Best Practices for Community-Based Medical Research
地域密着型の医学研究のベストプラクティス

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Participatory Approaches, Interdisciplinary Methods, and Complexity Thinking

FOUR EXAMPLES OF THE WORK I DO IN COMMUNITY-BASED MEDICAL RESEARCH

コミュニティベースの医療研究で私が行っている仕事の4つの例

1. I run **InSPIRE**, a UK policy and research consortium for mitigating the impact of air qualitative has on brain and mental health across the life course. (**www.inspireairbrain.org**)

InSPIRE
Innovating UK clean air policies to prevent cognitive disorders

https://youtu.be/nLoTdy5rdfM

Contents lists available at ScienceDirect
Environmental Research
journal homepage: www.elsevier.com/locate/envres

Review article

Mitigating the impact of air pollution on dementia and brain health: Setting the policy agenda

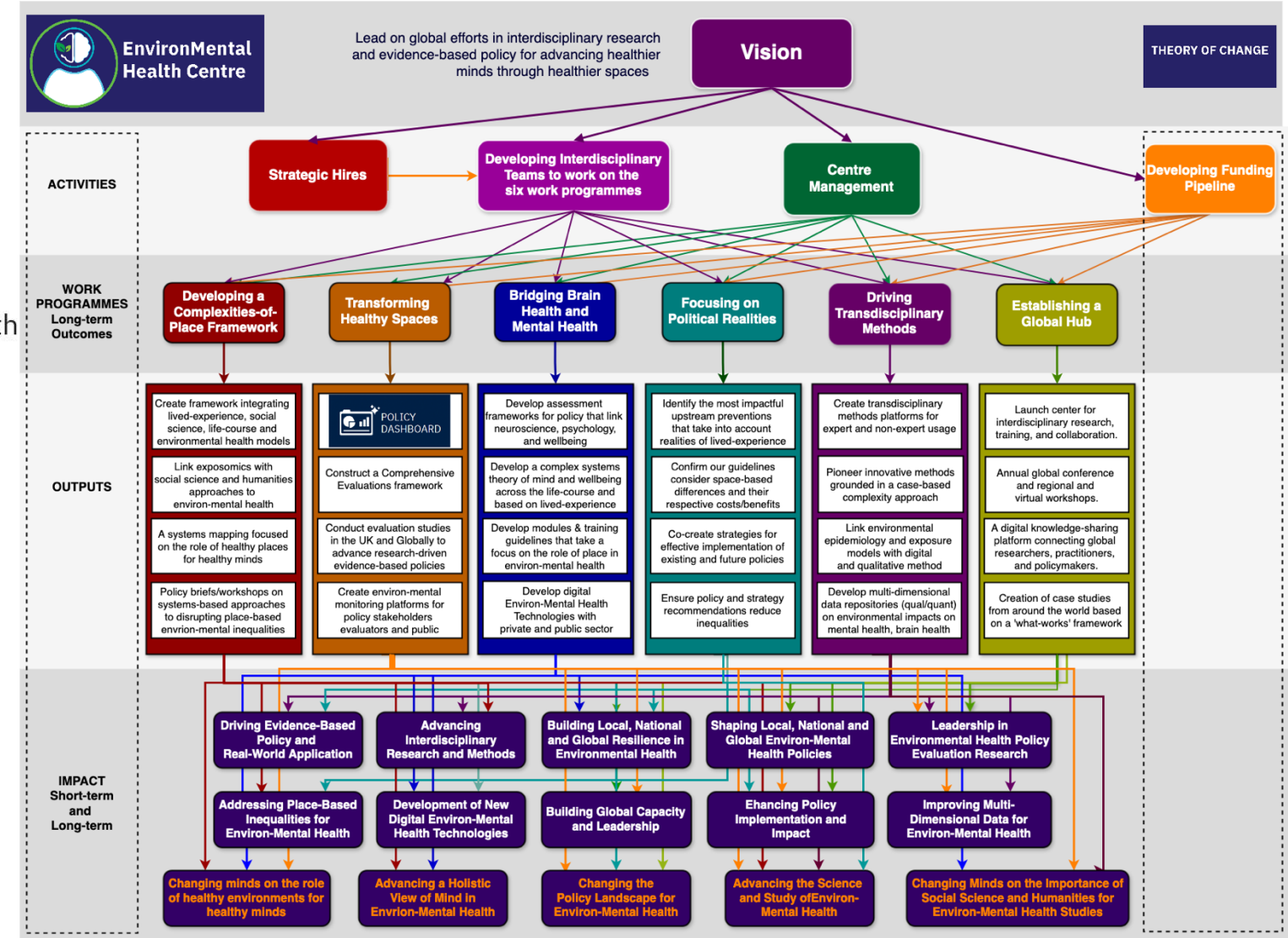
Brian Castellani [a,b,c,e,*], Suzanne Bartington [d], Jonathan Wistow [e,c], Neil Heckels [f], Amanda Ellison [c,g], Martie Van Tongeren [h], Steve R. Arnold [i], Pete Barbrook-Johnson [j,b], Martha Bicket [b], Francis D. Pope [k], Tom C. Russ [l,m], Charlotte L. Clarke [e,n], Monica Pirani [o], Matthias Schwannauer [n], Massimo Vieno [p], Rachel Turnbull [q], Nigel Gilbert [b], Stefan Reis [p,r,s]

ABSTRACT

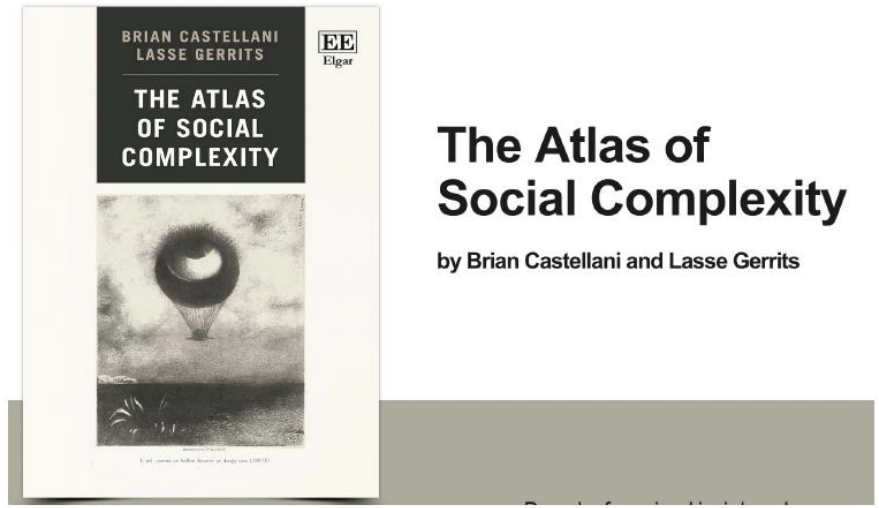
Background: Emerging research suggests exposure to high levels of air pollution at critical points in the life-course is detrimental to brain health, including cognitive decline and dementia. Social determinants play a significant role, including socio-economic deprivation, environmental factors and heightened health and social inequalities. Policies have been proposed more generally, but their benefits for brain health have yet to be fully explored.
Objective and methods: Over the course of two years, we worked as a consortium of 20+ academics in a participatory and consensus method to develop the first policy agenda for mitigating air pollution's impact on brain health and dementia, including an umbrella review and engaging 11 stakeholder organisations.
Results: We identified three policy domains and 14 priority areas. Research and Funding included: (1) embracing a complexities of place approach that (2) highlights vulnerable populations; (3) details the impact of ambient $PM_{2.5}$ on brain health, including current and historical high-resolution exposure models; (4) emphasises the importance of indoor air pollution; (5) catalogues the multiple pathways to disease for brain health and dementia, including those most at risk; (6) embraces a life course perspective; and (7) radically rethinks funding. Education and Awareness included: (8) making this unrecognised public health issue known; (9) developing educational products; (10) attaching air pollution and brain health to existing strategies and campaigns; and (11) providing publicly available monitoring, assessment and screening tools. Policy Evaluation included: (12) conducting complex systems evaluation; (13) engaging in co-production; and (14) evaluating air quality policies for their brain health benefits.
Conclusion: Given the pressing issues of brain health, dementia and air pollution, setting a policy agenda is crucial. Policy needs to be matched by scientific evidence and appropriate guidelines, including bespoke strategies to optimise impact and mitigate unintended consequences. The agenda provided here is the first step toward such a plan.

2. My colleagues and I are currently developing the **Environ-Mental Health Centre (EMHC)**, to lead global efforts in advancing healthier minds through healthier spaces in order to advance environ-mental health science, methods and policy (local to global).

