



Feminism and Geographic Information Systems: From a Missing Object to a Mapping Subject

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Abstract

Although feminism and the field of geographic information systems and science (GIS) have only recently begun speaking to each other, the feminist mapping subject is emerging across a variety of sites – academic, professional, and lay. However, it is most articulated in the work of critical GIS scholars. Both male and female, they are committed to nonpositivist practices of knowledge production and are sensitive to gender and other power hierarchies that produce social, economic, and cultural difference. These scholars have been creating ‘feminist cartographies’, practicing ‘feminist visualization’, and developing new mapping alternatives to mainstream cartographic and GIS representations. We begin by briefly re-reading the history of women in cartography and GIS as a first step toward reclaiming mapping as a critical practice. We then review feminist theorizations of visual representation and geography that move beyond critique and posit a feminist deployment of such technologies. Finally, we reflect on explicitly feminist engagements with cartography and GIS and their implication for the discipline of geography and contemporary mapping practices in general. Throughout, we trace the evolution of a feminist mapping subject and her or his potential to disrupt the traditions of mapping and reclaim the power of maps and GIS-based spatial analysis for critical intervention.

Introduction

Ten years ago, the possibility of a feminist geographic information systems (GIS) research would have been at best too far looking and at worst entirely misplaced (cf. Hanson 2002; Kwan 2002a; McLafferty 2002). While both feminism and GIS had, by then, significantly altered the discipline of geography, there was little or no dialogue between them. Moreover, they seemed farthest apart relative to such important questions of knowledge production as scientific objectivity, the possibility of a disembodied subject, and the political neutrality of knowledge (e.g., Kwan 2002a,b; McLafferty 2002).

Today, feminist GIS remains an oxymoron for many and yet it is clearly visible in the intellectual landscape of geospatial technologies (e.g., Hanson

2002; Kwan 2002b; Sheppard 2005) and has been at the forefront of a critical engagement of social theory with GIS.¹ The intersection of feminism and GIS began with feminist critiques of knowledge production in science, geography, and cartography (e.g., Rose 1993) and, more recently, of information and communication technologies (e.g., Kwan 2002b; Pavlovskaya 2006). Furthermore, feminism and GIS have intersected not only within the discipline of geography but in other locations as well, such as the humanities, commercial GIS settings, and feminist art. In all locations, feminism has radically transformed the mapping/knowning subject. Cartographers, practitioners of GIS, and the readers of their maps are no longer scripted into singular and masculinist subject positions.

The traditional mapping subject, dominant until recently, is a scientist, cartographer, or GIS expert, a 'disembodied' and, likely, male researcher or professional, in pursuit of objective knowledge, the discovery of the truth, and its accurate graphic representation (e.g., see the now classic 'the nature of maps' by Robinson and Petchenik 1976). Despite the quest for objectivity, the practices and products of this mapping subject have been infused with masculinist privilege (c.f. Rose 1992). What are most often mapped are worlds devoid of women's experiences produced from within professions that are dominated by men. Today, we argue, an embodied feminist mapping subject is emerging that disrupts the privileged positions and products of cartography and GIS. We think of this emerging subject as a manifestation of Donna Haraway's (1991a) mythical cyborg that is a product of the new social relations forming around science and technology but that simultaneously challenges Western cultural dualisms linked to domination along lines of gender, race, class, and sexuality. Not tied to traditional gender identities, with a boundary between a human and a machine blurred, the cyborg Haraway hopes would aspire to 'both building and destroying machines, identities, categories, relationships, [and] space stories' (181) in order to counter the emerging 'informatics of domination' grounded in new high-tech culture.

While the feminist mapping subject is emerging across a variety of sites – academic, professional, and lay – it is most articulated in the work of critical GIS scholars. Both male and female, they are committed to non-positivist practices of knowledge production and are sensitive to gender and other power hierarchies that produce social, economic, and cultural difference. These scholars have been creating 'feminist cartographies', practicing 'feminist visualization', and developing new mapping alternatives to mainstream cartographic and GIS representations. This ongoing feminist transformation of mapping and GIS parallels the relatively recent re-articulation of quantitative methods by feminist geographers (see Mattingly and Falconer Al-Hindi 1995).² Both quantitative analysis and geospatial technologies are among the tools that feminist scholars, inspired by Haraway's cyborg, are using to re-write the world in nonexploitive terms. Although not reviewed here, the expanding field of public participation GIS

represents another site where GIS is being re-thought. Public participation GIS is emerging as a set of anticorporatist, postcolonial, and community based GIS practices that align with a feminist GIS (see Craig et al. 2002; Elwood 2006).

We begin in the following section by briefly re-reading the history of women in cartography and GIS as a first step toward reclaiming mapping as a critical practice. We then review feminist theorizations of visual representation and geography that move beyond critique and posit a feminist deployment of such technologies. Finally, we reflect on explicitly feminist engagements with cartography and GIS and their implication for the discipline of geography and contemporary mapping practices in general. Throughout, we trace the evolution of a feminist mapping subject and her or his potential to disrupt the traditions of mapping and reclaim the power of maps and GIS-based spatial analysis for critical intervention.

Women in Cartography and GIS: From Absence to Presence

One goal of the feminist project is to eliminate socially constructed gender inequalities, including those that limit access to specific types of knowledge and work. Therefore, we begin the story of feminist GIS not where feminism has influenced geography philosophically and epistemologically but, as a strategy to reclaim a practice and past devoid of women, where there is evidence of women's engagement with cartography and GIS historically. As with other knowledge production professions, the history of cartography and/or GIS is written as one of men, their innovations, and their advancing of science (cf. Domosh 1997). Few histories point to the presence of women as either subjects or objects of mapping technologies. To find women engaged in cartography and GIS professions, we would commonly look to the last quarter of the 20th century when second wave feminism successfully challenged a variety of male-dominated fields of employment, especially in North America. Indeed, at that time, cartography and then GIS did see increased numbers of female specialists, albeit still clearly a minority within these fields (Kwan 2002a; McLafferty 2005; Schuurman 2002; Van den Hoonaard 2000).

