street View, photographs posted by Google Earth users, and other online sources of data. The mapping for each region was a painstaking process relying on careful specification of each landscape type, training of student researchers, and review by the primary investigator. In order to balance speed and precision it was done primarily at a scale of 1:30,000, with the person digitizing zooming in and out on a second screen to verify on-the-ground features of particular landscapes. Once databases were created for metropolitan regions, ArcGIS enabled the land area of each built landscape type to be calculated, and the prevalence of built landscape types compared across regions.

To relate census data to the 27 patterns, it was necessary to use the smallest possible unit of census information. This is because the spatial pattern of the built environment does not coincide neatly with census geography—census tracts might encompass more than one built landscape type, or one pattern might straddle more than one census tract. The same is true of block groups, the next lowest level of census geometry. By using the smallest geometry—the census block—there was a greater likelihood that census geography would be entirely included within a particular pattern. The drawback with using census block information is that the range of variables is limited. The variables we used are listed in Table 2.

We performed the identical process of relating social data to the built landscape patterns for six U.S. metropolitan regions: Boston, Atlanta, Chicago, Las Vegas, Portland, and Sacramento—a selection of mid to large sized cities across the U.S. that offer wide geographical and historical variation. Our process was as follows. We first created the polygon centroids of census blocks, and assigned that data to the pattern it was located in. In GIS terminology, this involved performing a spatial join of census block data with built landscape patterns. Because the built landscape patterns are relatively small geographically, it was necessary to use the smallest possibly census geography—census blocks—so that demographic data clearly fell *within* a landscape pattern. Some census block centroids did not fall within a pattern, so a follow-up procedure was required to ensure that census blocks that touched upon a pattern were counted. In the second iteration, we first located all unmatched census blocks (polygons) and identified those that intersected with each pattern. These blocks were then assigned the pattern they intersected. The end result for each metropolitan region was a census block data file that had demographic information as well as a pattern number.

4. Results

Tables 3 and 4 present some summary population and density statistics for each pattern by metro region—total acreage, population, density and population percent totals. As Table 3 shows, fifteen out of the 27 patterns had relatively few people living in them – each pattern housing less than 2% of the population. Several of these would not be expected to have much population: Airports, Civic, Commercial Strip, Csountry Roads, Heavy Industry, Hillside, Land of the Dead, and Malls and Boxes. Seven other built landscape types proved also to house a relatively small share of the population of these six US regions, and a few explanations can be offered. Apartment Blocks and Superblocks are rare due to U.S. disinterest in high-rise living. Organic forms are likewise rare in North America which was settled relatively recently by Europeans starting with grid forms. Long Blocks are rare everywhere, usually resulting from urbanization of long, narrow agricultural plots. New Urbanist landscapes are recent and have yet to become mainstream building industry practice. Trailer Parks represent an important low-income housing form in many parts of the U.S., but are a relatively

Table 3
Percent total population associated with each pattern.

Pattern Name	BOSTON	CHICAGO	PORTLAND	SACRAMENTO	LAS VEGAS	ATLANTA
Airports	0.03	0.01	0.01	0.09	0.05	0.00
Allotment Gardens	N/A	N/A	N/A	N/A	N/A	N/A
Apartment Blocks	0.19	0.29	0.04	N/A	N/A	N/A
Campus	1.36	1.15	2.98	2.06	1.86	2.02
Civic	0.08	0.04	0.03	N/A	0.05	0.02
Commercial strip	0.74	0.87	0.85	0.78	1.36	1.13
Country Roads	0.53	0.05	N/A	N/A	N/A	0.01
Degenerate grid	27.12	19.02	23.80	13.09	12.38	4.22
Garden apartments	1.93	5.22	7.76	8.55	15.75	11.58
Garden Suburb	4.07	0.74	0.48	1.24	N/A	0.06
Heavy industry	0.11	0.22	1.14	0.07	0.07	0.12
Hillside	N/A	N/A	N/A	0.15	N/A	N/A
Incremental mixed	4.26	0.94	2.06	2.38	4.34	2.18
Land of the dead	0.24	0.11	0.06	0.04	0.00	0.07
Long Blocks	N/A	1.00	N/A	N/A	N/A	0.27
Loops and lollipops	16.82	21.44	32.98	49.56	54.85	66.03
Malls and boxes	0.67	0.42	0.64	1.07	1.85	0.46
New Urbanist	N/A	0.01	1.05	0.25	N/A	0.05
Organic	N/A	0.00	N/A	N/A	N/A	N/A
Quasi Grid	8.20	0.48	0.07	0.37	N/A	0.66
Rectangular block grid	15.06	42.24	12.07	1.85	2.81	0.35
Rural sprawl	16.62	2.04	5.43	8.32	0.05	7.49
Superblocks	N/A	0.28	0.07	N/A	N/A	N/A
Trailer park	0.14	0.32	1.54	1.54	0.36	0.19
Upscale enclave	0.58	0.18	0.68	4.78	2.49	0.38
Urban grid	0.06	1.95	5.67	2.86	0.80	0.65
Workplace boxes	1.18	0.99	0.59	0.94	0.92	2.08
Total population included in analysis	4,797,558	8,679,901	1,853,789	2,252,949	1,877,974	4,608,991

Table 4
Density: square kilometers in each pattern divided by population in pattern.

