Introduction to Historical GIS and the Study of Urban History

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Over the past decade or so geographic information systems (GIS) methodology has become an accepted tool in historical research (Gregory and Ell 2007; Knowles 2008). Although often regarded as a mapping tool, GIS is perhaps better thought of as a type of database. What makes a GIS database unique is that a location is stored for each item of data, with this location taking any of a variety of forms: a point, a line, a polygon representing an area or zone, or, in the case of a raster system, a pixel. GIS can then present instantly on the screen a map showing the distribution of any variable or combination of variables in any of the chosen locational formats. This electronic display of information becomes an analytic tool, allowing the refinement of research questions, with answers displayed instantly: GIS creates a display of information once visible only in paper form, drawn slowly and expensively first by cartographers and then by vector plotters. GIS and its associated tools transform mapping into a dynamic exploratory process.

The fact that the data in a GIS database are spatially referenced allows a researcher to produce maps quickly, easily, and potentially in large volumes; but a number of other advantages also make GIS a platform that is well suited to the analysis of the geographies of the past. The first is that, as all data in a GIS-informed project have an explicit spatial location, it is easy to ask questions about where features are located in relation to each other. As Anne Knowles (2000: 453) notes, the enhanced visualization component of GIS has very positive results for historians, making available "dimensions of historical reality and change that no other mode of analysis can reveal."

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Second, as the locational data are based on real-world coordinate systems, such as latitude and longitude, Universal Transverse Mercator, or British National Grid, any dataset can potentially be integrated with any other dataset. Thus, for example, data on specific buildings based on points can be integrated with demographic data from census tracts represented as polygons, transport information can be represented as lines, and data on heights can be represented as pixels on a raster surface. This enables complex representations of a study area to be built up from multiple, apparently incompatible sources.

Third, and perhaps most important, GIS allows the researcher to explore the topic under study in a way that explicitly considers the impact of space and location. This might involve using formal spatial statistical methodologies (Fotheringham et al. 2000; Maguire et al. 2005) or might simply involve asking questions about why different places appear to behave in different ways. The increasingly sophisticated suite of statistical tools that accompany GIS software provide insight into the strength, rather than just the existence, of a spatial pattern, indicating how tightly grouped or widely dispersed it is. As correlation coefficients are to a scatter plot, so measures of the characteristics of spatial distributions are to the visualization of those patterns, providing indexed scores of the strength of complex relationships. Spatial statistics likely will assume increasing importance in guiding the development of GIS as this revolution turns from visualization to more ambitious analytic pursuits. At the very least, GIS enables and encourages the researcher to think carefully about the geography of the topic under study and the explanatory power of that geography.

While GIS approaches have these advantages, they also have a number of drawbacks. First, the time it takes to create a GIS database can be large, greatly increasing the variety of costs associated with a GIS-informed project. Second, the use of GIS software requires that the researcher learn certain technical skills, demanding additional time and effort. Third, and perhaps most fundamental, there is a lack of strong geographic skills among historians who are more used to asking questions about change over time. This relative neglect of the geographic tradition means that even with a good database and the technical skills to use it, a researcher still needs the conceptual tools to frame research questions and conduct the research in ways that make full use of the available spatial and thematic information. The good news in respect to this last issue is that GIS has reawakened interest in the

importance of geography and space to the historian (Bodenhamer et al. 2010; Gregory 2003). Myron Gutmann (2002: ix) puts the case well: "GIS enriches both qualitative and quantitative approaches to history . . . enabl[ing] students, teachers, and researchers to think differently about the past."