Recent work in history of cartography, however, presents a far more complicated picture. Following the lead of a new historiography of geography (e.g., Barnes 2000; Driver 2001; Livingstone 1992) that focuses on context and the role of a variety of players in the social construction of knowledge, the beginning alternative history of cartography (see Hudson and Ritzlin 2000; cf. to that of geography Monk 1998) demonstrates that a history of cartography entirely devoid of women is not accurate. It is certainly true that cartographic knowledge and map authoring per se were closed to women who were excluded from technical education (cf. Monk 1998 on women in geography). But women were, nevertheless, involved in modern map production and map printing and were central to the

distribution and interpretation of map products especially as educators throughout the 19th and much of the 20th century (Hudson and Ritzlin 2000).³ In addition, women have historically been prolific and popular travel writers who may have not have authored maps but clearly influenced the geographic imaginations of generations of women and men (e.g., Blunt 1994; Domosh 1997). Finally, women have long been shadow partners in or inheritors of their fathers' or husbands' cartography-related businesses (Hudson and Ritzlin 2000). In other words, unable to openly author maps, women nevertheless have actively participated in other aspects of cartographic production, map interpretation, and the development of geographic imaginations.

Reclaiming the past as a site of women's engagement with mapping technologies works to open contemporary geospatial technologies to the presence of women and women's agency. Such openings are desperately needed given the continued dominance of men in GIS and related fields. The private industry, too, is heavily male-dominated, especially among the top management, software programmers and application designers, and consultants (Kwan 2002a; Van den Hoonaard 2000). Those few women employed at this level feel like strangers in an often hostile territory (Van den Hoonaard 2000). While there are few women amongst the 'founding fathers' of GIS or GIS corporate executives, their numbers are increasing and at other levels and locations within the field they may even dominate. For example, creating and correcting digital spatial information is now largely a commercial and international practice that often relies upon women's labor and technical skills. Interpreting remotely sensed imagery, digitizing paper maps, and querying unwieldy government datasets represents much of what geotechnology corporations do and is essential to the consumption of spatial information by GIS users, as well as corporate profits. Women constitute an important part of this global spatial information industry and, in some countries such as Russia, GIS technicians who digitize maps and provide quality control are predominately women. While these jobs have lower ranks in the GIS hierarchy (despite the required technical expertise), the presence of women is undeniable. Women's presence and agency is also emerging within academia where several women are now established GIS academics; their presence and intellectual contribution continue to encourage women's entry into the profession. Although progress has been made, particularly in terms of the numbers of women choosing to study GIS at an undergraduate level, women are still under-represented amongst university GIS professors and especially those in senior ranks (Kwan 2002a; Schuurman 2002). The gender bias of the field is reversing but only slowly as has been the case for several decades now in geography as well (Lee 1990; Smith 1992).

While we have only sketched the many ways that women were and are present in map making, essential to the growth of digital geospatial

information, and increasingly influential within an academic GIS, acknowledging such a presence is the first step toward reclaiming a feminist mapping subject and re-reading contemporary GIS as a feminist practice. Such a feminist historiography both supports and emerges from the transformative impact of feminist scholarship in/on geography, cartography, and GIS-based research generally. This profound rethinking of knowledge production practices began with feminist critiques of science and vision that we will now briefly address.

Feminist Critique of Science, Vision, Cartography, and GIS

Documented scientific observation, the dominant strategy by which evidence is gathered and results verified, originates precisely in the trust invested in what we see (as opposed to hear or smell or feel); vision underpins the very fundamental practices of Western science (Sui 2000). Reliance on vision and observation demands that a distance be maintained between the observer and the observed, between the subject and the object. The observer is sufficiently removed to not only see a full picture but to position himself as uninvolved with that which is being observed. The objective knowledge thus produced unambiguously reflects the world, it is an unbiased mirror carefully crafted by the detached, neutral, and value-free scholar.

Critics of science counter this contention on the basis that science is a social practice developed and maintained within particular social contexts. Objective knowledge and unbiased truth are impossible because scientific practices necessarily embed social, economic, and cultural contradictions and their outcomes; moreover, they serve those in power and support the status quo. For example, in his analyses of the linkages between knowledge and power in Western societies, Michel Foucault (1979, 1980) has emphasized the centrality of vision in creating authority and maintaining discipline and order, such as in punitive institutions. Edward Said (1978) has showed how a colonial gaze perpetuates colonial institutions and practices even after the colonial system itself has disintegrated. Michel de Certeau (1984) conveyed the sense of mastery that an observer derives from visually examining the landscape from commanding heights. Critical cultural geographers also linked representations of landscapes (e.g., in European painting) to class power and the ability of privileged classes to master such landscapes (Cosgrove 1984; Cosgrove and Daniels 1988). Radical critiques of science by feminist scholars such as Donna Haraway (1989, 1991b) and Sandra Harding (1986), however, have specifically linked the authority of vision and the practices of looking to the patriarchal nature of Western societies (also see Deutsche 1991). In their opinion, a masculinist bias of science originated from the exclusion of women and the privileging of sight and vision that give power and sexual pleasure to the male Western observer.

Donna Haraway (1991b) has shown that scientific claims to objectivity reside on the authority of the so-called disembodied scientist. Such a scientist looks/observes from 'nowhere' (a value-free and neutral location) and produces unbiased knowledge about the world. That illusion of looking from nowhere – in Haraway's words, a 'god-trick' – has been fortified by a variety of visual technologies that range from microscopes to remote sensing (cf. Pickles 2004 on visual mapping god-trick). These devices, however, only further obscure questions concerning who has the authority to look and from where. In other words, scientific truth has been intricately linked to power and the location (e.g., social, economic, or cultural origin) of the observer (cf. Barnes 2000; Livingstone 1992 on locations of science). And because power in Western societies has resided with well off heterosexual white men, modern science is essentially their vision of the world disguised as universal and objective. The claimed ability of Western science to produce objective and universal knowledge serves another purpose as well. Simultaneously, it helps to define other subjects and ways of knowing as nonobjective, irrational, and partial. Clearly, women and colonial subjects, for example, as well as disabled people, the elderly, the children, sexual minorities, and so on, all inhabit the ranks of those who do not have the power to look. As a result, they – the embodied and situated subjects – cannot make claims to truth, authority, and power.

