Beyond Method, Beyond Ethics: Integrating Social Theory into GIS and GIS into Social Theory

Roger P. Miller

Abstract: Increasingly complex social issues make it imperative that GIS practitioners be aware of theoretical debates in the human sciences, where arguments over ontological status and epistemological approaches have subsumed technical and methodological issues. Understanding the debates around deconstruction, postmodernism, and structuration is crucial to the development of useful geographic information systems that deal with social constructs. GIS needs to be informed about social theory to remain relevant in contemporary research, but GIS also can contribute to the further articulation of social theory.

Introduction

Most who work with geographic information systems (GIS), when they consider the situation at all, think of themselves as technical analysts, blessedly removed from the pointless theoretical debates that seem to be modern-day equivalents of the Scholastic controversy over the number of angels that can dance on the head of a pin. More formally put, the current empirical and positivist basis of GIS has led to a general dismissal of the idea that the theoretical debates rocking the human sciences have any relevance for "practitioners" or "applied geographers." However, such a blanket rejection appears increasingly unwise and untenable, as is reflected in the growing chorus of calls for greater integration of technical and applied aspects of GIS with social theoretical concerns (Curry 1993; Lake 1993; Sheppard 1995).

Central to much of the current discussion is the fact that GIS technology has been developed within an empiricist and positivist tradition, with a primary emphasis on solving technical problems associated with data structures, integrating complex algorithmic modules within single "look-and-feel" user interfaces, and simplifying data input, analysis, and output processes (Lake 1993; Sheppard 1995 (this issue)). It is also important to remember that much of this work has been the result of commercial product development, undertaken by private corporations serving rapidly growing customer bases, themselves usually in the public agency or corporate sectors. In other

Roger P. Miller is a member of the faculty of the Department of Geography, University of Minnesota, Minneapolis, MN 55455.

words, most of the recent development of GIS technology has been demand-driven, with the demand coming from end-users who have very practical problems they wish to address using a GIS product. Small wonder, then, that there has been little impetus to examine issues that typically are raised by academics concerned with social critique and social theory. These are hardly the clientele to whom GIS developers and users address themselves in the applied worlds of facilities management, land management, or geodemographics.

Nevertheless, the issues raised by academic social theorists are relevant to the ways in which GIS permeates contemporary life in advanced industrial societies. To understand why, we first must examine the broad nature of these theoretical debates, which tend to be lumped together under the three general rubrics of **deconstruction, postmodernism,** and the **duality of structure and agency** (or structuration), each of which corresponds to a major strand of the current debates.

Deconstruction

Deconstruction is based on the idea that there are viable **alternatives to positivism,** and insists that "reality" is socially constructed, rather than "naively given." The goal of analysis is to analyze critically, or "deconstruct," the discourses through which socially constructed reality is constituted. This involves more than merely looking at the words used to convey meaning. Deconstructivists examine the "unspoken implications" that attach to words and images, the contexts in which words are uttered and images presented, and how the ensemble of meaning is created in the mind of the

reader or analyst. What the speaker or author intended is of secondary importance in deconstructivist analysis. Criticism is elevated to a higher position than authorship, since meaning is created by the audience.

Postmodernism

Postmodernism adds an emphasis on **diversity and intersubjectivity,** reflecting the variety of newly voiced experiences that now compete in the vacated space once occupied by the unitary, universalizing and authoritative voice of positivist science (Bondi and Domosh 1992; Pratt 1990). Postmodernism tries to redress the long-standing inequity that has existed because "white, Eurocentric male" discourse has been "privileged," to use a favorite term. Postmodernist analysis is an outgrowth of deconstructivism in that it acknowledges not only that reality is socially constructed, but also that different social groups have different realities, all of which can make claims to validity.

