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GIS and Geography: Elements of a Debate

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Opening definitions: What is GIS?

ANY DISCUSSION OF "GIS AND GEOGRAPHY" would do well to begin by pinning down exactly what is meant by "GIS," since the term is used in so many different ways, as a convenient label for what is actually a diverse and very dynamic set of activities. In the past, definitions of geographic information system have emphasized the functions performed by a particular class of software, and listed input, manipulation, storage, analysis, and output in particular (see, for example, Maguire 1991). Others have defined GIS through the problems it is designed to solve, focusing on decisions that have essential geographic elements (Cowen 1988).

Today, the acronym GIS seems to be attached to any use of digital computers to create or manipulate representations of the earth's

surface, including the forms and distributions of its features and phenomena. We use the term "GIS data" to refer to the digital representations in particular; "GIS community" to refer to the people who in one way or another "do GIS," and even redundantly to "GIS systems." GIS is used in conjunction with people and institutions, hardware, software, data, and even communication networks. Increasingly the "S" is dropped, because information today is almost by definition digital, and because "GI" suggests more than the software alone. The term "geographic information technologies" is used to refer collectively to GIS, remote sensing, and the Global Positioning System, all of which use digital technology and work in some way with the earth's surface. The deeper issues raised by these technologies and their use, and the research needed to advance them, increasingly are identified as "geographic information science." Finally, Forer and Unwin (1998) recently have suggested a third way of decoding the acronym: besides systems and science, they add "studies" to encompass the social context of GI and such issues as legal liability, privacy, and the geographic information market.

This definition of GIS includes both human and physical phenomena; in fact, all phenomena descriptive of earth as the home of humanity. The fact that it is restricted to digital information is hardly limiting today, when virtually all information communicated between people is in digital form at some point in its life, with the obvious exception of direct face-to-face contact. GIS seen in this way is clearly of importance to geography, since it shares geography's concern for the surface of the earth; and since geography has always been an information-rich discipline interested in the issues of representing its domain, and communicating those representations to others. But the relationship between GIS and geography is complicated in several ways:

1. The discipline of geography has no monopoly over GIS or the surface of the earth.

2. Geography as a discipline always has been ambivalent about the role of information, particularly information about the form of the earth rather than about the processes that operate on it. We are skeptical about a geography that places too much emphasis on what Taylor calls "mere facts" (Taylor 1990, but see Goodchild 1991), and many human geographers today are skeptical of empiricism (Johnston 1997).
3. GIS of necessity emphasizes information that can be communicated between people. If we believe in other kinds of information that are inherently personal and non-communicable, then GIS is necessarily hostile to them.

The second point above is of course one with a long history in the discipline, echoing the debates about idiographic geography that enlivened the late 1950s, and even the distinction made by Bernard Varenius between special geography (the characteristics of places) and general geography (knowledge of what is true everywhere; the principles and processes of the geographic landscape) (see, for example, Warntz 1989).

The place of GIS in geography

In an article in *The Professional Geographer* in 1992 (Kemp, Goodchild, and Dodson 1992), Karen Kemp, Rusty Dodson, and I discussed four arguments for teaching GIS in geography:

1. *Home discipline*. Geography has no monopoly on GIS, but it does clearly have the best case for teaching it. Geographers are interested in all aspects of the earth's surface, and the role of geography as an integrating discipline is nicely modeled by the ability of GIS to link independent sets of data through a common geography. The issues that lie at the intellectual core of geographic information science—scale, representation, accuracy, the nature of space—also lie at the core of the discipline of geography and pervade all that geographers do. Although others may think of GIS as being a "mere tool," the ability to design and use GIS effectively is much more than Jordan's (1988) "non-intellectual expertise," and instead requires exactly the kind of understanding of forms and processes on the earth's surface that is the basis of an education in geography.
2. *Marketable skills*. The *Los Angeles Times* (February 26, 1996) listed GIS as "one of the top ten high technology jobs," and quoted Cheryl Wilder, a BA in geography, as having "found a field that combined her training in management and economics with her lifelong interest in geography. The GIS industry draws people with backgrounds in geography, urban planning, and environmental studies, who have a facility for using computer databases." Gober et al. (1995a,b) provide more systematic evidence that much interest in GIS and related areas among undergraduate geography students is driven by a perceived need for job skills.
3. *Enabling technology for science*. GIS is designed to enable the kinds of research geographers do, and the kinds of problems they solve, so a training in it is an appropriate part of every geography student's experience. By this argument, GIS is the specialized software environment of the geographer, just as a statistical package serves the statistician.
4. *Intellectual theme*. Our fourth reason is perhaps the most provocative, as it argues that GIS (decoded now as geographic information science) is an intellectual field in its own right, and very much part of the intellectual core of the discipline. This theme is followed in a later article (Wright, Goodchild, and Proctor 1997; and see Pickles 1997), where we assemble the arguments on both sides of the debate between "GIS as tool" and "GIS as science."