EnvironMental Health Centre



3. My colleague Lasse Gerrits and I wrote **The Atlas of Social Complexity**, a tour of the future present in the work being done at the intersection of the social and complexity sciences. (**www.atlassocialcomplexity.org**)



About

Embark on a riveting journey through the study of social complexity with 'The Atlas of Social Complexity'. Over three decades of scientific exploration unfold, unravelling the enigmatic threads that compose the fabric of society. From the dance of bacteria, to human-machine interactions, to the ever-shifting dynamics of power in social networks, this Atlas maps the evolution of our understanding of social complexity.

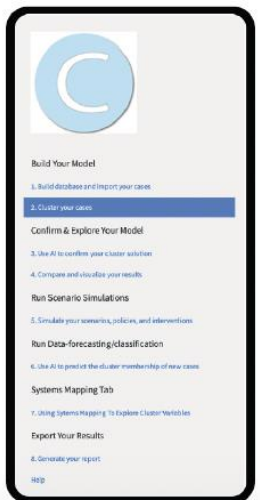
Brian Castellani's and Lasse Gerrits' Atlas is not merely retrospective. It is a compass pointing to uncharted territories: new directions for research and intellectual debate. With wit and insight, they invite the reader to ponder unanswered questions, taking them on a quest for alternative ways to understand the intricate complexities of societies.

'The Atlas of Social Complexity' is a thrilling expedition into the heart of what makes us human: from cognition, emotion, consciousness, the dynamics of human psychology, to social networks, collective behaviour, politics and governance, technology and planning, and the practice of social interventions. The Atlas also visits cross-cutting themes such as intersectionality, configurational complexity, and research methods.

Organised around six transdisciplinary themes and twenty-four topics the Atlas is an invaluable resource for all social science and complexity science scholars and students interested in new ideas and new ways of working in social complexity. It paves the way for the next generation of research in the study of social complexity.

4. My colleagues and I have developed **COMPLEX-IT**, a methods platform for non-experts in computational modeling to explore their data from a case-based complexity perspective, in a simple, seamless and secure research environment using the latest advances in machine learning, systems mapping, data visualization, data forecasting, and simulation.

(**www.complex-it-data.org**)

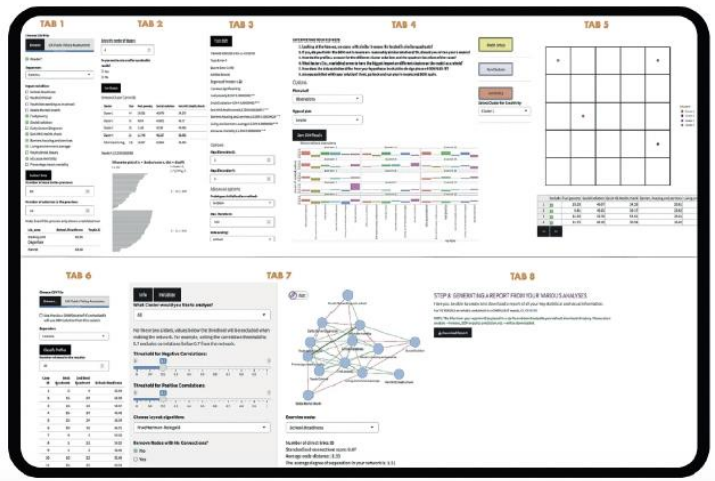


How **COMPLEX-IT** Works

COMPLEX-IT is a tab-driven interface.

Tab 1 allows you to import and organize your data.
Tab 8 generates a downloadable final report, complete with EXCEL files, statistical results, and graphs.
Tabs 2 through 7 offer you a suite of of computational methods designed for a *case-based complexity* approach to data exploration, modelling, forecasting and simulation.

TAB 2 – Cluster Analysis
TAB 3 - Machine Learning
TAB 4 - Data Visualization
TAB 5 - Scenario Simulation
TAB 6 - Data forecasting
TAB 7 - Systems Mapping



What is community health?

地域医療研究とは何か

- **It depends upon who you ask and in what country you are working.**

Community-based medical research

- Defines health as complete physical, mental, and social wellbeing, beyond the absence of disease.
- Emphasizes collaboration with communities to address pressing health issues.
- Leverages participatory research.
- Employs interdisciplinary methods
- Uses complex systems thinking enhances impact and inclusivity.

What is community health?

地域医療研究とは何か

- It depends upon who you ask and in what country you are working.

Community-based medical research

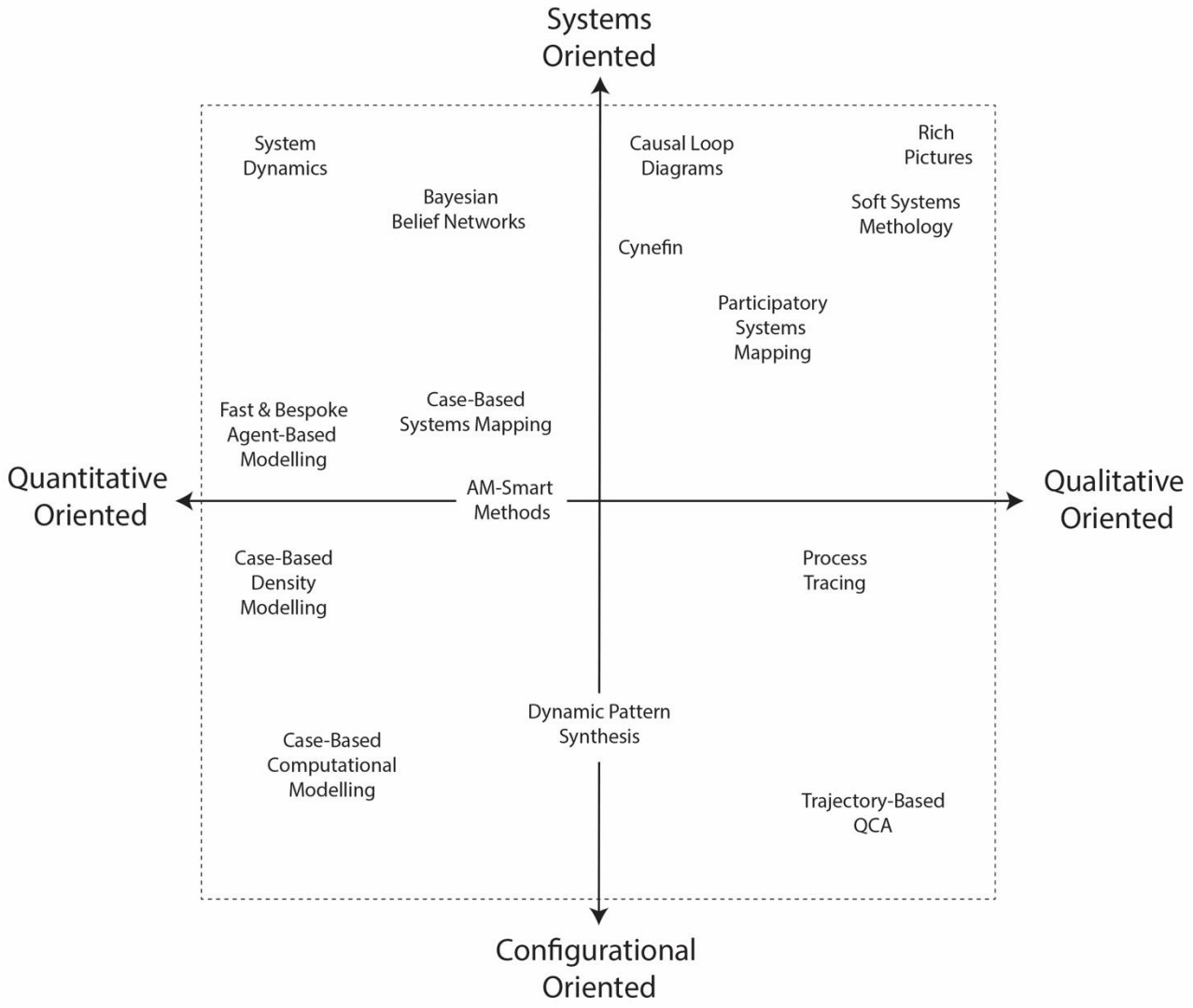
- Focuses on the determinants of health:
  - Broad causes include individual behaviours, susceptibility, and environmental factors.
- Focused on local action:
  - Emphasizes addressing local determinants and needs.
- Construct of Community:
  - Focus on social interactions and organization influencing health outcomes.

Diez Roux, A. V. (2002). Community Health. International Encylopedia of the Social Behavioral Sciences.