Structuration

The agency/structure debate grows out of this marked enthusiasm for questioning "received authority" and existing structures of domination and control. If the legitimacy of social authority is no longer assured, what keeps people acting according to social rules, customs, and mores? How much knowledge and influence do individual actors wield? How much understanding do we have of the social actions in which we participate? Do we act of our own volition, under conditions of relatively complete knowledge, or are we the puppets and pawns of structural forces, the true nature of which lies hidden behind ideological discourses?

Theorists such as Anthony Giddens have posited a model that loosely follows Marx's dictum, that "[people] make history, but not under conditions of their own choosing" (Giddens 1984). This is a position that attempts to mediate between the idea that we are controlled by social structures and institutions, and the opposite notion that social structures and institutions exist only insofar as individuals freely act to create them (the so-called "social contract"). Giddens makes an analogy with language. The existence of linguistic structure allows for speech and communication, but the speech acts of individuals replicate, continue, and change the very structures that make such acts possible. Over time, languages change as their structures are modified. Social structures and institutions provide the context for human activities, but are likewise legitimated, reproduced, and changed by those very activities they

make possible. And far from being unthinking automata, individuals have considerable knowledge about the social rules within which they operate, even though they can change those rules only incrementally, if at all.

The GIS Response

Faced with these theoretical developments, how do GIS professionals, both developers and practitioners, respond?

To the claim that reality is socially constructed, most state what seems to them obvious: "What's there is there." Once again, to put this more formally, they are saying that empiricist positivism is the only correct approach—the "given" one based on common sense and general experience. Most GIS professionals would be pleased to learn that the majority of scientists would support their position, and in fact would claim that the striking advances that have contributed to the very high material quality of life in the industrially advanced nations of the West are directly attributable to "the scientific method." However, strict reliance on empirical facts is much harder when we are dealing with social constructs and situations than when we are reporting on the locations of geophysical features, lot lines or utilities.

When presented with the competing claims of groups who have not generally been heard in scientific and policy debates—including the voices of women, racial and ethnic minorities, postcolonial citizens of Third World countries, and those with different sexual orientations—GIS practitioners often throw up their hands and exclaim, "Facts are facts, regardless of who holds them." The role of GIS is simply to present those facts in a value-neutral fashion, they say, and practitioners need strive only for accuracy and presentational clarity. However, your facts and *my* facts may be quite different, because the ends to which knowledge is put very much affect how that knowledge is constructed. Given that much of our knowledge (or data) is partial, indeterminate, or provisional, interpretation always must play an important role. Then the question becomes, whose interpretation is best served by a given form or type of data? Such claims cannot be adjudicated a priori, but necessarily involve political processes of confrontation, contestation, and compromise (Olsson 1991).

When faced with such opposition, GIS practitioners may find themselves falling back upon claims that, "Experts know best." As professionals, they note, they can avoid the realm of values, and concentrate on technical issues of data collection, organiza-

tion, and presentation, thus eliminating the need to deal with issues of power relationships and domination. They simply provide the best possible information to those who are responsible for making decisions, be they members of the public, elected officials, or technical experts. Politics, as such, really don't play a role in this process.

Clearly, however, experts know that which they're trained to know. By ignoring issues of social theory and the social construction of reality, they remove themselves from the possibility of understanding a very important aspect of social interaction—how the relative positions of actors in a given situation affect the ways in which information is presented and received. Having been, for the most part, in the advantageous position of holding power, GIS practitioners and specialists rarely have had to confront the ways in which different forms of presentation and unequal power relationships affect communication and the decision-making process. Many of the situations in which GIS data are used are complex and politically controversial, and it would be naive to pretend that the technically sophisticated presentations associated with GIS analysis do not affect the reception of these data.

Relaxing the Assumption of Objectivity in GIS

What would happen if we started thinking of GIS theory and practice as other than value-neutral and bias-free? First, we would see a shift in emphasis similar to that in the sociotheoretical realm. This involves a decreasing concern with **praxis** (questions of "how do we do this?"), and greater concentration on issues of **ontology** ("what exists?") and **epistemology** ("how do we know what we know?").