	Atlanta			Boston			Chicago			Las Vegas			Portland			Sacramento		
Pattern	Sq. km	Pop	Density	Sq. km	Pop	Density	Sq. km	Pop	Density	Sq. km	Pop	Density	Sq. km	Pop	Density	Sq. km	Pop	Density
Airports	32	64	2.0	25	1346	54.9	52	1166	22.4	23	897	39.2	18	199	11.2	47	2060	44.0
Allotment Gardens	0	NA		0	NA		0	NA		0	NA		0	NA		0	NA	
Apartment Blocks	0	NA		8	9140	1218.7	3	25216	8405.3	0	NA		0	811	8110.0	0	NA	
Campus	64	93042	1460.6	31	65060	2098.7	139	99993	719.4	17	34837	2013.7	38	55214	1453.0	55	46408	843.8
Civic	3	767	273.9	2	3994	2102.1	6	3433	572.2	2	936	445.7	1	501	715.7	47	NA	
Commercial Strip	160	51962	325.0	48	35493	733.3	112	75237	671.8	25	25603	1036.6	21	15675	742.9	24	17529	730.4
Country Roads	6	475	84.8	72	25536	352.7	12	4077	339.8	0	NA		0	NA		1	NA	
Degenerate Grid	107	194571	1818.4	429	1E+06	**3032.2**	697	2E+06	2368.9	66	232434	**3521.7**	182	4E+05	2422.9	108	294898	2720.5
Garden Apartments	122	533846	**4386.6**	30	92516	3073.6	104	452679	**4352.7**	49	295711	**6097.1**	26	1E+05	**5599.1**	43	192604	**4531.9**
Garden Suburb	1	2572	2857.8	84	195059	2316.6	32	64016	2000.5	0	NA		4	8934	2481.7	14	28028	2045.8
Heavy Industry	41	5342	131.9	17	5502	316.2	255	19281	75.6	12	1388	118.6	74	21110	286.0	32	1683	52.3
Hillside	0	NA		0	NA		0	NA		0	NA		8	NA		4	3338	902.2
Incremental/Mixed	68	100267	1468.0	148	204586	1378.6	41	81260	1982.0	94	81455	868.4	27	38106	1432.6	37	53533	1446.8
Land of the Dead	7	3194	491.4	22	11752	531.8	37	9616	259.9	1	92	131.4	4	1114	318.3	2	993	472.9
Long Blocks	8	12462	1483.6	0	NA		49	86759	1770.6	0	NA		0	NA		0	NA	
Loops & Lollipops	2469	3E+06	1232.5	601	807156	1343.7	1110	2E+06	1676.8	352	1E+06	2923.3	305	6E+05	2007.8	449	1E+06	2489.5
Malls & Boxes	65	21407	329.8	64	32155	501.6	92	36136	392.8	48	34664	729.8	23	11871	516.1	38	24081	628.7
New Urbanism	1	2091	1493.6	0	NA		1	560	560.0	0	NA		7	19487	2865.7	4	5567	1294.7
Organic	0	NA		0	NA		1	111	111.0	0	NA		0	NA		0	NA	
Quasi Grid	25	30255	1215.1	121	393459	**3265.2**	14	41842	2988.7	0	NA		1	1295	2590.0	6	8385	1397.5
Rectangular Block Grid	10	16229	1575.6	120	722628	**6001.9**	801	4E+06	**4577.2**	17	52845	**3164.4**	72	2E+05	**3091.7**	14	41741	3046.8
Rural Sprawl	943	345011	365.9	1024	797221	778.5	441	177133	401.7	13	1000	76.3	291	1E+05	346.3	954	187505	196.5
Superblocks	0	NA		0	NA		2	24130	12065.0	0	NA		0	1295	3237.5	0	NA	
Trailer Parks	4	8545	2248.7	6	6478	1098.0	8	28013	3501.6	9	6677	776.4	8	28510	3702.6	13	34756	2613.2
Upscale Enclave	32	17660	546.7	50	28042	558.6	31	15543	501.4	46	46842	1013.9	16	12545	779.2	135	107692	796.5
Urban Grid	13	29949	2358.2	1	2741	3915.7	43	169339	3938.1	1	15087	10776.4	35	1E+05	2995.9	27	64465	2414.4
Workplace Boxes	299	95936	320.6	144	56598	394.1	388	85589	220.6	51	17345	342.1	36	11016	305.2	102	21143	206.7
TOTAL	41	5342	131.9	17	5502	316.2	255	19281	75.6	12	1388	118.6	81	21110	259.7	36	5021	139.9

*shaded cells have >3,000 pop per square kilometer; patterns containing less than 2% of the population are a lighter shade

* Shaded cells have > 3000 pop per square kilometer; patterns containing less than 2% of the population are a lighter shade.

small niche. Finally, Allotment Gardens are a northern European and Russian landscape type not found in North America.

Among the dozen built landscape types that do house substantial populations within American urban regions, Loops & Lollipops was the clear "winner" – most of the population in our six metropolitan regions lives in that pattern. This was followed by Degenerate Grid, Garden Apartments, and, with the exception of Atlanta and Las Vegas, Rectangular Block Grid. Cities varied widely in terms of total number of built landscape types. Las Vegas had the fewest, with ten missing patterns, followed by Sacramento, which was missing seven. Chicago had only 2 missing patterns. Some cities' populations are consolidated in very few patterns. In Atlanta and Las Vegas almost 85% of the population lives in just 3 patterns: Loops and Lollipops, Degenerate Grid, and Garden Apartments.

We can see from Table 4 that patterns vary significantly in terms of density. Although most people live in Loops & Lollipops, its density is low, thus requiring a large land area to accommodate its population. The more urban patterns—Garden Apartments and Grids in all forms (Rectangular Block, Degenerate, Urban, Quasi) are predictably much denser, although the population they encompass varies from 69% in Chicago to 17% in Atlanta. The pattern Garden Apartments is consistently dense in all cities, and is ranked as the second or third most populous pattern in the three newer metro regions of Sacramento, Las Vegas and Atlanta. Superblocks and Trailer Parks are dense in some regions, although their population levels are low. This is to be expected since the former typically involve mid-rise multifamily buildings and in the latter trailers are usually placed on very small lots.

Fig. 3 shows the distribution for the top 5 patterns in each city. The figure shows that the three regions that grew rapidly in the 19th and early 20th centuries (Boston, Chicago, and Portland) have their populations distributed more evenly across several patterns, with Degenerate Grids and Rectangular Block Grids dominating. The three newer regions that grew rapidly in the mid to late 20th century have a less even distribution, with Loops and Lollipops dominating and less of the older, gridded urban core.

The population distribution between patterns varies dramatically across the six regions. For example, 42% of Chicago's population lives in a Rectangular Block Grid, while < 1% of Atlanta's does. Two-thirds of Atlanta's population lives in Loops & Lollipops landscapes, but only 17% of Boston's. This means that residents of American cities are living significantly different urban experiences. Fig. 4 shows the spatial distribution of the top patterns for each metropolitan region.

Across all regions Garden Apartment, Degenerate Grid, and Rectangular Block Grid landscapes tend to be more racially and ethnically diverse than other types. Chicago's Rectangular Block Grid is only 35% non-Hispanic white (the Chicago region as a whole was 55% non-Hispanic white as of 2010). In the Sacramento, Las Vegas and Atlanta regions Garden Apartment landscapes had even higher percentages of residents of color. Chicago, Sacramento, Las Vegas, and Atlanta Rectangular Block Grid residents were more than 50% people of color. Rural Sprawl stands out as being the least racially diverse—in 5 of the 6 metro regions, Rural Sprawl had the highest percentage of white (all ethnicities) and non-Hispanic white population (in Las Vegas the highest percentage of whites is in Upscale Enclaves). On average Rural Sprawl landscapes are 82% Non-Hispanic white, and Upscale Enclaves and Loops & Lollipops 79% and 65% respectively. Tables 5 and 6 present these statistics, showing the racial and ethnic composition of built landscapes (only patterns that had at least 5% of the population for at least one city are shown in Table 5).

