linking with the media on patient experiences, and undertaking comparative studies between different countries in terms of health experiences and issues.

It would provide a forum for partnership, both with other research groups and disciplines within the University, and with other organizations using a range of methods to explore patient experience, such as the Picker Institute in Oxford which conducts major NHS surveys.

"GTC is a very rich environment in which to start looking at these issues with its constituent interests of medicine and social science, including management, health and social policy, and media studies," says Dr McPherson.

Louise Locock, GTC research fellow and deputy research director at DIPEx will be very involved in the Institute. "The development of HEXI will provide a platform for us to broaden our remit and draw in a range of research partners to explore different approaches. I'd like to think that if we – researchers, managers, doctors and policy-makers – could all stop for a bit and think what policies based on patient experiences and preferences would look like, we would come up with some rather different ways of doing things."

The College has already secured funding for a three-year Cannon Fellowship funded by the Cannon Foundation, a charitable foundation established by retired UK entrepreneur Michael Cannon. The Fellowship starts in January 2010 and will explore the relationship between policy and patient experience and support work on using patient experience research to redesign healthcare processes.

"We were attracted by the unique opportunity presented by GTC for the close interaction between medical scientists and management specialists," says Michael Cannon. "We hope the research will influence health policy and practice on a global scale, with a real and immediate impact on the lives of patients."

"There is much work still to be done to refine our understanding of what really matters to patients, and to develop both qualitative and quantitative research methods for capturing different aspects of experience," says Dr McPherson.

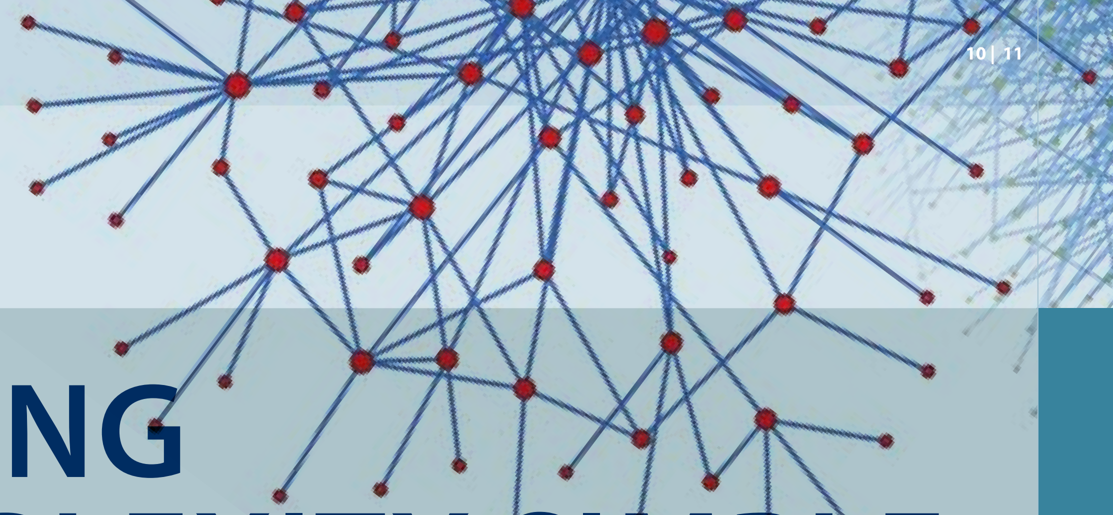
Healthtalkonline.org and the proposed new Institute are poised to take the lead in taking research out into the real world and making connections with healthcare users, practitioners and policy-makers.

If you are interested in supporting Healthtalkonline and the Health Experiences Institute, please contact GTC Development Director Heather Ebner on +44 (0) 1865 274777 or email: heather.ebner@gtc.ox.ac.uk

Dr Ann McPherson, medical director of DIPEx, and Jon Snow, patron of DIPEx, at the launch of the clinical trials section of www.healthtalkonline.org

"Ann is one of those people with unbelievable determination and enthusiasm. She has set her heart on establishing the first institute of Health Experiences which brings together research from all the different disciplines in this area – and I know she will make it happen. Very few people, myself included, can say no to Ann."

Jon Snow



FEATURE

MAKING COMPLEXITY SIMPLE

Analyzing complex systems can help us understand the world we live in, says Felix Reed-Tsochas.

From road and rail systems connecting towns and cities, through essential power grids and world-wide communications systems such as the Internet, to ever-evolving social networks of friends and family, our world today is crammed with myriad complex networks.

The challenge of understanding how these systems function is being grasped by the new science of complex systems, also referred to by some as 'complexity science'. A blend of physics, biology and sociology, to list just a few of the contributing disciplines, a central focus of this emerging field is to identify network properties and examine the factors which cause the networks that surround us to expand and evolve, as well as shrink and even collapse.

