

# GIS and the City: Nineteenth-Century Residential Patterns

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Geographic information systems (GIS) methods and technologies arrive at a time of renewed optimism for the field of urban history. GIS, with its dramatic visualization capacities, promises new insights into the broad question of urban social structures, their connection to wider social change, and the nature of social relations amongst urban residents.<sup>1</sup> The application of GIS to the study of towns and cities has the potential to build on Philip Abrams' insight into urban places as a social form "in which the essential properties of larger systems of social relations are grossly concentrated and intensified—to the point where residential size, density, and heterogeneity, the formal characteristics of the town, appear to be in themselves constituent properties of a distinct social order."<sup>2</sup> In this article, we use GIS to test the applicability of concepts associated with large cities to two medium-sized American cities of the mid-nineteenth century, in the process reflecting on the potential and limits of GIS techniques in urban historical settings.

It is important to emphasize both the potential and limits associated with the application of GIS to historical cases. In exploring the utility for historical analysis of GIS and its associated folio of ever more sophisticated statistical techniques, we turned to work underway on Alexandria, Virginia in the late 1850s (population 12,293) and Newport, Kentucky in the early 1870s (population 15,576). These two river cities shared important similarities as urban places but were also usefully distinctive.<sup>3</sup> A feature that lends itself to exploring these towns with GIS techniques is the 28,000 linked files we have created that include the place of residence for over 70 percent of the towns' inhabitants.<sup>4</sup> These files contain a vast array of information for each resident, including perhaps most surprisingly, individual political behavior.<sup>5</sup> With GIS we can map out the towns' individual inhabitants, including their behavior at the polls. The enormous effort required to create these files reminds us, however, of one of the difficulties of using GIS in historical environments, where the databases must be created from scratch rather than simply deployed from modern sources.

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Political information at the individual level is available for Newport and Alexandria because Virginia and Kentucky were *viva voce* states.<sup>6</sup> *Viva voce* election law required voters to assemble at assigned polling places and to call out, in a loud voice, the candidates for whom they wished to vote. Election clerks recorded in poll books the name and votes cast for every office by every voter; the poll books surviving for Alexandria and Newport are the complete official record of the vote cast by eligible male voters in these two towns. These official sources are better than any modern poll of voter intentions or any past party list of presumed supporters; they tell us precisely who voted and identify the candidates for all offices that each and every voter supported.<sup>7</sup>

A unique feature of this study, which has broader disciplinary implications, is that both social and political data for the residents of these two towns exist at the level of the individual. The rift and separation between social history and political history partly grew from the fact that, while the former was examinable at the individual level, the latter could only be studied at the aggregate level of policy outcome or ward election returns, frustrating efforts to connect social and political change.<sup>8</sup> In the eclipse of urban history a generation ago, data was only a small part of the problem; much more important was a “hardening of competing research agendas” between a narrative history based on identity and a sympathy for discourse, and a more scientific approach based on quantification with a sympathy for observation.<sup>9</sup> Amongst urban historians, the conflict was encapsulated in the question of whether “culture is considered more important than class in shaping human relations.”<sup>10</sup> Despite the breadth of that debate, linked data sets at the individual level and GIS technology might make testable some aspects of the disagreement over the relative importance of class and culture.

GIS techniques made mapping vast quantities of individual-level data from Alexandria and Newport remarkably straightforward. Our question was how GIS mapping and statistical techniques might assist our understanding of the socio-spatial relationships in these two towns and specifically how these techniques might further our understanding of the interplay between structural (e.g. class) and cultural (e.g. identity) approaches.<sup>11</sup>

This is a lot to ask of a case study resting on two nineteenth-century river towns and we advance our explorations very much aware of the limits to any conclusions drawn. Nevertheless, Alexandria and Newport do conjure up some important issues to be considered in the context of urban social and political change in nineteenth-century America.

## Alexandria and Newport

Alexandria on the Potomac and Newport on the Ohio were linked to larger metropolitan centers on their opposite shores: Washington, D.C. and Cincinnati, Ohio. At the time they become case studies for this work,

both were at the end of periods of sustained growth and prosperity. Both had recently admitted railroads into their central business districts, a vital step toward the concentration of land-use patterns.<sup>12</sup> Moreover, both Alexandria and Newport were in the early stages of periods of great uncertainty.<sup>13</sup>

Alexandria in May 1859 was poised for one of its last elections before the Civil War, a conflict that would leave the town physically intact but economically in ruins. The voters of Alexandria, who favored the Whigs, faced an unsatisfactory political situation as the state's Democrats became ever more dominant and a polyglot "Opposition party" became the only political alternative. In the May gubernatorial election, the Opposition candidate easily carried Alexandria over the Democrat but lost the state vote.

Newport in early 1874 felt threatened economically rather than politically. The depression sparked by the past year's financial panic was cutting deeper into the city's social fabric. A bitter industrial dispute had broken out at the town's largest single employer, the Swift Iron and Steel Mill. Alexander Swift, the mill's owner and founder, armed his strikebreakers and demanded that Newport's police prohibit townspeople gathering to harass his men. When the city government refused, he issued pistols to his strikebreakers and in the predictable violence a local butcher's apprentice was shot and killed. The city government acted to ban public demonstrations and the governor of Kentucky set in motion regulations to place the 334 Federal troops at the Newport Army Barracks under the authority of the mayor as "troops in aid of civil authorities."<sup>14</sup> Just eight days later, on March 2, the voters of Newport went to the polls to elect a new city government.<sup>15</sup>

The differences between the political economies of Alexandria and Newport were more substantial than these superficial similarities: Alexandria was southern, commercial, and slave owning, while Newport was northern, industrial, and immigrant. Newport was less than 1 percent black, and although race remained important, with Swift threatening the use of black strikebreakers, Newport's race relations were very different from those of Alexandria, home in 1859 to 1,237 slaves and 1,342 free blacks, constituting 10 and 11 percent of town's total population.<sup>16</sup>

Germans and the Irish were the largest immigrant populations in each place. The German-born comprised about 17 percent of Newport, representing many of the provinces of the federating Germany, while in Alexandria there were only 200 people of German birth (less than 2 percent of the city), many of whom were Jewish. The Irish proportions were more similar in the two places, making up 6 percent of Alexandria's population and 7 percent of Newport's. The vast majority of German and Irish born in Alexandria or Newport were adults, meaning that these two immigrant groups made up larger proportions of the adult population and electorate than of the population of the city as a whole. Irishmen were 11 percent of the potential electorate in both towns; the small and homogenous Ger-