Figs. 5 and 6 present a somewhat different perspective on race/ethnicity variation by pattern. Rather than showing the racial make-up of each pattern, the graphics show what patterns black, whites and Hispanics are living in. What the two figures reveal is that for the newer cities of Sacramento, Las Vegas and Atlanta, the built environment experiences for blacks and whites appears to be fairly similar, with vast majorities of both races living in Loops & Lollipops. But in Boston and Chicago, and to some extent Portland, the built form experiences of whites and blacks are very different. In particular, whites in Chicago and Boston are spread relatively evenly across three pattern types, while blacks in the two cities are consolidated in Rectangular Block Grids in Chicago and Degenerate Grids in Boston.

A final set of tables shows the variation among patterns for two additional demographics available at the census block level in 2010: units and households. Tables 7 and 8 present the data on units, population per unit, renter-occupied housing and vacant units. A few observations stand out. First, again Boston and Chicago stand apart from the three newer cities of Sacramento, Las Vegas, and Atlanta, with Portland standing somewhere in between. The older cities have most of their housing units in grid form (Degenerate or Rectangular Block), while the other cities have their units predominantly in Loops &

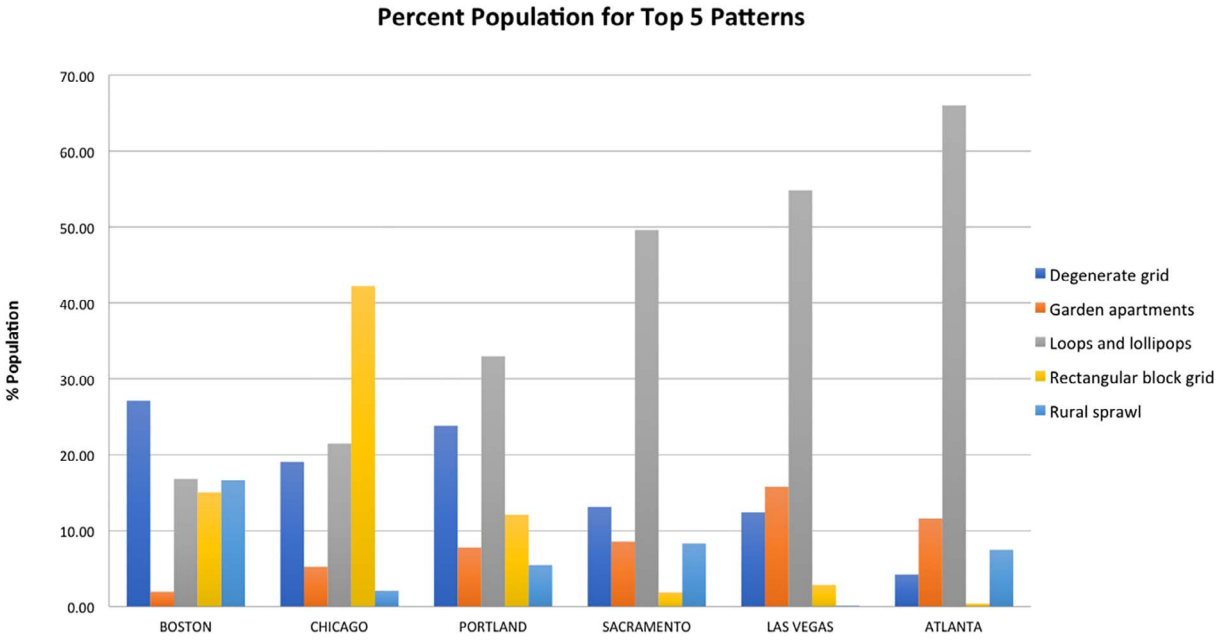

Fig. 3. Percent population of top 5 patterns.