As in other technical areas, there already exists a formal language and a large body of literature dealing with these issues (Olsson 1980). We tend to take for granted that the categories for which we obtain, organize, and present data exist, but this is manifestly not the case. As we increasingly use GIS analysis to address issues of social efficiency and the distribution of scarce resources, we necessarily deal in categories that resist precise definition. In our society, are the "disadvantaged" those with incomes less than 75% of median income, those with incomes less than 50% of median income, or those with incomes below the "poverty line"? What *is* the poverty line, and how do we determine its exact level? We can make precise operational definitions based on objective criteria, but this should not blind us to the fact

that these definitions are ultimately arbitrary, especially when we deal with categories such as race, class, and other social concepts.

In addition, a concern with ontology and epistemology leads naturally into a fourth major branch of philosophy—**ethics.** This implies that GIS practitioners and theorists should not be merely technical functionaries, but cognizant, socially-aware actors. In other words, GIS analysts have a responsibility to consider the ultimate disposition of their efforts, rather than simply to follow orders.

Social Theory in GIS

There are numerous ways in which GIS practitioners and theorists can incorporate notions from the recent debates in social theory outlined above. Three examples are given here; many more could be advanced.

A first approach involves an explicit acknowledgment of a major ontological and epistemological problem. Although we often are trying to model very complex and indeterminate situations, we tend to treat all data as highly determined. We need to develop ways to incorporate data that are less than precise into our analyses, while making it clear that such data are conditional. A number of approaches could be developed, including the use of fuzzy set theory, stochastic modeling, measures of data quality, and other methods. Such indeterminacy often more accurately reflects the social nature of the situations we model and analyze than do the exact presentations we frequently deliver. We still have a long way to go in deciding how to incorporate behavioral, social, and economic data into the databases associated with our geographic information systems.

For instance, Andrew Sayer has developed sophisticated schemata that help identify the necessary and contingent relationships that are involved in explaining complex situations (Sayer 1984). If we are trying to predict the occurrence of such social and economic upheavals as the recent riots in Los Angeles on the basis of underlying mechanisms involving racism, economic deprivation, high levels of violence and despair, and disparities in wealth, a GIS constructed to measure only these factors still would not be terribly useful in actual prediction. We know that conditions similar to those found in Los Angeles immediately before the 1993 conflagration, or those that existed 25 years earlier before the Watts riot of 1968, exist in a host of U.S. cities. Why did they, too, not explode?

According to Sayer's theoretical approach, the reason is because such complex phenomena in-

volve both necessary mechanisms (those shared among all like occurrences), and mechanisms or relationships that are contingent (i.e., based on historically specific, possibly unique, sets of circumstances). These latter relationships are exceptionally difficult to capture using systematic GIS methods. However, greater sophistication in incorporating a broader range of less determinate social and economic data might make it easier to identify likely locations for social upheaval. This is much like including a greater range of variables to increase the probability that weather forecasters can identify the most likely areas for tornado activity. But there is a major difference in the two situations. Weather forecasters can do little to ameliorate the conditions that give rise to tornadoes, but an urban GIS that identifies conditions likely to lead to civil unrest surely ought to have as a goal changing those conditions and improving the welfare of those who are affected. This is a clear instance of the moral responsibility that inheres in GIS practice. (On the other hand, precisely the same kinds of GIS data could be used by the police or military to stifle legitimate protest, in the name of preserving civil order. Such use of GIS in a surveillant society calls into question any faith that the technology itself will promote democratic change in pluralistic societies [Pickles 1991].)

A second example is based on the fact that we often exclude data from sources that do not conform to our notions of measurement accuracy, replicability or lack of bias. Such stringency has done little to ensure that our data are, in fact, accurate or useful. For instance, for social and economic information we are overly dependent on existing large data sources, particularly the U.S. Census of Population and Housing, as well as federally-mandated manufacturing and commercial censuses. The availability of such resources often has the unintended consequence of limiting the questions we can or do ask. If data of the correct sort are not available in the census, we often refuse to ask questions that would require us to perform expensive and time-consuming surveys to provide the answers.

