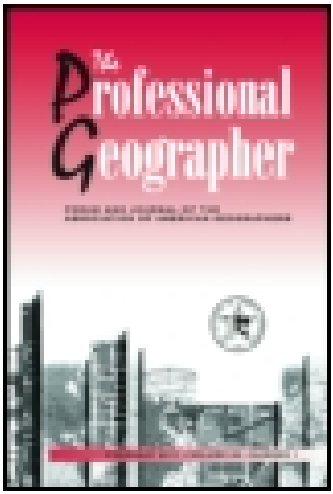

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Quantitative Revolution 2: The Critical (Re)Turn

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FOCUS SECTION:
CRITICAL QUANTITATIVE GEOGRAPHIES 1: BEYOND THE CRITICAL/ANALYTICAL BINARY

Quantitative Revolution 2: The Critical (Re)Turn

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Although many have questioned the adequacy of quantitative methods for addressing issues of concern in critical geographies, such as social justice and inequality, many have argued that quantification can potentially make rich contributions to understanding and addressing these issues. In light of the recent attempts to reassert the critical potential and positive role of quantitative geography, we suggest in this introductory article for the Focus Section that the antagonism between critical and quantitative geographies is not beneficial to the discipline. We highlight some promising developments in modern quantitative geography and reflect on the ways in which the critical–quantitative binary can be at least partially eclipsed. We emphasize that knowledge in quantitative methods is essential for deciphering and challenging regressive political agendas, now often supported by numbers and quantitative analysis. Quantitative geography, when integrated with a critical sensibility and used appropriately, can be a powerful tool for fostering progressive social and political change. **Key Words: critical geographies, the critical turn, quantitative geography, quantitative revolution.**

虽然很多人质疑在批判地理学中是否有足够的定量方法来处理所关心的问题，例如社会正义和不平等现象，但是有许多人争辩，量化分析对理解和解决这些问题有可能作出丰富贡献。鉴于目前试图重新评估定量地理的批判潜力和积极作用的趋势，在这篇关于专题组的介绍性文章里，我们认为批判地理和定量地理之间的对立对学科本身是不利的。我们重点介绍了一些现代定量地理学中有前景的发展，以及它们的间接影响：批判地理学和定量地理学的二分界限至少部分地失色。我们强调：对定量方法中的理解是破译和挑战回归政治议程的重要因素，现在这种分析往往依赖数字和定量方法。定量地理学，如果与一个敏锐的批判相结合并且得以适当的应用，可以是促进社会和政治变革的一个强有力工具。**关键词：批判地理学，批判转折，定量地理，定量革命。**

Aunque muchos cuestionan la conveniencia de utilizar métodos cuantitativos para enfrentar problemas que interesan a las geografías críticas, tales como justicia social y desigualdad, otros arguyen que potencialmente la cuantificación puede hacer valiosas contribuciones para entender y abocar esos asuntos. A la luz de intentos recientes que reafirman el potencial crítico y papel positivo de la geografía cuantitativista contemporánea, en este artículo introductorio para la Sección Focal se sugiere que el antagonismo entre las geografías críticas y la cuantitativista no es benéfico para la disciplina. Al respecto, destacamos algunos desarrollos promisorios de la geografía cuantitativista contemporánea, y reflexionamos sobre la manera como el binario crítica–cuantitativa podría romperse, por lo menos en parte. Destacamos que el conocimiento de métodos cuantitativos es esencial para descifrar y retar agendas políticas regresivas, que ahora con frecuencia se apoyan en números y análisis cuantitativos. Cuando a la geografía cuantitativista se la integra con sensibilidad crítica, y se utiliza con propiedad, puede convertirse en una herramienta poderosa que coadyuve al cambio social y político progresista. **Palabras clave: geografías críticas, giro crítico, geografía cuantitativista, revolución cuantitativa.**

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Quantitative geography emerged as a new practice in geography in the 1950s and 1960s through a movement now commonly referred to as the quantitative revolution, which sought to transform the discipline into a scientific pursuit through quantitative methods and, for certain practitioners, positivist logic.[1] Since the early 1970s, however, relevance and epistemological premises of quantitative geography have been challenged through several rounds of critiques by critical geographers, especially humanist, Marxist, feminist, poststructuralist, postcolonial, antiracist, and queer geographers. As critical perspectives and qualitative approaches have become widely adopted in contemporary geography, the use of quantitative approaches to address a progressive research agenda is often treated with suspicion or even contempt by many in the current intellectual milieu of the discipline (Brown 2007). Adding to the disdain for quantitative geography is the patent decline in interest in quantitative methods among geography students in the last two decades or so. As Fotheringham, Brunsdon, and Charlton (2000, 1) suggest, "quantitative geography generally experienced a 'downturn' in its popularity between the early 1980s and the mid-1990s." It is perhaps not an exaggeration to say that many geographers now believe that the quantitative revolution is long over and quantitative geography is in a moribund state (Plummer 2007).

