A desirable future: harnessing complexity in big data

Dr Emma Uprichard is leading initiatives to develop state-of-the-art quantitative training programmes and interdisciplinary methodologies for social scientists to harness the power of big social data to understand change and continuity in complex social systems

What attracted you to conduct research on quantitative social sciences?

I have always been fascinated by change – I remember watching caterpillars slowly cocoon themselves, and the magic that followed when the butterfly emerged from the chrysalis. I am both terrified and amazed by the necessity for all living things to change – or not – over time.

The challenge of applying complexity (an approach used to study complex patterns of change and continuity) to the social sciences has led me to analyse many qualitative, quantitative and mathematical models for exploring change and continuity. I have a particular interest in numerical taxonomy techniques that help to group data (and people and organisations), and the different ways that classifications and categories can be exploited to delve into change and continuity over time and space more generally.

Teaching quantitative methods prompted a deeper interest for me in the technicalities of measurements and the inscribed causality within quantitative models – and the implications these subsequently have for how we model the social, and how we plan and act in the social world, based on models, metrics and measurements.

A key issue I explore in a book entitled *Time and Method* (Routledge) is how all the methods that can be used to explore change have particular temporalities inscribed within them. To really grapple with the messiness and nonlinearity of social change, we need to start thinking more creatively about the methods and methodologies we use.

As co-Director of the Warwick Q-Step Centre, can you share examples of quantitative projects currently underway?

The Warwick Q-Step Centre comprises the departments of Sociology, Politics and International Studies and the Centre for Interdisciplinary Methodologies (CIM). We have a wide range of projects underway, on topics like: couple relationships and marriage; how childhood disability impacts the lifecourse; child development, education and transition to adulthood; mid-life economic risk and wellbeing, and intergenerational change; and cause and outcome, such as how gender explains long-lasting and successful careers in the trade unions. We also focus on development data and democracy; democratic transitions, political institutions and party systems in Africa and elsewhere; and violence and conflict and their economic costs in different countries.

In studying causality linked to complex systems, how do you achieve useful causal narratives?

Determining causality in relation to complex social systems in a way that is useful to policy planners and practitioners is very difficult. However, there is a growing group of scholars thinking hard about how empirical research can be done differently to get clues on how to effect desired changes in the social world. Traditionally, there is said to be a causal relationship when A always makes B happen. However, in the social world, it is more useful to consider that there are many pathways to the same outcome and vice versa that similar initial conditions can lead to very different outcomes.

What potential does your research on big data have for answering social questions?

Big data holds a lot of potential – but only if we recognise that it is part of the product of a social world and not simply what we might use to model it. At the Centre for Interdisciplinary Methodologies (CIM), we are currently leading and/or participating in several major data-driven projects. Our work ranges from investigations into digital mapping, issue mapping, interface design and data epistemology to the social issues that arise from the uses of big data, including questions of ranking, ethics and how data and the methodologies used to explore data mediate and shape social processes.

Given today's data-driven digital society, how do you see methodological challenges and applications of complexity theory in social science developing?

I think this is where it really gets very exciting for social science and complexity. Traditionally, social science data have not been very good for modelling trajectories, for example. This is precisely because, even if we are lucky, we only have a few time points. The Census, for instance, happens every five to 10 years, so even over 100 years, we have very few time points – and our categories and measurements, like counts of ethnicity and religion, usually change qualitatively over time. These 'basics' really restrict the kinds of methods we are able to use.

There has been much debate about big data and the ways in which it is transforming all domains. Importantly, it opens up space for serious innovation and methodological development, mainly because big data tends to come with many time and space points. So we can really start to explore the ways in which machine learning and other kinds of pattern detection methods might innovate social science methods altogether.

Making sense of a fuzzy world

How can we use big data to produce better outcomes for society? This is a fundamental question that drives multidisciplinary research into new quantitative social science methods at **University of Warwick** in the UK

THE SPEED AND SCALE of 21st Century digital technologies – in the shape of the internet, social media and platforms – and the free-form social interaction they support, are increasingly blurring the distinction between public and private sectors. Consequently, formal centralised social control systems are disintegrating.

Big social data is key to understanding patterns of change in society. However, much attention to analysing big data in societal terms has focused on means of leveraging economic value, such as improving operational efficiency in healthcare services, or maximising tax revenue collection. The logistics of how to assemble and analyse large sets of data tends to take priority over basic unresolved questions.

BIG QUESTIONS ABOUT BIG DATA

According to Dr Emma Uprichard, Associate Professor in the Centre for Interdisciplinary Methodologies (CIM) and co-Director of the Q-Step Centre at Warwick University, there are even more fundamental issues that are largely ignored, such as which methods might be used or developed to address big complex policy issues that demand a rigorous understanding of the local, regional and international context.

The main issue for her from the perspective of the social sciences is, given that social systems, like big data, are open, complex and dynamic, who determines what is 'social' about big data, and to what use should it be put? Also, how can cause and meaning be extracted from big data to support future social planning and policy? Meanwhile, a further layer of complexity is that big data is not simply a product of social systems: most big data is in fact social data and therefore feeds back into how the social world emerges.

New methods are urgently needed if meaningful information about social change or continuity is to be extracted from big data. Uprichard points out that the spotlight should turn to the use of big data to find ways of changing society to achieve a desired future by destabilising the processes that reproduce social divisions in certain settings: "I have spent years trying to explore a simple question: how do we empirically study social entities that change through time and space? And how do we do this in a way that helps us to make desired changes at a policy level?"