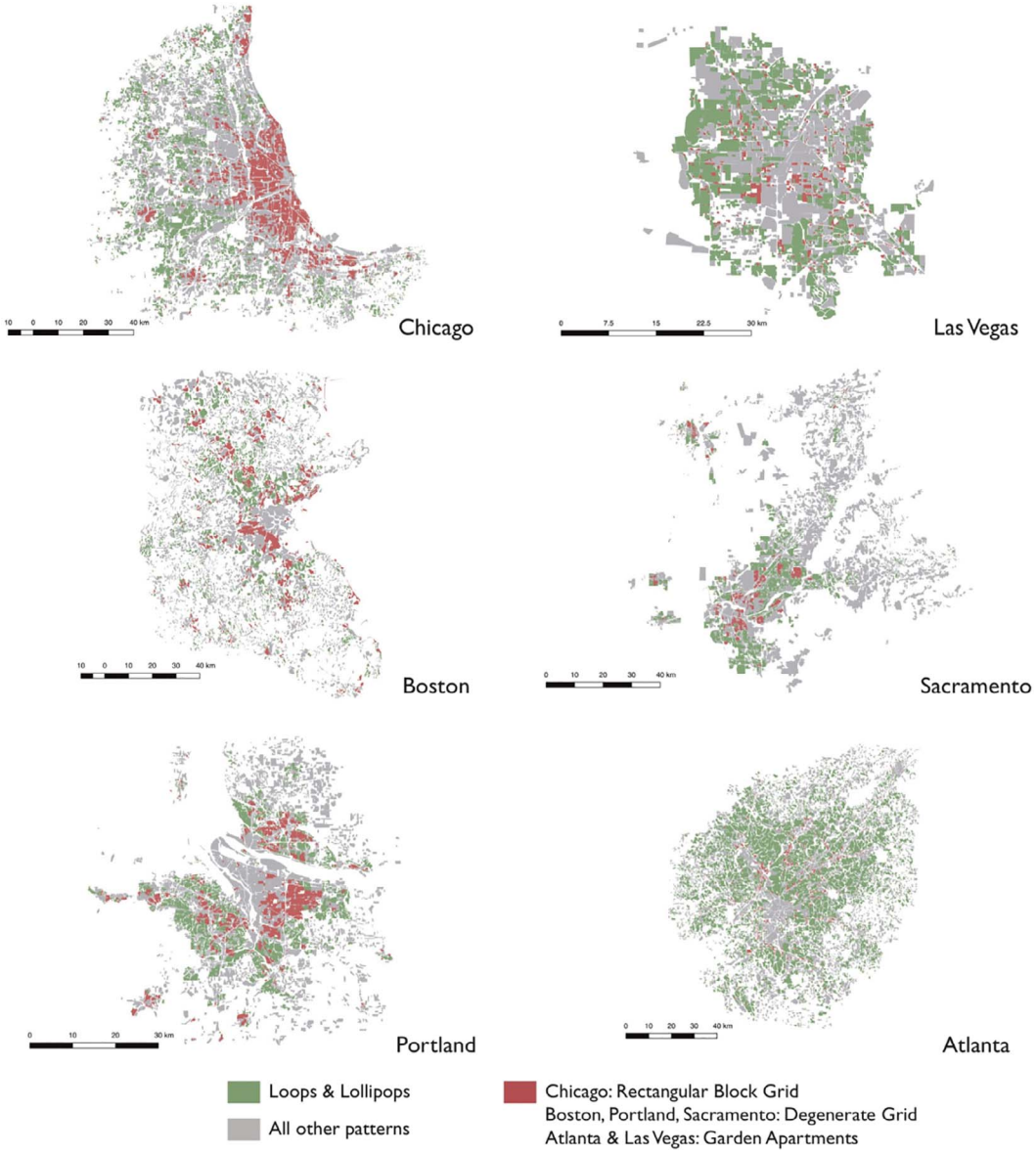

Fig. 4. Comparison of dominant patterns in six regions.

Lollipops. In terms of population per unit, the more urban patterns of Quasi Grid, Urban Grid, Workplace Boxes, and Garden Apartments have lower percentages, which is expected. Garden Apartments also have the most renters and the highest vacancy rates. For all cities except Las Vegas, Loops and Lollipops and Rural Sprawl had significantly lower rates of renter-occupied housing.

Finally, Tables 9 and 10 present data associating built landscapes and household type. We focus on two statistics—% married couple households and% female-headed households—because these two variables have traditionally been used as indicators of wealth status. Across all cities, Upscale Enclaves, Rural Sprawl, and Loops & Lollipops, have the highest percentages of married-couple households and the lowest percentages of female-headed households. It is interesting that in no city did the percentage of married couple households in the more urban patterns—Degenerate Grid and Rectangular Block Grid—exceed 50 percent. It is also interesting that the traditional (married couple) household percentages of Loops & Lollipops and Rural Sprawl were highest in the older cities. For all regions, the percentages of female-headed households are highest in the more urban patterns of Degenerate Grid, Rectangular Block Grid, and Garden Apartments.

5. Discussion

The number of census variables available at the census block level is limited, so this analysis yields the greatest amount of information about racial distributions of population relative to built landscape type, somewhat less about household size and character, and relatively little about income and wealth distribution, except to the extent that home ownership, married-couple households, and percentage of female-headed households are correlated. However, the stories that emerge are powerful ones with implications for future urban and regional planning. Some of these narratives are well-known, others less so.

An initial discussion concerns the very different distribution of population between built landscape types, and the social inequality that represents. Exurban built landscape types (Rural Sprawl, Upscale Enclaves, Country Roads) are predominantly white. Urban built landscapes are far more racially mixed. Urban Grids, Rectangular Block Grids, and Degenerate Grids are majority minority in many cases. Although in large part this diversity is the result of white flight and disinvestment, such built landscapes offer advantages to their current residents in terms of proximity to downtown business and entertainment districts as well as suitability for public transit and travel by foot

Table 5
Comparison of racial and ethnic composition by pattern for six metropolitan regions.

		BOSTON				CHICAGO				PORTLAND			
		% white	% black	% asian	% Hisp	% white	% black	% asian	% Hisp	% white	% black	% asian	% Hisp
4	Campus	73	7	14	7	65	22	7	12	80	2	7	10
8	Degenerate grid	71	12	6	12	74	12	5	17	77	4	7	14
9	Garden apartments	74	8	11	8	62	16	12	19	74	4	7	18
10	Garden Suburb	83	4	10	4	75	16	3	10	92	1	3	3
13	Incremental mixed	87	4	4	5	64	19	7	20	81	2	3	15
16	Loops and lollipops	89	3	5	3	78	7	9	11	82	2	7	9
20	Quasi Grid	76	8	7	10	55	25	8	23	70	4	11	25
21	Rectangular block grid	67	10	10	20	49	29	4	31	77	7	5	9
22	Rural sprawl	93	1	3	2	90	3	4	5	93	1	2	4
25	Upscale enclave	93	1	4	2	86	1	11	3	86	1	9	3
26	Urban grid	97	1	1	2	64	17	8	18	83	3	4	10
27	Workplace boxes	68	13	12	10	64	14	10	19	73	3	7	20

		SACRAMENTO				LAS VEGAS				ATLANTA			
		% white	% black	% asian	% Hisp	% white	% black	% asian	% Hisp	% white	% black	% asian	% Hisp
4	Campus	59	13	12	23	57	13	10	31	51	35	9	8
8	Degenerate grid	61	8	9	28	58	9	6	43	38	52	3	11
9	Garden apartments	54	13	12	25	52	15	8	35	32	48	7	19
10	Garden Suburb	77	4	6	17	N/A	N/A	N/A	N/A	84	9	2	4
13	Incremental mixed	62	6	13	23	68	9	5	26	45	38	4	19
16	Loops and lollipops	62	7	15	18	63	10	10	24	56	32	6	10
20	Quasi Grid	85	1	2	14	N/A	N/A	N/A	N/A	41	46	2	17
21	Rectangular block grid	57	10	11	27	48	9	3	64	41	49	2	9
22	Rural sprawl	87	1	3	9	72	4	5	15	78	15	2	7
25	Upscale enclave	84	2	8	8	78	5	10	9	65	26	6	4
26	Urban grid	67	6	7	25	49	23	8	30	40	49	5	6
27	Workplace boxes	58	10	11	26	54	19	6	28	41	40	6	19

* Percentages in light gray represent < 2% of the population for that metro region.

and bicycle. However, a potential downside is that more affluent whites may seek these same advantages in future decades, leading to gentrification and displacement of the current minority populations. Planners might wish to take proactive measures to preserve affordable housing within these older built landscape types, and to promote job opportunities and training, thus helping protect these diverse populations from displacement.

The diversity of a given landscape type can also vary between regions. While suburban tracts (Loops & Lollipops) in Atlanta, Las Vegas, and Sacramento are relatively diverse (only about half non-Hispanic white), those in Boston, Portland, and Chicago are much less so, 87, 78, and 72% non-Hispanic white respectively. The white racial make-up of these landscapes persists despite the fact that suburbs overall have gained ethnic and racial diversity in the past decade (Walker, 2016). Such demographic differences between landscape types and between cities are masked if analysis relies solely on census data-based definitions of “suburban” vs. “urban”.