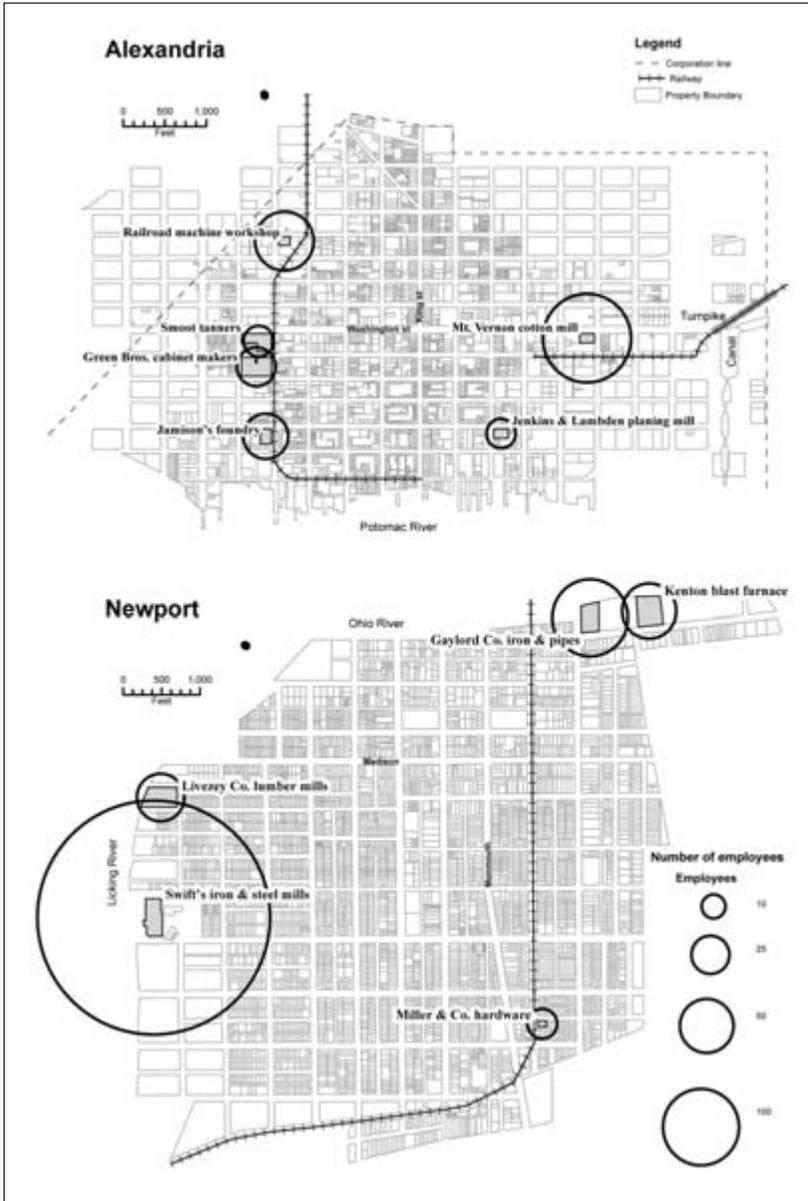
man population of Alexandria made up 4 percent of the eligible voters while the highly varied German population of Newport constituted 28 percent of the potential electorate.

These groups played different roles in the cities' political economies. Alexandria, like Michael Katz's Hamilton, Ontario, was a commercial and mercantile town, the *entrepôt* for the Shenandoah Valley's agricultural produce.<sup>17</sup> Germans here tended to be merchants and the Irish overwhelmingly (over 70 percent of adult men) were laborers. Alexandria had nearly twice as many officials as Newport, and in proportion to its population, it had more grocers and druggists, teachers, hotel and bar employees, midwives and nurses, and prostitutes too. There was a surprising amount of industry for a "southern town," but it was small scale, with the average firm employing ten workers. Fully 20 percent of manufacturing employees in the town were white women (15 percent) and free black males (5 percent).<sup>18</sup> The only two significant heavy industries in Alexandria (Figure 1) were the Thomas S. Jamison foundry (thirty-five men) and the Orange and Alexandria Railroad workshop (sixty men).<sup>19</sup> Only 390 white men provided unskilled labor, making up 11 percent of the total white workforce. The largest employer in Alexandria was the Mt. Vernon Cotton Mill—135 hands, of whom 88 were women. Alexandria, especially for its white citizens, was proto-industrial rather than industrial: its limited manufacturing sector consisted of many small firms that produced consumer goods and served the commercial focus of the town. Alexandria was at base a commercial town and distinctively Georgian in character.

Newport's manufacturing activity, by contrast, was concentrated in heavy industry. Germans and the Irish were very much a part of the town's industrial labor force. There were more than 2,000 manufacturing employees in Newport, of whom 97 percent were male. The largest employer in town, the Swift Rolling Mill, employed 398 hands in 1870. Only seven were women. Fifty-five men worked the furnaces, 295 worked in the rolling mill, and 38 worked in the burnishing operation. Industrial expansion continued and four years later, as economic depression roiled Newport, some 610 men were employed at the Swift Mill.<sup>20</sup> Newport had 246 machinists to Alexandria's 89 and 327 ironworkers to Alexandria's 12. Newport produced industrial rather than consumer goods and its industry was a man's world—and a child's world, for 12 percent of the industrial labor force were children under 16. Newport was industrial and Victorian.<sup>21</sup>

The broad area of investigation we sought to advance with GIS techniques concerns spatial patterning. We sought to test in these divergent small towns Sam Bass Warner's evocative summary description of the pattern of social life in a largely pre-industrial Philadelphia of 1860:

Social and economic heterogeneity was the hallmark of the age. Most areas of the new big city were a jumble of occupations, classes, shops, homes, immigrants, and native Americans. Although by 1860 there



**Figure 1.** Industrial Employment in Alexandria and Newport. Employment at the Swift Mill far exceeded that at any other industrial establishment in Alexandria or Newport and helped define a residential area. (All figures produced by Jacqueline Best, Flinders University Spatial Information Laboratory.) Sources for the figures are listed in note 29.

were the beginnings of concentrations which reflected the future economic and social articulation of the city—a downtown, three manufacturing clusters, a small slum, a few black blocks, and occasional class and ethnic enclaves—these concentrations did not dominate the spatial patterns of the city.<sup>22</sup>

Warner's finding provided a compelling context for a lively debate on the ways in which ethnic groupings in pre-industrial cities gave way, or were immune to, class groupings in the industrializing city. Olivier Zunz long ago identified in the industrialization of Detroit the city's central theme, using this to explain the shift in segregation from ethnicity to class and race.<sup>23</sup> These tendencies had hardly begun in the mid 1870s, but we can use these alternate characterizations drawn from the pre-industrial and industrial large city to explore the spatial patterning of Alexandria and Newport. Was Warner's "jumble" of social patterning in the pre-industrial large city—unlikes living cheek by jowl—also characteristic of the small commercial town of Alexandria and was it equally applicable to the small industrial city of Newport?

Exploring in small cities the larger issues of political economy echoes the rationale for Helen and Robert Lynd's choice of Muncie, Indiana in the mid 1920s for their study of industrialism in an American community. The Lynds chose the small industrial city of Muncie because it let them study the effects of industrialism without the compounding effect of urbanism.<sup>24</sup> Studying small cities like Alexandria and Newport, representing different stages in the economic evolution of modern America, echoes the Lynds' strategy. And of course the American small city, whether in the mid-nineteenth century or in the 1920s, was the predominant type in the American urban matrix. The differences between Alexandria and Newport are analytically important. Alexandria was largely commercial in orientation and based significantly on slave labor, while Newport was a rapidly industrializing town based on free labor, largely immigrant. These poles—slave vs. free, commercial vs. industrial—were fundamental alternatives in the evolving American political economy.

We will also explore a second theme emerging from the older urban history: concern for "the political dimension of urban change."<sup>25</sup> Howard Gillette indicates the importance of exploring, in class terms, ways in which "the distribution of residents and jobs through space might have further fragmented interests common to the working class."<sup>26</sup> The poll book data will assist this aspect of our study.

The work that follows is based on information from all the towns' residents rather than a sample. In broad terms (ethnicity, race, gender, occupational status), the characteristics of the mapped populations approximated the whole populations of these towns. We have linked the political record of voters in Alexandria and Newport to other details of their lives as recorded in surviving nineteenth-century social inventories.