Historical GIS in Urban History

The most important factor in determining the extent to which historical GIS will become an established part of the discipline of history is the success or otherwise that its practitioners have in delivering research that demonstrates that GIS can and is making a direct contribution to knowledge in the discipline. Key to this is not the fact that GIS is used but instead that the research advances our understanding of the topic under study. The field where arguably the most progress has been made toward this goal is urban history. A number of reasons may be identified for this. First, urban history has a long tradition of acknowledging geographic features, as exemplified by the work on Milwaukee produced by Kathleen Conzen (1976) and Michael Conzen and Kathleen Conzen (1979); Michael Katz's (1975) study of Hamilton, Canada; John Kellogg's (1982) study of segregation in Lexington, Kentucky; Sherry Olson's (1989) study of Montreal; and the Philadelphia Social History Project (see Hershberg 1976, 1981). Urban studies also tend to offer the historian a rich variety of spatially referenced sources, such as maps, addresses, street names, electoral lists, gazetteers, and tract-level data. More pragmatically, urban areas tend to be relatively small, reducing the size of the spatial databases required. Nevertheless, boundary problems and controlling the size of the population as well as the number of variables being examined are important considerations as the researcher moves from the database construction phase of an urban project into its more substantive phases.

In an early paper concerned with the development of a database on Tokyo's urban growth, Loren Siebert (2000) provides a frank account of how he created such a database, what he sees as its potential, and the problems he encountered in developing it. More recent papers have moved the field forward by looking at how spatially informed databases can be used to make a contribution to knowledge in urban history. Andrew Beveridge (2002) takes tract-level data on population, ethnicity, and other socioeconomic variables for New York City from censuses from 1900 to 2000. He uses these to show how the city grew over the twentieth century and how different ethnic areas

developed in the larger city. His approach is primarily descriptive, deploying detailed spatial and temporal data to present a narrative of the development of ethnic segregation. Colin Gordon (2008) follows a similar approach in his study of the decline of St. Louis since 1945. He draws on a wider range of sources and makes extensive use of maps to produce a book that explores how and explains why St. Louis experienced urban blight and decay after World War II.

Amy Hillier (2002, 2003) follows a more targeted analytic approach, focusing on the relationship between mortgage redlining (the process of not giving mortgages to certain areas because of the perceived problems of their residents) and ethnicity and poverty in Philadelphia in the 1930s. She combines data on home loans for a sample of specific addresses, maps of the different "residential security zones" used to define redlined and other areas, data from a 1934 residential survey, and the 1940 census. Using spatial statistical techniques, she shows that areas with high African American and recent immigrant populations were more likely to be redlined than others, but she is also able to challenge the assumption that once areas had been redlined, their subsequent decline was inevitable because of the problems of getting a mortgage. Etan Diamond and David Bodenhamer (2001) follow a somewhat similar approach in a study of white flight in 1950s Indianapolis. They take data from two censuses, 1950 and 1960, and the locations of churches in the city at the start and end of the 1950s and compare the changing ethnic makeup of the city with the changing locations of churches. Their aim was to explore the assumption that mainline Protestant churches followed the white population in abandoning inner-city areas. They found very little evidence that churches moved out of areas that had large and growing African American populations but found that when they did relocate, this would typically be to suburban areas with overwhelmingly white populations.

More recent work in this field has begun to use large databases constructed from individual-level information. This has been particularly driven by the awareness that segregation and spatial concentrations of social groups can only really be understood and seen when working with data at this level. To this end significant work has been undertaken in Hartford, Connecticut (Schlichting et al. 2006; Tuckel et al. 2007), looking at African American populations in the city during the Great Migration. Donald A. DeBats (2008) also uses individual-level data in a similar way but compares two contrasting cities: Alexandria, Virginia, and Newport, Kentucky.

These examples all use primarily quantitative, social science–style approaches to analyze cities that are almost all American. A contrast is provided by the work of Keith Lilley and colleagues, who use GIS to explore medieval cities in England and Wales. Their approach is based on using GIS to integrate and explore archaeological records, surveys conducted using the Global Positioning System (GPS), and environmental data. They use these to shed new insights into the structure of towns in this period (Lilley et al. 2005a, 2005c) and also to disseminate information about them to a wide audience in an interesting and attractive way through the *Mapping the Medieval Townscape* (Lilley et al. 2005b) and *Mapping Medieval Chester* (Mapping Medieval Chester Project 2009) websites. This work illustrates that while quantitative approaches have shown the most progress to date, perhaps reflecting the development of historical GIS and GIS technology more generally, the use of GIS does not force the researcher to take a particular approach to quantitative data. Many different types of data can be included in a GIS, and the approach to analyzing them is very much determined by the interests of the researcher and the available sources.