In addition, feminists have shown how science is infused with meanings of masculinity and femininity (see Haraway 1989, 1991b; Merchant 1990). Despite its history of excluding of women and overwriting gendered experiences, as any other social practice, science is shaped by Western culture and this culture consistently identifies nature, the primary object of science, and the unknown in nature with the feminine. While similar associations are part of other cultures as well, in the West both nature and women are constructed as disempowered and/or threatening. The resultant binary of men/women aligns with other binary constructs such as science/nature, masculine/feminine, subject/object, rational knower/irrational unknown. The first term in each binary is dominant, while the second is subordinate; taken together, these aligned binaries work to elevate the authority of the male scientist empowered to discover and inscribe a feminine nature and to exclude those subjects that do not possess the authority of the 'objective scientist' (Table 1).

To counter the hegemonic authority of science and its ability to subordinate, feminists rely upon an alternative epistemology of science. Haraway's (1991b) concept of 'situated knowledges' posits that all knowledge comes from a particular location and cannot claim to be objective truth. This partiality of knowledge does not mean that it has no purpose and is useless. Rather, situated knowledges diversify and enrich our understanding of the world by engaging into dialogue with each other. For such dialogue to have meaning, however, the location of the knowing

Table 1. Dichotomies in Western culture.

Culture	Nature
Scientific	Nonscientific
Rationality	Irrationality
Known	Unknown
Masculine	Feminine
Male	Female
Looking	Listening
Active	Passive
Subject	Object
Empowered	Disempowered
Objective	Subjective
Reason	Feeling
Knowledge	Experience

subject should be made clear. Becoming an 'embodied' subject (e.g., the Third World woman, African American man, white middle-class woman, or Hispanic gay scholar) not only reveals the origins of the truth but also makes its author responsible for what it says and its effects on the world. The knowing subject can no longer escape responsibility as nobody looking from nowhere. The disembodied scientist no longer exists.

The feminist critique of the role of vision and its relationship to authority in the Western scientific tradition is clearly relevant to geography insofar as geography has relied not only upon a traditional science model but upon sight as a way of knowing and the production of images (i.e. maps and related geotechnology products) as its primary way to represent places. In other words, geography is fundamentally a visual discipline (Rose 2003) and, following Haraway, a masculinist practice (Rose 1992). Gillian Rose (1992, see also 1993) has argued that the geographic tradition of analyzing landscapes, for example, involves not just an objective recording/mapping but a pleasure in viewing, a pleasure that is not simply aesthetic but also sexual. As nature is associated with the feminine, examining its landscapes is analogous to viewing the female body. Given the patriarchal scripting of Western society, the viewer experiences sexual pleasure that is also premised on possession and control of the unknown and irrational other. Women and images of nature are, however, contradictorily inscribed as simultaneously something to be adored and to be feared, as nurturing and threatening, and as passive and mysteriously dangerous. Rose points to geography's long history of exploration where the geographer, typically a man, discovers unknown and uncontrolled nature to become a conquering hero, a rational knowing subject, an excited lover, and a benevolent master. These unresolved contradictions both attracted the geographer to its object of study and demanded cautious separation. Such an ambiguity expressed itself in the need to maintain

distance between the subject and the object of research. The job of the geographer was to go and observe, describe, and map feminized landscapes. According to Rose, this particular and ambiguous linkage of geographical inquiry to visual inspection of landscapes – whether pristine or urban – defined the masculinist nature of modern scientific geography.

In step with feminist critiques of science and geography, poststructural and postcolonial authors also contend that knowledge is situated and implicated in the production of social power. They too emphasize the role of vision in producing scientific authority but add to this a sense of mastery over the world that is, perhaps, most clear in colonial era world maps where Europe is depicted as the source of a global enlightenment and a global domination (Edney 1999). Drawing on the work of Foucault and Derrida, Harley (1988) and others have examined the role of cartography in supporting colonial practices and the constitution of an imperial imagination. They deconstruct maps as objective mirrors and reveal how they are instruments of Western power. This new history of cartography, re-reads maps and their contexts relative to whose interests they serve (e.g., Edney 1997; Godlewska and Smith 1994; Rundstrom 1995; Sparke 1998). The evolving field of ‘critical cartography’ (see Crampton and Krygier 2006) examines the emancipatory and subversive effects of mapping practices (including digital mapping with GIS) that are emerging outside of the cartography traditionally controlled by the state and corporate interests.⁴

Feminist geographers, however, point to the fact that the colonial gaze was also masculinist and, therefore, supported the imperial quest to discover, analyze, conquer, civilize, and control new territories and peoples. The imperial imagination feminizes colonized lands and enables colonial masters to treat both the land and its women – and by extension entire nations – as legitimate colonial subjects unable to rule themselves (Blunt and Rose 1994; also Nash 1994). Interestingly, cartography has played a crucial role in supporting colonial ambitions by mapping colonized lands and their inhabitants and, therefore, imposing a rational order on previously unknown and dangerous worlds. Nash (1994), for example, has shown how the mapping and subsequent colonization of Ireland by the British necessitated the association of the subjugated lands with the female body.