New methods of quantitative analysis are thus required that acknowledge complex causality and important feedback loops between data, methods and policy planning and practice. Uprichard's research, therefore, focuses on the challenge of developing methods from the perspective of complex systems to study change – and continuity too – in social systems through time and space. For this to happen, new methods should apply knowledge from multiple disciplines.

THE WARWICK Q-STEP CENTRE

The UK currently has a shortage of social science graduates with quantitative skills. To meet the need for qualified social scientists with quantitative skills in academia, government, business and charities, the Nuffield Foundation, the Economic and Social Research Council (ESRC) and the Higher Education Funding Council for England have jointly funded a £19.5 million programme called Q-Step to promote a step-change in quantitative social science training. Q-Step has funded the establishment of Q-Step Centres at 15 universities across the UK to support the development and delivery of specialist undergraduate programmes.

The Q-Step Centre at Warwick encompasses the departmental units of Politics and International Studies, Sociology, and the Centre for Interdisciplinary Methodologies. Teaching is driven by real-world problems, employing virtual learning and small tutorial group approaches, and emphasising statistical literacy in both workplace and citizenry contexts. Warwick Q-Step offers internationally-competitive degree programmes: two undergraduate degrees in Sociology and Quantitative Methods, and Politics, International Studies and Quantitative Methods, an MA in Politics and International Studies: Big Data and Quantitative Methods and an MSc in Big Data and Digital Futures. A fifth Master's programme in Sociology is in development.

SEMINARS ON COMPLEXITY

The ESRC Seminar Series brings together complexity scholars from across disciplines to develop empirical ways of studying the social world from the complexity perspective. The main aims are to develop a set of resources for natural and social science students, graduates and faculty, and to consider how change and continuity can be examined to inform practical application in policy. For the Series, CIM is running nine one-day seminars across three years.

The first two Series themes dealt with the state-of-the-art in complexity methods and different approaches to complexity. The next one in February 2016 will cover the creation of a complexity toolkit for teaching and learning complexity methods in the social sciences.

For Uprichard, understanding change is predicated on acknowledging that it is possible to have multiple pathways to the same outcome, and vice versa, trajectories that begin from the same initial conditions can end up in very different places. "This is really very important in relation to social systems, since the local context is so important in determining whether a change can or cannot – or may or may not – happen," she states. "The fact that causality is contingent emphasises the difficulty of prediction and planning and the need for flexibility and adaptability to unforeseen events

The spotlight should turn to the use of big data to find ways of changing society to achieve a desired future by destabilising the processes that reproduce past social divisions

CENTRE FOR INTERDISCIPLINARY METHODOLOGIES (CIM)

CIM aims to foster innovative experimental forms of knowledge production through a sustained focus on methodology using knowledge from different disciplines. The research team has expertise in, among other things, cartography, cities, cultural economy, aesthetics, digital media, software studies, topology, visualisation, complexity, value/valuation and food studies. Below are some of the projects underway.

Dr Nerea Calvillo focuses on the design and production of digital devices as research and artistic methods to investigate urban ecologies. She is also curator of the EU-funded Connecting Cities Network project.

Dr Michael Dieter investigates interface criticism and the social influence of user-experience design in commercial app development and social media platforms.

Dr Sybille Lammes is Principal Investigator (PI) on the European Research Council project Charting the Digital, which investigates the big data intrinsic to digital maps. Her team is also developing a cartographical game employing personalised data to track learning processes, lifestyle and mobility.

Professor Celia Lury is Director of the Centre. She is also Co-Investigator on the ESRC project Socialising Big Data and is on the ESRC Professorial Fellowship on Order and Continuity: Methods for Enacting Change in a Topological Society.

Dr Noortje Marres developed Issue Mapping Online, a tool for digitally analysing and visualising topical affairs (issuemapping.net). This has been used for mapping internet governance issues with Twitter, smart meter controversies on the web and selfie stick debates between Instagram and Twitter.

Dr Greg McInerny investigates methods in modelling, visualisation and software to progress how data and information are analysed, communicated and managed.

Professor David Stark is working on three big data-related projects: one on commercial video game developers spanning 40 years, another on jazz recording musicians and the releases that ensued in the 20th Century, and the last on estimated end-of-year earnings for all securities traded on the New York Stock Exchange since 1978.

Dr Nate Tkacz is PI on the ESRC Interrogating the Dashboard project, which explores the use, function, legacies and potential of dashboard formats that typically use radically-condensed data.

COMPLEXITY ACROSS THE SOCIAL SCIENCES

OBJECTIVES
To empirically study complex social science entities that change through time and space through the use of big social data.

KEY COLLABORATORS
Dr Nerea Calvillo; **Dr Michael Dieter**; **Dr Sybille Lammes**; **Professor Celia Lury**; **Dr Noortje Marres**; **Dr Greg McInerny**; **Professor David Stark**; **Dr Nate Tkacz**, Centre for Interdisciplinary Methodologies, Warwick University, UK

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DR EMMA UPRICHARD is Associate Professor and Deputy Director at the Centre for Interdisciplinary Methodologies, and co-Director of the Warwick Q-Step Centre. Her work is driven by the methodological challenge of studying complex social systems across time and space and has substantive interests in cities, childhood and food. Uprichard is currently Principle Investigator (along with Byrne and Castellani) on the ESRC Seminar Series 'Complexity and Methods in the Social Sciences' and holds an IBM Faculty Award on 'Big Data and Real Time Analytics'. She is currently working on a monograph titled *Time and Method* (Routledge).

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