As an illustration of this phenomenon, it is interesting to compare nineteenth century Dunn and Bradstreet reports with those of today. In the nineteenth century, subjective assessments of trustworthiness of principals in various businesses were commonly included. This information was obviously subject to biases based on ethnic, relig-

ious, class, or other grounds. Nevertheless, despite its biases, such information was essential for the utility of the Dunn and Bradstreet system at a time when there were few institutional guarantees protecting investors. Today, Dunn and Bradstreet data tend to be based on "objective" measures of corporate performance, including capital-to-earnings ratios, investment performance histories, and productivity ratios. This reflects our increasing dependence on "objective" measures, which, however, still fail to provide complete protection from risk.

When we depend on existing sources of information, the questions we can ask are limited by the data that have been collected, often for purposes quite different from our own. Rather than excluding imperfect data, we should utilize it in ways that acknowledge the biases it contains, while attempting to relate those biases to the alternative viewpoints of those who created or collected the data. Too often, we find that we have excluded data because they don't conform to *our* biases, not because they are bias-free. This is directly related to one of the tenets of postmodern approaches: in acknowledging multivocality, we also must focus on and make explicit our own biases and assumptions.

A third example involves the great deal of attention we pay to forms of presentation, while ignoring the fact that information provision is an explicitly political process. By concentrating on methods of presentation, we are implicitly acknowledging the fact that our data are not value-neutral. We know that certain forms of presentation are more useful, convincing, or intimidating than others. The very fact that "experts" are presenting data processed by computer adds weight to the results, regardless of the quality of the initial data on which the results are based.

This is an area in which we need to think clearly about the inherent power relationships that arise in technical and scientific analyses. We might consider Jürgen Habermas's notions of barriers to ideal communication acts.[1] This involves recognition of the role played by unequal power, unequal access to information, and the subtle and not-so-subtle cues that are inherent in various modes of discourse. We could also think about the role that information plays in legitimating authority to act in our society, a role in which GIS plays an increasingly powerful part. We should be cognizant of our power, and be careful not to abuse it ourselves, or let others misuse it.

[1] Habermas notes that a hypothetical ideal communication act rests on the elimination of power inequalities and other barriers to the free exchange of ideas. He labels such a communication act as hypothetical because the elimination of relevant barriers is a social impossibility, due to the ways in which many impediments operate at the preconscious or nondiscursive level of communication (Habermas 1984).

GIS in Social Theory

The three examples suggest ways in which an active engagement with issues in the theoretical wings of social science disciplines can enrich GIS practice and theory. Must the enrichment be one-way? Can GIS not only utilize current social theory, but actually contribute to the debates in such areas?

In some cases, simply emphasizing the disjuncture between modes of presentation and quality of information would make such a contribution. This is probably the major contribution that GIS practitioners can make in areas such as facilities management, geophysical resource monitoring, and other more technical, empirically based applications. In other areas, however, especially those that involve large-scale social, political, or economic processes, GIS can help researchers, analysts and policymakers understand how theory itself should be modified and reconstructed. GIS information can provide a good "reality check" for the sometimes ethereal formulations of academicians and politicians.

In the 1960s, as academicians and policymakers grappled with questions about the historical effects of race on the social mobility of African-Americans, an early form of GIS technology was utilized. Researchers were testing several competing explanations for the high levels of residential segregation and the low levels of social mobility experienced by African-Americans. Were they simply the "last of the immigrants," or had they been discriminated against systematically over a much longer historical period? Research at several large urban social history projects concluded that African-Americans had been systematically discriminated against in ways that were not typical for other immigrant groups, such as the Irish, Germans, Italians, Eastern European Jews, and others. Residential locations of households were compared across different groups, and African-Americans were found to have experienced far more residential segregation and less access to jobs than did other groups (Hershberg et al. 1981).

