

Research Article

Critical Issues in Participatory GIS: Deconstructions, Reconstructions, and New Research Directions

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Abstract

In the mid-1990s, several critical texts raised concerns about the social, political, and epistemological implications of GIS. Subsequent responses to these critiques have fundamentally altered the technological, political, and intellectual practices of GIScience. Participatory GIS, for instance, has intervened in multiple ways to try to ameliorate uneven access to GIS and digital spatial data and diversify the forms of spatial knowledge and spatial logic that may be incorporated in a GIS. While directly addressing core elements of the 'GIS & Society' critique, these reconstructions of a critical GIScience introduce their own ambiguities with respect to access, equity, digital representation of spatial knowledge, and epistemologies of new GIS research practices. In this paper, I examine some of the new and persistent ambiguities of participatory GIS that bear inclusion in future critical GIScience research.

1 Introduction

In 2005, speaking about the challenges of participatory GIS research with grassroots community organizations, I was asked, "Why use GIS? If it is so challenging and potentially problematic, why do it at all?" Interestingly, this inquiry was nearly identical to questions posed about early participatory GIS initiatives that began to emerge almost ten years ago, following the publication of *Ground Truth* (Pickles 1995) and other critical GIS texts.¹ For me, the answer to this question remains largely the same. In spite of its limitations and challenges, GIS is tremendously important because it is such a powerful mediator of spatial knowledge, social and political power, and intellectual practice in geography. In short, the answer is the same today as it was ten years ago: Because the stakes are very high.

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But the persistence of this question and the concerns it suggests about participation, representation, and power in GIScience illustrate the need to re-examine some of the central contributions of participatory GIS as well as important future research directions. Ongoing questions about the utility and impacts of GIS in a variety of social, political, and geographical contexts do not necessarily suggest that efforts to re-create GIS practice over the past decade have failed. Rather, they underscore that GIScience continues to engage contradictory technologies and social practices, while expanding and diversifying its theoretical frameworks and applied practices to respond to critical concerns about access, representation, epistemology and power.

The technological, social, and political practices that comprise participatory GIS emerged from self-conscious reflexive efforts of some GIS researchers, but also through the efforts of non traditional user groups to gain access to GIS and adapt it to fit their spatial knowledge, priorities, and needs. Participatory GIS has sought to reconstruct GIS on several fronts to respond to its deconstruction in critical texts of the mid-1990s. These reconstructed GIS practices have sought to address uneven access to GIS and digital spatial data, diversify the types of spatial knowledge that GIS can include, and use GIS within more robustly inclusive participatory research and decision-making processes. In these and other practices, much has changed in terms of how GIS works and how it is used. Why then are we still being asked such similar questions about access, representation, expertise, and power? Reviewing core contributions from participatory GIS, as well as successes and failures in my own research partnerships in this arena, I identify two elements that give rise to these persistent ambiguities.

First, while participatory GIS interventions in the technologies and social/political practices of GIS do directly address many of the central concerns of the GIS critique, these interventions introduce their own contradictions with respect to knowledge, access, representation and power. Second, the technological and political contexts in which participatory GIS is undertaken have themselves shifted a great deal in the past decade, further exacerbating some contradictions. While the financial costs of hardware, software, and data have dropped and the options for acquiring and representing spatial information are greatly expanded for the most advantaged users, at the bottom of the digital divide relatively little has changed. With respect to the social and political contexts of participatory GIS, efforts to embed GIS in more collaborative research and decision making processes are affected by an explosion of interest in so-called participatory planning and governance schemes, backed by powerful public and private interests. In this paper, I will further detail these persistent ambiguities, as well as new contradictions that bear investigation in ongoing critical GIScience research. I begin with a discussion of concerns about access, representation, epistemology, and social and political impacts raised in the first wave of GIS critiques in the mid-1990s, and how participatory GIS has emerged in response to these critiques.² Then I examine some of the new ambiguities and dilemmas of these diverse participatory GIS practices. Specifically I consider accessibility challenges of new technological practices, contradictions within the growing range of GIS initiatives that are deemed participatory, and epistemological challenges inherent in the qualitative GIS approaches that are often part of participatory GIS initiatives. Finally, I conclude with some propositions for how future research in participatory GIS that might speak to some of these emerging questions.