学際的なメソッド

Transdisciplinary Methods

- Benefits of Interdisciplinary Approaches:
- - Integration of diverse expertise (social, medical, environmental sciences)
- - Enhanced problem-solving through holistic perspectives
- - Breaking down silos to address multifaceted health challenges
- - Creating adaptable and sustainable solutions

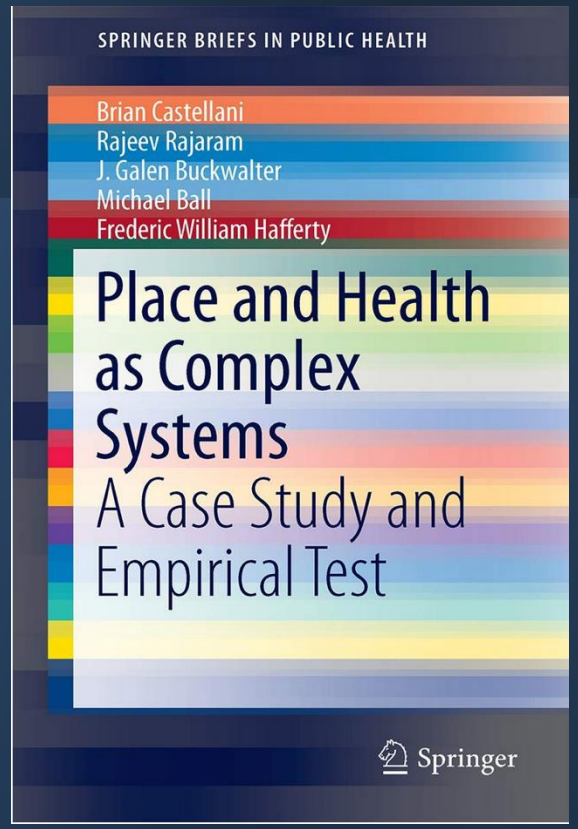


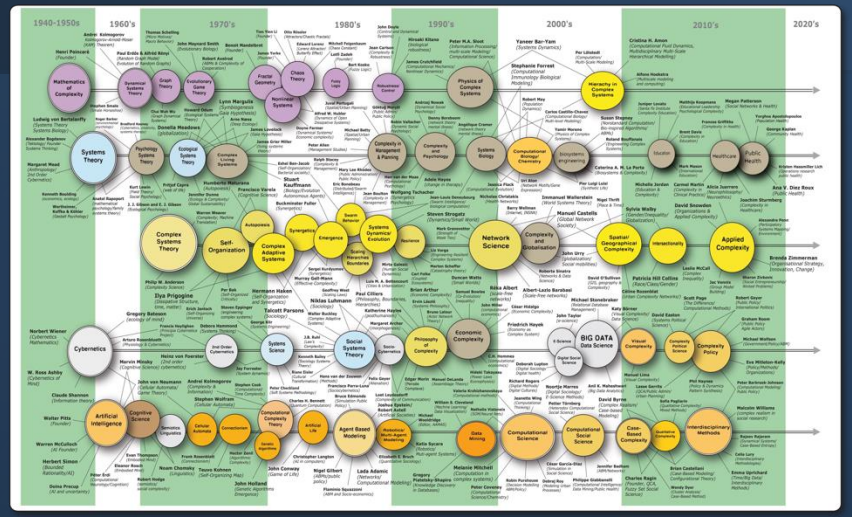
参加型研究

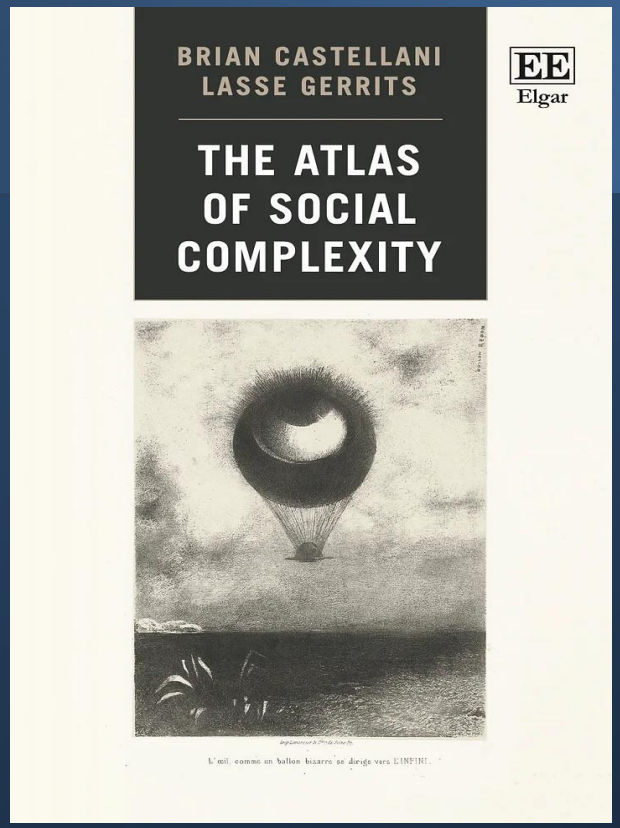
Participatory Research

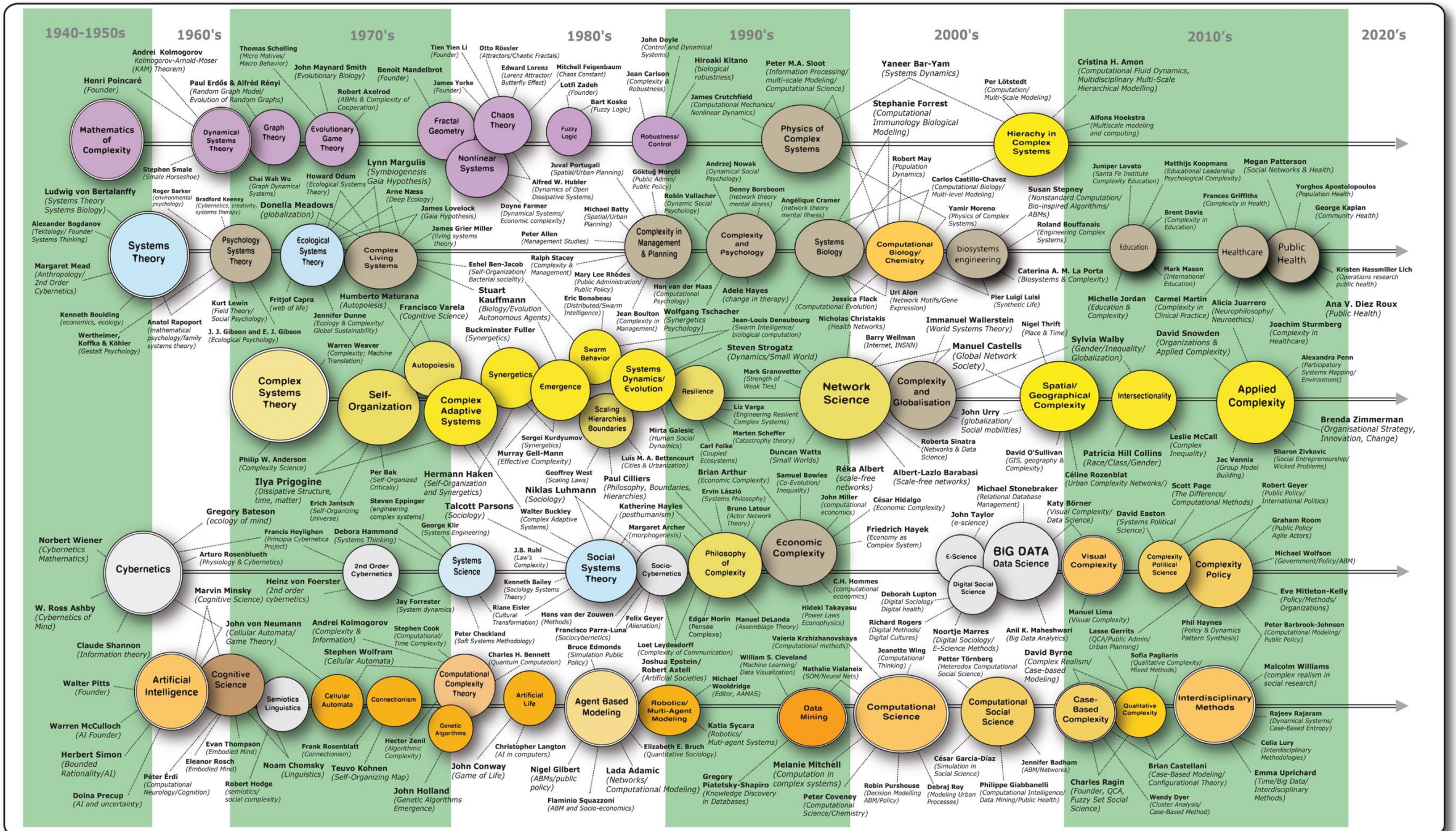
- Key Principles:
- - Collaboration and co-creation with community stakeholders
- - Respect for local knowledge and cultural context
- - Capacity-building and empowering participants
- - Shared decision-making and equitable partnerships

