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ABSTRACT
The space/place dichotomy has long been recognized in geography, and more broadly in the social sciences. The geographic information technologies that have emerged in the past few decades are almost exclusively spatial, however. The concepts, principles, and tools of the spatial perspective are reviewed, along with their importance in facilitating multidisciplinary social science. Arguments for a comparable placial perspective are presented and discussed.

KEY WORDS
Space, place, Center for Spatially Integrated Social Science, geographic information system.

INTRODUCTION
Space and place are two of the most fundamental – and contested – terms in the lexicon of the discipline of geography (e.g., Tuan, 1977; Hubbard, Kitchin, and Valentine, 2004), and more broadly in the social sciences and humanities. Space, or the spatial perspective, is generally held to refer to the surface and near-surface of the Earth, as organized by coordinate systems such as latitude and longitude, and to concepts such as distance and direction that are measurable or computable within that space. Defined in this way, space has strong connotations of science and its aims of rigor and replicability. In recent years the rapid growth of interest in geographic information systems (GIS; Longley *et al*., 2011), remote sensing, the Global Positioning System (GPS), and digital technologies in general have reinforced the importance of space, and implemented and formalized many of its concepts in computing systems.
Place, on the other hand, is normally defined as a social construction. A place is a named domain that can occur in human discourse (by contrast, references to latitude and longitude in human discourse are of course extremely rare). Places may be persistent through time, or transient and related to specific events. They may be poorly defined, with indeterminate boundaries that make it difficult to determine whether a given spatial location is or is not within a named place. Places have properties, but there may be substantial differences in individual perceptions of those properties, and their importance in defining places.
While it lacks an exact English equivalent, the French term *territoire* has elements of both space and place, as well as more abstract concepts such as landscape. What follows focuses therefore on space and place, and on a problem that has grown rapidly in importance in recent years with the emergence of the digital age: the formalization of space and place in computing systems. Formalization is of course necessary for the successful representation of anything digitally. It implies standard definitions of terms, and the existence of an agreed coding scheme to translate knowledge of the real world's spaces and places into a binary alphabet. Without formalization, there can be no successful sharing of information that satisfies the criteria of science.

The remainder of the paper is organized as follows. The next section examines the spatial perspective, the power of spatial analysis, and the emergence of space as a common, integrating theme in the social sciences and humanities. The development of a Center for Spatially Integrated Social Science (CSISS) in the United States, with funding from the National Science Foundation, is a direct result of the growth in importance of the spatial perspective. The section ends with a brief review of some of the more important concepts of the spatial perspective. The third section introduces the perspective of place – the *placial* perspective, discusses its importance as the world of human discourse becomes increasingly engaged with the world of digital computing, and compares it to the spatial perspective. The fourth and final section discusses the implications of this comparison, and the prospects for a range of technologies that parallel the technologies of space.

1. THE SPATIAL PERSPECTIVE

Over the past four decades it has become increasingly easy to tie information to specific locations on the surface of the Earth. This process began in the 1960s with early techniques for capturing such locations from maps, received a significant boost from the development of GPS, and today has advanced to the point where it is trivially easy to identify location, often by recognizing a location on a computer-generated image of an area. Vast amounts of geo-referenced information are now available, much of it also referenced in time (*spatial* should also be assumed to imply *temporal* where appropriate in this discussion). A device as simple and ubiquitous as a mobile phone can now be used to identify the precise location of the user, to provide detailed assistance in navigation, and to locate nearby points of interest. The spatial perspective has clearly come of age.

At the same time these advances have opened the door to sophisticated forms of *spatial* analysis, searching for patterns and anomalies, tracking the spread of disease, or looking for correlations that may suggest cause. The spatial technologies are also extensively used to plan, by determining optimal locations for activities, or evaluating the impacts of proposed developments on their local environments. These techniques are now widely available to researchers in the form of GIS, which have evolved to be capable today of virtually any conceivable form of spatial analysis and modeling.