We determined residence of individuals from their tax, census, city directory, and poll records and located the precise place of residence of 78 percent of the free inhabitants of Alexandria in 1859 (8602 of 11,065) and 72 percent of the non-Army residents of Newport in 1874 (11,155 of 15,576).<sup>27</sup>

## GIS Techniques

Quantitative geography and urban history place an emphasis on the analysis of spatial patterns. Statistical measures of the density, clustering and dispersion of resident groups in an urban landscape can provide insights into a community's social, political, cultural and economic structure. We deployed techniques designed for individual-level spatial information that allowed us to analyze both city-wide and highly localized patterns.<sup>28</sup>

We linked the 19,757 inhabitants of Alexandria and Newport whose residence we could determine to a reconstructed property map of each city and then tied to those individuals all social, economic, and political information available for them.<sup>29</sup> Essentially, we created a plat map for Alexandria in 1859 and Newport in 1874 in a way that allowed all characteristics to be spatially displayed.<sup>30</sup> For the purpose of measuring patterns, we assigned these individuals to the center points rather than areas of their properties, reflecting the urban characteristic of several individuals sharing the same residence and ensuring that our maps were not unduly influenced by the differing size of properties.<sup>31</sup>

We used two separate approaches to describe the level of segregation and clustering of socio-political groups. The first approach, a non-parametric Kernel-density estimator, displays the density of a group of individuals in the form of a smooth surface with contour lines (isopleths) indicating the percentage of individuals sharing a particular characteristic contained inside each contour.<sup>32</sup> The second approach used a fixed Kernel-density estimator and a Gaussian weight function with the same smoothing parameter of 300 feet for each of our distribution maps so that the spatial characteristics of each group could be directly compared.<sup>33</sup>

In applying these techniques to real populations, we were conscious that small pockets of outliers could dramatically affect the shape of our outer contour lines and confound our sense of the extent of overlap of groups. For consistency and to reduce outlier effects, we focused on core areas of concentrated populations. We set as core areas those defined by contours encompassing 60 percent of the relevant populations. We could then compare areas of occupation and the extent to which groups separated or overlapped in their residential presence.<sup>34</sup>

While a useful descriptive statistic, the Kernel-density approach can seem to suggest that within core areas there is little or no admixture of people; in other words, that core areas are homogeneous. Moreover, there is a risk that the shape and size of these core areas could be in part deter-

mined by the city's grid layout. Therefore we used a second approach that tests the extent to which pairs of groups (the German born and the Irish born for example) were clustered or dispersed relative to each other, using the real distances between individuals along the streets and alleys on which they lived. We tested the degree of randomness for these groups in relation to one another, using "Manhattan distances" that measure real walking distances between individuals.<sup>35</sup>

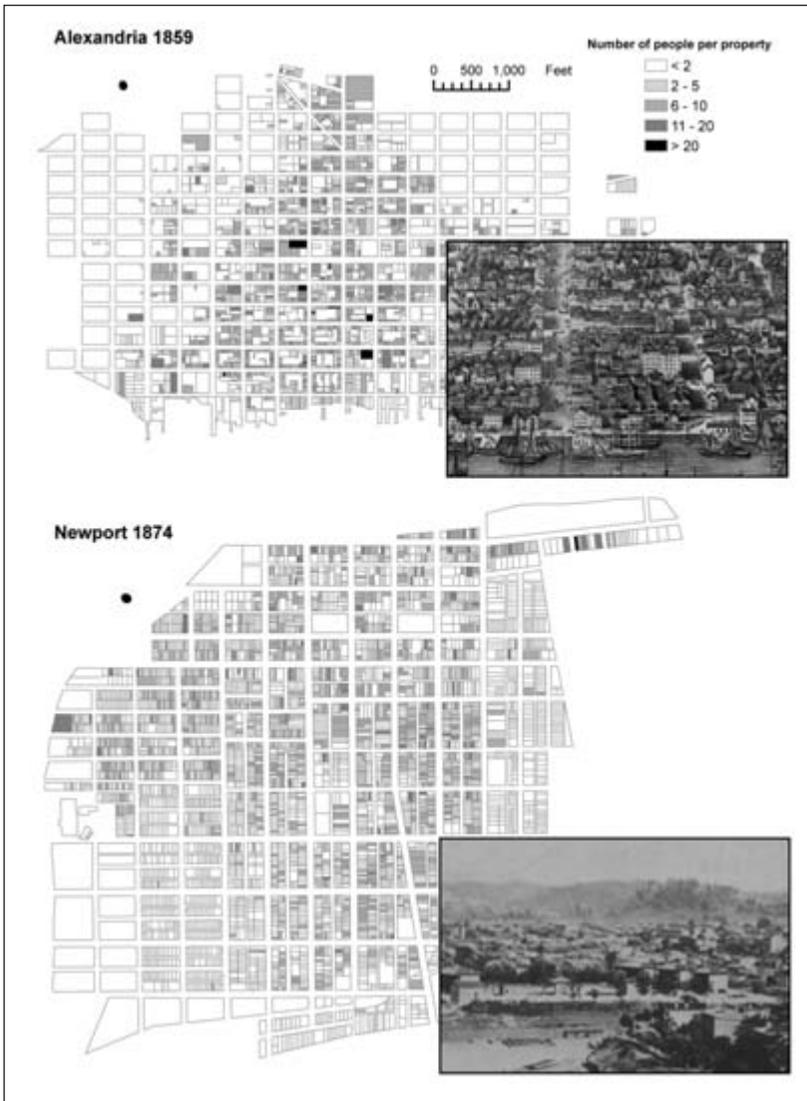
The degree of clustering or dispersion between two groups was tested against a null hypothesis that the individuals of one group were randomly located.<sup>36</sup> The O-ring statistic generates the null hypothesis for one group, say Irish-born adults, by repeatedly and randomly drawing alternative groups of Irish from the whole population of adults.<sup>37</sup> We calculated the "Manhattan distances" between the randomly selected group of individuals and the nearest neighbors in our group, say the German-born adults, and compared that with the real distances between Irish and German nearest neighbors. We were attracted to this approach because it acknowledges the heterogeneity of each town and the density of housing accommodation in the urban landscape.<sup>38</sup> A statistically significant departure of the nearest neighbor distances of Irish and Germans from the distances between the Irish and our randomly selected adults in the town indicates clustering or dispersion at a given distance—the O-ring.<sup>39</sup>

## Findings

Our first finding, arising from the visualization capacities of GIS, concerns a surprising difference in the population density of the two cities (Figure 2). GIS readily maps out population density from individual residential data and allows us to see that in neither town did populations settle heavily along the rivers or the main business thoroughfares; even the railroads so recently admitted to both cities did not have a great effect on residential patterning.

What is striking is the dispersion of population in Newport, with 11,155 mapped residents spread over approximately 30-million square feet of developed property as against a much more-densely populated Alexandria with its 8,602 free residents concentrated in 18.5-million square feet of developed property. The population density of Alexandria was approximately 1.4 times higher than that of Newport, suggesting perhaps a demographic rationale for the persistent finding of a jumbled heterogeneity in the pre-industrial town.<sup>40</sup>

A powerful clue to the difference in population densities of Alexandria and Newport is provided in the 1864 "bird's-eye" painting of Alexandria and the 1866 photograph of Newport which appear as inserts in Figure 2. These depictions show a substantial difference in building height in the two towns: Alexandria generally two or three stories; Newport overwhelmingly one story.