The debate: GIS in geography

That there is debate within the discipline of geography over the place of GIS is hardly surprising. To quote the *Times Higher Education Supplement* (the UK's premier academic trade magazine) in a fal 1995 article titled "Chart Hits" that quoted such leaders of the

UK discipline as Peter Taylor and Ron Johnston, "Some geographers are getting very excited over the uses of computerized mapping systems. Others are not convinced." In essence, there are two main arguments in this debate, which has now generated a substantial and stimulating literature (see, for example, Pickles 1998):

1. *Surveillance and control.* The roots of GIS lie in the military and intelligence communities, a fact that the GIS literature scarcely acknowledges (Smith, 1992). The GIS community has failed to consider the social context of its activities, and the potential for misuse and abuse; instead, GIS is presented as a context-neutral and even altruistic technology. Mapping lies in the military sector in most countries, and in the US today the number of people employed in military and intelligence applications of GIS is at least an order of magnitude greater than the number in the civilian federal mapping establishment. Counterarguments usually stress the inherent neutrality of the technology, and the need for explicit safeguards in areas such as privacy invasion, where the potential to link records legally by geographic location is every bit as powerful as (illegal) linking by social security number.
2. *GIS as filter.* I noted earlier that a digital database is inherently hostile to information that is personal or subjective, and difficult to communicate from one person to another. Simple concepts such as distance, location, or bearing are captured readily in digital form, but more sophisticated concepts of place are not, and neither are complex feelings about place. A GIS database emphasizes the primacy of one view of the world, and does not attempt to accommodate alternative ways of knowing. It is argued, therefore, that GIS is necessarily a technology of the empowered, and its possession serves to further the objectives of certain elements of society. To be fair, the argument is more about the current state of GIS than about GIS in general, and it is accepted by both sides in the debate that there are many possibilities for improvement (Pickles 1998). In fact, the improvement of GIS representations is a current, fundamental, and very exciting research area (see, for example, the topics of the research agenda of the University Consortium for Geographic Information Science, *www.ucgis.org*).

Concluding comments

So where does this leave us? I would like to make four points in conclusion:

1. Although there is evidence of tension between the various factions in the "GIS and Geography" debate, the tension is essentially creative; as the *Chronicle of Higher Education* titled its article on GIS in its issue of November 29, 1996: "New Technologies Revitalize the Ancient Field of Geography." There are no signs of weakening in the pattern of the past 30 years, which have seen a constant and accelerating supply of new information technologies to be evaluated, interpreted, and put to the service of geography.
2. Whether we call it geographic information science or not, it is clear that GIS is raising or reinvigorating a series of profound questions for geographers. What does the digital medium do to our collective knowledge of the world? What could be more challenging to a geographer than the creation of a useful and insightful representation of the infinite complexity of the human environment in the impossibly crude and limited space of a digital computer, in which everything must be expressed in an alphabet of zeroes and ones?
3. Geography has the best claim to GIS, but no monopoly, and it will be a challenge for us to maintain that claim in the face of rapid and continued growth in interest in GIS from all directions of the academic compass.

4. Teaching and using GIS in geography raise numerous questions of a practical nature, which I have not had the space to dwell on here. There is a sharp difference, for example, between education in the principles of GIS and training in its details; there are many views of the most appropriate curriculum for geographers (see, for example, Nyerges and Chrisman 1989, and the various curricula of the National Center for Geographic Information and Analysis, http://www.ncgia.ucsb.edu); and there are problems finding the resources to support expensive GIS programs in departments that are often located in the social sciences rather than engineering, and always underfunded.

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