URBAN STUDIES

# Connecting Paradigms

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Science is an endeavor of artful simplification, of discovering general principles. Fruit flies, for example, look very different from humans, but the two species share 75% of disease-causing genes. Thus, we can study fruit flies to learn about our own weaknesses under the common framework of genetics. Similarly, the unifying principles of allometry allow us to make sense of most forms of life on Earth, where a cat is just a blown-up mouse and a human is just a blown-up cat. Multiply an animal's size by *x*, and its heart rate, lifetime, and other features will increase in proportion to specific powers of *x*. This is the case because the physical rules that govern the formation of circulatory systems hold everywhere. Turning to social phenomena, can we find universal processes underlying them?

**The New Science of Cities**

***by Michael Batty***
MIT Press, Cambridge, MA, 2013. 518 pp. $45, £31.95. ISBN 9780262019521.

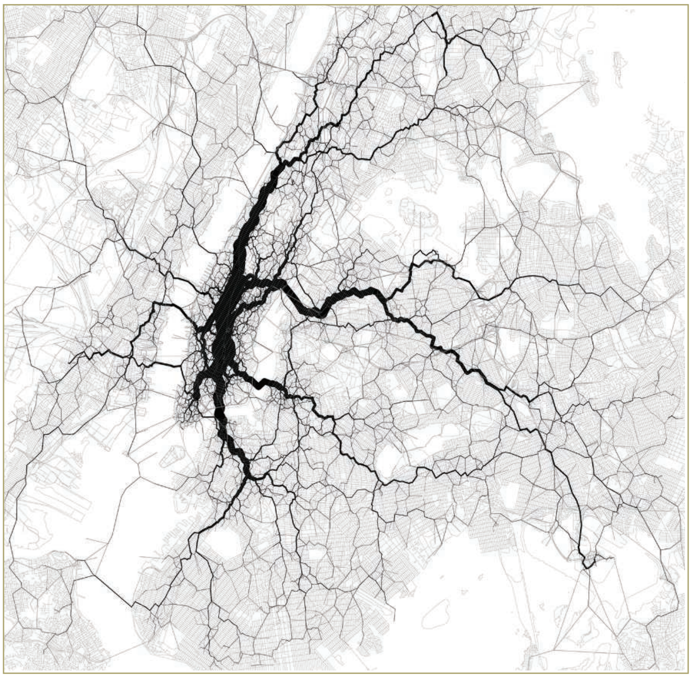
Let us take a big leap and consider cities: Perhaps something similar to biology's allometric rules would allow a megacity as complicated as New York to be better understood by looking at what goes on in a small village. Is New York just a blown-up version of Venice? Universal principles that govern urban shapes and growth processes independent of particular history or geography could support a "grand unified theory of cities." What would it take to discover them?

*The New Science of Cities* presents a herculean attempt to bring together widely fragmented approaches to making sense of human social organization with the goal of eventually establishing a consolidated "science of cities" able to answer our questions. Michael Batty bases his argument on the interplay among space, dynamics, and relations. He holds that "to understand place, we must understand flows, and to understand flows we must understand networks." Batty (a geographer at University College London) also stresses two other principles: an intrinsic order of scale determines a city's form and function, and a science of cities should not merely observe but also predict. The book draws on the work of urbanists, economists, mathematicians, and physicists as well as almost five decades of his own contributions to urban studies.

Batty's approach rests on a physicalist philosophy: He focuses on what can be immediately observed. In a treatise that eventually becomes technical, he simplifies cities as "sets of actions, interactions, and transactions." The book develops a toolbox of mathematical models—well applicable to "big data" that are being increasingly collected about cities—from a mesmerizing potpourri of paradigms. Its foundational part takes us on a fascinating historical journey through these perspectives, from urban economics and transportation to fractal geometry, dynamical systems, and network science. All these aspects can be embedded in complexity theory, the most likely candidate to provide the consistent philosophy for achieving the author's ambitious goal.

The foundations for modern urban studies were laid in the 19th century, with the first analytical, economic approaches and the concept of agglomeration. The closer we live together, the more opportunities of trade we find, creating economies of scale. Today, extensive empirical evidence supports an urban allometry that convincingly shows cities are humanity's socioeconomic reactors, in which citizens produce, consume, and interact more as the city increases in size. These interactions can be explained mechanistically using Newtonian metaphors of cities as entities that exert gravitational-like forces on populations. Such gravity models are used in various social sciences and have recently experienced a boom in the study of human mobility through mobile phone data.

Powerful metaphors populate the histories of urban studies and planning. For a long time, the prevailing line of thinking saw the city as a machine, a model in which a "controller steered the city cybernetically toward a future desired state." Now we know better, realizing that cities are complex systems meandering through a space of configurations, like biological organisms evolving in a Darwinian fitness landscape. Such systems exhibit hallmark features of nonlinear dynamics far from equilibrium. Small interventions can have massive, counterintuitive consequences, making cities almost impossible to control. In a field where planning is essential, this discovery is devastating. It means that monumental top-down plans, which dominated most of 20th-century city planning, are a recipe for failure.



**Urban complexity.** Human flows (mapped by Eric Fischer using geotagged tweets) illustrate the organic structure of New York City.

CREDIT: ERIC FISCHER/USING DATA FROM THE TWITTER STREAMING API; BASE MAP DATA © OPENSTREETMAP CONTRIBUTORS

The book provides some better options. Parsimonious bottom-up models and agent-based simulations unveil basic mechanisms of competition and growth. Cutting-edge visualizations facilitate the exploration and the interpretation of empirical and synthetic data. Through a synthesis of the descriptive and the normative and a combination of quantitative modeling with qualitative theories of social exchange and collective action, the author shows how to model urban design to improve the decision processes of authorities and policy-makers.

Batty stresses that the set of approaches he tackles is a first step and by no means exclusive: "it would be presumptuous to think of this effort as the only science of cities, for the city and its planning admits many viewpoints." He concludes that an

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Published by AAAS

integrated, "nicely packaged," and immediately applicable science of cities might never be reached. Nevertheless, *The New Science of Cities* succeeds in clearing a way. It illustrates convincingly the particular promise of mathematical modeling and complexity theory for designing sustainable urban futures.

10.1126/science.1249599