Yet, despite the seemingly widespread antipathy against quantitative geography, it remains quite active in several geography subfields, especially transport, economic, and urban geography. Indeed quantitative work is regularly published in general and specialty journals in geography, including *Annals of the Association of American Geographers*, *Geographical Analysis*, *Environment and Planning A*, *The Professional Geographer*, *Journal of Geographical Systems*, *Urban Geography*, and many others (cf. Goetz, Vowles, and Tierney this issue). Although quantitative geography might be generally "perceived as a relatively static research area," it is actually "a vibrant, intellectually exciting, area in which many new developments are taking place" (Fotheringham, Brunsdon, and Charlton 2000, 3; see also Clark 2008; Golledge 2008). In fact, quantitative geography itself has undergone profound changes in the past two decades or so. It now aligns more closely with certain premises of critical geographies than the kind of quantitative geography conceived during the quantitative revolution—for instance, its emphasis on local context and local relationships instead of global generalizations about spatial processes, its increased sensitivity to multiple axes of difference (e.g., gender, race, ethnicity, sexuality, and age), and its attention to processes through which individual spatial knowledge is constituted and shapes spatial behavior (Kwan and Weber 2003; Poon 2003; Fotheringham 2006). Further, quantitative geographic research informed by critical perspectives has been and still is an active area of research in transport, economic, and urban geography (e.g., McLafferty and Preston 1997; Wyly 1998; Rigby and Essletzbichler 1997; Plummer and Taylor 2001; Schwanen, Kwan, and Ren 2008; Bergmann, Sheppard, and Plummer 2009; Ren and Kwan forthcoming).

Although many have questioned the adequacy of quantitative methods for addressing issues of concern in critical geographies, such as social justice and inequality, many have argued that quantification can potentially make rich contributions to understanding and addressing these issues (e.g., McLafferty 1995; Moss 1995; Plummer and Sheppard 2001; Sheppard 2001; Kwan 2004). Quantitative and critical geographies are not necessarily incompatible and should not be considered inherently antagonistic. In light of the recent attempts to reassert the critical potential and positive role of quantitative geography, we suggest in this introductory article that the persisting antagonism between critical and quantitative geographies is not beneficial to the discipline. We highlight some promising developments in modern quantitative geography and reflect on the ways in which the critical–quantitative binary can be at least partially eclipsed. We emphasize that knowledge in quantitative methods is essential for deciphering and challenging regressive political agendas, now often supported by numbers and quantitative analysis. Quantitative geography, when integrated with a critical sensibility and used appropriately, can be a powerful tool for fostering progressive social and political change.

Quantitative Geography and Its Critiques

Quantitative geography was originally developed to make geography a scientific discipline not unlike physics, where validity of the knowledge generated was justified according to positivist principles (at least for certain practitioners).[2] Part of this development was associated with what was called social physics, which drew directly on theories in physics to derive mathematical relations for analyzing human socio-spatial interaction. When positivist epistemology was adopted, the purpose of geographic research was to seek universally applicable generalizations. The researcher was considered a detached observer capable of acquiring objective knowledge of the world through discovering empirical regularity in social, economic, or spatial phenomena.

As critical geographers began to question the relevance and value of spatial science in the early 1970s, quantitative geography was criticized as positivist and empiricist because it was based on the principles of scientific objectivity, value neutrality, and the search for universally applicable generalizations. Although some of the early quantitative work illuminated certain aspects of social inequalities such as housing and crime, these studies tended to be considered empiricist as they privileged claims to knowledge based primarily on observable "facts." Feminist geographers have further argued that "truths" often put forward as universally applicable were valid only for men of a particular culture, class, or race (Women and Geography Study Group [WGSG] 1997). They are also critical of the tendency to draw conclusions based on the principle of universal causality from inferential statistics.