**Figure 2.** Population Density of Alexandria, Virginia (1859) and Newport, Kentucky (1874). The population density of commercial Alexandria was 1.4 times that of industrial Newport. Sources: Charles Magnus, "Bird's-Eye View of Alexandria, Va.," (Washington, D.C., 1864); "Newport Seen from the Roebling Suspension Bridge, 1866" in Thomas J. Purvis, ed., *Newport, Kentucky: A Bicentennial History* (Newport: Thomas L. Purvis, 1996): 105.

The "high-rise" character of Alexandria raises questions about the extent of home ownership, a point our database allows us to explore in detail. There were about the same number of independent householders in the two towns: 2,841 in Alexandria (2,459 white and 382 free black) and 3,068 in Newport.<sup>41</sup> But as Table 1 shows, these households lived in

**Table 1. Household Accommodation and Home Ownership by Occupational Status.**

	Type of Accommodation by Percent			Home Ownership by Occupational Status by Percent	
	Alexandria	Newport		Alexandria	Newport
Home Owner	20	45	Highest	22	46
Tenant	51	41	Middle	17	42
Boarder	28	14	Lowest	9	26
	n=2459	n=3068		n=369	n=1202

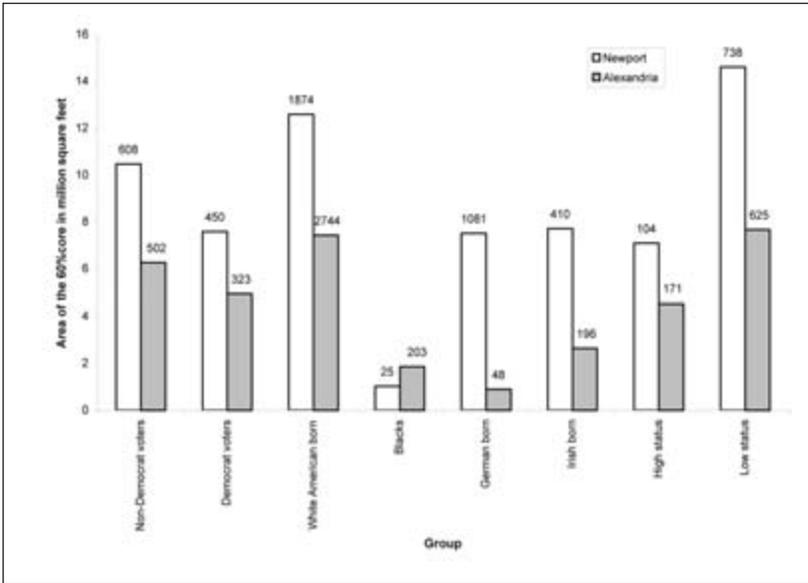
very different residential arrangements.<sup>42</sup> Nearly 80 percent of households in Alexandria lived as tenants or boarders while in Newport nearly half of all households resided in owner-occupied houses. Home ownership was two-and-a-half times more common in industrial Newport than in mercantile Alexandria.

Significantly, this home ownership was spread evenly across the status hierarchy of Newport. The lowest status groups in Newport—unskilled and semi-skilled workers—were three times as likely to own a house as the lowest status groups in Alexandria. This seems a powerful confirmation of the point made in Stephen Thernstrom's seminal study of Newburyport. In industrial Newport, as in industrial Newburyport, there was the real prospect of home ownership across the social hierarchy, something commercial Alexandria did not offer.<sup>43</sup>

Our second finding deals with the distribution of specific groups within the city and arises from the new statistical tools embedded within GIS. Here we are interested in the spatial patterning of groups within the city—ethnic and racial groups, occupational status and wealth groups, and groups defined by voters' partisan preferences. These considerations help in understanding community groupings within the urban landscape.

In both towns there was social and political patterning of great intensity and variety. Figure 3 shows the areas covered by the 60 percent core of the adults within eight selected groups in the two cities.<sup>44</sup> Given the higher overall density of Alexandria's population, it is not surprising that the cores of most of these groups occupy a smaller area than those same groups in Newport. Within this, however, Figure 3 reveals two distinctive features.

We see first that, relative to population size, the free blacks of Alexandria just prior to the Civil War were six times more concentrated than blacks living in Newport just after the Civil War, suggesting that the free blacks of Alexandria had a quite restricted range of housing options open to them.<sup>45</sup> Many of Alexandria's slaves lived with their owners and this may have provided a sense of a black presence spread throughout the city. But one of the consequences of slavery was a free black population spatially compressed. Mordecai and Robert Miller, both Quakers, were among



**Figure 3.** Core Population Dispersions: Areas Over Which the 60 Percent Cores of Each Group Were Spread. Except for blacks, social groups in Newport were spread over greater areas than those same groups in Alexandria.

the few whites willing to build and rent or sell housing to free blacks; in time, the ten houses built by the Millers on a single block became the center of “Hayti,” one of Alexandria’s most distinctive black communities.<sup>46</sup>

Equally clear is the contrast between the very wide distribution of those with low-status occupations across Newport and the compression of both high-status and low-status areas in Alexandria. The numbers of adults with low-status occupations in the 60 percent core of those two groups are nearly equal; yet, as Figure 3 shows, Alexandria’s core group of low-status workers was concentrated in just half the area occupied by those of low status in Newport. Those with high occupational status were three times as concentrated in Alexandria as in Newport.

While groups may be concentrated, as were the free blacks in Alexandria, they need not be isolated from other groups. Tables 2 and 3 show the extent to which the cores containing 60 percent of the black, Irish, German, and white American-born populations overlapped.<sup>47</sup> What we see is the near total isolation of the small black population in Newport from concentrations of white native-born, German-born and Irish-born populations. While German, Irish, and white American-born neighborhoods overlapped to a considerable extent (15 percent, 22 percent, and 26 percent, respectively), there was almost no overlap between the core of Newport’s small black population and any of these white groups. Cultural groups overlapped more with one another in Newport than they did with the small black population.

**Table 2. Newport 60 Percent Core Overlaps.**

	Irish Born	White U.S. Born	Black
German Born	15%	26%	0%
Irish Born		22%	5%
White U.S. Born			5%

As Table 3 shows, something close to the opposite was true in Alexandria where despite a more densely settled population, the cores of the Irish and native-born populations overlapped less with one another than with the free black population. The tables also show us that the German-born cores in both Alexandria and Newport remained well separated from the black neighborhoods.