In carrying out the analysis, however, researchers found that they had to utilize creatively the information contained in large databases such as the manuscript schedules of the U.S. Census, city directories and special censuses. Engagement with issues of how one determined ethnicity or race from the census led to a rethinking of what constituted race or ethnicity in general. For instance, was the ethnicity of a person with grandparents born in Bohemia, but one parent born in Silesia and another born in Pennsylvania, German, German-Polish, or American? Did Polish ancestry mean different things in Poland and in Chicago (the two places in the late nineteenth century with the largest Polish populations)? Dealing with such questions in the databases that were part of these primitive GIS endeavors led to the development of new ideas about ethnicity and its effects on social mobility and community formation. More importantly, a dialectical process of theory formation, database construction, and analysis of the categories of data occurred. The process involved an active dialog between those constructing the databases and those creating the social theory, to the benefit of both.

To some extent, this example has more to do with the development and interpretation of data sources that can be entered into a GIS than with analysis of that data. However, these early efforts to analyze ethnic and racial mobility using GIS approaches ultimately led to a complete reconsideration of the methods that had been used to describe segregation and clustering. The ability to map subject populations using GIS quickly led to the discovery that the standard measures that were being used—the index of dissimilarity and especially the index of segregation—were very sensitive to the relative sizes of the subpopulations being studied as well as their spatial distribution. As a result, new measures that more accurately expressed the experience of different ethnic, racial, and occupational groups in nineteenth century cities were developed, including measures of relative group clustering, predominance of a group within a geographical area, and combinations of similar measures (Burstein 1976).

This example illustrates how researchers are finally beginning to acknowledge the role of space in the construction of social theory. Human activities are concretely situated in both time and space. Heretofore, much greater emphasis has been placed on the role of time, privileging history over geography, and creating a curiously aspatial notion of how societies function. Economic, political, and social models have been seriously deficient because they have been viewed as universal constructs, ignoring important spatial variations in the distribution of resources, attitudes, and opportunities. Postmodern theories, however, explicitly acknowledge spatial variability as an important component of social theory, while analysts grappling with the structure/agency debate insist on the importance of the spatial "situatedness" of human activities. Both developments open the door for a significant role for GIS.

Within theories about the economic transformation of contemporary society, there is a major debate between structuralists and postmodernists interpreting what is happening to the U.S. economy as we move from a "Fordist" to a "post-Fordist" regime of accumulation. David Harvey

and Ed Soja, for instance, have interpreted the recent transformation of the American economy in very different ways (Harvey 1989; Soja 1989). In each case, however, the crux of the argument rests on assumptions about the behavior of firms and the relocation of economic activities for which scanty data exist. Is a true economic transformation occurring, in which our old theories about behavior of firms according to economic location theory no longer hold, or are we seeing some combination of economic restructuring and relocation that is a continuation of trends that began shortly after the Second World War?

None of the principals in the debate have yet undertaken the multiscalar empirical research that would help answer these questions. To do so clearly requires the use of GIS analysis. However, GIS experts need to familiarize themselves with the terms of the sociotheoretical debate if they are to assist in the creation of geographical information systems that will be useful in this area. The mere replication and updating of the formats and data that sufficed for mainstream economic analyses simply will not work in a situation in which basic economic premises and assumptions are no longer valid. A host of new considerations need to be factored into our analytical models, including interactions among local, regional, national, and global economies; labor force mobility, deskilling, and job insecurity; out-sourcing and subcontracting of production; competition for public subsidies at the local, state, and federal levels; and changing production models based on "just-in-time" manufacturing, which eliminate stockpiling and warehousing of components. If GIS practitioners are unaware of the changing nature of the questions their systems will be utilized to help answer, it is doubtful they can design them to be useful into the twenty-first century.