2 Deconstructing GIS and the Reconstructions of Participatory GIS

Questions about the social and political impacts of GIS were evident from the earliest development of automated and digital systems for the representation and analysis of spatial data (Dobson 1983, Chrisman 1987). By the mid-1990s, these critiques coalesced around questions of epistemology, ontology, uneven access to GIS technologies and digital data, and the implications of its techniques for representing people and place. These questions gave rise to a critical GIScience research agenda that in the last decade has altered GIS technologies, the practices of decision making processes in which GIS is used, and the intellectual position of GIScience as a research methodology in geography. A central focus in critical GIScience has been uneven access to GIS, digital spatial data, and the growing number of important societal processes that incorporate them. Researchers have identified the financial, temporal, and experience and skills barriers that can impede access to and use of GIS and digital data by resource poor organizations and social groups (Weiner et al. 1995, Sawicki and Craig 1996, Barndt 1998, Craig and Elwood 1998). Others questioned the utility and appropriateness of GIS for grassroots organizations, community decision makers, and other 'non traditional' GIS users. They noted that these users had difficulty sustaining GIS use, that publicly available spatial data often did not represent their needs and concerns, and how the commitment of resources needed for GIS could be an unreasonable burden on struggling institutions (Yapa 1991, Rundstrom 1995, Harris et al. 1995, Elwood and Leitner 1998).

Critical assessments of GIS also centered on its ontologies and epistemologies, and on its representational capabilities and politics. Some scholars cautioned that wholesale reliance upon it in geographical research, urban planning, and other forms of spatial decision making would promote a positivist epistemology and instrumental forms of decision making (Taylor and Overton 1991, Lake 1993, Aitken and Michel 1995, Taylor and Johnston 1995). Others noted the difficulty of including non-Cartesian, contradictory, or shifting forms of knowledge in a GIS arguing that such knowledge might be excluded from a decision-making process solely reliant on GIS, by extension excluding the people and places represented by this knowledge (Rundstrom 1995, Sheppard 1995, Weiner et al. 1995). Some scholars worried about the extent to which GIS software obscured the hidden assumptions of the technology's spatial analysis techniques (Obermeyer 1995). Others were concerned about a "god's eye view" (Goss 1995b, p. 146), in which GIS-based maps and spatial analyses were argued to erase their social, political, and economic contexts, and hide the positionality of the user (Goss 1995a, Roberts and Schein 1995). In sum, the epistemological and representational concerns about GIS focused on the limitations of the technology, and the potential social and political implications of these limitations, especially given the seemingly unmitigated enthusiasm for GIS at the time.

These critiques offered a detailed examination of the social, political, and knowledge practices of GIS, a crucial starting point in efforts to address critical concerns about GIS. A number of scholars and practitioners chose not to reject GIS based upon these concerns, but to try to better understand how GIS technologies are socially constructed and how they produce space, knowledge, and power. These efforts laid the groundwork for changes in GIS technologies and applications that comprise participatory GIS, with a focus on three main kinds of interventions. These have included altering participatory decision making processes to enable more equitable access to GIS and digital spatial data; developing new representational strategies to diversify the forms of spatial

knowledge that can be included in a GIS; and re-designing GIS software and databases to alter the way in which they represent and analyze spatial data in digital form.³

Some participatory GIS interventions concentrate on altering the research, planning, and decision making processes in which GIS is used, to try to make these GIS applications inclusive of a greater diversity of people, places, and priorities (Craig et al. 2002). For instance, some researchers have sought ways to use GIS to enhance participatory planning processes or collaborative decision making (Shiffer 1998, MacEachren 2000, Al-Kodmany 2000, Sieber 2000, Kyem 2004b). Other process-oriented GIS practices have developed strategies for ameliorating some of the barriers experienced by grass-roots groups and other comparatively resource poor or marginalized GIS users. These efforts have included strategies such as university-community partnerships, inter-organizational collaborations, local knowledge production, and participatory research (Harris and Weiner 1998, Leitner et al. 2000). These interventions comprise a context-focused reconstruction of GIS, an effort to identify some of the social, political, and institutional factors that shape GIS access and application, and to alter them in ways that foster inclusion of diverse users, institutions, and social groups.