Some regions appear more segregated than others. Not only are Boston’s Loops & Lollipops neighborhoods the least diverse of any region, but its Rural Sprawl landscapes are as well. These account for almost a fifth of the Boston area’s population and are 92% non-Hispanic white, despite the fact that Massachusetts has substantial Hispanic and Black populations. Possibly Boston’s bitter mid-twentieth-century fights over court-ordered busing of students to reduce racial segregation in schools helped fuel spatial segregation. In general white flight from central cities—abetted by a range of economic and institutional factors as shown by historians such as Jackson (1984)—appears to have succeeded in creating landscapes of whiteness in the outer regions of all of these metro regions. Improving social equity across these regions may require steps to promote built landscape types in all communities that will best accommodate a diverse population.

As noted in the previous section, Upscale Enclave, Rural Sprawl, and Loops & Lollipops built landscape types are correlated with more traditional family structures than others. These correlations probably track closely with wealth; married couples are more likely to have two incomes and to be able to afford large houses in these suburban or exurban landscape types. Conversely, more urban landscape forms such as Urban Grids, Apartment Blocks, Garden Apartments, Rectangular Block Grids, and Trailer Parks have on average a much lower percentage of married couples and a higher percentage of female-headed households. These landscapes contain smaller and cheaper units likely to be chosen by single individuals or nontraditional families. The percentage of rental housing likely makes a difference as well. Rural Sprawl and Loops & Lollipops landscapes have relatively little rental housing—the average percentage for Rural Sprawl is 13% and for Loops & Lollipops 23% (excluding cities with < 2% population in the pattern). Conversely, Garden Apartments and Rectangular Block Grids average 75% and 48% rental housing respectively. Type of tenure is not necessarily related to landscape form—owned units during one historical era may be rented out in the next. But the more urban landscape types tend to have many units specifically built for rental purposes, while suburban patterns have generally been built for the ownership

Table 6
Percent non-Hispanic white.

Pattern	Pattern Name	BOSTON	CHICAGO	PORTLAND	SACRAMENTO	LAS VEGAS	ATLANTA
1	Airports	91	71	90	60	47	61
2	Allotment Gardens	N/A	N/A	N/A	N/A	N/A	N/A
3	Apartment Blocks	62	53	92	N/A	N/A	N/A
4	Campus	69	58	75	47	43	47
5	Civic	57	61	72	N/A	49	17
6	Commercial strip	71	52	59	49	37	39
7	Country Roads	94	82	N/A	N/A	N/A	41
8	Degenerate grid	67	65	71	50	40	33
9	Garden apartments	70	52	67	44	38	25
10	Garden Suburb	80	70	90	69	N/A	82
11	Heavy industry	59	23	78	35	57	22
12	Hillside	N/A	N/A	N/A	78	N/A	N/A
13	Incremental mixed	85	52	75	53	56	37
14	Land of the dead	75	61	73	57	50	31
15	Long Blocks	N/A	68	N/A	N/A	N/A	9
16	Loops and lollipops	87	72	78	54	52	51
17	Malls and boxes	71	58	62	43	42	31
18	New Urbanist	N/A	90	71	55	N/A	40
19	Organic	N/A	77	N/A	N/A	N/A	N/A
20	Quasi Grid	71	43	56	77	N/A	34
21	Rectangular block grid	59	35	74	47	23	38
22	Rural sprawl	92	87	91	82	66	74
23	Superblocks	N/A	47	84	N/A	N/A	N/A
24	Trailer park	94	48	72	62	27	28
25	Upscale enclave	92	83	84	79	72	63
26	Urban grid	95	56	78	56	36	38
27	Workplace boxes	62	55	65	48	43	34

* In 2010, 63% of the U.S. population was non-Hispanic white.
* Percentages in light gray represent < 2% of the population for that metro region.

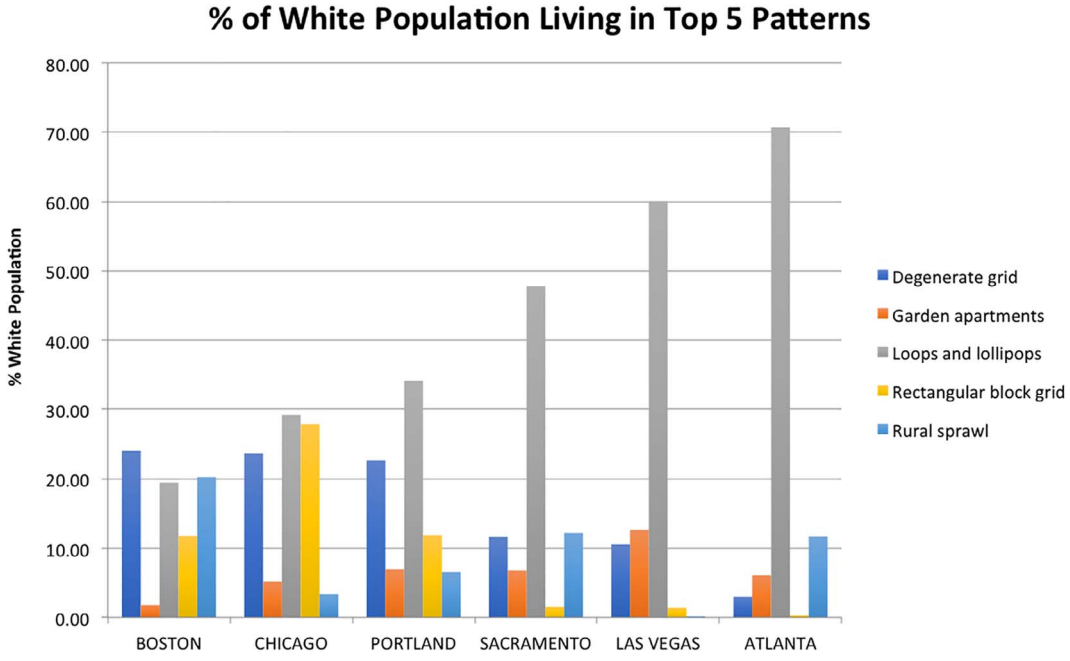

Fig. 5. Percent of white population living in top 5 patterns.

market. Since ownership housing is often out-of-reach financially for lower-income households, which also tend to be disproportionately minority and female-headed, a preponderance of ownership housing within a built landscape would tend to reduce diversity and increase spatial inequities. Potential planning steps to promote non-traditional and diverse family access to the more suburban and exurban built landscape types would be to encourage a greater range of unit sizes and prices within new development, creation of small accessory units within