The advent of GIS in the 1990s, with its extreme visual power, enhanced further the authority and rhetorical power of maps. This power was also magnified by the assumed association of GIS with quantitative analysis and, by extension, science (Pavlovskaya 2006). In addition, the expansion of GIS was propelled by its association with information technologies that acquired a powerful status in the West generally. And, on the top of this, GIS is a clearly male-dominated technical field. Not surprisingly, GIS and geospatial technologies have been criticized for being masculinist and supporting structures of power, surveillance practices, and militarism (Armstrong and Ruggles 2005; Dobson and Fisher 2003;

Pickles 1995; Roberts and Schein 1995; Smith 1992). Associated with a technocratic and sterile spatial science tradition, GIS was blamed for elevating a Cartesian conceptualization of space (Bondi and Domosh 1992) that fails to represent space in terms of relations, networks, connections, emotions, and other nonstandard patterns or movements that characterize women's life-worlds (Kwan 2002b). In addition, because of its reliance on maps and remotely sensed images, GIS, it was claimed, could not capture scales of human activities at which gendered patterns manifest themselves (e.g., subsistence farming, see Rocheleau 1995; see Kwan 2002a for overview).

Another interesting strand of feminist critique focused on geographic visualities within academia itself. Visuality studies look at how images (and maps) are employed by different actors such as people, institutions, and artists. Rose (2003) found that the way the geographers deliver their knowledge asserts the particular relationship between the researcher and the place or object of research, the relationship in which the geographer is able to speak from the position of authority and power and claim knowing the truth about his research object. Rose examines a slide show, a very common way today to present research results, to conclude that it is the moment of eye witnessing that consolidates truth claims by establishing the authority of the visual observation. We believe that a similar argument can be made about the rhetorical power of cartography and especially of GIS (Pavlovskaya 2006). Maps deliver knowledge as scientific and based on data that is amplified by the glow of computer screen and the power and charisma of digital and information technologies. In that sense, GIS presents knowledge and imposes it on the audience in a very authoritative and – as Rose would probably agree – masculinist way.

The above traces a feminist critique of and engagement with science and geography. It points to the feminist/poststructural break from traditional scientific and positivist ways of knowing. This epistemological break has produced a clear and consistent critique of the ways that knowledge, and geographic/cartographic knowledge in particular, are implicated in the production of power and maintenance of a gendered status quo in science and society. Yet, the 'epistemic break' (cf. Crampton 2001) does more than allow for a powerful critique, it opens science, geography, and cartography to the possibility of alternative ways of knowing, new relationships between experts and nonexperts as co-producers of knowledge (Pain 2004), and the production of multiple and diverse subjectivities where there existed only a single masculine knowing subject. Indeed, feminism and poststructuralism have led to productive redeployments of science and technology including those of visualization and, of interest here, have engendered the becoming of a feminist mapping subject. This movement conjures Haraway's cyborg that masters the tools that once served to construct power in order to deconstruct all possible foundations of such power.

Feminist Cartography and GIS: The Evolution of the Feminist Mapping Subject

Not only have feminist geographers exposed the masculinist foundations of geography, cartography, and GIS-based mapping but they also began to develop alternative mapping practices. The result was an emergence of feminist GIS and feminist cartographies that employ feminist visualities – ways of looking and seeing that are not masculinist. These practices are not meant to control or support systems of domination but to understand, they subvert rather than support the status quo. They also are aware about gender and other dimensions of power (e.g., class, race, heterosexuality) and advocate progressive politics that destabilize these power hierarchies. Finally, they are informed by a feminist rethinking of geographic methods and they generate new kinds of research. Through these practices, new feminist knowing subjects ask new research questions, including but not limited to gender, they employ diverse research methods, and they transform the relationship between the researched object and the knowing subject. In addition, owing to the recent ‘spatial turn’ in social sciences, humanities, and art, new work is emerging that actively employs mapping, digital spatial imagery, and spatial metaphors.

Having rejected the disembodied, possessive, disciplining, and mastering male gaze, feminist geographers have worked to create new ways of looking. This effort is particularly important for geography that has traditionally relied upon visual imagery as an epistemological foundation. Work by feminist geographers incorporates visual images (e.g., historical or contemporary maps, photographs, pictures) in powerful ways. Mona Domosh (1996) has used 19th-century photographs to document gendered urban spaces of New York and Boston; Gillian Rose (2004) has explored what she calls ‘emotional geographies’ by examining how family members view photographs (as opposed to the analysis of the photographs themselves); and Catherine Nash (1996) has analyzed work by several artists that destabilizes gender hierarchies by positioning the male body to be viewed as a landscape. In all cases, ‘looking’ is a means toward understanding or even pleasure that subverts rather than supports ‘looking’ as appropriation or domination. A self-reflexive rediscovery and appropriation of visual power for use with a variety of nonpositivist methodologies in geography is taking place (Crang 2003; Rose 2001; 2003).

MAPPING WOMEN’S WORLDS: BECOMING AN OBJECT OF RESEARCH

With this new power to look, feminist geographers began to analyze and map gendered spaces and spatial patterns. A large body of research already shows how significant these patterns are for the economy, society, and culture (this literature is vast but see, for example, Hanson and Pratt 1995; McDowell 1999). In other words, women became the object of geographic research. In many cases, geographers consciously and explicitly

turn to cartography and GIS to advance their argument. Joni Seager (2003), for example, employs cartographic methods and international statistics to transform the object analysis; in her work, visualization produces not an appropriation of nations populated by 'disembodied' individuals but an engagement and understanding of women's well-being in different parts of the world. Her recently updated *The Penguin Atlas of Women in the World* (2003) presents unique country-level data on women's employment and the types of work they do, women's health, maternity, political rights, migration, childcare, sex trade, etc. This atlas powerfully unveils the realities of women worlds usually hidden behind average statistics that apply to entire populations (see Figure 1 as an example). Mona Domosh and Joni Seager (2001) have also used many images and maps to 'make sense of the world' by analyzing the place of women in it. They included data and maps on, for example, domestic servants and the sex trade – two aspects of the global economy that specifically rely on exploitation of women bodies.