The division of the academy into disciplines has always appeared somewhat counter-productive, encouraging as it does the emergence of discipline-specific practices, a narrowing of vision, and increasing difficulty in communication and collaboration. This is more than ever apparent today, when the complexity of modern scientific questions and problems points more and more to a multidisciplinary approach. Yet there are few obvious bases for improved communication. A shared language, such as English, is not necessarily a solution since its terms may be coopted and redefined by individual disciplines, as for example in the distinct meanings assigned to both the verb and the noun *map* by geography and mathematics. Statistics is a potential basis for communication, as its principles and techniques are standard, and today the statistical computing packages provide one basis for unambiguous communication between participants in a multidisciplinary project.

With this problem in mind, in 1999 the US National Science Foundation provided funding for a Center for Spatially Integrated Social Science (CSISS), based on the principle that a spatial perspective could provide an effective basis for communication across the social sciences (Goodchild and Janelle, 2004). Disciplines as distinct as criminology and economics study phenomena distributed in space and time, and may potentially gain insights by applying the tools of spatial analysis to their data. Those tools, and the associated language of the spatial perspective, might thus form an

additional glue to cement multidisciplinary work. The center sponsored the development of a computer package for spatial analysis geared to the needs of the social sciences; organized a series of popular summer training programs; sponsored multidisciplinary workshops to explore cross-cutting issues; and developed a very substantial collection of on-line resources (csiss.org). The establishment of the center proved to be extremely timely, since it coincided with an increased interest in spatial perspectives in the social sciences and humanities – the *spatial turn*. More recently we have seen a rapid growth in new forms of geographic information generated by Web users, a form of user-generated content sometimes termed *volunteered geographic information* (Goodchild, 2007). The foundational concept of the center has been adopted in other parts of the world, for example in the establishment of an Australian Research Council Research Network. Janelle and Goodchild (2009) provide an overview of the Center, and an assessment of its contributions to date.

The spatial perspective incorporates several principles that differ in major respects from traditional scientific methods, at least as applied in the social sciences. One is a belief in the importance of context as a key to understanding social processes. To a geographer, this is often seen as establishing a distinction between *site*, the location of some event or process, and *situation*, the surroundings of the event or process – based on the principle that social processes are more readily understood when the situation is known, rather than or in addition to the site. Many social processes would operate just as well in different sites, but not in different situations – or more formally, social processes tend to be invariant under relocation, but not under a change in context. GIS is a powerful tool for capturing, characterizing, and examining the effects of context.

A second principle is *spatial dependence*, often expressed in the statement "nearby things are more similar than distant things" (Sui, 2004). Spatial dependence conflicts directly with the independence assumption of classical inferential statistics, which requires each observation to be drawn independently from some parent population. Students who have learned classical statistics often find it very difficult to adjust to the realities of spatial analysis, with its very different assumptions about sampling. A third is *spatial heterogeneity*, the principle that conditions vary in the geographic world, that universal explanations are unlikely, and that scientific investigations should more often be *place-based*. These and other principles add strength to the argument that dealing with phenomena distributed in space and time requires specialized approaches, and that these approaches can provide a useful unifying framework for what are otherwise disparate disciplines.

2. SPACE AND PLACE IN HUMAN DISCOURSE

The past few centuries have witnessed a steady separation of the languages of science and everyday life. Words that humans use to convey meaning are often vague, but resolved by context or by dialog. Thus the comment "it's warm today" would frustrate a scientist with its inherent vagueness, but might well satisfy the needs of human communication, especially when augmented by gesture, verbal inflection, or spatial and temporal context. A scientist would resolve the ambiguity quite differently, but replacing "warm" with a well-defined reading on a system of measurement such as Celsius temperature. In a similar fashion, the growth of the spatial perspective, with its formal systems of coordinates, has provided a scientific basis for reasoning about phenomena embedded in space and time. There is little ambiguity, for example, about the boundaries of France or the distance from the Equator to the Pole, though all of these are subject to measurement error.