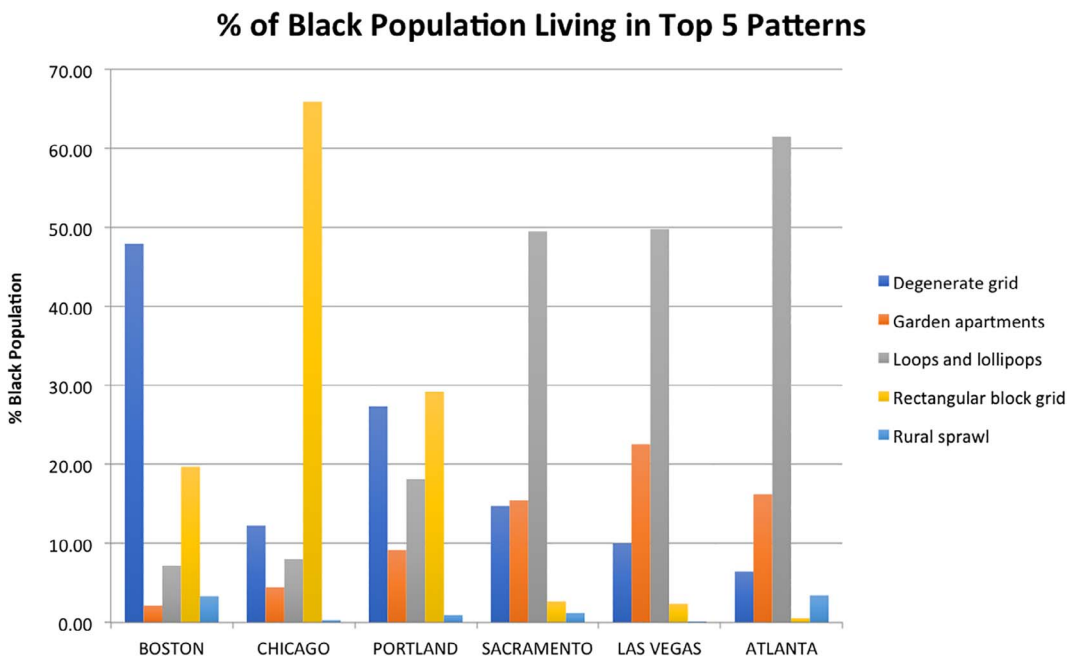

Fig. 6. Percent of black population living in top 5 patterns.

existing single family home landscapes, and promotion of a higher percentage of rental housing within certain built landscape types.

On a more general level, residents of different cities will have very different experiences because of the different landscapes they live in, and will probably engage in different behaviors and lifestyles. Some may drive much more than others, or may engage in far more walking, biking, or active forms of recreation. Some may encounter only people like themselves (because of the relatively homogenous building forms and frequent high housing prices of suburban landscapes), while others may live amidst greater diversity. Urban and regional planners may

Table 7
Comparison of unit variables by pattern for six metropolitan regions.

		BOSTON				CHICAGO				PORTLAND			
		% of total units	pop per occup unit	% units renter-occup	% units vacant	% of total units	pop per occup unit	% units renter-occup	% units vacant	% of total units	pop per occup unit	% units renter-occup	% units vacant
1	Airports	0	2.76	20	4	0	2.62	19	9	0	2.12	26	4
2	Allotment Gardens	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	Apartment Blocks	0	1.80	77	13	0	1.82	52	11	0	1.33	61	14
4	Campus	1	2.05	63	7	1	2.35	38	8	3	2.53	44	6
5	Civic	0	1.78	80	13	0	1.66	39	20	0	2.05	72	11
6	Commercial strip	1	2.28	52	8	1	2.29	50	10	1	2.33	75	8
7	Country Roads	1	2.69	15	6	0	2.41	28	11	N/A	N/A	N/A	N/A
8	Degenerate grid	27	2.54	42	6	19	2.63	28	6	23	2.62	39	5
9	Garden apartments	2	2.14	52	6	7	2.16	54	8	9	2.12	79	8
10	Garden Suburb	4	2.49	31	5	1	2.76	22	6	0	2.54	17	4
11	Heavy industry	0	2.26	60	10	0	2.48	53	12	1	2.28	45	8
12	Hillside	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	Incremental mixed	4	2.46	33	7	1	2.20	53	12	2	2.48	48	7
14	Land of the dead	0	2.27	45	7	0	2.04	40	8	0	2.11	75	10
15	Long Blocks	N/A	N/A	N/A	N/A	1	2.81	20	5	N/A	N/A	N/A	N/A
16	Loops and lollipops	16	2.68	18	4	19	2.93	11	4	30	2.75	25	4
17	Malls and boxes	1	2.13	60	7	0	2.19	49	8	1	2.33	71	6
18	New Urbanist	N/A	N/A	N/A	N/A	0	2.15	17	14	1	2.63	36	6
19	Organic	N/A	N/A	N/A	N/A	0	2.18	2	2	N/A	N/A	N/A	N/A
20	Quasi Grid	10	2.15	61	8	1	2.24	56	10	0	2.35	63	5
21	Rectangular block grid	16	2.39	59	7	42	2.78	45	11	13	2.32	40	5
22	Rural sprawl	15	2.81	13	4	2	2.86	7	5	5	2.80	13	5
23	Superblocks	N/A	N/A	N/A	N/A	1	1.63	59	17	0	1.58	49	19
24	Trailer park	0	1.89	13	10	0	2.52	20	9	2	2.27	28	5
25	Upscale enclave	1	2.62	13	10	0	2.58	8	9	1	2.37	16	8
26	Urban grid	0	2.05	31	9	3	1.99	54	15	7	1.86	68	9
27	Workplace boxes	1	2.25	55	9	1	2.18	55	10	1	2.42	60	5

* Percentages in light gray represent < 2% of the population for that metro region.

Table 8
Comparison of unit variables by pattern for six metropolitan regions.