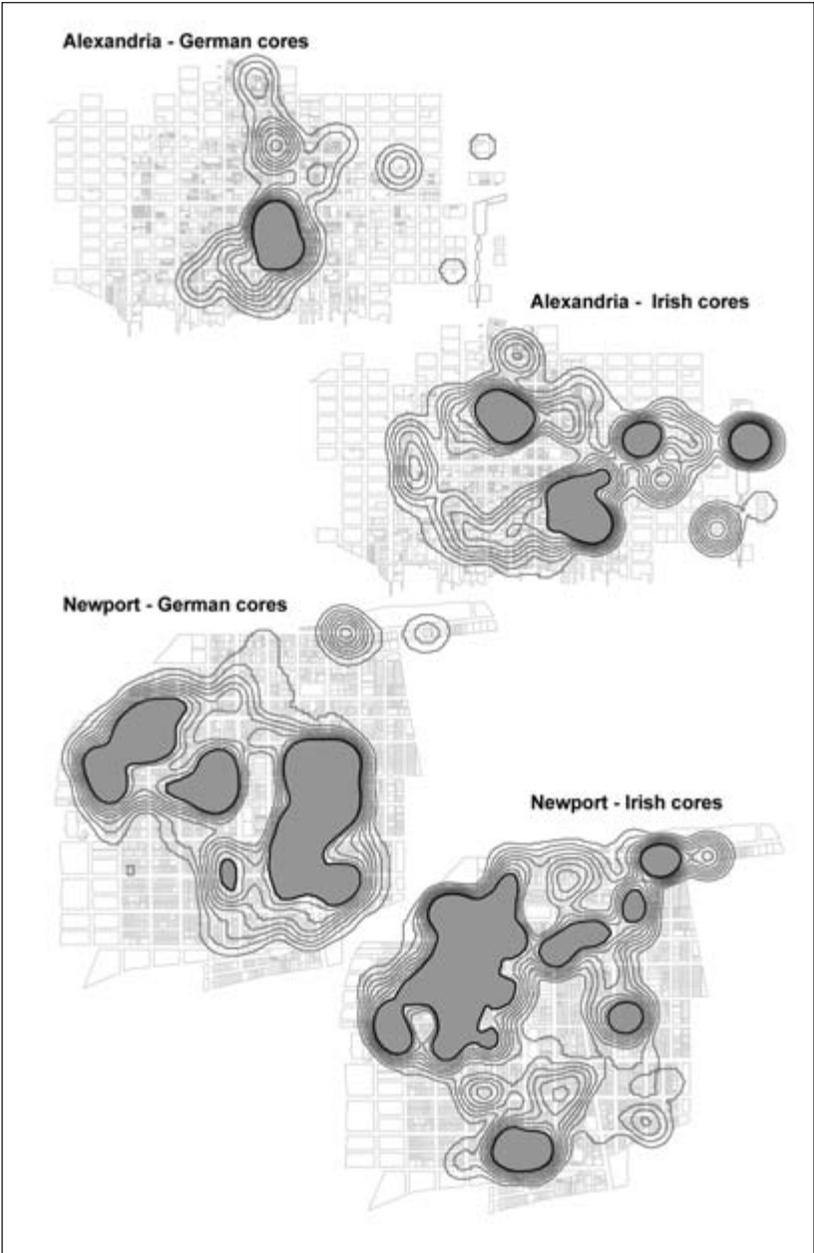
**Table 3. Alexandria 60 Percent Core Overlaps.**

	Irish Born	White U.S. Born	Black
German Born	6%	12%	0%
Irish Born		16%	8%
White U.S. Born			12%

These statistics reveal more overlap between Irish and German populations in Newport (15 percent) than in Alexandria (6 percent), reflecting, no doubt, the small and distinctive German population of Alexandria. Does this also suggest a greater tendency for an industrial city to be organized more by classes than ethnic groups?

Figure 4 shows a clear contrast between the single German population core in Alexandria and the four German cores in Newport. Figures 1 and 4 allow us to relate these groupings of immigrants to areas of industrial employment. The small and highly concentrated German population of Alexandria was significantly Jewish, mercantile, and centered along a single core on King Street, which was Alexandria's main commercial street.<sup>48</sup> This was very different from Newport.

We wish to focus on two particularly interesting German core groups, one centered in the industrial areas along Newport's Licking River, which we will call the Mill Core, and the large German core in the southeast of the city centered in the higher-status mercantile area along Monmouth Street, which we will call the Monmouth Street Core. While we do not know religious affiliation for the individual Germans in these two groups, we do know—probably because the 1870 Newport census taker was twenty-five-year-old Henry A. Wiese, son of German-immigrant parents—the province of birth for all the German-born population of the city. The mixture of cultural, economic, and political information for Newport's Germans offers an opportunity for a detailed exploration of ethnic groupings in this industrial setting.



**Figure 4.** Cores of Irish and German Populations. Contour intervals are 5 percent. The shaded areas contain 60 percent of the adult German or Irish populations. The outmost contour for each core represents the areal extent of 95 percent of that group's population.

The Mill Core and the Monmouth Street Core had no apparent cultural differences—immigrants from Bavaria and Prussia predominated in both—but there was an underlying economic difference.<sup>49</sup> There were 50 percent more German laborers in the Mill Core than in the Monmouth Street Core (26 percent vs. 16 percent) and the Mill Core had an average household wealth of just a third of the Germans in the Monmouth Street Core (\$1,220 vs. \$3,151). There were amongst the Mill Core highly skilled industrial workers—iron founders, molders, and rollers—whereas amongst the Monmouth Street Core there were more craft workers—cigar makers and machinists. There were very few high-status Germans in either group, but the Monmouth Street Core was very much a middle-class German area with 71 percent of the labor force holding mid-status occupations.

Perhaps most significantly, these two German cores had quite different political colorations. The Germans of Newport voted Republican (67 percent), but the Germans in the Mill Core voted 56 percent Democratic. Those in the Monmouth Street Core voted precisely like Germans in the city as a whole—67 percent Republican. German laborers who lived in the middle-class area along Monmouth Street voted as Democratic (61 percent) as their fellow Germans living next to the mills (58 percent). Prussian laborers voted Democratic in both places—about 63 percent. But if we look at Prussians who traded and contracted with people, we can see these more middle-status Germans picking up the political coloration of their area. Thus, Prussian tailors in the Democratic Mill Core voted 80 percent Democratic while Prussian tailors in the Republican Monmouth Street Core voted 100 percent Republican; likewise, Prussian grocers voted 100 percent Democratic in the Mill Core and 100 percent Republican in the Monmouth Street Core. Prussian carpenters voted two to one Democratic in the Mill Core and four-to-one Republican in the Monmouth Street Core. In other words, the difference between the Mill Core and the Monmouth Street Core was more than simply economic.

These tendencies suggest distinctive neighborhood political groupings in a more dispersed and industrial Newport, a development not present in a more closely settled Alexandria where overlap between political groups was high. This was also true in economic terms, with the overlap between the cores of neighborhoods defined by the bottom and top wealth quartiles, lower in Newport (15 percent) than in Alexandria where 21 percent of top and bottom economic groups overlapped.

But the areas developing in Newport were significantly defined in political terms; the admixture in Newport of poverty and wealth and of high and low status, even in the Mill Core, is powerful evidence against the notion of class replacing ethnicity as the basis for spatial organization. There is clear evidence of the political coloration of areas influencing the political views of residents across all wards of the city.