As gender has become an analytical category that can no longer be ignored, mainstream researchers in human geography and other social sciences, turn their eye to analysis of gendered spaces, often assisted today by GIS-based analysis and mapping. For example, researchers have analyzed HIV risks among rural pregnant women in Africa in relation to distance to road networks (Tanser et al. 2000), and they have examined the negative impacts of the World Trade Center disaster on birthweight depending upon distance from the site (Lederman et al. 2004). In addition, following now classic research by feminist geographers (e.g., Hanson and Pratt 1995; McLafferty and Preston 1991), a large body of work addresses the spatial aspects of gender inequality that results from access to employment, commuting, and childcare availability. For example, Van Ham and Mulder (2005) have recently analyzed childcare availability in the Netherlands in relation to women's employment opportunities. These researchers collected data, designed indicators, visualized, and analyzed the distribution of daycare slots within the entire country using GIS (Figure 2). Their analysis of local labor markets found that in areas where the number of slots per 100 children is higher, women are more likely to be employed.

The effects of GIS and information technologies on women's everyday lives have become another research focus. The emerging picture is complex: GIS can empower women and give them more control over their environment but it can also work to exclude women who do not have access to GIS technologies and increase their surveillance. For example, access to information technologies such as the Internet and GIS fundamentally transforms women's lives by opening employment opportunities in the global information economy and reducing time spent on many household chores (e.g., shopping). Yet, Gilbert and Mascucci (2004) find that women have less access than men and they demonstrate that the 'digital divide' has a gender dimension. Where women have access, how

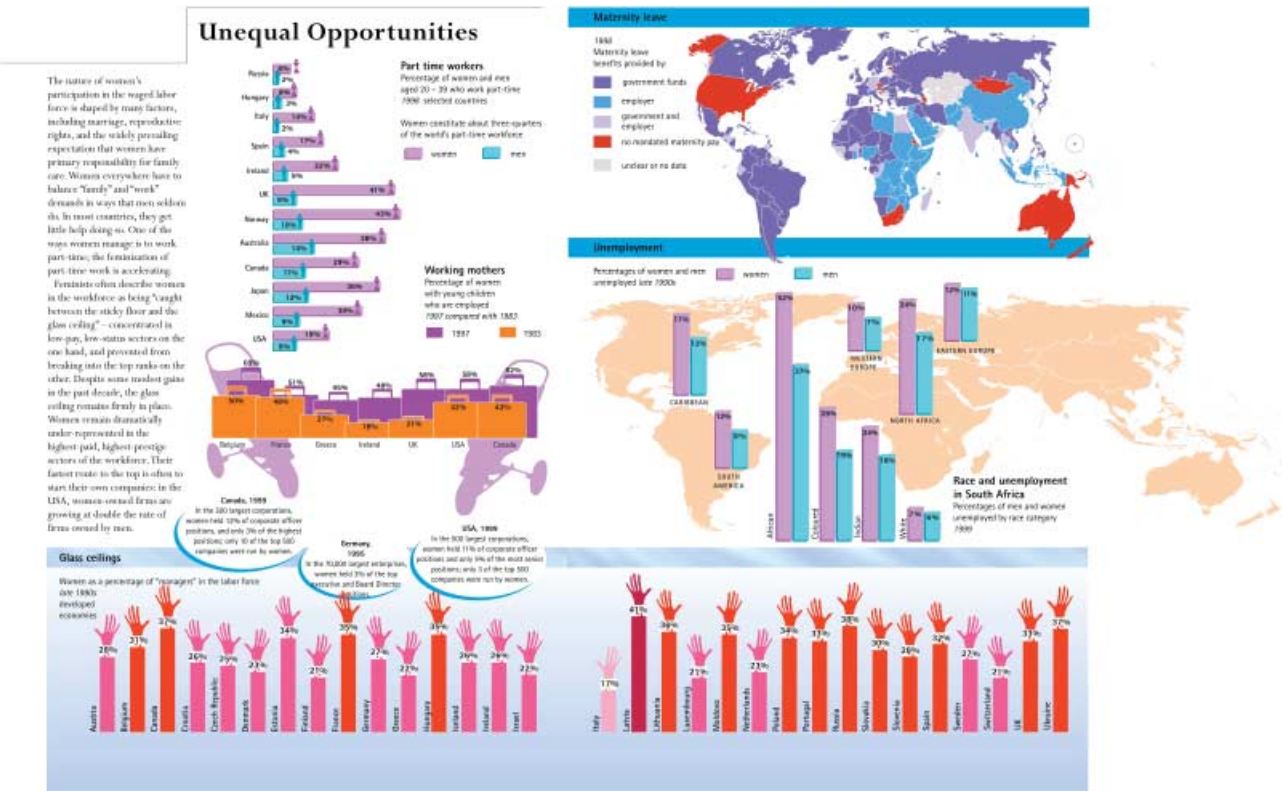


Fig. 1. Unequal opportunities. (Source: Myriad Editions 2003 From The Penguin Atlas of Women in the World by Joni Seager. www.MyriadEditions.com. Reprinted with permission)