This tension between science and everyday discourse has shifted markedly in the past decade. Human discourse has become a subject of scientific study, in the disciplines of

linguistics, communication, and cognitive science, so that it is now possible to ask what people mean by "warm", for example. People have become engaged with the formal world of GIS and the spatial perspective, both as consumers of map information and as producers of it. As a result the contrast between Celsius and "warm" now has its analog in geography, in the contrast between latitude and longitude on the one hand, and references to places on the other. The traditional response has been analogous also: places were recognized in the formal world only if they could be unambiguously defined, for example by legal boundaries. National mapping agencies established *gazetteers*, or lists of formally recognized place-names, under the control of national committees such as the US Board on Geographic Names. Less formal places, such as "downtown", were left out of this formal, modernist world, and omitted from authoritative maps (for a discussion of techniques for addressing vaguely defined places in the precise structure of GIS see Montello *et al*., 2003).

By the 1990s it had become clear that GIS was developing in a distinctly formal direction that moved it further and further from the vague world of human discourse: that GIS in many ways *imposed* itself on its users and their ways of thinking. Burrough and Frank (1996) published a collection of papers on the difficulties of dealing with vaguely defined objects, and a growing critique of GIS by social scientists (Pickles, 1995) often targeted the simplistic geometric assumptions of GIS. It was difficult to make room for vagueness, and the kinds of reasoning favored by people rather than scientists, in the rigid planimetrically controlled world of GIS.

The names people give to places and points of interest constitute a very significant form of geographic information, so it is surprising to note the lack of interest in the "names layer" in early GIS. The US National Spatial Data Infrastructure that emerged in the 1990s (National Research Council, 1993) did not list names as one of the seven most important types of geographic data. By the turn of the century, however, this omission was becoming glaring. Web services such as the Alexandria Digital Library (Goodchild, 2004), which offered to retrieve geographic information, needed to allow their users to refer to areas of interest by name, rather than by latitude and longitude. Several workshops were organized to draw attention to the importance of place-names and the need for associated research, and a special issue of the *International Journal of Geographical Information Science* on gazetteer research appeared in 2008 (Goodchild and Hill, 2008). But this interest in place-names proved to be part of a much larger rebalancing of the tension between formal and informal. Turner (2006) recognized this broader trend in the term *Neogeography*, a new vision of the discipline in which everyone was both a consumer and producer of geographic information, and in which the distinction between expert and amateur was less and less clear. Maps could now be generated at essentially no cost, to meet needs that were individual, transitory, and presented through devices as small as a mobile phone. Maps no longer needed to present a "god's eye" view, but could augment directly the user's real-time perspective.

3. PROSPECTS FOR A PLACIAL PERSPECTIVE

In the previous sections my intent has been to paint a picture of the spatial perspective as precise and hostile to vagueness, planimetric, and scientifically replicable. But in the broader neogeographic world these properties may not be as important as they once seemed. Places certainly exist, though they may not be fixed in space, or have precisely defined or universally agreed boundaries. Routes exist between places, though their precise planform may not be as essential to human navigation as knowledge of intermediate points of interest. Indeed, the vast sums invested by mapping agencies over the past few centuries in the production of accurate planimetric maps may in the final analysis have benefited landowners and administrators more than everyday human

tasks such as wayfinding – and Everest's painstaking survey of the Indian Great Arc (Keay, 2000) may have had more to do with imperial domination than with anything of immediate practical significance. Consider the famous Beck map of the London Underground, which freely distorts distances and directions, and yet provides a very effective source of information to travelers, so much so that its format has been almost universally adopted by the world's public-transit systems.

I am always reminded of this apparent obsession with planimetric control when I visit countries such as Japan, and realize that almost every map I am given as a tourist is schematic and non-planimetric. At one level this is frustrating, since I never know quite how far it is from one place to another, or in exactly what direction, but at another level these diagrams can simplify the task of wayfinding enormously, by removing superfluous detail. In essence they are a prototype of what might become a placial approach, depicting places and their relative proximities and connections rather than their precise geometric positions. The spatial problem of indeterminate boundaries and positional uncertainty is thus resolved, and the primary mode of access is by name rather than by spatial position.