Some of the most interesting research in this area is taking place at the CABDyN Complexity Centre which is coordinated from the Saïd Business School in Oxford and includes a range of University departments. CABDyN stands for Complex Agent-Based Dynamic Networks and is an initiative established in 2003 to encourage research on complex systems across disciplines using tools such as agent-based modelling and complex network analysis.

GTC Fellow Felix Reed-Tsochas is Director of Complex Systems at the Institute for Science, Innovation and Society and a founding co-director of CABDyN.

One of the most powerful ways of characterising a complex system is by representing it as a network which is where much recent research has been focussed. But while you might think that the characteristics of complex networks are entirely predetermined by the specific, idiosyncratic contexts in which they are found – for example, that a business network probably has something to do with very specific business conditions – in fact, networks seem to follow very generic rules.

"Interestingly, there are certain very important characteristics that networks share that seem to be universal and are manifested again and again," explains Felix-Reed Tsochas, GTC Fellow and a founding co-director of CABDyN.

"These characteristics appear in the Internet, or in biological interaction networks representing chemical pathways, or in important infrastructural networks such as the power grid. We even see them in less substantive and more entertaining examples, such as the network of actors linked by the Hollywood movies in which they have jointly appeared.

"If that's true, it suggests that many of the key organising principles behind such networks can't be all that sensitive to the precise details of context but are more universal in the way that they're constructed," he adds.

The framework of complex networks therefore potentially provides a powerful language enabling the translational exercise of understanding how problems from one domain relate to problems in another.

A key example is Reed-Tsochas's recent research into the New York garment manufacturing industry which highlighted striking similarities between the structure of cooperative interactions in the relationship of manufacturers and contractors to one another and the collaborative ecological networks formed by plants and the insects that pollinate them.

The researchers studied 700,000 payment transactions between New York firms over 20 years, and constructed a computer simulation model which reproduced the structural characteristics of ten large pollination networks as well as the inter-firm network in the garment industry.

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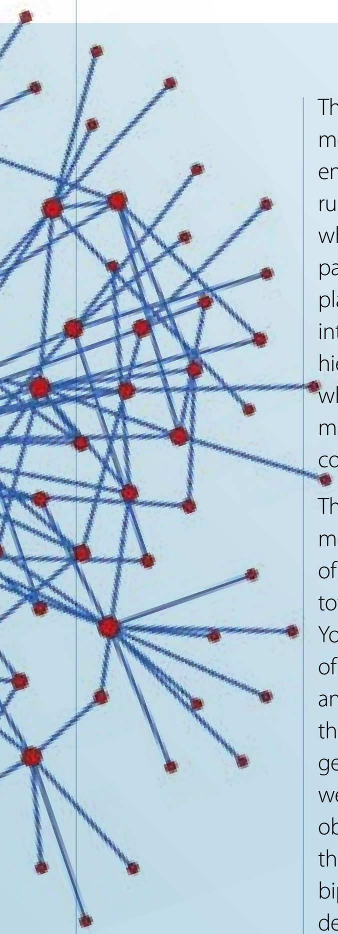

The model incorporated two mechanisms which could be encoded using remarkably simple rules: a specialization mechanism, which determined how few or many partners each manufacturer (or plant) will cooperate with; and an interaction mechanism, which used hierarchical ordering to determine which contractors (or insects) a given manufacturer (or plant) will cooperate with.

The empirical data fed into the model simply recorded the number of partners in each category and the total number of links, so for the New York garment industry the number of manufacturers and contractors and the number of links between them. The computer model then generated network structures, which were compared to the empirically observed networks by focusing on three key features that characterise bipartite cooperation networks: degree distribution (the probability distributions of how many connections manufacturers and contractors or plants and insects have); nestedness (the level of hierarchical 'order' found in the network, reflecting whether firms or species with many links seek to cooperate with partners that have many or few links themselves), and modularity (the degree to which the network can be broken down into weakly interdependent components or modules).

Unexpectedly, the two mutualistic networks used the same patterns of cooperation and their key features appeared very similar despite the different contexts, suggesting that firms and plant and insect species follow similar rules when deciding whom to cooperate with. So it appears that cooperative interactions are structured in a very generic way which means that the simple rules of cooperation could be relevant to the study of many different examples of cooperative behaviour across a range of domains.

"Of course, it is hypothetically possible that we have come up with a model that works for the bees and the flowers and the New York garment industry and nothing else!" says Reed-Tsochas. "But that would be pretty bizarre, which leads us to think that both systems must be examples of a broader category of how cooperation works, both in nature and in society."

The research team, including Serguei Saavedra (CABDyN and the Oxford University Centre for Corporate Reputation) and Brian Uzzi (Kellogg School of Management at Northwestern University), is now studying other complex networks to test the model and will publish results of an analysis which also includes findings for the Broadway musical industry.