The Complexity Science, Social Complexity, and the Complexities of Place








1940-1950s
1960's
1970's
1980's
1990's
2000's
2010's
2020's
Mathematics of Complexity
Dynamical Systems Theory
Graph Theory
Evolutionary Game Theory
Fractal Geometry
Chaos Theory
Nonlinear Systems
Fuzzy Logic
Robustness/ Control
Physics of Complex Systems
Hierachy in Complex Systems
Systems Theory
Psychology Systems Theory
Ecological Systems Theory
Complex Living Systems
Complexity in Management & Planning
Complexity and Psychology
Systems Biology
Computational Biology/ Chemistry
biosystems engineering
Education
Healthcare
Public Health
Complex Systems Theory
Self-Organization
Autopoiesis
Complex Adaptive Systems
Synergetics
Emergence
Swarm Behavior
Systems Dynamics/ Evolution
Resilience
Scaling Hierarchies Boundaries
Network Science
Complexity and Globalisation
Spatial/ Geographical Complexity
Intersectionality
Applied Complexity
Cybernetics
2nd Order Cybernetics
Systems Science
Social Systems Theory
Socio-Cybernetics
Philosophy of Complexity
Economic Complexity
E-Science
Digital Social Science
BIG DATA Data Science
Visual Complexity
Complexity Political Science
Complexity Policy
Artificial Intelligence
Cognitive Science
Semiotics Linguistics
Cellular Automata
Connectionism
Computational Complexity Theory
Genetic Algorithms
Artificial Life
Agent Based Modeling
Robotics/ Multi-Agent Modeling
Data Mining
Computational Science
Computational Social Science
Case-Based Complexity
Qualitative Complexity
Interdisciplinary Methods
Henri Poincaré (Founder)
Andrei Kolmogorov (Kolmogorov-Arnold-Moser (KAM) Theorem)
Paul Erdős & Alfréd Rényi (Random Graph Model/ Evolution of Random Graphs)
Thomas Schelling (Micro Motives/ Macro Behavior)
John Maynard Smith (Evolutionary Biology)
Robert Axelrod (ABMs & Complexity of Cooperation)
Benoit Mandelbrot (Founder)
James Yorke (Founder)
Tien Yien Li (Founder)
Otto Rössler (Attractors/Chaotic Fractals)
Edward Lorenz (Lorenz Attractor/ Butterfly Effect)
Mitchell Feigenbaum (Chaos Constant)
Lotfi Zadeh (Founder)
John Doyle (Control and Dynamical Systems)
Jean Carlson (Complexity & Robustness)
Bart Kosko (Fuzzy Logic)
Hiroaki Kitano (biological robustness)
James Crutchfield (Computational Mechanics/ Nonlinear Dynamics)
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Yaneer Bar-Yam (Systems Dynamics)
Stephanie Forrest (Computational Immunology Biological Modeling)
Per Lötstedt (Computation/ Multi-Scale Modeling)
Cristina H. Amon (Computational Fluid Dynamics, Multidisciplinary Multi-Scale Hierarchical Modelling)
Alfons Hoekstra (Multiscale modeling and computing)
Stephen Smale (Smale Horseshoe)
Chai Wah Wu (Graph Dynamical Systems)
Howard Odum (Ecological Systems Theory)
Lynn Margulis (Symbiogenesis Gaia Hypothesis)
Arne Næss (Deep Ecology)
Juval Portugali (Spatial/Urban Planning)
Alfred W. Hubler (Dynamics of Open Dissipative Systems)
Doyne Farmer (Dynamical Systems/ Economic complexity)
Michael Batty (Spatial/Urban Planning)
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Göktuğ Morçöl (Public Admin/ Public Policy)
Robin Vallacher (Dynamic Social Psychology)
Andrzej Nowak (Dynamical Social Psychology)
Denny Borsboom (network theory mental illness)
Angélique Cramer (network theory mental illness)
Robert May (Population Dynamics)
Carlos Castillo-Chavez (Computational Biology/ Multi-level Modeling)
Yamir Moreno (Physics of Complex Systems)
Susan Stepney (Nonstandard Computation/ Bio-inspired Algorithms/ ABMs)
Roland Bouffanais (Engineering Complex Systems)
Juniper Lovato (Santa Fe Institute Complexity Education)
Matthijs Koopmans (Educational Leadership Psychological Complexity)
Megan Patterson (Social Networks & Health)
Frances Griffiths (Complexity in Health)
Yorghos Apostolopoulos (Population Health)
Brent Davis (Complexity in Education)
George Kaplan (Community Health)
Ludwig von Bertalanffy (Systems Theory Systems Biology)
Roger Barker (environmental psychology)
Bradford Keeney (Cybernetics, creativity, systems therapy)
Donella Meadows (globalization)
James Lovelock (Gaia Hypothesis)
James Grier Miller (living systems theory)
Alexander Bogdanov (Tektology/ Founder Systems Thinking)
Margaret Mead (Anthropology/ 2nd Order Cybernetics)
Kenneth Boulding (economics, ecology)
Wertheimer, Koffka & Köhler (Gestalt Psychology)
Anatol Rapoport (mathematical psychology/family systems theory)
Kurt Lewin (Field Theory/ Social Psychology)
J. J. Gibson and E. J. Gibson (Ecological Psychology)
Fritjof Capra (web of life)
Jennifer Dunne (Ecology & Complexity/ Global Sustainability)
Humberto Maturana (Autopoiesis)
Francisco Varela (Cognitive Science)
Warren Weaver (Complexity; Machine Translation)
Eshel Ben-Jacob (Self-Organization/ Bacterial sociality)
Ralph Stacey (Complexity & Management)
Mary Lee Rhodes (Public Administration/ Public Policy)
Eric Bonabeau (Distributed/Swarm Intelligence)
Stuart Kauffmann (Biology/Evolution Autonomous Agents)
Buckminster Fuller (Synergetics)
Han van der Maas (Computational Psychology)
Adele Hayes (change in therapy)
Jean Boulton (Complexity in Management)
Wolfgang Tschacher (Synergetics Psychology)
Jean-Louis Deneubourg (Swarm Intelligence/ biological computation)
Jessica Flack (Computational Evolution)
Uri Alon (Network Motifs/Gene Expression)
Pier Luigi Luisi (Synthetic Life)
Caterina A. M. La Porta (Biosystems & Complexity)
Nicholas Christakis (Health Networks)
Barry Wellman (Internet, INSNN)
Immanuel Wallerstein (World Systems Theory)
Nigel Thrift (Place & Time)
Steven Strogatz (Dynamics/Small World)
Mark Granovetter (Strength of Weak Ties)
Manuel Castells (Global Network Society)
Sylvia Walby (Gender/Inequality/ Globalization)
David Snowden (Organizations & Applied Complexity)
Michelle Jordan (Education & Complexity)
Carmel Martin (Complexity in Clinical Practice)
Alicia Juarrero (Neurophilosophy/ Neuroethics)
Joachim Sturmberg (Complexity in Healthcare)
Mark Mason (International Education)
Kristen Hassmiller Lich (Operations research public health)
Ana V. Diez Roux (Public Health)
Alexandra Penn (Participatory Systems Mapping/ Environment)
Liz Varga (Engineering Resilient Complex Systems)
Marten Scheffer (Catastrophy theory)
Mirta Galesic (Human Social Dynamics)
Carl Folke (Coupled Ecosystems)
Luís M. A. Bettencourt (Cities & Urbanization)
Sergei Kurdyumov (Synergetics)
Murray Gell-Mann (Effective Complexity)
Geoffrey West (Scaling Laws)
Duncan Watts (Small Worlds)
Roberta Sinatra (Networks & Data Science)
John Urry (globalization/ Social mobilities)
David O'Sullivan (GIS, geography & Complexity)
Patricia Hill Collins (Race/Class/Gender)
Leslie McCall (Complex Inequality)
Jac Vennix (Group Model Building)
Sharon Zivkovic (Social Entrepreneurship/ Wicked Problems)
Brenda Zimmerman (Organisational Strategy, Innovation, Change)
Philip W. Anderson (Complexity Science)
Ilya Prigogine (Dissipative Structure, time, matter)
Per Bak (Self-Organized Critically)
Hermann Haken (Self-Organization and Synergetics)
Erich Jantsch (Self-Organizing Universe)
Steven Eppinger (engineering complex systems)
Talcott Parsons (Sociology)
Niklas Luhmann (Sociology)
Walter Buckley (Complex Adaptive Systems)
Paul Cilliers (Philosophy, Boundaries, Hierarchies)
Katherine Hayles (posthumanism)
Margaret Archer (morphogenesis)
Brian Arthur (Economic Complexity)
Ervin László (Systems Philosophy)
Samuel Bowles (Co-Evolution/ Inequality)
Bruno Latour (Actor Network Theory)
John Miller (computational economics)
César Hidalgo (Economic Complexity)
Friedrich Hayek (Economy as Complex System)
Réka Albert (scale-free networks)
Albert-Lazlo Barabasi (Scale-free networks)
Michael Stonebraker (Relational Database Management)
John Taylor (e-science)
Katy Börner (Visual Complexity/ Data Science)
Céline Rozenblat (Urban Complexity Networks/)
David Easton (Systems Political Science)
Scott Page (The Difference/ Computational Methods)
Robert Geyer (Public Policy/ International Politics)
Graham Room (Public Policy Agile Actors)
Michael Wolfson (Government/Policy/ABM)
Eve Mitleton-Kelly (Policy/Methods/ Organizations)
Peter Barbrook-Johnson (Computational Modeling/ Public Policy)
Malcolm Williams (complex realism in social research)
Rajeev Rajaram (Dynamical Systems/ Case-Based Entropy)
Celia Lury (Interdisciplinary Methodologies)
Emma Uprichard (Time/Big Data/ Interdisciplinary Methods)
Gregory Bateson (ecology of mind)
Francis Heylighen (Principia Cybernetica Project)
Debora Hammond (Systems Thinking)
Arturo Rosenblueth (Physiology & Cybernetics)
George Klir (Systems Engineering)
Norbert Wiener (Cybernetics Mathematics)
Heinz von Foerster (2nd order cybernetics)
Marvin Minsky (Cognitive Science)
Jay Forrester (System dynamics)
W. Ross Ashby (Cybernetics of Mind)
Claude Shannon (Information theory)
J.B. Ruhi (Law's Complexity)
Kenneth Bailey (Sociology Systems Theory)
Riane Eisler (Cultural Transformation)
Hans van der Zouwen (Methods)
Peter Checkland (Soft Systems Methodology)
Francisco Parra-Luna (Sociocybernetics)
Felix Geyer (Alienation)
Edgar Morin (Pensée Complexe)
Manuel DeLanda (Assemblage Theory)
Hideki Takayasu (Power Laws Econophysics)
C.H. Hommes (computational economics)
Deborah Lupton (Digital Sociology Digital health)
Richard Rogers (Digital Methods/ Digital Cultures)
Noortje Marres (Digital Sociology/ E-Science Methods)
Petter Törnberg (Heterodox Computational Social Science)
Anil K. Maheshwari (Big Data Analytics)
David Byrne (Complex Realism/ Case-based Modeling)
Manuel Lima (Visual Complexity)
Lasse Gerrits (QCA/Public Admin/ Urban Planning)
Phil Haynes (Policy & Dynamics Pattern Synthesis)
Sofia Pagliarin (Qualitative Complexity/ Mixed Methods)
Brian Castellani (Case-Based Modeling/ Configurational Theory)
Wendy Dyer (Cluster Analysis/ Case-Based Method)
Charles Ragin (Founder, QCA, Fuzzy Set Social Science)
Jennifer Badham (ABM/Networks)
Philippe Giabbanelli (Computational Intelligence/ Data Mining/Public Health)
Debraj Roy (Modeling Urban Processes)
César García-Díaz (Simulation in Social Science)
Robin Purshouse (Decision Modelling ABM/Policy)
Peter Coveney (Computational Science/Chemistry)
Gregory Piatetsky-Shapiro (Knowledge Discovery in Databases)
Melanie Mitchell (Computation in complex systems)
Nathalie Vialaneix (SOM/Neural Nets)
Valeria Krzhizhanovskaya (Computational methods)
Jeanette Wing (Computational Thinking)
William S. Cleveland (Machine Learning/ Data Visualization)
Michael Wooldridge (Editor, AAMAS)
Joshua Epstein/ Robert Axtell (Artificial Societies)
Loet Leydesdorff (Complexity of Communication)
Katia Sycara (Robotics/ Muti-agent Systems)
Elizabeth E. Bruch (Quantitative Sociology)
Lada Adamic (Networks/ Computational Modeling)
Flaminio Squazzoni (ABM and Socio-economics)
Nigel Gilbert (ABMs/public policy)
Christopher Langton (AI in computers)
John Conway (Game of Life)
John Holland (Genetic Algorithms Emergence)
Hector Zenil (Algorithmic Complexity)
Teuvo Kohnen (Self-Organizing Map)
Frank Rosenblatt (Connectionism)
Noam Chomsky (Linguistics)
Robert Hodge (semiotics/ social complexity)
Eleanor Rosch (Embodied Mind)
Evan Thompson (Embodied Mind)
Péter Érdi (Computational Neurology/Cognition)
Herbert Simon (Bounded Rationality/AI)
Warren McCulloch (AI Founder)
Walter Pitts (Founder)
Doina Precup (AI and uncertainty)
Stephen Wolfram (Cellular Automata)
Andrei Kolmogorov (Complexity & Information)
Stephen Cook (Computational/ Time Complexity)
Charles H. Bennett (Quantum Computation)
Bruce Edmonds (Simulation Public Policy)
John von Neumann (Cellular Automata/ Game Theory)
Marvin Minsky (Cognitive Science)
Claude Shannon (Information theory)
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Biographical Summary