A placial representation of the geographic world would treat named places and points of interest as the primary entities, and would depict the topological relations between places, including connectivity and adjacency. It would not support the accurate measurement of distance or direction, especially between objects with spatial extent, thus avoiding a problem that spatial technologies have struggled with for decades and never satisfactorily resolved. It would not support the GIS functions of overlay or spatial join, which rely on accurate positioning of features in a metric space. In short, many of the functions of GIS would not be possible. On the other hand, a placial technology would have no problem providing driving directions, and would preserve a good enough approximation to planimetric accuracy to allow for the identification of nearby features and context, albeit with substantial uncertainty. It would represent hierarchical relationships, including part-whole aspects of places, for example "The Eiffel Tower is in Paris, on the Left Bank of the Seine".

Humans have theorized about space for centuries, and we now have formal theories of geographic information (Goodchild, Yuan, and Cova, 2007) and formal principles such as those reviewed in the previous section. Place, on the other hand, has received far less attention, perhaps because of its implicit vagueness. But once one thinks beyond the rigidity of planimetric control, it seems possible to envision a theory of place that is possibly even richer. What, for example, is the relationship between the attributes of places and the attributes of their component places? To what extent is "Paris" related to "Eiffel Tower", "Left Bank", "Seine", etc.? What metrics of separation are appropriate to a placial perspective, and how do they relate to topological relationships and intervening places? What is the placial equivalent of the principle that "nearby things are more similar than distant things"? Answers to some of these questions, and more generally the development of a set of placial technologies to parallel the spatial ones, would do much to bring us closer to the ways humans think about and discuss the geographic world – in short, to realize the vision of neogeography. Perhaps it is also possible to imagine a placially integrated social science.

Implicit in the modernist thinking that lies behind official gazetteers is the notion that there should be one, unique, authoritative view of the world, and that maps can play an important role in achieving that goal. It comes as something of a surprise to many people, therefore, that there are still disputes over boundaries and place-names in the world of the 21st Century. Microsoft's Encarta precipitated some diplomatic incidents in the 1990s, and similar events have occurred recently over Google's services. As a result, today maps.google.com depicts many of the international boundaries in the Himalayan region as disputed, including the boundaries of Kashmir and of Arunachal

Pradesh. A user in India is automatically diverted, however, to google.in and presented with a map showing the official Indian position, that Kashmir and Arunachal Pradesh are parts of India – and a user in China is diverted to google.cn and shown Arunachal Pradesh as Chinese territory. Computing technology finds it easy to adapt to the post-modern world in which maps are functions not only of what is depicted, but also of who is doing the depicting.

This suggests a rather different approach to the gazetteer from the traditional authoritative one. In essence a gazetteer should be a source of *binary* geographic information, representing the relationships between features on the Earth's surface, the names given to them, and the regions where those names are used, instead of the traditional *unary* form that recognizes only the feature and its official, universal name.

CONCLUSION

The geographic information technologies that have evolved over the past few decades have addressed only half of the space/place dichotomy, and dealt with place only to the extent that it can be treated spatially. The modernist perspective of the authoritative mapping agencies has reinforced this perspective, insisting on precisely defined boundaries of features and accurate planimetric control. The result has been a set of technologies that have imposed themselves on human society, requiring their users to learn and employ specific modes of thinking, rather than adapting themselves to the realities of human discourse and thought.

In this paper I have argued that recent trends, including the emergence of neogeography, have provided the motivation for a re-examination of the placial perspective, and the possibility of a set of technologies designed to support it. I have also outlined the kinds of questions that might be addressed by a theory of place that is as powerful as the theory of space that underlies our current geographic information technologies, and the possibility of a placially integrated social science that might be more consistent with theories of social process.

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