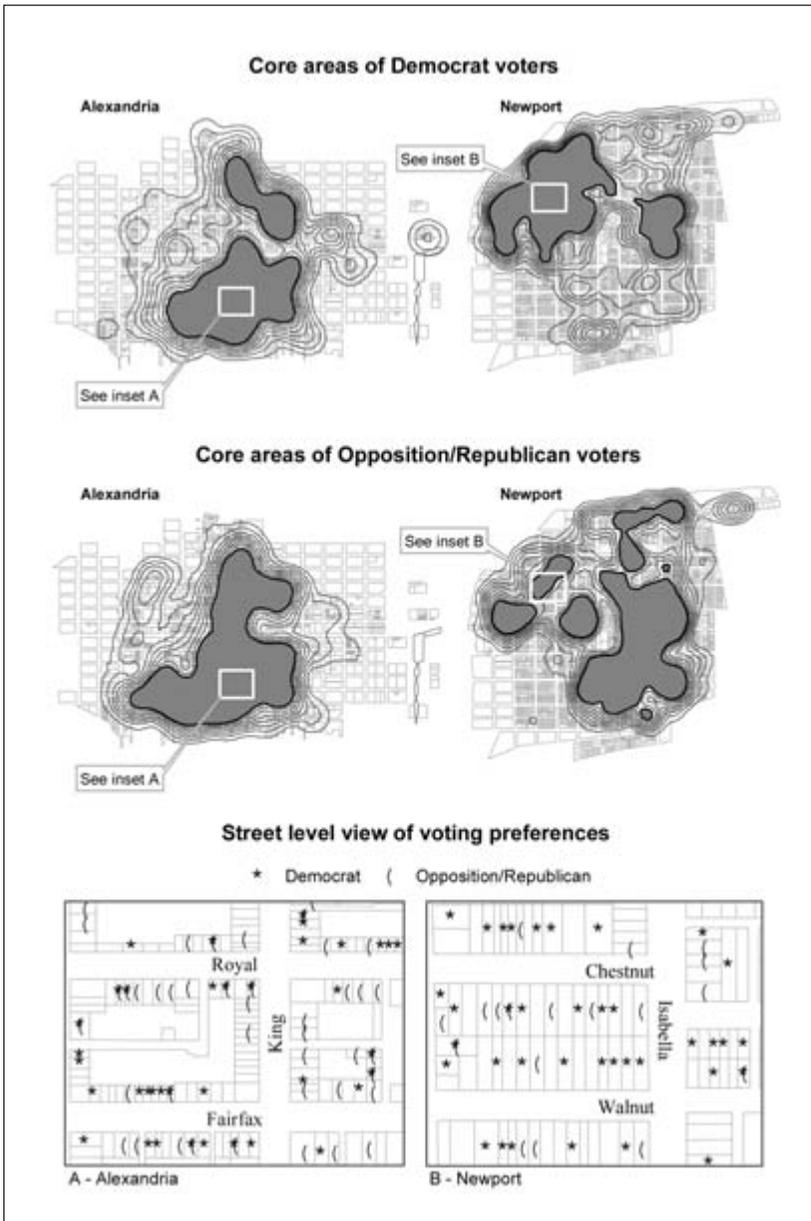
The Newport Irish, who appear in Figure 4 as five core groups, four small and scattered and one very large area defined by industrial employ-

ment along the Licking River, were everywhere Democratic. While in neither city were they notably present in high-status occupations, the Irish as a group were better positioned economically in Newport. Seventy-eight percent of the Irish in Alexandria as against 51 percent in Newport were in the lowest occupational groups, while 45 percent of the Irish in Newport were in middle-status occupations as against only 21 percent in Alexandria. Even in the Newport Irish core area adjacent to the Swift Mill, 43 percent of the Irish held middle-status occupations. The same trend shows in home ownership: in Alexandria only 16 percent of the Irish owned their own home, while in Newport 47 percent were home owners. The presence and overlap of German and Irish cores, with their economic heterogeneity in the mill area along the Licking River, helped define a neighborhood and community with a distinctive political identity.

Nothing better illustrates this than the dramatic difference in the extent of overlap of partisan cores in Newport and Alexandria (Figure 5). In Alexandria the overlap of core Democrat and Opposition neighborhoods was 62 percent—these political partisans, more than any social or economic group in the city, did indeed live cheek by jowl. But in industrial Newport, the overlap of Democratic and Republican core groups was reduced to 21 percent, a third of Alexandria's overlap. There is evidence here to suggest that the dispersion associated with an early industrialism allowed the formation of political communities that exerted an independent influence on political behavior.

While our application of GIS techniques to these two towns has shown major differences in the spatial relationship of groups, it is important to emphasize that these groupings were not homogeneous and did not define "ghettos" of any sort. GIS statistical techniques can make this point with some precision. While analyzing the density surfaces gives a useful snapshot of core distributions of groups in relation to each other, proximity analysis provides a more detailed understanding of the mix of individuals at the street and household level. In addition, proximity analysis tests the statistical significance of the clustering, or dispersion, of individuals with or from each other, compared with the null hypothesis that they are randomly intermixed.<sup>50</sup>

Table 4 shows measurements of proximity taken at two ranges: 0-50 feet, approximating households; and 51-100 feet, approximating neighbors (including those across the street). The results remind us that, apart from partisan groups, which were much more separate in Newport, in both cities there was an admixture of individual members of groups. This supplements the Kernel-density analyses (Figures 4 and 5), which reveal distinctive core areas, particularly for German and Irish groups. The localized statistical measures in Table 4 show the need for caution in interpreting group uniformity, whether we are talking about Germans and the Irish, Germans and blacks, or high- and low-status groups. Overall, Table 4 shows little or no difference in the clustering, randomness, or dispersion



**Figure 5.** Partisan Cores in Alexandria and Newport. Partisan groups overlapped more and lived in closer proximity to one another in mercantile Alexandria than in industrial Newport.

**Table 4. Patterns of Individual Proximity Using “Manhattan” Distances.**

	Alexandria Distance (feet)		Newport Distance (feet)	
	0-50	51-100	0-50	51-100
Irish & American	D	R	D	R
German & American	X	D-R	D-R	R
Irish & German	X	D-R	D-R	D
High & Low Status	D	D-R	D	R
Democrats & Non-Democrats	D	C	D	D-R
Black & White	D	C-R	Not tested	Not tested
Irish & Black	D-R	C-R	Not tested	Not tested
German & Black	D-R	D	Not tested	Not tested

“R” indicates the two groups are randomly arranged with respect to each other in that distance range. “D” indicates the two groups are significantly dispersed with respect to each other. “C” indicates the two groups are significantly clustered with respect to each other. “X” indicates that no agreement could be reached using the two antecedent measures of proximity. All significance testing is at  $\alpha=0.05$ .

of *individuals* from these groups in these towns. We also tested greater distance ranges and again found little or no difference in the clustering or dispersion of individuals.

However, Table 4 also shows that the voters of opposing parties were much more intermixed in Alexandria than in Newport where political separation, even at the individual level, was much greater. In neither town was it likely that supporters of opposite political parties would reside in the same house, but Alexandria’s streets and blocks were much more likely to contain both Democrats and non-Democrats than were those of Newport, a point illustrated by the partisan overlap in selected blocks in the two cities. (See inserts, Figure 5). This we see as a possible consequence of the higher overall density of population in Alexandria and the greater dispersal of population in industrial Newport.

Our study highlights the importance of understanding the effects of scale and intrinsic biases in each GIS statistical methodology and the assumptions within a methodology. The Kernel-density estimator used here effectively smooths out the localized processes in the data to reveal overall trends. This method does not consider the shape of the underlying urban landscape and describes the population density as continuously changing throughout the urban infrastructure. The proximity method is less sensitive to population density because it measures the distance from the target group to the nearest individual found in another group, regardless of

how many individuals exist in the other group. The complexities of GIS should not be underestimated, but equally it is this very sensitivity that will allow urban historians to understand as never before the subtleties of cities and their people.

As we have tried to demonstrate here, GIS makes it possible to visualize urban spatial patterns thus encouraging exploration of aspects of those patterns that may have historical resonance. GIS statistical packages offer new opportunities to measure the patterns found. Those techniques are demanding and carry the risk of exclusivity. At the same time, GIS techniques must be correctly applied to properly constructed historical questions. Above all, GIS applied to urban history demands databases, the construction of which require enormous effort, even as the results of applying these techniques to those databases represent very real gain.