Quantitative methods were also criticized for other reasons. For instance, because quantitative methods depend on some quantifiable attributes of the phenomena under study, they are not capable of representing complex human experiences and social realities. This is a serious limitation, as a substantial portion of people's experiences cannot be expressed through numbers and is therefore not quantifiable. Further, the live connections with research participants are often lost through the use of quantitative data, making it difficult to convey a sense of people's feelings and their interactions with others (McLafferty 1995). This, in turn, makes it difficult to obtain a contextualized and holistic understanding of the complex processes involved in their everyday experiences. Quantitative data and methods are therefore "disembodied," as abstracted and decontextualized information is used in the process (WGSG 1997). Feminist geographers have also argued that these methods make the identity and masculinist biases of the researcher invisible, thus obfuscating his or her positionality relative to the research and those being studied.

Quantitative geography was criticized for assigning any specific individual's experience into hard-and-fast categories in the collection and analysis of quantitative data, whether these categories are predefined by the researcher or according to official criteria (Jayaratne and Stewart 1991). The rigid nature of the categories and variables used not only imposes a structure that hinders our understanding of socio-spatial processes, but it also fails to reflect the complexities of people's lived experiences. Very different phenomena can be lumped together in the statistics as if they were the same thing, and the statistics might have a problematic connection with the life they claim to represent (Pugh 1990). Further, because preexisting categories and official statistics are often based on the lives of men and other dominant group(s) in society, using them without extreme caution in geographic research can be problematic. They might actually make it more difficult, if not impossible, to reveal the processes underlying the inequality that women and other marginalized groups experience (e.g., Perrons 1999). For instance, official statistics are often found to be unreliable and even useless for studying women's labor force participation or contribution to the economy, because many forms of women's unpaid work are omitted in official definitions of work (Samarasinghe 1997). Another example is Pugh's (1990, 107) study on homelessness, where she concluded that "life will always be more complex and ambiguous than any possible usable system of coding and classification." Further, using predetermined categories makes it difficult for research to be open to change or surprise during the research process. This in turn means that it becomes more difficult for the researcher to be responsive to the input or

influence of respondents in the research design and process, seriously limiting the practice of the researcher's reflexivity.

Beyond the Critical–Quantitative Binary

In light of these criticisms, it is fair to say that quantitative methods have some serious limitations when applied to the study of certain kinds of phenomena—for example, when the purpose is to uncover the complex and nuanced gendered, racialized, or sexualized experiences of individuals or the socio-spatial construction of identities. It does not necessarily imply, however, that quantitative geography cannot make important contributions to critical geographies. The difficulty in reconnecting the critical and the quantitative, however, has been in part due to the real or imagined existence of the kind of quantitative geography developed and practiced in the 1950s and 1960s in contemporary geographic research. Certain geography subfields, such as transport geography, are historically more quantitative than others due to the influence of allied fields such as civil engineering and neoclassical economics (Goetz, Vowles, and Tierney this issue). Although many quantitative geographers are critically inspired, with primary research interests on significant social issues such as racial segregation, income inequalities, and health disparities, some critics tend to understand quantitative geography in terms of the most abstract kind of mathematical theorization.

Another reason for the difficulty in reconciling the critical and the quantitative apparently stemmed from the identity politics in geography, in which contentions between critical–qualitative and spatial–analytical perspectives over several decades have reinforced and rigidified the critical–quantitative antagonism in geography (Kwan 2004; Barnes this issue). Consequently, many in the discipline tend to perceive or represent the two approaches as irreconcilable spheres of geographic research in spite of recent attempts to bring critical and quantitative geographies together.

Further, despite considerable progress in quantitative geography that has helped to bring the two closer, the image of "bone-headed number crunching" seems to linger on in the minds of many critics (Ellis this issue). Recent developments in quantitative geography, however, have addressed certain limitations of conventional quantitative approaches, the primary objective of which was often taken to be the establishment of law-like generalizations (Fotheringham 2006). The application of local forms of spatial analysis (e.g., local statistics and geographically weighted regression) and multilevel modeling, for instance, has facilitated the analysis of the relationship between local context and people's everyday life (e.g., Jones 1991; Anselin 1995; Fotheringham, Brunsdon, and Charlton 2002; Weber and Kwan 2003; Lloyd 2007; Kwan and Weber 2008; Zolnik this issue). Instead of making sweeping generalizations of an entire study area or population, these methods were developed to reveal the effect of local context on social processes and their spatial outcomes. Recent developments and applications of complexity theory, agent-based modeling, evolutionary and non-equilibrium-based models, Bayesian statistical inference, geocomputation, and geovisualization also suggest that the complexities of urban and social systems and people's everyday life can be taken into account in quantitative models to a certain extent (Kwan 2000; Manson 2001; Davies Withers 2002; Parker et al. 2003; O'Sullivan 2004; Torrens 2006; Plummer 2007; Xie, Batty, and Zhao 2007; Hornsby and Yuan 2008; Bergmann, Sheppard, and Plummer 2009). Although these recent developments have moved quantitative geography away from positivist tenets and therefore seem helpful in bridging the critical–quantitative divide in geography, recent attempts to delink positivism and quantitative methodologies do not seem to be very successful; many critical geographers continue to see quantitative geography as a largely positivist and empiricist endeavor.