		SACRAMENTO				LAS VEGAS				ATLANTA			
		% of total units	pop per occup unit	% units renter-occup	% units vacant	% of total units	pop per occup unit	% units renter-occup	% units vacant	% of total units	pop per occup unit	% units renter-occup	% units vacant
1	Airports	0	2.70	53	10	0	1.80	96	14	0	1.75	75	6
2	Allotment Gardens	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	Apartment Blocks	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	Campus	2	2.63	54	10	2	2.64	51	16	2	2.64	35	11
5	Civic	N/A	N/A	N/A	N/A	0	1.41	99	13	0	1.40	65	23
6	Commercial strip	1	2.26	78	12	1	2.49	68	17	1	2.08	67	14
7	Country Roads	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	2.90	48	15
8	Degenerate grid	13	2.81	40	8	11	3.04	33	11	5	2.35	49	18
9	Garden apartments	10	2.25	84	9	19	2.30	77	18	14	2.25	80	13
10	Garden Suburb	1	2.45	30	7	N/A	N/A	N/A	N/A	0	1.88	55	8
11	Heavy industry	0	3.04	38	9	0	2.35	89	13	0	2.63	58	16
12	Hillside	0	2.44	42	7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	Incremental mixed	2	2.87	50	9	4	2.81	39	16	2	2.50	53	14
14	Land of the dead	0	2.57	41	6	0	N/A	N/A	N/A	0	2.29	71	26
15	Long Blocks	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	2.87	43	23
16	Loops and lollipops	46	2.91	29	6	51	2.82	31	11	61	2.84	22	8
17	Malls and boxes	1	2.30	76	9	3	2.35	71	43	1	2.07	79	13
18	New Urbanist	0	2.68	40	7	N/A	N/A	N/A	N/A	0	2.19	60	10
19	Organic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20	Quasi Grid	0	2.27	59	10	N/A	N/A	N/A	N/A	1	2.16	61	15
21	Rectangular block grid	2	2.55	48	9	2	3.51	48	13	0	2.47	49	20
22	Rural sprawl	9	2.62	17	9	0	2.55	19	16	7	2.78	16	9
23	Superblocks	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24	Trailer park	2	2.06	24	9	0	2.62	69	28	0	3.55	40	13
25	Upscale enclave	5	2.54	17	6	3	2.32	24	18	0	2.91	11	8
26	Urban grid	4	1.94	76	11	1	1.75	95	30	1	1.70	61	23
27	Workplace boxes	1	2.52	66	9	1	2.20	78	24	3	2.17	63	19

* Percentages in light gray represent < 2% of the population for that metro region.

wish to consider altering the future mix of built landscape types within particular regions so as to achieve planning goals related to such topics. Atlanta will never become Chicago or Boston; however, strategic redevelopment of older industrial or commercial sites may offer it the opportunity of creating more urban landscape nodes within a primarily suburban regional fabric, and thus possibly meeting objectives such as reducing motor vehicle use.

There is much consistency across regions in terms of which patterns are dense and which patterns are not. In all regions, Garden Apartments and Rectangular Block Grids had the highest densities, while Loops & Lollipops and Rural Sprawl were predictably low. However, within a particular pattern, the density could vary significantly. For example, the density of Loops & Lollipops in Las Vegas is more than double the density of Loops & Lollipops in Atlanta and Boston, and almost double the density in Chicago. An important question to explore in future research is the degree to which denser forms of otherwise low-density patterns produce a higher likelihood of diversity and better access to services.

What do these findings mean for sprawl and inequality? Our results show that a large portion of our six metropolitan regions consist of sprawl-like patterns—in particular Loops & Lollipops, Rural Sprawl, and Degenerate Grids. The commercial landscapes designed to service these residential areas— Workplace Boxes, Malls & Boxes, Commercial Strips—further establish car-centric patterns characteristic of sprawl. One equity implication is that these landscapes require car access, which puts a strain on affordability and limits the ability of lower-income populations to easily access jobs and services.

More fundamentally, the dominant patterns are, at least in part, likely tied to a desire for social separation. This desire has long fueled development patterns in the U.S., resulting in the expansion of suburban and exurban landscapes (Fishman, 1987; Jackson, 1984). For example, racially restrictive covenants governing Rectangular Block Grid and Garden Suburb neighborhoods created in the late 19th and early 20th centuries frequently prevented sale of properties to minorities. As such, these segregated suburban landscapes express a deeply engrained part of the American story. Residents sought not simply escape from “the city,” but separation based on class, race, and ethnicity. This has significant equity implications, because resources—services, amenities, schools, parks, and (more generally) tax base—are not evenly distributed across the landscape. In sum: landscape patterns enable social separation; separation engenders inequity.

Some inferences can be drawn regarding spatial mobility and race. In Boston, Chicago, and Portland, blacks did not experience the conventional pattern of outward mobility, as 77, 81 and 62 percent respectively of the black population in these regions still live in the more urban gridded landscapes (Fig. 6). To the degree that urban gridded landscapes are associated with lower incomes (which, as noted above, is not always the case), this may mean that residents stayed poor (and therefore had less upward mobility), that they chose not to move to suburban and exurban landscapes, and/or that they were prevented from relocating (due to discriminatory mortgage practices, for example).

However, Atlanta, Las Vegas, and Sacramento have a different pattern in terms of outward mobility. Nearly 62 percent (Fig. 6) of Atlanta’s large black population lives in suburban Loops & Lollipops landscapes. This reflects the fact that the Atlanta region grew rapidly in the twentieth century using suburban forms, but it may also be an indication of some degree of spatial mobility among the black population. However, only 1 percent of Atlanta’s blacks live in Upscale Enclaves and 0.02 percent live in Rural Sprawl, indicating that even middle and upper-middle-class black residents have not chosen or have not been able to reside in these built landscape types. In both Las Vegas and

Table 9
Comparison of household variables by pattern for six metropolitan regions.

		BOSTON		CHICAGO		PORTLAND	
		% married couple households	% female-headed households	% married couple households	% female-headed households	% married couple households	% female-headed households
1	Airports	57	13	60	6	44	7
2	Allotment Gardens	N/A	N/A	N/A	N/A	N/A	N/A
3	Apartment Blocks	31	6	28	11	19	1
4	Campus	33	7	43	11	49	11
5	Civic	25	7	35	5	27	18
6	Commercial strip	39	13	35	14	27	15
7	Country Roads	62	8	46	10	N/A	N/A
8	Degenerate grid	43	15	50	11	47	12
9	Garden apartments	39	11	34	14	29	14
10	Garden Suburb	53	9	56	13	61	7
11	Heavy industry	35	10	30	16	44	9
12	Hillside	N/A	N/A	N/A	N/A	N/A	N/A
13	Incremental mixed	49	12	33	14	45	11
14	Land of the dead	40	11	34	11	26	16
15	Long Blocks	N/A	N/A	56	12	N/A	N/A
16	Loops and lollipops	60	10	68	9	60	10
17	Malls and boxes	36	12	36	11	32	16
18	New Urbanist	N/A	N/A	62	8	53	10
19	Organic	N/A	N/A	53	8	N/A	N/A
20	Quasi Grid	32	12	30	16	30	14
21	Rectangular block grid	34	14	40	19	37	11
22	Rural sprawl	67	8	74	6	70	6
23	Superblocks	N/A	N/A	24	6	30	2
24	Trailer park	37	9	34	16	37	13
25	Upscale enclave	69	6	71	5	62	4
26	Urban grid	42	9	30	8	24	7
27	Workplace boxes	38	14	34	12	38	13

* Percentages in light gray represent < 2% of the population for that metro region.