Brian Castellani (PhD, FAcSS) is professor and Director of the *Durham Research Methods Centre* and *Wolfson Research Institute for Health and Wellbeing*, Durham University (UK). He is also adjunct professor of psychiatry, Northeastern Ohio Medical University (USA).

Lasse Gerrits (Dr.Dr.) is Associate Professor and Academic Director, *Institute for Housing and Urban Development Studies*, Erasmus University Rotterdam

Durham University

ERASMUS UNIVERSITEIT ROTTERDAM

BRIAN CASTELLANI
LASSE GERRITS

THE ATLAS OF SOCIAL COMPLEXITY

EE Elgar

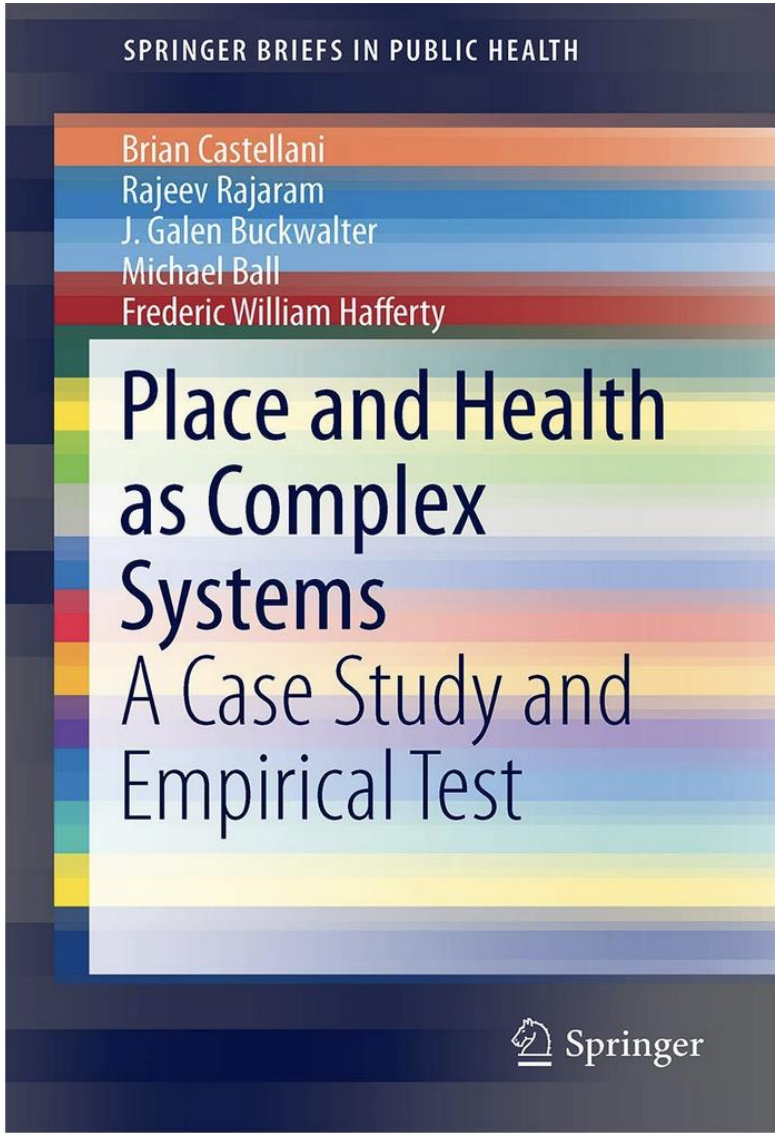
L'œil, comme un ballon bizarre se dirige vers L'INFINI.