Contemporary social and political imperatives, however, indicate that the critical–quantitative divide can be detrimental to geography, and that this is a more opportune moment to attempt to reconnect critical and quantitative geographies (Barnes and Hannah 2001). The urgency arises from the selective use of quantitative information in conservative politics and neo-liberal governance (Brown and Knopp 2006). As the articles by Ellis (this issue) and Wyly (this issue) in this Focus Section show, conservative politicians embrace such

information if it supports their purposes but defy it if it counteracts conservative or neoliberal ends. The latter kind of antiquantification tactics could seriously undermine the possibility for activists to pursue progressive social and political change. If statistical data and analyses that can help reveal social injustice or discrimination are now under attack (and even suppressed), the extent to which activists or marginalized social groups can advance their critical agenda now depends on how effectively they can defend the use of quantitative data and analyses. As statistics on "population welfare, inequality, deprivation, and discrimination" are powerful "weapons," as Ellis (this issue) argues, it is difficult to image "critically inspired, progressively oriented research and activist agenda on race and racialization—or social justice more broadly—in any discipline that would want collection or estimation of these numbers stopped, or research on them sidelined." It is thus more urgent than ever before to reassess the role of quantitative geography and to question why quantitative methodologies cannot be part of critical geographies.

To shed light on the possibilities for bridging the critical–quantitative divide in geography, we organized a series of five sessions—entitled "Critical Quantitative Geographies: Beyond the Critical/Analytical Binarism"—at the 2007 annual meeting of the Association of American Geographers (AAG) in San Francisco. The purpose of these sessions was to explore the possibilities for crossing the boundary of and forging creative connections between critical–qualitative and analytical–quantitative geographies. We sought contributions that attempted to develop new vocabularies or alternative rationalizations that help reconnect critical–qualitative and analytical–quantitative geographies. We also solicited papers that explore how critical–qualitative and analytical–quantitative approaches can enrich each other and how quantitative methods can be used to address issues informed by critical geographies. Several questions were emphasized in our call for papers: (1) To what extent is a "new quantitative geography" that is based on critical social or cultural theory possible? (2) In what ways can quantitative methods be used in research inspired by critical social theory? (3) How can quantitative geographies take people's lived experiences into account? (4) How can social, cultural, and political contexts be foregrounded in quantitative analysis? (5) How can quantitative geographies take situated knowledges and positionality of the researcher and researched into account? (6) How can reflexivity be practiced when conducting quantitative analysis? How can this be articulated in research reports or publications?

A total of twenty-nine geographers participated in these sessions, with twenty-four papers or panel presentations. Participants spanned a wide spectrum of specialties and theoretical perspectives, including economic geography, feminist geography, population geography, transport geography, and spatial analysis. The articles included in this Focus Section of *The Professional Geographer* are viewpoint papers that address conceptual or theoretical issues pertinent to the themes of the AAG sessions. Four articles largely based on practical engagements and empirical studies are included in another Focus Section that will appear in the next issue of the journal. In addition, another set of papers presented at the AAG sessions was published as a special issue of *Environment and Planning A* (Kwan and Schwanen 2009). Instead of providing a summary of the articles in this Focus Section, we outline some of the issues they highlight to provide a context for these viewpoint articles, which seek to contribute to the debate on the critical–quantitative divide in geography.

Reinvigorating Quantitative Geography's Critical Sensibility

A surprising and often ignored aspect of the quantitative revolution, cogently described by Barnes (this issue), is that locational analysis and spatial science were originally developed with intentions that closely aligned with those of contemporary critical geographies. They were developed as means of critique and progressive social change. The original intent of the three most influential location theorists, who inspired much of the work in early quantitative geography (Alfred Weber, Walter Christaller, and Johann Heinrich von Thünen), was to reveal the abject social conditions of their times using quantitative data and methods. As Barnes (this issue) argues, they "intended their mathematics for politically progressive ends." Further, even the key figures in the quantitative revolution did not consider their quantitative

methods and their critical politics contradictory, and many of them were actually leftist activists in their times (Barnes this issue; Wyly this issue). The understanding that quantitative geography is antagonistic to or incompatible with critical geographies was due to the particularly influential critique of quantitative geography in the early 1970s by David Harvey, who represented critical geographies as nonquantitative, if not antiquantitative. It is now important to reinvigorate quantitative geography's critical sensibility and to recognize that it was originally meant for a critical politics that seeks to challenge and transform "prevalent relations, systems, and structures of capitalist exploitation, oppression, imperialism, neo-liberalism, national aggression, and environmental destruction" (Moss, Berg, and Desbiens 2002, 3).