Other reconstructions of GIS target software and databases, seeking ways to extend and diversify the forms of spatial knowledge that may be included and represented in a GIS, and to adapt the technology to foster broader access by diverse institutions and social groups. Multimedia GIS strategies, for instance, try to move beyond the traditional Cartesian representation of spatial knowledge in a GIS by incorporating digital photographs, sound files, sketch maps, or three-dimensional representations (Kwan 2002a, Shiffer 2002, Weiner and Harris 2003, Kwan 2004b, Kwan and Lee 2004). While emerging as much from industry pressures as from concerns about the accessibility of GIS, Internet and mobile GIS technologies are seen by some as having the potential to reduce some of these barriers. For instance, Internet delivery of GIS-based maps and spatial data may expand access to GIS-based maps and spatial data, and decision making processes in which they are used. Individuals who do not have GIS software or cannot be physically present at a collaborative forum may be able to participate by taking advantage of Internet mapping sites or web-mediated collaborative decision making (Peng and Tsou 2003, Wong and Chua 2004).

Other technology-focused reconstructions of GIS have sought ways to alter the digital practices used in GIS software and databases to represent and analyze spatial knowledge, strategies that Schuurman (2002b) has termed 'engaging the cyborg'. Kwan (2002b, 2004a) and Kwan and Lee (2004) for instance, have adapted GIS software to try to represent individuals' and social groups' differential experiences and perceptions of space and place, or include phenomena such as emotions that are not inherently Cartesian but may be linked to particular spaces and places. Schuurman and Leszczynski's (2006) work on ontology-based metadata attempts to enrich GIS metadata to include information about the socio-political and institutional factors that shaped the collection and attribute representation of a particular data set. While primarily oriented toward addressing the tremendous semantic complexity of spatial data and problems this presents for data sharing and integration, ontology-based metadata also has the potential to incorporate some of the contextual complexity that critics charge is stripped from spatial knowledge when it is incorporated in a GIS. Similarly, Sieber's (2004) strategies for using new macro languages to represent complex, fuzzy, or multiple attribute data is another attempt to engage GIS at the level of programming languages to enable more diverse forms of representation.

Some scholars may have worried that concerns raised in *Ground Truth* and other critical texts of the mid-1990s would undermine the intellectual and practical developments of GIScience. I would argue that precisely the opposite has occurred. The critiques articulated in these texts set in motion a variety of efforts to alter the technologies, data representations and structures, and social and political processes of GIS and its application. Among these are the participatory GIS practices described above. But while participatory GIS directly addresses key concerns about access, representation, and epistemology, it introduces new tensions and paradoxes into GIS applications, GIScience, and their social and political impacts. In the next section, I examine some of these new tensions and dilemmas in reconstructed GIS, and articulate some directions for future participatory GIS research.

3 New Ambiguities, Persistent Dilemmas, and Emerging Methodologies

The many different practices that comprise participatory GIS have changed both the technologies and social and political practices of GIS. These reconstructions are closely intertwined with a range of other changes in spatial technologies, their applications and presence in daily life, and their use in planning, problem solving and other spatial processes. Clearly, desktop GIS are increasingly powerful, and their relative financial costs have continued to decline. Advances in data interoperability and creation of large shared databases have greatly altered the availability of digital spatial data. Internet and mobile GIS technologies alter the hardware and software requirements for GIS access, such that geospatial data and technology services are becoming a pervasive part of everyday life. Some scholars argue that broad cultural shifts, such as increasing reliance on visual images to produce and communicate information, suggest that GIS must be understood as communicative media, not just as spatial analysis technologies (Sui and Goodchild 2003, Kwan 2004a, Sui 2004). In decision making processes such as urban planning, resource management and a host of other forums, rapid growth in citizen participation or collaborative governance practices has shifted not just the involvement of individuals and social groups, but altered their access to and use of the geospatial information and technologies used in these forums (Elwood 2002, Elwood and Leitner 2003).

In short, as critical GIScience research has altered GIS, the social and technological contexts of GIS have shifted as well. These broader societal and technological changes, together with the practices of participatory GIS, produce new tensions and contradictions around access, participation, representation and power. New technologies, such as the Internet, multimedia, and mobile GIS address some concerns about uneven access to GIS, but also reconstitute some aspects of a digital divide with respect to GIS and spatial data access. Participatory GIS practices democratize GIS-based decision making processes for marginalized groups in some ways, but these practices are also being adopted by dominant institutions in a kind of 'mainstreaming' of participatory GIS that bears careful examination with respect to its empowerment potential. Participatory GIS also engages new multi-method research practices, especially recent efforts to develop qualitative GIS methodologies. In the final part of this section, I briefly characterize these qualitative GIS approaches and argue that they require the same critical questions about epistemology and representation that were part of the critical agendas of the mid-1990s.