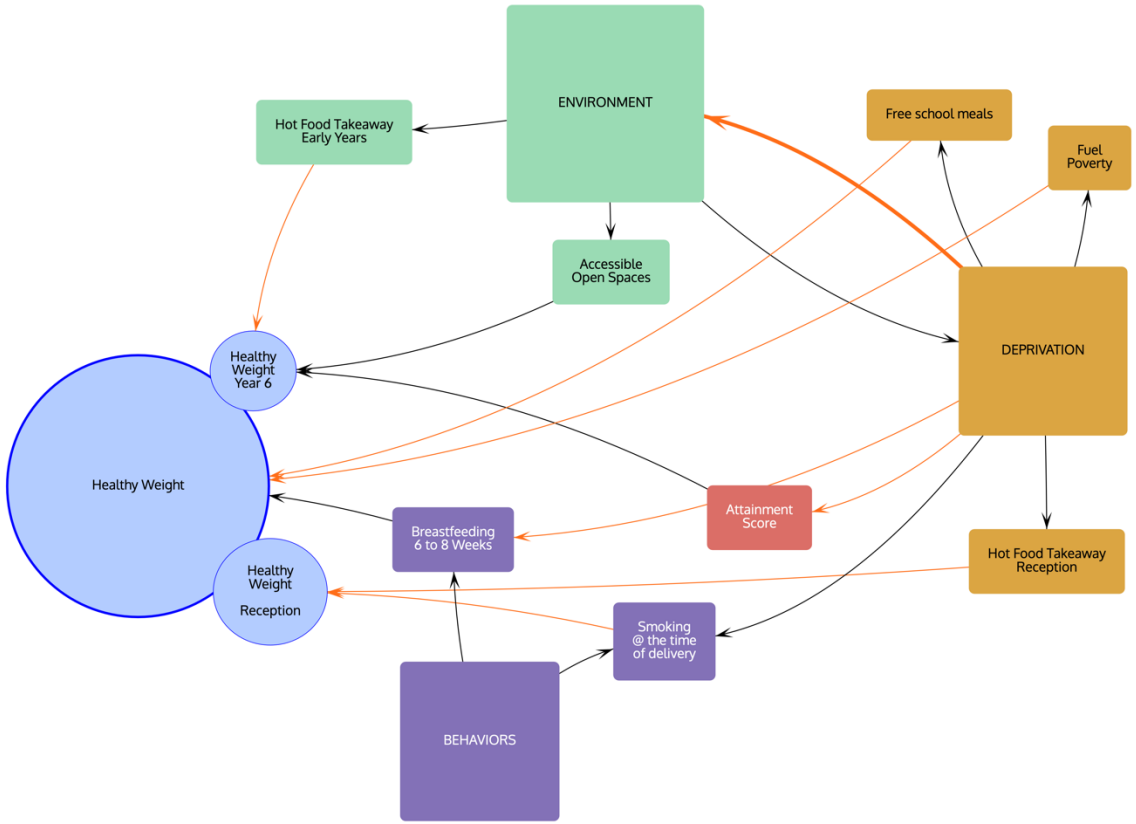
場所の複雑さ

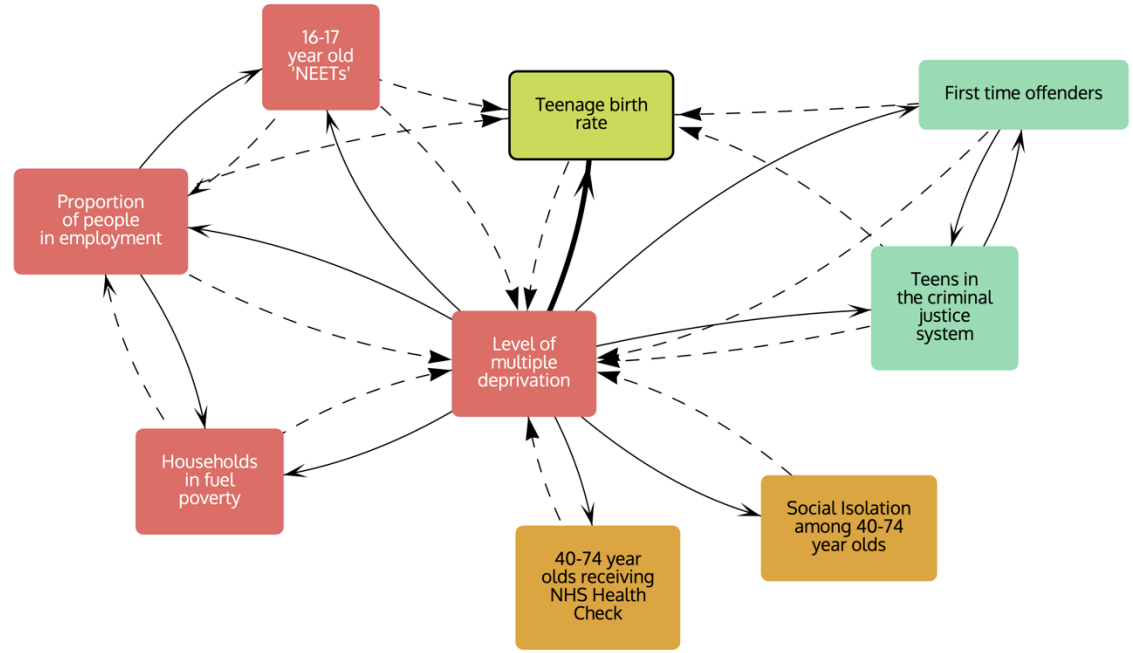
Complexities of Place

- Why Complexity Thinking Matters:
- - Acknowledges interconnected systems and feedback loops
- - Considers the dynamics of social determinants of health
- - Embraces uncertainty and emergent behaviors

- Place-Based Approaches:
- - Recognize the unique characteristics of local environments
- - Address disparities shaped by geographic and social contexts







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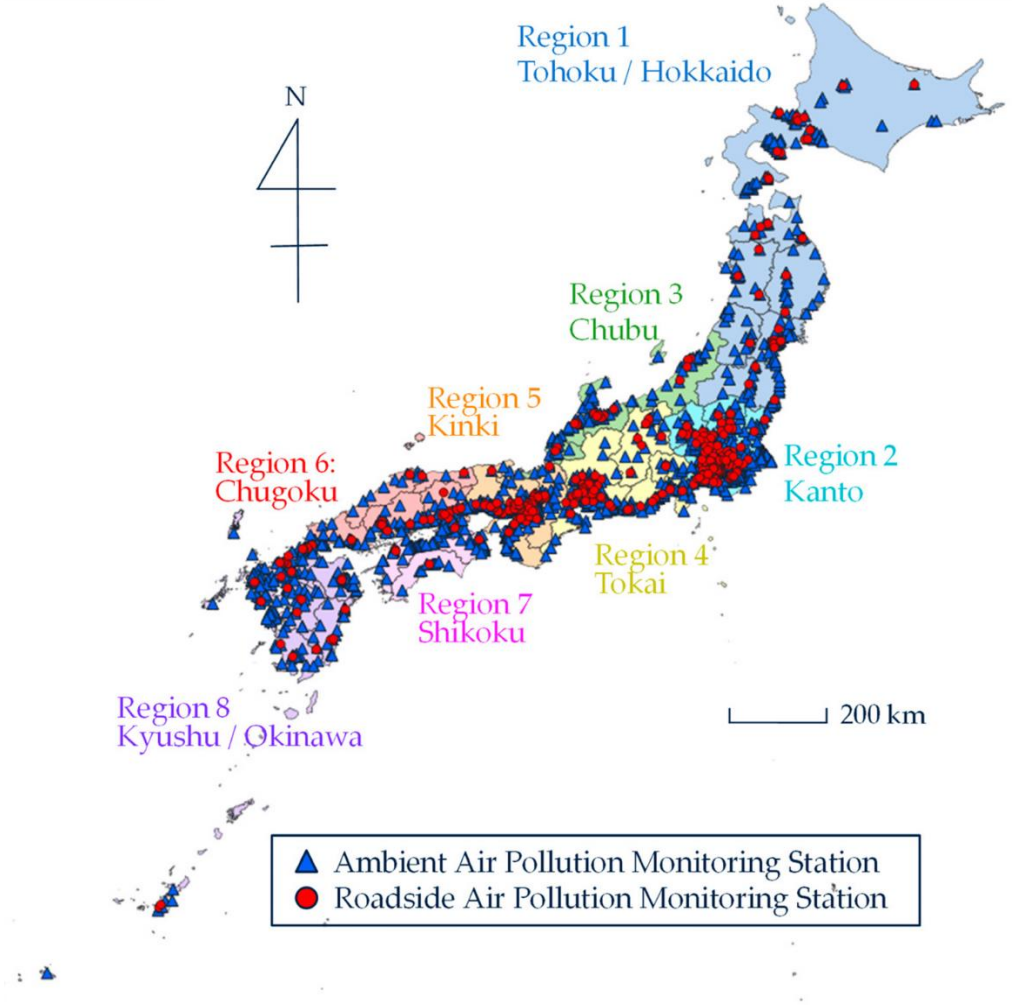
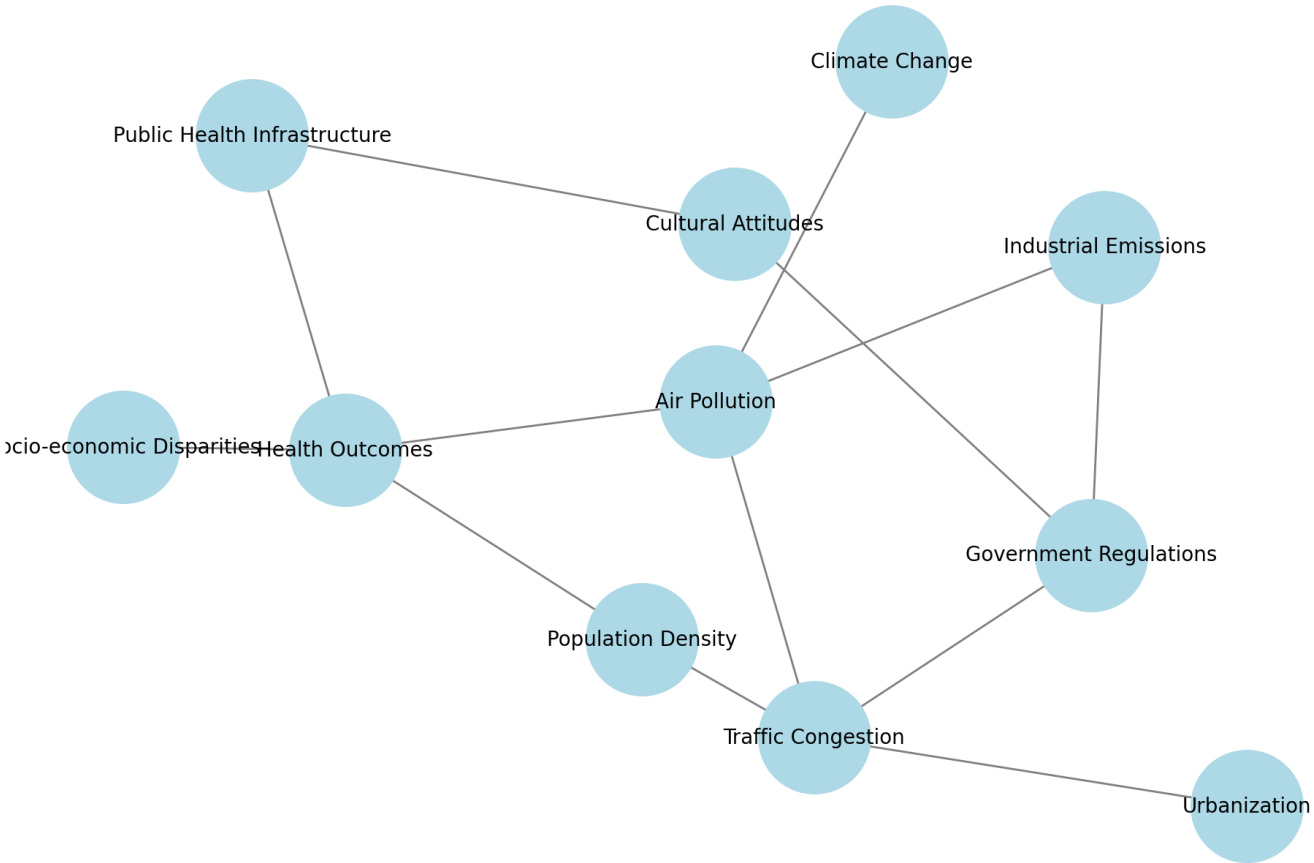