Reconnecting the Critical and the Quantitative

To reconnect the critical and the quantitative in geography, themes or notions that are central to both critical and quantitative geographies can be used as possible bridges to overcome the divide, and means that facilitate their interactions can be developed. On one hand, important notions central to both critical and quantitative geographies can be used to reconnect critical and quantitative geographies. The notions of difference and context, for instance, are two such connective constructs that can stimulate dialogue and enhance mutual understanding, even though—or perhaps exactly because—their conceptualizations in critical theory and spatial analysis differ in various ways (cf. Dixon and Jones 1998). Geographers in general are now more attentive to difference among individuals across multiple axes and attribute fine-scale variations in "the outcomes of spatial events to differences between places and differences between people within places" (Zolnik this issue). In this regard, multilevel models seem to be promising tools for examining the effects of differences among individuals and geographic context on a wide variety of phenomena. Further, they can be complemented by qualitative work that greatly enhances our understanding of the lived experiences of individuals in their daily lives.

Another potential means, as suggested by Barnes (this issue), is by creating "trading zones," which are made possible by the use of a simplified, hybrid trading language that facilitates exchange between different groups of people with different values, languages, and meanings. Other possible means for moving beyond the critical–quantitative binary are the practices of hybrid geographies and "boundary projects," proposed by Kwan (2004, 758) to refer to geographic practices that challenge the boundary and forge creative connections between the critical and the quantitative. Examples of hybrid practices include studies that use quantitative or geographic information system (GIS) methods to address issues informed by critical geographies, analyses that employ mixed-method approaches to explore the multiple realities and lived experiences of individuals, and works that integrate critical social theory and spatial analytical methods.

The practice of hybrid geographies is, however, fraught with difficulties and limitations. As Wyly (this issue) warns:

> How can we ever find the time to master the dizzying array of traditions and techniques required to create truly hybrid geographies, without giving up the depth that comes with specialization in social theory or spatial econometrics or feminist ethnography or participant observation or policy analysis or . . . the list goes on. . . . If we are not careful, radical openness can permit fragmented, shallow engagements that leave us equally incompetent in everything.

How attempts to reconnect the critical and the quantitative can avoid this predicament remains a serious challenge. Further, there are real ontological and epistemological limits to hybridity due to the mathematical language used in quantitative geography and GIS (Leszczynski this issue). Certain types of knowledge simply cannot be handled quantitatively (Brown and Knopp 2008). It is now important to explore how existing quantitative tools like GIS can be used to handle nonquantitative information meaningfully (e.g., Kwan 2007; Kwan and Ding 2008).

Conclusion

Because of the often-ignored critical root of quantitative geography (as discussed earlier), calling this movement the second quantitative

revolution or the critical turn in quantitative geography is somewhat misleading. It seems more precise to talk about recovering the critical potential (or sensibility) of quantitative geography, or a return to the original critical spirit of the "first" quantitative revolution in geography. The critical (re)turn in quantitative geography has been underway for quite some time and "a new generation of geographers is responding to the urgent need to discern and analyze the assumptions and starting points for the things done and the things thrown before the minds of the many different people involved in public policy and urban (in)justice" (Wyly this issue). Although a revolution entails a significant and often abrupt change that usually occurs in a short period of time, we do hope that the articles in this Focus Section challenge the dominant understanding that quantitative geography and critical geographies (or politics) are necessarily conflicting endeavors. We also hope that this critical (re)turn will help abrogate decades of antagonism since the "first" quantitative revolution and that it will benefit geography and progressive social and political change over time. We invite all geographers to participate in this important project, which seeks to reinvigorate the critical sensibility of quantitative geography and to transcend the critical–quantitative binary. Quantitative geography is a powerful tool for challenging social and global injustice, and it can play an important role in progressive social and political change. ■

Notes

[1] Involving many individuals, networks, and events, the quantitative revolution was actually far more complex and historically contingent than a coherent movement as suggested by the term (Barnes 2004; Hubbard and Kitchin 2007).

[2] Many geographers have argued that quantitative geography does not necessarily have to be based on the epistemological premises of positivism (e.g., Plummer and Sheppard 2001; Kwan 2004; Fotheringham 2006).

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