Sacramento, 50 percent of blacks live in suburban Loops & Lollipops, with sizable numbers in other suburban types such as Garden Apartments (23 and 16 percent respectively). As with Atlanta, black migrants to these urban areas probably settled in suburban areas initially rather than within older urban cores (which are smaller than in Boston and Chicago). As in Atlanta, the percentage of the black population in Upscale Enclave or Rural Sprawl landscapes is miniscule.

The patterns for Hispanics are very similar to those of blacks. Whatever upward mobility has been possible, Hispanics remain in urban landscapes in the cities of Boston and Chicago (80 and 79 percent of Hispanic residents respectively). Even in Sacramento and Atlanta, few Hispanics live in exurban locations: Rural Sprawl (4 percent for Sacramento and 5 percent for Atlanta) or Upscale Enclaves (2 percent for Sacramento and 0 percent for Atlanta). Upward mobility, to the extent that it exists for blacks and Hispanics, does not appear to be taking either of these populations outward toward exurban landscape types.

Sprawl and the inequality it engenders is not just a late-twentieth-century phenomenon, but has occurred in multiple historical eras due to separation pressures. Merchants and the upper middle class left the 19th century industrial city in favor of country estates and streetcar suburbs, while 100 years later white executives moved to exurban landscapes further removed from the first wave of suburban landscapes. But the enormous expanse and fragmentation of twenty-first century metropolitan regions, as our study documents, means that physical separations between different social groups are, mostly likely, greater than ever before. Unlike the nineteenth-century city, the insular nature of many current built landscapes means that it is easy for people to live daily life without interacting with people different from themselves. Individuals are thus less likely to understand the needs of others from different backgrounds or feel a sense of interrelationship and shared responsibility with them. Quite likely this spatial separation is one cause of the current decline of social capital (Putnam, 2000), as well as current political polarization.

6. Conclusions

Cities throughout history have witnessed spatial divisions between demographic groups. However, the current distribution of populations across large spatial distances and between many built landscape types is unprecedented. Our analysis has uncovered the extent of these patterns, giving a sense of just how much the American landscape is dominated by sprawl and the inequities that landscape implies.

Our study should be seen as an initial, exploratory analysis of the relationship between built form and demographic social groupings. Most often, understanding the social qualities of urban form is limited to census tract summaries using data on counts of housing unit types (attached or detached dwellings) or land uses. Rarely is it possible to quantify the social qualities of urban form in a way that is both quantitatively rigorous and nuanced in terms of the on-the-ground character

Table 10
Comparison of household variables by pattern for six metropolitan regions.

		SACRAMENTO		LAS VEGAS		ATLANTA	
		% married couple households	% female-headed households	% married couple households	% female-headed households	% married couple households	% female-headed households
1	Airports	41	22	17	5	19	13
2	Allotment Gardens	N/A	N/A	N/A	N/A	N/A	N/A
3	Apartment Blocks	N/A	N/A	N/A	N/A	N/A	N/A
4	Campus	41	15	39	15	48	14
5	Civic	N/A	N/A	7	6	14	7
6	Commercial strip	26	16	31	16	24	13
7	Country Roads	N/A	N/A	N/A	N/A	38	29
8	Degenerate grid	44	17	49	15	26	19
9	Garden apartments	25	17	27	16	24	20
10	Garden Suburb	48	13	N/A	N/A	28	5
11	Heavy industry	49	15	30	12	30	26
12	Hillside	43	13	N/A	N/A	N/A	N/A
13	Incremental mixed	45	16	51	12	34	18
14	Land of the dead	44	13	N/A	N/A	24	18
15	Long Blocks	N/A	N/A	N/A	N/A	27	31
16	Loops and lollipops	56	13	51	13	55	15
17	Malls and boxes	29	16	31	14	23	15
18	New Urbanist	49	11	N/A	N/A	31	19
19	Organic	N/A	N/A	N/A	N/A	N/A	N/A
20	Quasi Grid	34	15	N/A	N/A	22	18
21	Rectangular block grid	37	14	47	17	28	21
22	Rural sprawl	63	7	49	10	63	11
23	Superblocks	N/A	N/A	N/A	N/A	N/A	N/A
24	Trailer park	32	13	33	14	50	16
25	Upscale enclave	66	7	55	7	69	10
26	Urban grid	21	10	15	8	14	11
27	Workplace boxes	33	16	25	13	26	14

* Percentages in light gray represent < 2% of the population for that metro region.

differences of urban places. We are not claiming causation or effect, but we are exploring patterns linking form and social context in a detailed, quantified way—an approach that, to our knowledge, has not been attempted before. Our study is not without limitations, however. The selection of six cities is not necessarily representative of the U.S. at large, and other types of cities – smaller ones, for example – might yield different results. The study is also constrained by the lack of address-level demographic data, and data at the block scale is necessarily limited. Importantly, it does not include income-related data.

Despite these constraints, new approaches to measurement of the built environment are needed to support planning goals like compact cities, livable communities, and smart growth— building awareness about urban form and enabling better communication about urban patterns. Jacobs (1961) wrote that the job of the planner was to help the public 'see' the city, to help uncover existing realities, exposing patterns and helping residents discover meaningful elements. In particular the landscape approach that we are working with here—-considering district-scale patterns of streets, blocks, buildings, and infrastructure—offers advantages over previous approaches looking more at the building, lot, or block scale.

By knowing how much of a city has been given over to spatial configurations of various kinds, and by understanding the dominant social profiles of these landscapes, the process of implementation is better informed. This is not possible when urban conditions are only related in aggregate terms or via census data, as is often the case. Understanding the social context of built landscapes has the potential to communicate planning ideals and existing conditions more effectively.

Most US cities are fragmented, their built forms isolated and separated into monolithic zones. As planners seek to recondense the city and rebuild a civic fabric that enables access, opportunity, and social connection, they need a more nuanced understanding of form and social context to better match their improvement strategies with particular urban forms.

At a more theoretical level, understanding the social context of built landscapes opens up new ways of interpreting the social life of the city. Though the interpretation of the meaning of different urban forms is a longstanding avenue of research, it is one that has not been informed by large, quantified data relating form to social life. Revealing the details about what urbanism in physical form consists of in social terms tells us something about the meaning and valuation of cities. In the same way that the hierarchical centrality of Baroque urbanism can be contrasted with the facilitation of land speculation enabled by the Manhattan grid, different urban forms in the contemporary US city can be contrasted as holding different meanings. Understanding the social context of form,

these forms also reveal something about urban society and social structure. It may be possible to say a great deal more about urban social structure and the meaning of it when we are able to say a great deal more about the physical context in which this structure exists.

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