Social and Environmental Factors Determining the Impact of Air Pollution on Health in Japan



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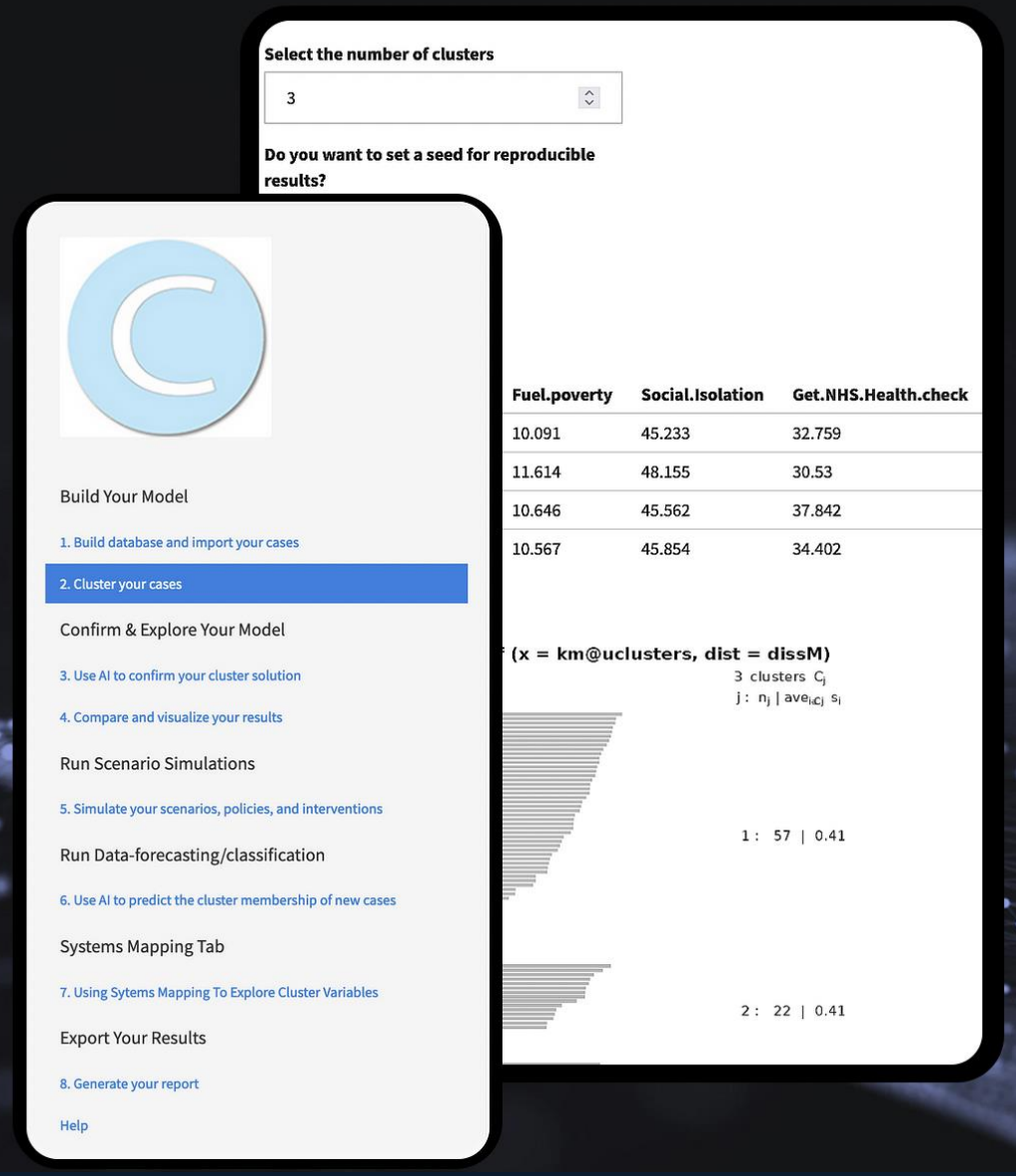
COMPLEX-IT

Run Online or Download for R-Studio

WEB VERSION

DOWNLOAD VERSION

https://www.complex-it-data.org/



COMPLEX-IT

Team

As a team we are committed to advancing a **case-based complexity approach** to research, policy and practice in an effort to advance the study of social complexity and to support decision making. We each bring to the team a wide range of methodological and programming expertise and are proud of the truly transdisciplinary and international makeup of our work.

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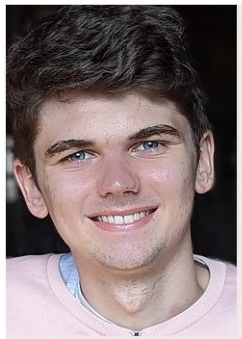

