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Quantitative methods: not positively positivist

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I Introduction

A chief reason why the past 10 years have not been kind to human geographers practicing quantitative geography has been the notion that quantitative geography must be positivist; more specifically, *any* practice of quantitative methods is associated with logical positivism. In my second report (Poon, 2004), I suggested that quantitative methods have undergone retooling in the field. Nonetheless, it may be argued that such retooling does not move the field away from the monopoly of logical positivism as the central way of knowing. In this third report, I pursue the theme that epistemology is a matter of representation and practice: in recent years, this practice is underscored by methodological and theoretical pluralism that does not betray logical positivism as its foundationalist faith. Further, positivism has come to be associated with narrow social interests, and the exercise of power from above. Again, this view reflects a particular view of positivism. Hence a second theme is to suggest that the field need not be an ally of social conservatism that promotes the narrowing of knowledge representational perspectives based on technical fixes.

II Methodological pluralism

Classical positivism, as practiced in the 1960s, was rooted in a form of formalism that is largely embedded in a deductivist tradition in the Popperian sense where the focus is on refuting falsehoods. Quantitative geography and formalism were seen to share the same foundation. In an extreme form, formalism operates insensitively in an environment of social facts and its monopoly reduces geographic facts to a set of explanations that are sometimes trivial. The hypothetico-deductive method, in the spirit of Euclidean geometry and cartesian space, focuses on scientific practice as a product rather than as a process. Geographic explanations are 'public objects of justification' that can be verified by an independent and logical set of criteria (Sebok, 1995; Aliseda, 2004: 341). In recent years, however, pressure is mounting within the community to constitute a more encompassing logic of inquiry that hesitates to assert in any doctrinal way in a world that is permeated with particularity and intersubjectivity. To borrow from McLennan (2002: 493), this implies that quantitative geographers are under pressure to 'move closer to reality', 'emphasize non-cartesian space', 'do narrative'.

Notwithstanding its appeal, embracing the reflexive turn implies a repudiation of any theoretical commitment since it is not possible to say anything outside of one's social context. As noted by Bohman (1998), there is no clear way to think about the social organization of critical inquiry under reflexive methodologies.

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This said, however, the field has had to confront one paradox, namely how to democratize knowledge representation that addresses reflexive deficit? Rather than develop meaner and leaner models, some quantitative geographers appear to have favored the transformation of their practice in the direction of increased methodological and theoretical pluralism that is sensitive to this deficit.

This present section will focus on two major points. In the first and more significant point, instead of formulating explanations as a product in the context of justification under the deductivist tradition, a group of quantitative geographers is moving towards constructing explanations as a process within the context of 'discovery' that uses abduction or retroduction. Secondly, while epistemological divides will no doubt continue to persist between third-person objective investigations that are said to dominate quantitative geography and first-person subjective experiential investigations that characterize postpositivist geography, there is nonetheless sympathy among some quarters in the former to engage in ontological constructions that attempt to capture some degree of a subject's interior or internal mental reasoning in addition to third-person objectivity.

In contrast to the deductive method where the investigator starts with reasoning or explanation (hypothesis) and then proceeds to consequences, the abductive method begins with consequences and then searches for reasons and explanations (Peirce, 1955). In abduction, the aim is to try and find the best explanation among several plausible or even competing explanations; and the emphasis is not on the amount or volume of data but the relative importance of the data. Abduction is process-driven since it is necessary to distinguish between constructing possible explanations and selecting the best one. Informational content, rather than formalism, serves as the main semantic property (Aliseda, 2004), while anomalies (idiography) can be a premise for the discovery of new concept, categories and ideas. In addition, abductive reasoning also contains extra-theoretical characteristics, and it is possible to withdraw hypotheses because 'things get messy' (Rasmussen, 2001: 648), and to produce and correct mistakes than to try to restore consistency of the hypothesis by modifying the assumptions (Magnani, 2004).

The deployment of abductive reasoning among some quantitative geographers enriches the geographical language since it uses a variety of methodologies, not just the logical, that potentially liberates the field from a formalistic and deductive-centric view. Abductive practice is evident among some geocomputional geographers (see Fotheringham, 1998, for an introduction to geocomputation) in part because more information-based approaches result in a richer state that potentially helps satisfy an explanation. In an increasingly information-rich environment, data are organized around computerized databases that are also becoming geo-referenced. The parallel emergence and dominance of geographical information systems (GIS) as well as computational-intensive algorithms such as neural networks and cellular automata has also hastened geocomputational research on geographical problems (e.g., Couclelis, 1997; Wu, 2003; Miller, 2005a).

Much spatial knowledge is qualitative, not just quantitative, where data are mined in categories rather than continuous terms. Qualitative reasoning tends to be motivated by reasoning that is supported with little, incomplete or even subjective information, for example, research on spatial directions such as wayfinding (Golledge, 1999). It has become popular in artificial intelligence to recognize that humans experience space and the physical environment without any calculus or differential equations; that they act with imprecise and sometimes little or incomplete information and data. At the heart of qualitative reasoning then are the constructions of categories and the cognitive

processes behind them. Given its emphasis on knowledge discovery in knowledge production, abduction that admits qualitative reasoning allows geographers to focus on the human as an active rather than passive agent in the problem-solving process.