3.1 *Technological Reconstructions in GIS: Reconfiguring a Digital Divide?*

Without a doubt, efforts to 'rewire' GIS for greater access by altering its technological structures have dramatically altered the representative capabilities of GIS. However, there are several issues with respect to these efforts to rewire GIS that bear further investigation. I would argue that technological developments in the past decade may widen the gap between the most advantaged geospatial technology users and the most disadvantaged. Desktop GIS software are more user-friendly than they were a decade ago and the relative cost of hardware, software, and data continues to decline. But numerous examples from participatory GIS initiatives with small non-profit organizations and grassroots groups suggest that the fundamental barriers of time, funding, technology, and expertise continue to impede their access (Sawicki and Peterman 2002). Comparatively, the geospatial technology and data resources of the public and private institutions with which these groups interact have dramatically increased. The basic entry requirements for GIS access and use have not shifted a great deal, and users still require at the very least access to computer hardware; GIS software or internet access to use web-based GIS services; and spatial data appropriate to their concerns, area of inquiry, or spatial strategies. These 'start up costs' for GIS continue to function as barriers for comparatively resource poor institutions in all parts of the world (Kyem 2002, 2004b; Elwood and Ghose 2004).

The landscape of access to rewired GIS is similarly uneven, and also has the potential to widen gaps between the most advantaged and disadvantaged geospatial technology users. Internet GIS, for instance, does address some spatial and temporal barriers to GIS use and participation in decision making that uses it, and can reduce software requirements. But the uneven development of infrastructures for Internet access mean that at the bottom of this hierarchy, relatively little has changed. A non-profit neighborhood revitalization group I am working with in a participatory GIS project has long wanted to use data and maps available from the City of Chicago's Internet GIS services. However, at the time of writing neither high speed cable nor DSL internet access was available in their area, rendering these resources functionally inaccessible. Similar situations are evident in a host of other social, political, and economic contexts. Along the southern Arizona/Mexico border, an ambitious project called the US/Mexico Colonias Web Mapping Service makes available a wealth of human and physical spatial data to monitor and plan for the needs and conditions of these rural border communities (Lam et al. 2006). An evaluation of this internet mapping service indicates that on both sides of the border, reliable high-speed internet access remains a major barrier for individuals, government officials, educators, and community organizations that have attempted to use it (Pavri et al. 2005). These examples of access to and use of Internet GIS illustrate that while new technologies in GIS can and do ameliorate some barriers to access, there remain distinct hierarchies that separate potential users with respect to their financial and technological resources, expertise, and even geographical locations.

Multimedia GIS solutions carry similarly mixed outcomes for participatory GIS. Undoubtedly, multimedia strategies enable GIS to include and represent more diverse forms of data, greatly expanding the representational capabilities of GIS software. The literature is filled with examples of GIS applications that include animations, sounds, text, sketches, or digital pictures (Krygier 2002, Shiffer 2002). But while these approaches do expand the representational flexibility of traditional GIS software, they carry their own costs and barriers for resource poor organizations. Multimedia GIS and other

creative strategies that try to extend the technological capacities of GIS are likely to require a higher level of technological expertise. They may also require additional software for image or sound file preparation and editing, and additional hardware for data collection, such as sound recorders and digital cameras. While there are many successful participatory initiatives of this type, it is worth noting that the start up costs of doing this sort of GIS are significantly higher than doing traditional GIS, using the software 'out of the box'. In the case of participatory GIS initiatives, participants are often novice GIS users and sometimes also inexperienced in their use of digital spatial data. Thus, traditional GIS applications and forms of spatial data present a significant challenge, one that may become still more complicated in the context of multimedia GIS.