Christopher Caden
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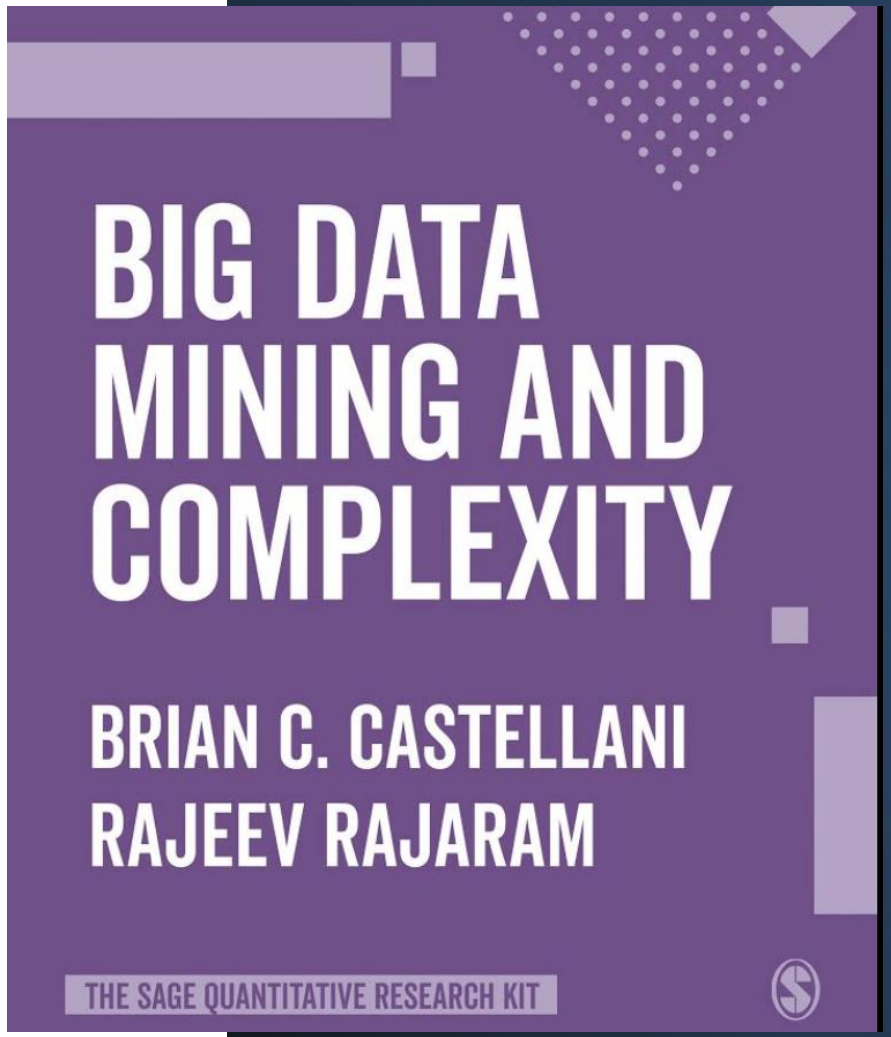
- Case-based complexity is anchored in **four core epistemological arguments**:

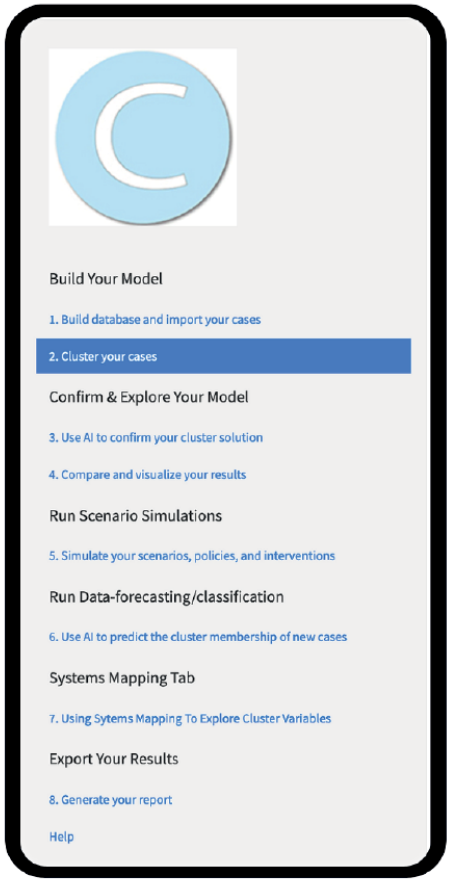
  - Cases are the methodological equivalent of complex systems – that is, they are emergent, self-organizing, nonlinear, dynamic, etc – and therefore should be studied as such.

  - The case and its trajectory across time/space are the focus of study, not the individual variables or attributes of which it is comprised.

  - Cases and their trajectories are best treated as composites (profiles), comprised of an interdependent, interconnected sets of causal conditions, factors or attributes.

  - The wider social contexts/systems in which cases are situated needs to be considered.



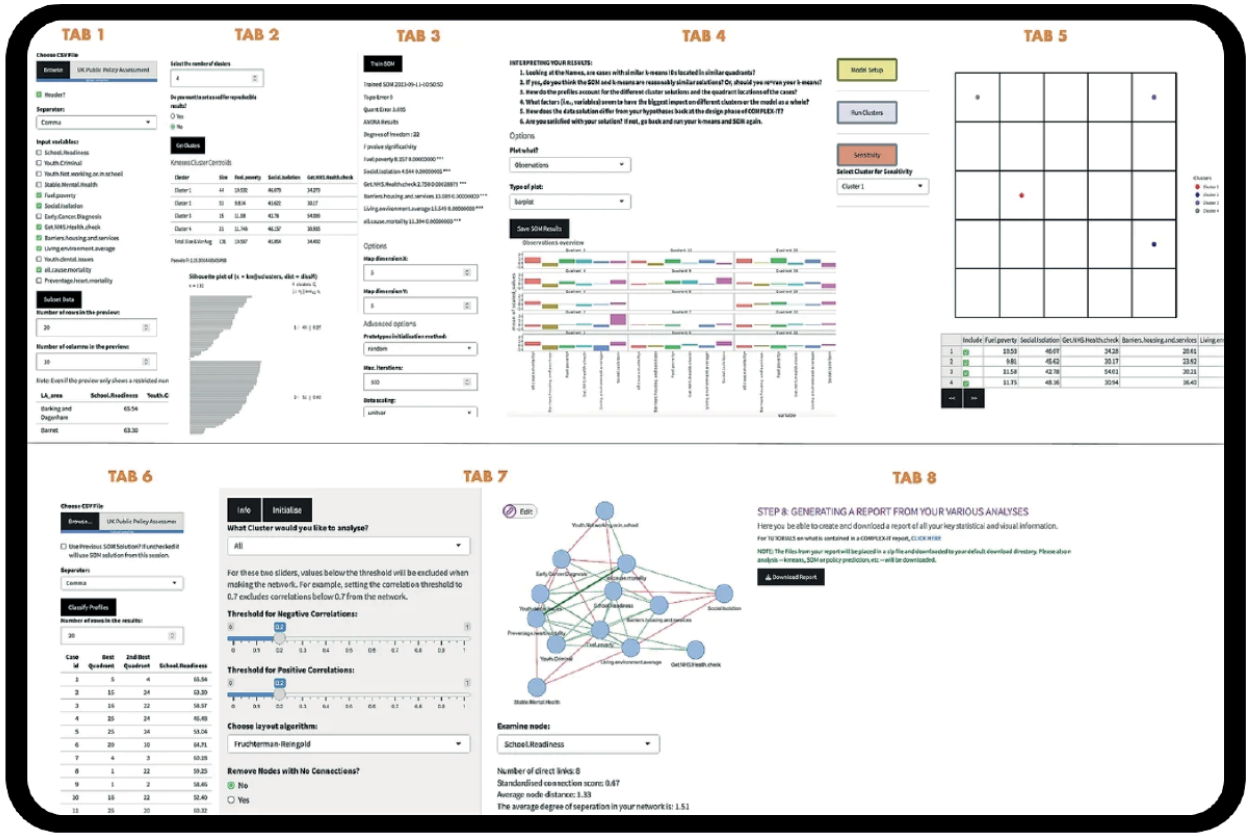


How **COMPLEX-IT** Works

COMPLEX-IT is a tab-driven interface.

Tab 1 allows you to import and organize your data.
Tab 8 generates a downloadable final report, complete with EXCEL files, statistical results, and graphs.
Tabs 2 through 7 offer you a suite of of computational methods designed for a *case-based complexity* approach to data exploration, modelling, forecasting and simulation.

TAB 2 – Cluster Analysis
TAB 3 - Machine Learning
TAB 4 - Data Visualization
TAB 5 - Scenario Simulation
TAB 6 - Data forecasting
TAB 7 - Systems Mapping



Barriers and Levers to Good Practice

優れた実践への障壁と推進力

- 1. Ambiguities in Definition: Lack of clarity on what 'community health' entails.
- 2. Issues with 'Community': Idealized notions of consensus and equality often unrealistic.
- 3. Terminology Critiques: Risk of desocialization and focus on biomedical reductionism.
- 4. Emphasis on Local Action: May shift focus from larger social determinants.
- 5. Alternative: Collective health emphasizes social determinants and interdisciplinary approaches.

Diez Roux, A. V. (2002). Community Health. International Encylopedia of the Social Behavioral Sciences.

Barriers and Levers to Good Practice

優れた実践への障壁と推進力

- Barriers:
- - Power imbalances between researchers and communities
- - Limited funding and resources for participatory projects
- - Challenges in interdisciplinary collaboration
- - Resistance to adopting complexity approaches

- Levers for Success:
- - Building trust and transparent communication
- - Training in complexity science and participatory methods
- - Securing institutional and community buy-in
- - Developing flexible and adaptive research frameworks

Conclusion

- Community-based medical research requires a commitment to inclusivity, interdisciplinary collaboration, and an appreciation for complexity. By embracing participatory approaches and innovative modeling techniques, we can address the diverse and interconnected challenges communities face.