The above may be illustrated with Gahegan and his colleagues' construction of the GeoVISTA *Studio* model (Gahegan *et al*., 2002). With the discipline's shift to a greater emphasis on situated rather than objective knowledge, this model represents a move away from relying only on third-person objective ontological constructions, as in classical informational approaches, to a weak form of first-person intersubjectivity by removing the power of ontology from the expert to the user. In this weak form of intersubjectivity, knowledge is not necessarily based on mutual experiential engagement of users, as would be the case in stronger forms, but on individual subjectivity ontologically. Users may not co-participate because the main interaction here relates to individual human ability to interact with data, information, and the development of categories. Indeed as Smith and Mark (2002) have argued, the development of a common ontology in geographical information science has proven to be quite difficult because such integration relies on closed models that are rarely in congruence with reality. As observed earlier, spatial knowledge also contains a large amount of qualitative phenomena; hence they conclude that informational methods will need to accommodate the transformation of quantitative geospatial data into qualitative representations that are meaningful for the nonexpert user.

Given the interdisciplinary tendencies of geographic data (social, economic, political, physical, etc.), geographical analysis tends to be data fertile (i.e., integration of various disciplines like epidemiology, economics, sociology); much of these data are also scale-sensitive and are not directly comparable. Gahegan and his colleagues suggest that the nature of geographic data creates considerable difficulties in formal representation of the domain knowledge, hence some geovisualization approaches rely on visual abduction to produce knowledge where abductive inference is made from perceptual judgement through visual stimuli; that is, an approach towards image-based formulation of explanation(s) (see Gahegan, 2001). Indeed some abductive inference is better understood using pictorial, iconic or other visual stimuli. The GeoVISTA *Studio* model attempts to make a stronger connection between such visual abduction and geographical analysis. More importantly, postnormal quantitative practice of this sort is motivated by the objective of allowing the user to explore multiple and layered meanings within the context of knowledge discovery.

Another example of quantitative geographical research that attempts to incorporate intersubjectivity is the urban cognitive model SIRN (Synergetic Inter-Representation Networks) reported by Portugali (2004). Here, the main concern is not only with how urban individuals develop mental categories of specific and general urban spaces but also with the simultaneous categorization of these spaces. Consistent with a growing research on the self-organizing nature of cities in the urban literature, the model 'relates cognition and spatial behavior to the dynamics of cities, and admits the complexity of urban agents and the city as a self-organizing system' (p. 599). What is interesting about SIRN is that the author goes to great lengths to incorporate in the model postpositivist sensibilities of knowledge production through discursive social processes and notions of sociospatial reproduction. Compared to GeoVISTA *Studio*, intersubjectivity is of a stronger form because the cognitive maps of urban individuals or agents are influenced by their mutual interactions and experiences. Consequently, the emerging self-organizing urban system should capture the construction of urban meanings at the individual and the collective level. That is to say, SIRN consists not only of mathematical and

computational urban simulations but also of 'soft social-theory-derived discourse on cities' (p. 601).

Abduction, as a mode of geospatial knowledge production, potentially provides explanations that may be richer. It also contributes to a more pluralistic view of quantitative geography since it recognizes that explanations in everyday life do not necessarily conform to a deductivist logic. What is apparent from the review in this section so far is that there has been a move beyond the formalistic and tool-centric practice of quantitative geography under logical positivism to the production and construction of geographic knowledge in the field. Couclelis (2003) rightly observes that knowledge is not always known and a tool-centered emphasis leads potentially to empirical or even theoretical failings in the context of 'bad knowledge and erroneous beliefs', the latter of which is hard to detect in, for example, current GIS tools. Indeed, information uncertainty is no longer simply a product of statistical sampling or measurement errors for there are things that are unknown because of human limitation.

While abduction has been presented at length here to support methodological and even theoretical pluralism in the practice of quantitative geography, there are also other modes of knowledge production being pursued in the field.

First, there is the Duhem-Quine (D-Q) thesis of underdetermination which promotes a shift away from individual if isolated hypotheses under logical positivism to a system or web of complex sentences or multiple propositions. One of the premises of the thesis is that theories are too complex for the testing of single hypotheses, and this impossibility potentially undermines all forms of testing (Morad, 2004). Under the deductivist notion of falsifiability, it is rarely the case that a theory is rejected because of the difficulties of testing; hence practitioners are generally reluctant to change their original belief in the face of negative empiricism. The D-Q underdetermination thesis, on the other hand, views knowledge production within a larger system of propositions and may be said to be a more pragmatist approach where theory and empiricism collide, an 'empiricism without the dogmas' (Boylan and O'Gorman, 2003: 9) as it were:

> Since the whole of our knowledge is a man-made web which touches reality only along the edges, there is no foundational epistemological way of neatly dividing this web into purely analytical and synthetic dimensions, or, if one prefers, into logical and empirical dimensions. (Boylan and O'Gorman, 2003: 14)

Secondly, Sheppard (2001: 536), in rejecting the argument that quantitative geography is necessarily deductivist, argues that mathematics is a 'humanly constructed language for describing and conceptualizing the world', which is no more superior than other forms of languages being deployed in nonquantitative works. His call for a postpositivist mathematical geography (e.g., fuzzy set theory, fractals) has been paralleled by O'Sullivan's (2004) introduction of complexity theory and Robbins and Krueger's Q-Method (2000) to human geography. The lack of space prevents detailed documentation of these postnormal methodologies that are being advocated for quantitative geography. However, they share both abduction and the D-Q theses that logical positivism's privileged ontological position in quantitative geography is misplaced, if not misguided.

III Social conservatism

In a recent assessment of the field of urban geography in the 1990s, Hanson (2003) makes three interesting findings after surveying the content and themes of articles that have been published in journals like *Annals of the Association of American Geographers*, *The Professional Geographer* and *Urban Geography*. First, she writes:

> The reigning epistemology within urban geography is decidedly positivist ... The version of positivism that now guides urban geographic research is, however, a softer one

> than that practiced three or four decades ago. For example, most investigators no longer build theory via the hypothetic-deductive model or aim to discover universal laws. (Hanson, 2003: 469)

Secondly, she concludes that urban geographers tend to shy away from research on public policy. Thirdly, segregation that is concerned with spatial inequality (housing, immigration, labor markets, gentrification) commands the largest share of published articles.

One of the criticisms against enumeration in the qualitative turn has been a belief that deductivism reduces social life to a set of norms that privilege a class on society. Put in another way, scientific laws encourage pedigree building that insulates geographers from social and political activism since they are self-contained and potentially insensitive to social facts. The finding from Hanson that segregation is a predominant theme alongside positivist-inclined research would seem to challenge this perception (see, for example, Holloway and McNulty, 2003).

Hanson's definition of 'positivism', however, is rather generous; in actual fact, her findings point much more to a strong empiricist tradition than hard formalism among urban geographers. Further, the popularity of social-urban, political-urban, nature-urban and cultural-urban themes do not seem to square with a worldview of the programmatic, the mechanistic and the universal that typically characterize socially conservative research.

In addition to Hanson's finding that segregation is a prominent theme in urban geography, segregation-related themes may also be found in transport geography despite the fact that this field is 'highly technical' and uses 'a substantial amount of quantitative data' (Deka, 2004: 334). In this case, the concern is associated with the impact of social exclusion through lack of access to opportunities and services. Two studies on social exclusion merit some elaboration in the remaining of this section. The first focuses on the multiple dimensions and meanings of the social exclusion concept including nonmaterial deprivations such as power relationships between the individuals, groups and the state, unequal access to participation in society, powerlessness and civic rights (Kenyon *et al*., 2002). In considering these nonquantitative dimensions, the authors focus on virtual mobility, that is the internet, as a means to access networks, information, political participation and support groups that are otherwise not available with physical mobility. Secondly, more recent developments in transport geography suggest a space-time activity model (Miller, 2005b) that enables thinking about social exclusion, not just as a problem of accessibility, but also a problem of extensibility (that is, an individual's ability to extend himself/herself to spatially and temporally variations in resources and information). The space-time activity model seeks to integrate physical and virtual forms of mobility. Like Kenyon *et al*., it recognizes the unique experiences of social exclusion in time and space, in terms of gender (Kwan, 2002) and race-gender (Johnston-Anumonwo, 2000).

IV Conclusion

Epistemological diversity in human geography in recent years has resulted in the co-existence of both foundationalist and anti-foundationalist philosophies in the discipline. There is no reason why philosophical foundationalism that has been popular in the past in quantitative geography need be mortgaged into a conservative and undemocratic posture in the sociology of knowledge, as this third report has attempted to show. In finding social sciences a discursive activity that cannot ignore relativism the way natural or physical sciences can, Gunnell (1993: 573) reminds us that social science is 'parasitic' because 'most second-order [social science] activities arose from critical and legitimating discourses once embedded in, entwined with, substantive first order [natural science] discourses'. Put in another way, the 'human'

in human geography calls into question the physical and natural sciences' tendencies toward universal beliefs and truth claims, and the purpose of geographers is to question, criticize, validate and interrogate these discourses. The recent call for geographers' increased attention to public policy to some extent resonates with the above in the sense that quantitative methodologies in their current hybrid and pluralistic forms can facilitate communication between geographers and policy-makers typically trained in positivist or physical science traditions (Hamnett, 2003; James *et al.*, 2004; Keylock and Dorling, 2004).

Methodological and theoretical pluralism should mean that any attempt to epistemologically argue for the hegemony of logical positivism could be a fruitless effort. The field is not positively positivist. Instead, this final review suggests that, like the rest of the discipline, quantitative geography finds increased resonance in the increased fluidity and multiplicity of methodology.

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