It is important to factor in how participants in participatory GIS initiatives assess the costs and limitations of these different ways of doing GIS, and how they balance such trade-offs between extended representational capacities and increased expertise or technology needs. In a participatory GIS project I am currently involved in, the participating organizations have opted for simple, static, Cartesian applications of GIS over multimedia or Internet GIS, even while recognizing the greater diversity of spatial knowledge that could be included and the greater community access to this information that might be achieved. A variety of organizational goals, political conditions, and past experiences inform this strategy. Both groups have a strong emphasis on community capacity building, extending to their decision to have staff members learn GIS themselves, rather than cooperating with an institution that would provide GIS expertise for them. The developing GIS skills of these staff members mean starting with relatively simple applications, but not more complicated multimedia or internet capabilities. The desire for self-determination in GIS development and application and self-representation in GIS-based data and maps is also strongly informed by the groups' uneasy history with local government and even university partnerships. This particular situation does not imply that novice GIS users or resource-limited institutions should not attempt multimedia and other creative representational approaches to GIS use. Rather, it is important to consider the ways in which new technological practices in GIScience affect existing differences in their costs, accessibility, and appropriateness for diverse individuals and social groups. While efforts to rewire GIS do address some of the access, representational, and epistemological limitations of traditional approaches to GIS, there are other ways and circumstances under which these activities simultaneously re-inscribe the so-called 'digital divide', rather than ameliorating it.

3.2 Participatory GIS Goes "Mainstream"

Just as there are a number of ways in which technological shifts affecting participatory GIS have introduced new ambiguities, efforts to enhance the participatory knowledge production and decision making processes that use GIS have done the same. Participatory GIS has over the past decade built a broader understanding of the political and institutional conditions under which participatory uses of GIS are likely to thrive, and developed some effective strategies for fostering more inclusive GIS practices (Craig et al. 2002, Sieber 2004). Specific structures adapted to support participatory GIS have included university-community research and teaching collaborations (Esnard et al. 2004), collaborative forest resources management (Kyem 2002), urban environmental planning and monitoring (Merrick 2003), and contested land redistribution processes (Weiner and Harris 2003). The successful development of participatory GIS processes

has spawned a growing mainstream popularity. Critical GIScience must examine the widening range of practices that are articulated as participatory GIS and community mapping. These diverse initiatives vary widely in terms of the inclusiveness of their knowledge production practices, empowerment potential, and capacity to inform autonomous and influential decision making by institutions and communities.

Paralleling the growing enthusiasm of the public, private, and non-profit sectors for participatory planning and other purportedly collaborative governance and decision-making programs (Cooke and Kothari 2001), a variety of practices deemed participatory GIS or community mapping are being widely adopted. The Northeastern Illinois Planning Commission, for instance, began to use geospatial information technologies in its metropolitan regional planning efforts in 2002, framing their use of web-based GIS and structured public involvement technologies as a kind of participatory GIS (Allen and Morgan 2003, Dieber 2003). GIS-based community mapping initiatives are emerging across the US, their solid entrenchment evident in such activities as the proliferation of internet-based community mapping websites⁴ and recent release of an ESRI Press publication on GIS-based community mapping (Knapp and Orton Family Foundation 2003).

The mainstream enthusiasm for participatory GIS that is reflected in these developments is not intrinsically problematic for its own sake. But a closer examination of some of these initiatives suggests that some of these emergent participatory GIS and community mapping initiatives and processes may not be as attentive to issues of access, power relations, and diverse knowledge claims as the critiques of GIS that fostered participatory GIS in the first place. That is, it is important not to assume that all such efforts are necessarily inclusive and attentive to problems of access and disempowerment and the multiple ways they are produced. Participatory GIS research has as one of its central goals increasing the power of grassroots groups and marginalized social groups in social and spatial decision making, and enhancing their efforts to improve their social and physical environments (Craig et al. 2002). While a discourse of empowerment and positive socio-spatial change pervades these more mainstream participatory GIS and community mapping initiatives that have begun to emerge, the greater emphasis is frequently on facilitating the GIS access and use.

Making Community Connections, the recent publication on community mapping, provides a wealth of practical advice for community organizations, educators, and local residents on how to successfully organize GIS-based data collection and mapping. But relatively little is said in this text about how communities might successfully link this new knowledge to social, political, or economic change. The text suggests that after a community mapping project, the community should continue the work of implementing its results. While emphasizing the importance of local knowledge as an essential benefit of community mapping, the text downplays the possibility of contradictions and contestation within these local perspectives, with the introduction reading, "Because the Foundation believes that local community members are best suited to understand local needs and goals, it advocates no particular point of view, approach, nor agenda . . ." (Knapp and the Orton Family Foundation 2003, p. viii). This discussion of GIS-based community mapping also does not speak to the starkly uneven distribution of resources for GIS development, presenting a model in which the participatory process is guided by paid staff, a challenging proposition for a resource poor community, school district, or non-profit organization.