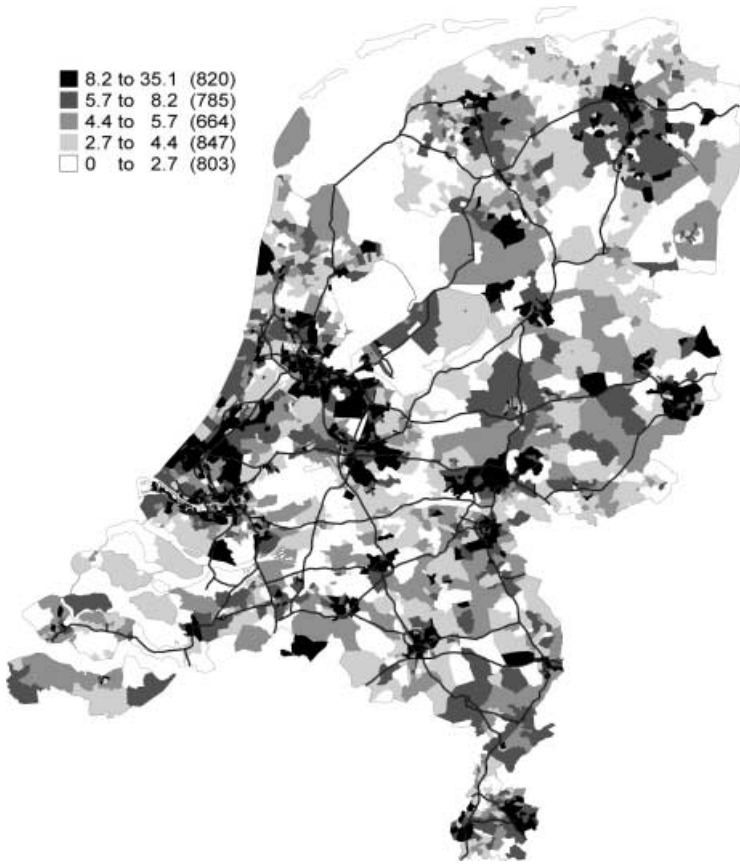


Fig. 2. Geographical access to childcare within 10 min (slots per 100 children). Calculations using data from Monitoring Agency Childcare Provision (NUK 2001). (Source: Van Ham and Mulder 2005. Reprinted with permission)

they use and are being used by the Internet is also gendered. For example, for many women the Internet is becoming a medium for performing a variety of domestic chores that both reduces time spent on these chores and reproduces gendered divisions of labor in the home (McLafferty 2005). Community services, such as bridal services and other network-based information exchanges that were once place-based, increasingly occur within the emerging virtual spaces of transnational communities (Adams and Ghose 2003). While women have seized the Internet to maintain community, they are also increasingly subject to a proliferation of location-based tracking devices that integrate their online and locationally identifiable lives into spatial databases for surveillance purposes; in this case, not only may this represent a threat to democracy but women (and

children) in particular may be negatively affected. Despite the capacity of the Internet and other geospatial and information technologies to liberate, we must be aware of their potential to work as a tool for patriarchal surveillance and control of women's bodies and movement in space (Armstrong and Ruggles 2005; Curry 1997; Dobson and Fisher 2003).

A FEMINIST MAPPING SUBJECT

The effect of feminism on geography and GIS is to not only produce gender as an object of analysis but to transform knowledge itself. This epistemological influence of feminism is very powerful although not always explicitly acknowledged. While making a unique contribution, feminism also complements and re-enforces the impact of other alternative epistemologies on mainstream (and positivist) science. These alternative traditions, with which feminism has interacted in complex, very fruitful but often contradictory ways, include critical theory, Marxism, poststructuralism, and anticolonial thought (e.g., Fraser and Nickolson 1990). As a result, feminism shares many concerns with these traditions and they themselves have been infused with feminism.

The work of the feminist knowing subject, therefore, extends beyond research restricted to gender issues but necessarily addresses power and social hierarchies. Committed to emancipation and progressive politics, the feminist subject questions the status quo, because social structures are historically contingent and socially constructed. Therefore, they may be changed to the better. This subject examines how different dimensions of power (e.g., patriarchy, class, and race) interact, re-enforce, and subvert each other. She or he uses an expanded range of methodologies that, apart of standard quantitative methods, include qualitative and other research techniques traditionally dismissed or ignored by science (Lawson 1995). Finally, feminist scholarship abandons the claim of knowledge to objectivity in favor of its partiality (see above on feminist critique of science). The research process becomes more reflexive and the relationship between the knowing subject (the researcher) and the object (the researched) is redefined. In this new relationship, the epistemological location of the researcher is explicitly recognized and participants in the research are seen as involved partners in knowledge production. They are no longer the distanced objects to be researched (Pain 2004).

FEMINIST GIS AND OTHER MAPPINGS INSPIRED BY FEMINISM

While women have long impacted the development of geospatial technologies, contemporary mainstream GIS remains male-dominated and masculinist and identifies (although with a few grounds) with quantitative and positivist traditions in geography (Pavlovskaya 2006). New, predominantly feminist, voices are, however, emerging that are redefining

rather than rejecting GIS (Schuurman and Pratt 2002); they 're-read' GIS as a tool suitable to nonpositivist analyses and thus counter the mainstream discourse of GIS that still defines it as quantitative, positivist, and a corporate technology (Kwan 2002b; Pavlovskaya 2006; Schuurman 2002; Sheppard 2005; St. Martin and Wing 2005). In addition to the spread of postpositivist scientific practices in geography noted above, important changes have occurred within the geospatial field per se that have enabled the new definitions and practices of GIS. The field has responded to social theoretical critiques and debates (see Schuurman 2000 for summaries) and has entered, what might be called, a postpositivist stage. Some of these changes include uncertainty modeling, the rise of the geovisualization, democratization of GIS, and the integration of multimedia technologies with GIS (Ahlqvist 2004; Crampton 2001; Kwan 2002b).

Geovisualization in GIS (MacEachren et al. 1999) signifies a departure from the traditional map communication model of cartography (e.g., Robinson and Petchenik 1976). This model presented cartography as the science of accurately representing to a passive map reader the products of geographic discovery or spatial analysis. Today, the visualization of spatial data within GIS environments is highly interactive and versatile, and the traditional model is being replaced such that visualization itself becomes a powerful tool of analysis rather than the presentation of its outcome. Visualization suggests not the communication of observed spatial patterns but a visual (and qualitative, intuitive) exploration and engagement with spatial information. The expansion and diversification of visualization techniques points to an emerging GIS that is compatible with feminist and other nonpositivist epistemologies (Kwan 2002b; Pavlovskaya 2002).

Geovisualization research coincides with advances in creating more friendly GIS interfaces and the expansion of interactive Internet-based and multimedia applications. If we take into account the explosion of digital and spatial information, much of which is available through the Internet, it becomes clear that GIS and spatial analysis are no longer accessible only to narrowly trained GIS experts or geographers working the spatial science tradition. Today, GIS is utilized by geographers representing a wide range of social theoretic perspectives (Sheppard 2005), by nongeographers within other social sciences and the humanities (e.g., Kidner et al. 2002), and a public that is increasingly engaged with mapping and spatial data analysis for community and grassroots initiatives (e.g., Craig et al. 2002). As a result, the meaning of GIS data and GIS analysis is dramatically changing.