## Notes

1. As examples of GIS applied to the historical understanding of American cities and communities, see Anne Kelly Knowles, ed., *Past Time, Past Place: GIS for History* (Redlands, Calif.: ESRI Press, 2002); Philip J. Ethington, "Los Angeles and the Problem of Urban Historical Knowledge," *American Historical Review* 105:5 (2000): 1667; William G. Thomas and Edward Ayers, "The Differences Slavery Made: An Overview," *American Historical Review* 108 (2003): 1299-1307.
2. Philip Abrams, "Towns and Economic Growth: Some Theories and Problems," in Philip Abrams and Edward A. Wrigley, eds., *Towns in Societies: Essays in Economic History and Historical Sociology* (Cambridge: Cambridge University Press, 1978):10.
3. Alexandria in 1859 was an incorporated city in an eponymous county. We included in our city population those in the 1860 manuscript free and slave census schedules for the four city wards (completed on June 1); the *Alexandria Register of Free Blacks*; those who voted in the May 26, 1859, gubernatorial election; and those who appeared on the 1859 city tax list (completed on July 18). For Newport, we included those in the 1870 manuscript census (completed on August 24); *Williams' Newport Directory for 1873*; those who voted in the March 2, 1874, municipal election; and those who appeared on the 1874 city tax list (completed on July 9). The 1870 census includes some individuals who would have left Newport by the spring of 1874, which may explain the somewhat lower finding rate for Newport. We are also aware of the bias toward men in our sources. Suffrage was restricted to males in the nineteenth century. While some women held property and appear on the tax lists, tax lists are more likely to reveal male than female residents. Membership lists from all twelve religious congregations serving the white population of Alexandria survive and allow the construction of a town religious census. See Donald A. DeBats, "German and Irish Political Engagement: The Politics of Cultural Diversity in an Industrial Age," in Wolfgang J. Helbich and Walter D. Kamphoefner, eds., *German-American Immigration and Ethnicity in Comparative Perspective* (Madison: Max Kade Institute for German-American Studies, 2004):171-220. The original poll books and tax schedules are located at the Virginia State Library in Richmond and at the Kentucky Division of Archives and Records in Frankfort.
4. All linkage of individual records was done manually.
5. Electoral records for Newport and Alexandria, note 3.
6. On the study of English poll books and opportunities for similar work using American poll books, see Paul F. Bourke and Donald A. DeBats, "Identifiable Voting in Nineteenth-Century America: Toward a Comparison of Britain and the United States Before the Secret Ballot," *Perspectives in American History* 11 (1977-1978): 259-88. For a study of British urban politics based on poll books, see Patrick Joyce, *Work, Society, and Politics: The Culture of the Factory in Later Victorian England* (Brighton: Harvester Press, 1980). Virginia abandoned *viiva voce* elections and moved to the ticket system as a Congressional condition for re-admission to the Union. Kentucky gradually restricted the elections in which oral voting was required and in 1891 adopted the Australian ballot.

7. Poll lists have their considerable use. See Ronald P. Formisano, *The Birth of Mass Political Parties: Michigan, 1827-1861* (Princeton: Princeton University Press, 1971).
8. Paul F. Bourke and Donald A. DeBats, "Individuals and Aggregates: A Note on Historical Data and Assumptions," *Social Science History* 4:2 (1980): 229-50.
9. Howard Gillette, "Rethinking American Urban History: New Directions for the Posturban Era," *Social Science History* 14:4 (1990): 211; Charles Tilly, "What Good Is Urban History?" *Journal of Urban History* 22 (September 1996): 708.
10. Gillette, "Rethinking American Urban History," 218. On the centrality of class in the work of British urban historians, see Robert J. Morris and Richard Rodger, eds., *The Victorian City: A Reader in British Urban History, 1820-1914* (London: Longman, 1993): 26-35. See by contrast Mary Corbin Sies, "North American Urban History: The Everyday Politics and Spatial Logics of Metropolitan Life," *Urban History Review* 32:1 (2003): 29-31. On the cultural dimensions of British urban history, see Richard Rodger, "Taking Stock: Perspectives on British Urban History," *Urban History Review* 32:1 (2003): 59-60.
11. Olivier Zunz emphasizes the replacement of ethnic by class communities in *The Changing Face of Inequality: Urbanization, Industrial Development, and Immigrants in Detroit, 1880-1920* (Chicago: University of Chicago Press, 1982). For recent studies emphasizing diversity and heterogeneity overlaid by shared civility, see Paul H. Mattingly, *Suburban Landscape: Culture and Politics in a New York Metropolitan Community* (Baltimore: Johns Hopkins University Press, 2001) and Joseph C. Bigott, *From Cottage to Bungalow: Houses and the Working Class in Metropolitan Chicago, 1869-1929* (Chicago: University of Chicago Press, 2001).
12. The Orange and Alexandria Railroad entered Alexandria in 1851. After a bitterly fought referendum in December 1855, the Alexandria and Washington Railroad was built to connect the city to the 14th Street Bridge into Washington. The Louisville, Cincinnati and Lexington Railroad entered the central business district of Newport in the spring of 1872 when the city secured what it hoped would be a major stimulus for economic and urban growth in the construction of the LC& L Bridge establishing the first railroad bridge to Cincinnati across the Ohio. See Thomas L. Purvis, *Newport, Kentucky: A Bicentennial History* (Newport, Ky.: Thomas L. Purvis, 1996):109; Paul A. Tenkotte, "Rival Cities to Suburbs: Covington and Newport, Kentucky, 1790-1890" (Ph.D. diss., University of Cincinnati, 1989).
13. While Alexandria would fall gently to sleep after the Civil War, Newport's industrial economic expansion continued. By 1880 it was one of the 100 largest cities in the United States. Newport's stagnation and slow decline would begin in the years after WWII as organized crime gained a powerful foothold in the city. Today Alexandria is a flourishing town of 116,000 and a jewel in the vast population sprawl surrounding Washington D.C. while Newport, its industries stripped away and its downtown entirely demolished, has declined to an embattled 23,800.
14. Governor Preston H. Leslie to Mayor Robert D. Hayman, March 5, 1874, printed in *The Cincinnati Daily Gazette*, March 7, 1874. See Herbert G. Gutman, "An Iron Workers' Strike in The Ohio Valley, 1873-1874," *The Ohio Historical Quarterly* 68 (October 1959): 353-70.
15. In the nineteenth century, controlling industrial violence in small towns was often particularly difficult. In cases with a single large employer, the city government, in deciding how to deploy its police powers, became a key player in determining industrial outcomes. See Morris and Rogers, eds., *The Victorian City*, 31 and Gutman, "Iron Workers' Strike," 364.
16. Gutman, "Iron Workers' Strike," 360. See Note 3 for population sources.
17. Michael Katz, *The People of Hamilton, Canada West: Family and Class in a Mid-Nineteenth-Century City* (Cambridge: Harvard University Press, 1975).
18. We find no evidence of any of Alexandria's 1,237 slaves being employed in industry.
19. The Manassas Gap Railroad workshop employed 30 men according to the 1860 Census of Manufacturing, City of Alexandria.
20. Gutman, "Iron Workers' Strike," 354.
21. 1870 Census of Manufacturing, City of Newport. Despite the industrial character of employment in Newport, the city was only very slightly more male in population makeup than Alexandria. Our total population figures show Alexandria as 48 percent male if we count slaves as well as the free population while Newport in 1874 (excluding the U.S. military garrison on the edge of the city) was 51 percent male. The free population of Alexandria, considering both whites and blacks, was 49 percent male. The mapped populations of Alexandria and Newport very closely approximate the gender ratios in the total populations. The mapped population of Alexandria was precisely 50 percent male as against a total town population 48 percent male; in Newport the mapped population was 51 percent male, precisely the same as the total population of the city.