The recent surge in purportedly participatory GIS initiatives and community mapping activities is strongly linked to efforts to reconstruct GIS to make it more

accessible to a diverse range of users, and to support more collaborative processes for developing spatial knowledge. But many of these new participatory GIS initiatives seem less cognizant of the central issues raised in critical perspectives on GIS from the 1990s. Thus, an element of future critical GIS research must be an examination of the role and implications of these mainstream participatory GIS initiatives, as they are promoted by both public and private institutions. We need to ask some of the same questions about these mainstream community mapping practices as were posed in the initial critique of GIS: How inclusive and participatory are its knowledge production and spatial decision making? What forms of knowledge are promoted, and which are excluded? Will these newer community mapping initiatives concentrate on collection of local knowledge and internal community use of that knowledge, without simultaneously fostering critical assessment of 'official' and expert knowledge, or community engagement with powerful public and private decision makers? Just as some researchers have questioned whether 'collaborative visioning' and participatory planning practices currently popular in local government preoccupy residents in tracking local conditions without giving them an influential voice in decision making (North 2000, McCann 2001), these same questions must be asked of the plethora of emerging GIS initiatives that are purportedly participatory.

3.3 Methodological and Epistemological Diversity: Participatory GIS and Qualitative GIS

The new research and participation practices of participatory GIS are closely linked to a small but active discussion of qualitative methods in GIScience. While there is not an exact equivalency between the two areas, many qualitative GIS methodologies are being developed within participatory GIS initiatives. Critical GIScience research has long incorporated a strong focus on its epistemologies and methodologies, such as the efforts to several researchers to explore links between GIS and feminist theory and method (Kwan 2002b, McLafferty 2002, Pavlovskaya 2002, Pratt and Schuurman 2002). The discussions of feminist GIS challenged characterizations of GIS as a necessarily positivist, masculinist, or primarily quantitative form of inquiry and knowledge production, making possible some of the current explorations of qualitative GIS. Within critical GIScience research, we need to consider how the diversity of practices that engage qualitative methods and GIS operate differently in terms of their underlying assumptions and ways of using GIS for knowledge production.

Some research informing this discussion of qualitative methods and GIS adopts a multiple methods approach, exploring how GIS and qualitative data collection and analysis techniques might be used together in productive ways. Pain et al. (2006), for example, illustrate how qualitative data gathered through ethnographic and interpretive data collection and analysis techniques might be used together with data developed through GIS applications. They show how this approach, termed 'qualified GIS', enables more nuanced exploration of social and spatial phenomena being researched and the potential to generate more robust and appropriate policy responses. Specifically, they bring together GIS analysis of street lighting with qualitative information gathered from focus groups, to examine individuals' senses of safety and fear in particular places.

While this line of discussion focuses on GIS *with* qualitative methods, other discussions in critical GIScience research focus on GIS *as* qualitative method. That is, some research contributing to this discussion has developed methodologies that use GIS, but do so

outside of a strictly quantitative framework or deductive approach to building knowledge. For instance, Pavlovskaya (2002) and Schuurman (2002a) have shown how GIS may be used in exploratory and inductive approaches to building knowledge, alone or in combination with other techniques for data exploration and analysis. Knigge and Cope's (2006) technique for grounded visualization involves iterative exploration and analysis of spatial data using GIS, but doing so in an inductive knowledge production strategy informed by grounded theory, a similar technique used for interpretive analysis of qualitative text-based data (Glaser and Strauss 1967). Krygier and Hawthorne (2003) offer a mixed method participatory research process that combines quantitative statistical analysis of qualitative data such as text or photographs with GIS-based analysis of participants' sketch maps.

These different trajectories in qualitative GIS are both important, but they contribute to critical GIScience development differently and necessitate different kinds of questions. The "GIS with qualitative methods" approach, for instance, invites questions about how researchers can most productively interpret knowledge that is developed not just from different data collection and analysis techniques, but from different forms of spatial knowledge altogether. Most of the "qualified GIS" research designs involve not only several techniques for data collection and analysis, but also strive to incorporate multiple forms of knowledge – local knowledge from multiple perspectives, expert knowledge, official knowledge, and more. While the existing literature on qualitative methods has strong traditions to draw on with respect to interpretive analysis among different data sources, it has not as distinctly considered the additional challenges inherent in research designs and methods that simultaneously intersect different forms of knowledge, tools and technologies for knowledge production, and sources of information.