This Collection

The essays in this collection mainly reflect social science approaches to analyzing urban history. Jason A. Gilliland, Sherry H. Olson, and Danielle Gauvreau use GIS individual-level data from Montreal for the years 1881–1901 to explore patterns of spatial separation on four dimensions: language, religion, socioeconomic status, and age. GIS is important in this investigation because it allows the identification of spatial aggregations at various scales that are consistent across time, facilitating comparison and testing for the salient level of spatial separation on those four dimensions. The work identifies "frontier areas" of diversity and high levels of growth but also reveals an industrial city committed to a pattern of housing stock that made its own contribution to the maintenance of patterns of spatial differentiation. Montreal emerges as a city with high and consistent levels of residential segregation based on ethnicity and socioeconomic status, both most noticeable at the micro level.

The project by Donald A. DeBats on Alexandria, Virginia, and Newport, Kentucky, uses individual-level data to map the populations of these two small mid-nineteenth-century cities, one commercial and one industrial,

one based on slave labor and one based on immigrant labor. With the populations assigned to specific addresses, GIS allows the display of social, economic, and political data across the cities, revealing the contrasting spatial patterns associated with their very different political economies. The work contrasts the extent of vacant land in the cities and their use of river frontage and explores the differences in the extent of home ownership. It uses kernel-density measures of the distribution of social groups to explore neighborhood formation and, with individual-level political information, the political influences of such groupings.

Mathew J. Novak and Jason A. Gilliland use GIS with a database of retailers in the commercial city of London, Ontario, between 1844 and 1916 to track the changing distribution of businesses, particularly those in the broad categories of food retailers and fashion retailers. But of course retail establishments and their distribution tell us far more about a city than where people shopped; as Novak and Gilliland point out, the retail sector of a city defines "vital places in the public realm where people congregate and interact." The work suggests that while food retailers, such as butchers, opened shops to serve the localized needs of an expanding city, businesses dealing with fashion, especially dry goods shops, remained committed to a presence in the city's retailing core. This concentration created a crucial mass of options that attracted customers and facilitated comparison shopping. Those fashion shops that located in the periphery tended to be smaller and offered less choice than the major dry goods stores in London's central retailing district.

Finally, Aaron Raymond demonstrates the ability of GIS to visualize change. He uses GIS to discover the extent of topographic alteration of Seattle between 1906 and 1930 and to show the impact of these changes on the spatial profile of the city. The specific point of his study is the massive effort to remove from the city's business district Denny Hill, 245 feet high and 60 blocks in area. The city developers attacked the hill and the buildings on it in two massive "regrades" to permit the expansion of the central business district of this major port city. Raymond's work preserves the building dimensions and shapes that were lost over a 105-year period of Seattle's history, allowing a unique view of urban development over time.

Conclusion

Each of these articles shows how GIS can make a contribution to our understanding of urban history. Most of them do this with large datasets about individual people, households, or properties. They then focus on a range of questions that stress the geographic aspects of urban history, including segregation, core and periphery, and topography. The GIS provides the framework that helps the researcher ask questions concerning what, where, and when. The final and most important stage in the research process is to ask why. GIS does not of itself answer this. Instead, it provides the descriptive information that the researcher has to explain. In this way the GIS enhances analytic skills through its ability to summarize large amounts of complex information in space and time. Explaining why these patterns are as they are remains the task for the skilled historian, not the computer. It is well known that learning GIS skills and building GIS databases represents a major investment of time and effort. Each article describes this effort in some detail. The question remains, is it worth it? Judging by the innovativeness and success of the articles in this collection, the answer is clear—yes, it is. In all of this, there are clear signs that GIS is encouraging a revival of urban history.

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