While feminist GIS research informs and intersects with much of the above, it has developed in its own right beginning with an explicit combination of feminism with GIS. Focusing on feminist research issues such as gender, labor markets, and the everyday lives of women, feminist researchers sought innovative ways to use GIS. In this, they followed feminist geographers who earlier advocated using quantitative methods for

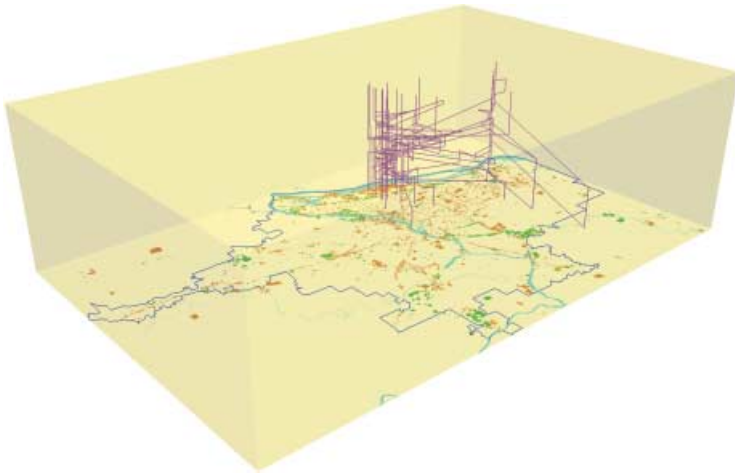


Fig. 3. The space-time paths of a sample of African American women in Portland, Oregon. (Source: Kwan 2002b. Reprinted with permission)

feminist research instead of discarding them as a positivist method (Hanson 2002; Lawson 1995; McLafferty 1995, 2002). Mei-Po Kwan (2002b), for example, argued that GIS is not inherently masculinist but its nature depends on its uses. Following Donna Haraway's call that feminists should use technologies creatively instead of discarding them, Kwan set the agenda for 'feminist visualization' in GIS (Kwan 2002b). In her research, she developed dedicated GIS-based algorithms to analyze and visualize gendered access to urban opportunities. Her powerful three-dimensional visualizations, inspired by the time-space geographies of Hagerstand, represent women's lived paths in urban space (Figure 3). To construct these visualizations, Kwan innovatively combined large commercial data-bases with data from the personal diaries of study participants. In other research, Kwan visualized how Muslim American women experience urban space (e.g., level of fear) after 9/11 using a three-dimensional simulation of movement enhanced by an audio narrative.

Marianna Pavlovskaya (2004) used GIS to visualize the multiple economies of households in Moscow before and after the Soviet collapse (Figures 4, 5, and 6). In her theoretical framework, multiple economies include gendered activities that are formal and informal, monetized and non-monetized, belong to state and private sectors, occur in the larger economies or within the home, and often are network-based. Many of these types of income earning and production of goods and services are invisible in official statistics but they underpin the daily lives of women and their households (e.g., housework, childcare at home, reliance on informal networks of support, etc.) and directly affect, for example, women's

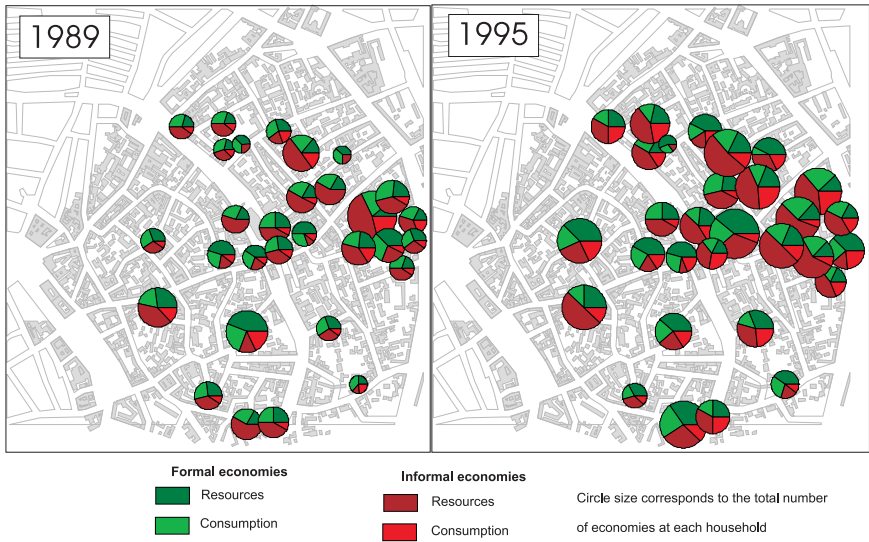


Fig. 4. Multiple economies and households, 1989–1995, downtown Moscow. (Source: Pavlovskaya 2004. Reprinted with permission)

performance in the labor market. Collecting this information through in-depth qualitative interviews and then visualizing the previously invisible landscape of undervalued economic practices makes the local and gendered experiences of economic transition real, significant, and important for research and policy (Pavlovskaya 2006).

Outside of academia, the feminist mapping subject emerged as well, often in conjunction with feminist-minded GIS academics. Sara McLafferty (2002) describes the case of community-based breast cancer research on Long Island. To better explain the high level of breast cancer in their communities, local activist women sought to refocus research from personal risk factors to environmental ones (e.g., water pollution) in order to draw the attention of the government to this issue. To do so, they created their own database of breast cancer occurrences that they first visualized using pin maps and then in a GIS in collaboration with the university scholars. The result of this effort was not only an increase in funding for such research but the transformation of local women from 'disembodied' objects of scientific analysis to active co-researchers and mapping subjects.