Within the "GIS as qualitative method" approach, other issues bear investigation. We need to investigate the extent to which these methodologies develop and use different underlying assumptions and knowledge production strategies than other kinds of GIScience research. For instance, qualitative GIS techniques such as Knigge and Cope's (2006) grounded visualization imply a rethinking of the epistemological significance of maps in GIS. In the mid-1990s critique of GIS, maps were taken as a masculinist 'god's eye' view of space, place and people, with a predisposition for representing quantitative spatial knowledge. In contrast, these emerging qualitative GIS methodologies are premised on a much different understanding of the epistemologies and ontologies of maps in GIS, understanding maps more as cartographic texts that can be part of an interpretive production of meaning. This shift in perspective is linked to critical GIScience's introduction of concepts from social theory into GIScience, as well as broader societal shifts such as expanding reliance on visual images and visualization for the production and dissemination of knowledge (Perkins 2004, Sui 2004, Warren 2004). Just as Kwan (2002a) considered the very different perspectives of feminist theory and GIScience upon vision, visual images and visualization, critical GIScience must consider the shared and contested methodological and epistemological territories of qualitative GIS.

Both approaches to qualitative GIS – GIS *as* qualitative method and GIS *with* qualitative methods – have their own productive possibilities and potential problems in terms of epistemologies, representation, and social and political implications. An important move in exploring these methodological and epistemological developments may well be to examine them in conversation with broader discussions of methodology in geography. Most critical GIScience and participatory GIS methodological discussions have been

framed within critical GIScience research, not in conversation with the geography research methods literature more broadly. With growing interest in participatory research methods across geography (Leitner and Sheppard 2003, Pain 2003), critical GIScience has the opportunity to directly link its contributions in critical research methodologies to these discussions. As Kwan (2002a) has argued, geography is increasingly characterized by multi-faceted intellectual practices and hybrid epistemologies. Critical GIScience has been directly engaging these hybridities for a decade, especially in its mixed methodological practices and attempts to foster epistemological flexibility in its knowledge production and representation strategies, and these efforts have a great deal to offer the discipline as whole.

4 Persistent Themes and New Directions

Ground Truth and other critical GIS texts challenged geographers and others to examine the role of spatial technologies in mediating power relations and political practices, producing spatial knowledge, and altering physical and social environments. In the previous sections, I have outlined some central ways that participatory GIS research and practice has responded to this challenge, restructuring its technological practices, its application in a variety of spatial and social processes, and its research methodologies and knowledge production practices. These interventions introduce their own new questions and ambiguities, charting some possible directions for future research in participatory GIS. Participatory GIS remains an area of research and practice informed by a tremendous range of methodological and substantive arenas in geography and beyond. Thus, my propositions for future research are neither exhaustive nor directed solely at contributions in GIScience.

In participatory GIS research and practice we must continue to be critically reflective upon the forms of politics, participation, and representation fostered in these efforts. Participatory GIS has come to encompass a wide array of practices in which individual and social groups may participate in a variety of different ways in GIS-based spatial analysis, knowledge production, or planning and decision making. As Weiner and Harris (2003) have suggested, the actual forms of involvement in GIS applications that constitute ‘participation’ in a participatory GIS project can vary greatly. But in the recent proliferation of participatory GIS initiatives, we may see the potential emergence of a problematic hierarchy within community-based or participatory GIS: participatory GIS or community mapping initiatives that inform local activism or negotiations with powerful public and private actors; and those that are directed primarily toward more inwardly-focused community information gathering. While both kinds of practices are important, we need continued critical reflection upon the power dynamics of the diversifying range of practices that constitute participatory GIS. In short, there are a great many actual and potential ‘digital divides’ within participatory GIS that bear investigation – those that are rooted in data and technologies, those that relate to constructions of rationality and expertise, and those that may be inscribed in different kinds of participatory practice.

More broadly, related to our interrogation of participation and representation within participatory GIS, we must continue to refine and extend our conceptualization of “power” and “the political”. Of course both concepts have been central to participatory GIS since its inception. But in the rush to facilitate new forms of GIS and new ways of

using it in participatory or collaborative decision making, it is imperative that we not lose sight of the need for continued theorization of the practices, relationships, and societal impacts of our efforts. Specifically, some researchers have called for participatory GIS to re-engage with conceptualization of power and politics drawn from feminist theory and method and from urban and political theory in geography (Wilson 2005, Ramsey and Wilson 2006).