22. Sam Bass Warner, *The Private City: Philadelphia in Three Periods of Its Growth* (Philadelphia: University of Pennsylvania Press, 1968): 50.
23. Zunz, *The Changing Face of Inequality*. For another powerful statement of the effects of industrialism on a large city, see Theodore Hershberg, "The New Urban History: Toward an Interdisciplinary History of the City," in Theodore Hershberg, ed., *Philadelphia: Work, Space, Family, and Group Experience in the Nineteenth Century: Essays Toward an Interdisciplinary History of the City* (New York: Oxford University Press, 1981): 11.
24. See Maurice Stein, *The Eclipse of Community: An Interpretation of American Studies* (Princeton: Princeton University Press, 1960): 47-69.
25. Gillette, "Rethinking American Urban History," 212. See also Sies, "North American Urban History," 32-3 and Tilly, "What Good is Urban History?" 707.
26. Gillette, "Rethinking American Urban History," 213.
27. These mapped populations include men, women, and children in Newport and free men, women, and children in Alexandria. We did not attempt to map Alexandria's slaves as the only available place of residence was that of their owners. Excluded from Newport population and residential patterns are the 334 Army officers stationed at Newport Barracks. The only group not proportionally represented on our residence maps was the low-occupational-status group in Alexandria. This group made up 39 percent of the whole population, 35 percent of the mapped population and 52 percent of the unmapped population.
28. This distances our work from indices of segregation and diversity that focus on aggregate units such as blocks, wards, or census tracts. See Douglas S. Massey and Nancy A. Denton, "The Dimensions of Residential Segregation," *Social Forces* 67:2 (1988): 281-315; Michael J. White, "Segregation and Diversity: Measures in Population Distribution," *Population Index* 52:2 (1986): 198-221; John Iceland, Daniel H. Weinberg, and Erika Steinmetz, *Racial and Ethnic Residential Segregation in the United States, 1980-2000* (Washington D.C.: U.S. Bureau of the Census, 2002); Philip J. Ethington, "Segregated Diversity: Race-Ethnicity, Space and Political Fragmentation in Los Angeles County, 1940-1994," [www.usc.edu/college/history/lab/Haynes\\_FR/](http://www.usc.edu/college/history/lab/Haynes_FR/). Such global measures characterize areas with single summary statistics but do not allow exploration of localized trends that are especially important in small cities. See A. Stewart Fotheringham, Chris Brunsdon, and Martin W. Charlton, *Geographically Weighted Regression: The Analysis of Spatially Varying Relationships* (Chichester: John Wiley, 2002).
29. The street plan of Alexandria was based on Maskell C. Ewing, "Plan of the Town of Alexandria, D.C." (1845) and C.M. Hopkins, "City Atlas of Alexandria" (Philadelphia, 1877). Residence was determined from the Corporation of Alexandria tax books, 1855 and 1862, and the Corporation of Alexandria tax ledger, 1859. The street plan of Newport was based on the City of Newport plat book, 1869 and the 1886 Sanborn fire insurance map of the city. Residence was determined from the 1870 census, the 1874 Campbell County tax list, the 1869 Williams' Cincinnati Directory (Newport section), and the Williams' Newport Directory for 1873.
30. In analyzing the Irish and German populations of these two cities, we considered only adults as inclusion of American-born children of foreign parents created an artificial sense of inter-ethnic residential patterning. Occupational status was defined through a complex occupational dictionary that is available from the authors; in this work we report on only those of high status (professional, major merchants, and major officials) and low status (unskilled and semi-skilled workers).
31. Trevor C. Bailey and Anthony C. Gatrell, *Interactive Spatial Analysis* (New York: John Wiley, 1995). We followed Bailey and Gatrell in considering these exclusive point themes as events. See also A. Stewart Fotheringham, Chris Brunsdon, and Martin Charlton, *Quantitative Geography* (London: Sage Publications, 2000).
32. Bernard W. Silverman, *Density Estimations for Statistics and Data Analysis* (London: Chapman and Hall, 1985); Fotheringham, et al., *Quantitative Geography*.
33. Brian J. Wornton, "Kernel Methods for Estimating the Utilization Distribution in Home-Range Studies," *Ecology* 70:1 (1989): 164-8; Fotheringham, et al., *Quantitative Geography*. The smoothing parameter was calculated using the "ad hoc" approach.
34. On the use of stable core areas see Gary C. White and Robert A. Garrott, *Analysis of Wildlife Radio-Tracking Data* (San Diego: Academic Press, 1990). Core areas are defined by the relative distance between isopleths. See Imants G. Priede and Susan M. Swift, *Wildlife Telemetry: Remote Monitoring and Tracking of Animals* (Chichester: Ellis Horwood, 1992).
35. The alternative is a measurement of "as the crow flies," which ignores the actual physical arrangement of streets and houses.
36. This is termed complete spatial randomness. Brian D. Ripley, *Spatial Statistics* (New York: John Wiley, 1981).

37. Thorsten Wiegand and Kirk A. Moloney, "Rings, Circles, and Null Models for Point Pattern Analysis in Ecology," *Oikos* 104 (2004): 209-29. The O-ring statistic is a variation of Ripley's K-function. See Ripley, *Spatial Statistics*.
38. We believe this is a less-biased approach because it allows each adult resident at a property to be randomly chosen rather than the property being randomly chosen.
39. This is known as an antecedence comparison since one of the point locations (here, the Germans) is held fixed. We also tested the opposite relationship, fixing, for example, Irish-born adults and replicating the null hypothesis for German-born adults.
40. Had we added the 1,237 slaves to the residences of their owners, the density figure for Alexandria would have been 1.6 times that of Newport.
41. An independent householder was defined as either a head of household (a homeowner or a tenant) or a boarder over age 16 who lived outside their immediate family.
42. Because so few free blacks were able to own a home in Alexandria, we excluded this group from the calculations in Table 1.
43. Stephan Thernstrom, *Poverty and Progress: Social Mobility in a Nineteenth Century City* (Cambridge: Harvard University Press, 1964): 115-20.
44. We restricted the analysis to adults, defined here as those over age 16, to facilitate comparison across groups.
45. We know the place of residence for 337 free black adults in Alexandria and for 42 blacks in Newport, amounting to 25 percent and 36 percent, respectively, of the total non-slave black population of each city.
46. See T.B. McCord, "Across the Fence, But a World Apart: The Coleman Site, 1796-1907," in Steven J. Shephard and Pamela J. Cressey, eds., *Occasional Papers in Alexandria Archaeology* (Alexandria: City of Alexandria, 1985): 26.
47. The percentage overlaps reported in Tables 2 and 3 are calculated by dividing the area of overlap by the total area of the relevant 60 percent cores.
48. Only 27 percent of adult white males in Alexandria appear on religious membership rolls. Of the Germans on religious rolls, 59 percent were members of Beth El synagogue.
49. Immigrants from Bavaria and Prussia accounted for over 50 percent of Germans in both areas.
50. The Newport black population was too small to be reliably included in this analysis.