While focusing on the experiences of men, the 'Atlas project' incorporates a feminist epistemological position with GIS to advocate for community-based management of fisheries resources in New England. As an action-oriented participatory project (Pain 2004), community-based researchers (primarily women) interviewed local fishers (primarily men) in a variety of New England ports in order to map the presence and

Interviewed household locations in a study area in downtown Moscow

- Household types:
- ▲ Single-parent nuclear
 - ▲ Single-parent extended
 - Two-parent nuclear
 - Two-parent extended
- Daily network:
- Good
 - Fair
 - None
- Woman earns high income:
- Yes
 - No
 - Not employed

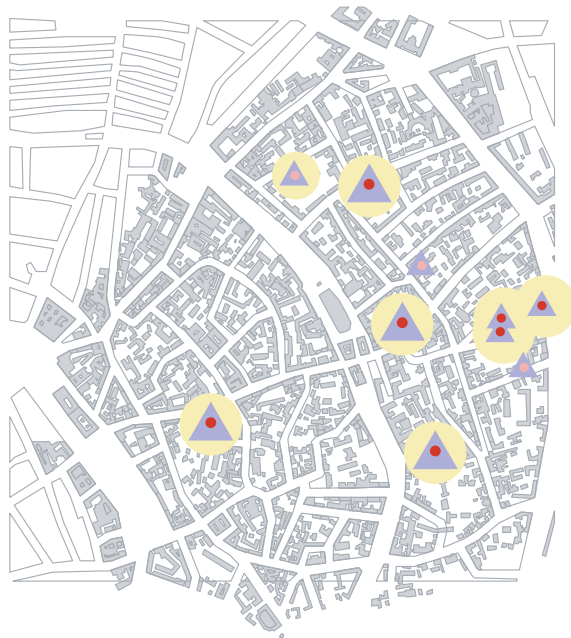


Fig. 5. Networks and female employment in single-parent households in Moscow in the 1990s. High income in households with daily networks.

territories of fishing communities at sea, as well as their local ecological knowledge of those locations (St. Martin and Hall-Arber 2006). The goal of the project was to counter the dominant form of science-based fisheries management that reduces fishing communities to individual competing men and the lived spaces of the ocean to an abstract statistical grid (St. Martin 2001, 2006). GIS generated maps depicting community territories were central to the project, they acted as a forum for the interviews and means by which individual fishers could reproject themselves as community members and fishing communities (represented by both the men and women involved) could reassert a presence within the marine environment. As in the previous example, participants not only remapped their environments, they reconstituted themselves as mapping subjects.

Finally, many observers have noted that the social sciences and humanities are increasingly using spatial and cartographic metaphors in addition to the actual use of geotechnologies. This is also the case for art that provides us with another example of the feminist mapping subject at work. Recently, a number of feminist artists have decidedly turned to cartography, GIS, and remote sensing and have made them important components of their art. For example, the artist Zarina (Samantrai 2004) employs cartographic metaphors and incorporates maps and map objects



Fig. 6. Networks and female employment in two-parent households in Moscow in the 1990s. Ability to earn income depends on daily networks.

into her work to render the experiences of people divided by borders and living in places ravaged by wars. Ursula Biemann (2002) includes remotely sensed images in her multimedia art projects to better visualize the international trafficking of women's bodies and children from Asia and Eastern Europe to Western Europe and the United States. In this way, she creates powerful visualizations of flows that constitute the global sex industry that is, according to the artist, a key component of global capitalism.

These selected examples demonstrate that feminist mapping subjects have expanded their transformative mappings of the world in many directions and that geospatial technologies play an increasingly important role in the rewriting of social realities via critical epistemologies including feminism.

Conclusion

As it stands today, GIS and related geospatial fields still lack female professionals and perpetuate a discourse of GIS that associates them with a masculinist positivist science and with corporate capitalism (St. Martin and Wing 2005). As such, GIS inscribes the everyday spaces and practices of women and men into hierarchies of power and domination. In addition, the digital divide continues to exclude the poor, women, minorities, and

the elderly from full access to digital information resources and technologies that provide this access (Gilbert and Masucci 2004).

And yet, GIS scholars and users, include growing numbers of women, have started to reclaim – along with other feminist and feminist-minded geographers – both practices of mapping and GIS technology (Schoorman 2002; Kwan 2002a; McLafferty 2005; Pavlovskaya 2002, 2006). Women and their experiences have become objects of geographic analysis and mapping while geographers (both women and men) have begun to engage into research that not only analyzes gendered experiences but also is informed by feminist scholarship.

We called this process the evolution of the feminist mapping subject and traced its development using the examples above. These examples show that GIS indeed can enable and has already enabled new – nonpositivist and nonhierarchical – mappings both inside and outside academia. New cartographies are being charted, today mainly digital and even more powerful so. It is as important as ever that feminist scholarship continues to transform the world through our always evolving mapping practices.

Short Biographies

Marianna Pavlovskaya has a MA in geography from Moscow State University and a PhD in geography from Clark University. Her research focuses on the constitution of class and gender in post-socialist Moscow and New York City, rethinking neo-liberal transition in Russia, and critically re-reading geo-spatial technologies.

Kevin St. Martin has a MA in geography from the University of Massachusetts, Amherst and a PhD in geography from Clark University. He is interested in critical analyses of economic and resource management discourses. His current research focuses on the discourse and practice of fisheries science and its implications for both resource management and community-based economic development. His interest in GIS has led to an examination of the use of GIS in participatory scientific and resource management initiatives.

Notes

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¹ See the special issues of *Gender Place and Culture on GIS and Feminism* (2002, 9 (3)), *Cartographica on Critical GIS* (2005, 40 (4)), *ACME on Critical Cartographies* (2006, 4 (1)), as well as related work that dominates alternative and critical readings of GIS.

² See also the entire special issue on feminism and quantitative methods in *The Professional Geographer* (1995, 47 (4)).

³ Hudson and Ritslin (2000) have started a master list of women who made an especially important contribution to North American cartography and so far this list includes over 300 names!

⁴ See also the special issue of *ACME* (2005, 4 (1)) on critical cartographies.

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