Finally, I contend that we must devote significant effort toward understanding how participatory GIS practice, in all its diversity, is situated in and contributes to critical GIScience and GIScience more broadly. Reflections on participatory GIS have raised concerns that it fails to tap the full range of GIS's spatial analytic capabilities or build robust theoretical frameworks (Barndt 2002, Haklay 2003). In response to these critiques, I would argue that participatory GIS practice in many cases deploys geospatial technologies in a different way than GIS applications in academia or policy research. But for those of us working in participatory GIS, I would suggest that such critiques indicate a continued need to demonstrate these practices, and explicitly situate their theoretical significance to GIScience. For example, my experiences with grassroots urban revitalization groups suggest that they frequently use GIS not for spatial analysis directed toward specific research questions. Rather, they are using GIS for production of cartographic spatial narratives – map-based images of space and place – that can be adapted and revised to support a range of political projects and characterizations of a place and its needs (Elwood 2006). For these groups, the most valuable function of GIS is not its spatial analysis capabilities, but the capacity to experiment with spatial representations and produce visual texts to support shifting portrayals of community space and needs. Other participatory GIS projects have illustrated how GIS may function as a conflict mediator in contentious community decision making, as groups examine different spatial scenarios and representations (Kyem 2004a). In this instance, the visualization capabilities of GIS are again central, along with the capacity to model multiple scenarios and outcomes. While some participatory GIS initiatives mirror other kinds of GIS applications, there are many that are quite different and we need to continue to include these diverse applications in our efforts to unpack the full range of ways that GIS is used in the production of knowledge and power.

Participatory GIS applications blur boundaries between GIScience and critical cartographies, and a recent resurgence of interest in the concept of visualization may well be a useful framework for conceptualizing the diversity of participatory GIS practices. Previously, visualization was framed as the exploratory practices of cartographers and GIS researchers to develop spatial knowledge through iterative production of visual images of space and spatial relationships (MacEachren and Taylor 1994). More recently, visualization is used to conceptualize an expanding range of other practices, such as the use of GIS-based maps as a form of communicative media, or the counter-mapping strategies of activist groups (Kwan 2002a, b; Krygier 2002).⁵ This expanded notion of visualization is important as a conceptual framework under which critical GIScience might examine a fuller range of ways that knowledge and power are negotiated in and through participatory GIS, not just through the spatial analysis techniques that were earlier identified as visualization. As GIS and other technologies with geospatial data handling capabilities are increasingly present in our everyday lives, we need this expanded notion of visualization to help critical GIScience researchers examine the diversity of ways that geospatial technologies are used to produce knowledge and meaning.

Notes

- 1 Other central texts of this period included a 1995 special issue of *Cartography and Geographic Information Systems* (now *Cartography and Geographic Information Science*) and several papers in *Environment and Planning A*, including Openshaw (1991, 1992) and Taylor and Overton (1991).
- 2 There exists a great deal of variation in the terms used to describe what I articulate here as 'participatory GIS'. Other terms in use include "public participation GIS" and "public participatory GIS". Debate about the difference between these terms and the 'real world' situations they are most appropriate to describe continues. "Public participation GIS" begs the questions of who is the public and what may be considered participation. Some scholars insist on reserving 'participatory' for autonomous grassroots activities and using 'participation' to describe those practices which are more top-down or state-linked in their approach. Here I have chosen to use 'participatory GIS', but do so with full acknowledgement of these ongoing debates.
- 3 In this discussion of reconstructed GIS practices, I focus primarily on interventions that have been explicitly identified by participating researchers as addressing issues raised in the critique of GIS. Of course, there are countless ways in which the everyday GIS practices of scholars not active in critical GIScience research have been influenced by this research agenda, but systematic discussion of these would require a much longer paper.
- 4 For example, see the Tucson Community Technology Education Network (<http://ag.arizona.edu/agnet/cte/>), or the New York Public Information Research Group's Community Mapping Assistance Project (<http://www.cmap.nypirg.org>).
- 5 This expanding conceptualization of visualization is in keeping with arguments that visual images are increasingly a primary means of producing and communicating information, in geography and in society as a whole (Sui 2000, Crang 2003, Rose 2003, Perkins 2004).

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