GIS can also make a major contribution in helping to model the spatial context of human activity in theoretical debates about structure versus agency. Theorists from Anthony Giddens to Allan Pred have utilized the time-geographic research of Torsten Hägerstrand to illustrate the movement of individuals through time and space. Hägerstrand's model traces individuals through temporally and geographically located stations as they join other individuals and utilize specific resources to accomplish tasks. Although it is primarily a heuristic model, several researchers have used time-geographic methodology to examine situations related to social theoretical issues, especially the structure/agency debate (Miller and Gerger 1985; Pred 1986). Research has been limited by the difficulty of creating adequate GIS models to test large-scale empirical situations. To

utilize GIS in this fashion, it is necessary to include fine-grained information on times associated with a wide variety of social phenomena that we currently tend to describe in purely geographical terms. GIS holds considerable promise in this field precisely because its data structures, coupled with appropriate stochastic or Markov-chain techniques, can handle the interdependencies that characterize time-geographic analysis.

As databases of information become more sophisticated and incorporate data more sensitive to the issues that have recently gained prominence in social debates, GIS will be able to contribute significantly to the development of social theory. It is our responsibility as GIS practitioners to actively participate in such debates, rather than passively sit on the sidelines, ignorant of the implications of our work.

REFERENCES

Bondi, L. and M. Domosh. 1992. Other figures in other places: On Feminism, Postmodernism, and geography. *Environment and Planning-D: Society and Space.* 10:199-213.

Burstein, A. N. 1976. Patterns of segregation and the residential experience. *Historical Methods Newsletter.* 9:59-98.

Curry, M. 1993. Geographic information systems and the inevitability of ethical inconsistency. In Pickles, J., ed. *Representations in an electronic age: Geography, GIS and democracy.* New York: Guilford Press, 68-87.

Giddens, A. 1984. *The constitution of society: Outline of the theory of structuration.* Berkeley: University of California Press.

Habermas, J. 1984. *The theory of communicative action.* McCarthy, T., trans. Boston: Beacon Press.

Harvey, D. 1989. *The condition of postmodernity : An enquiry into the origins of cultural change.* Cambridge, Mass.: Blackwells.

Hershberg, T., A. N. Burstein, E. P. Ericksen, S. W. Greenberg, and W. L. Yancey. 1981. A tale of three cities: Blacks, immigrants, and opportunity in Philadelphia, 1850-1880, 1930, 1970. In Hershberg, T., ed. *Philadelphia: Work, space, family, and group experience in the Nineteenth Century.* New York: Oxford University Press.

Lake, R. W. 1993. Planning and applied geography: Positivism, ethics, and geographic information systems. *Progress in Human Geography.* 17(3): 404-13.

Miller, R., and T. Gerger. 1985. *Social change in 19th-century Swedish agrarian society.* Stockholm: Almqvist and Wiksell International.

Olsson, G. 1980. *Birds in egg/eggs in bird.* London: Pion.

Olsson, G. 1991. *Lines of power/limits of language.* Minneapolis: University of Minnesota Press.

Pickles, J. 1991. Geography, G.I.S., and the surveillant society. In Frazier, J. W., B. J. Epstein, F. A. Schoolmaster III, and H. E. Moon, eds. *Papers and Proceedings of the Applied Geography Conference.* 14:80-91.

Pratt, G. 1990. Feminist analyses of the restructuring of urban life. *Urban Geography 11,* 594-605.

Pred, A. 1986. *Place, practice and structure: Social and spatial transformation in southern Sweden, 1750-1850.* Totowa, N.J.: Barnes & Noble.

Sayer, A. 1984. *Method in social science: A realist approach.* London: Hutchinson.

Sheppard, E. 1995. GIS and society: Towards a research agenda. *Cartography and Geographic Information Systems* 22(1): 5-16 (this issue).

Soja, E. W. 1989. *Postmodern geographies: The reassertion of space in critical social theory.* New York: Verso.   ■