"Brian Uzzi had previously compiled a dataset of people who have produced Broadway musicals over the last hundred years, working out whether their shows were successful, whether they know each other, and so on, to build up a network of people who have previously interacted with each other," Reed-Tsochas says.

"Returning to this dataset with our new model, it turns out that the pattern of cooperation that works for flowers and insects and for manufacturers and contractors works equally well for the theatres in which musicals are staged and the producers. The producers seem to act just like the bees and the theatres act just like the flowers. We have a few other examples to show that this is a very generic pattern of behaviour."

A related study has thrown light on contracting or shrinking networks, an area little researched to date since most studies looking at changes in economic or social networks over the last decade have focussed on static or growing networks such as the Internet.

During the 20-year period studied, the New York garment manufacturing industry was rapidly declining by a factor of ten, from over 3,000 firms to just 190. The network contracted but it did not fragment and its overall structure and the way relationships were distributed across firms remained largely unchanged.

In addition, the network's ability to continue to function depended on a very specific set of relationships, linking firms to business partners with a different status or level of connectivity. This suggests that relationships between specialist and generalist firms are likely to be favoured, although this could not have been planned or coordinated.

Crucially, claims Reed-Tsochas, these findings are not limited to the manufacturing industry but may be relevant to other contracting networks. This has obvious significance for the car and banking industries in the current financial climate, but also for other shrinking networks such as ecological networks facing extinction and networks of neurons affected by degenerative diseases, for example.

Interestingly, Reed-Tsochas' academic background is not in management or social science but in theoretical condensed matter physics. It is however, he asserts, a natural move from physics to complex systems.

"In physics, one is often interested in how interactions between different entities lead to novel behaviours – for example how electrons combine to produce superconductivity – and more generally to understand what happens when many constituent parts of a system affect each other and what sort of behaviour they collectively exhibit," he explains.

"The key question about complex systems is to understand collective behaviour, understanding that systems are composed of individual entities or particles or people, all following what can often be viewed as quite simple rules and that gives rise to unanticipated, unplanned, highly ordered forms of behaviour at a collective level. What I seek to do is to describe their properties and characteristics."

Physics has developed some powerful mathematical formal and conceptual tools which are highly relevant when trying to understand how collective behaviour relates to individual behaviour, he says, even though traditionally they have been applied to particles and atoms not people. An increasing number of physicists are turning their attention to complex systems, largely driven, believes Reed-Tsochas, by the fact that these sorts of generic questions not only arise within physics but also in sociology or economics.

For him, the key to applying physics principles seriously and sensitively to the characterization of social systems is to be embedded in a department where people have a lot of knowledge about the issues and "where you are forced to make what you have to say appear relevant. That's an important challenge to have – although I'm not claiming that I always succeed! Being based at Saïd is very beneficial for my work."

As an example of the relevance of physics tools to social science research, he cites a 2007 study on the architecture of social networks which analyzed mobile phone data from seven million mobile phone users (approximately 20 per cent of the total population) of a European country to assess the flow of information through society. Sociologists have long sought to understand social networks and have traditionally used questionnaires to probe the issues.

However, there are problems with that approach when considering vast networks, Reed-Tsochas points out.

"First, it requires respondents to faithfully reconstruct their behaviour retrospectively, and second, as a technique it is limiting because it typically allows social scientists to construct social networks which are unlikely to have more than about 100 people in them. So the questions posed are most appropriate for networks of this size, such as who is the most important actor in it? This is a meaningless question when a network involves hundreds of thousands or millions of actors and connections."

Tools from physics can be valuable here as they allow modelling and analysis of large-scale networks and meaningful questions to be asked.

Meanwhile, CABDyN is developing its own collaborative research networks both in Oxford and internationally, in particular with the Santa Fe Institute, a leader in the field, and Northwestern University in Evanston, Illinois. The Centre has grown considerably, attracting researchers of the highest calibre, and is gaining an international reputation for its research.

"I believe that we have a real opportunity to become one of the worldwide leaders in this sort of research, because in Oxford we have what strikes me as the most genuinely interdisciplinary group in the UK. This is partly helped by the college system which encourages collaboration across disciplinary boundaries. A college dinner might just generate interesting cocktail conversation but if used in the right way it can also be a lever to help build interdisciplinary research. That puts Oxford in a strong position," says Reed-Tsochas.

Although the science of complex systems is focussed on developing a fuller understanding of systemic properties and behaviours across a wide range of problem domains, findings already show promise of wider significance. In the commercial world, many companies need to adjust their business models to a context where customers are increasingly likely to interact with each other directly, and influence each others' behaviour.

"A deeper understanding of how networks function also allows you to address important societal problems, like social exclusion in the age of technology. How the notions of social exclusion will change and shift as our social lives become more mediated by information and communication technology is uncertain – although it is unlikely to lead to an end to social exclusion, it may just transform the kinds of social exclusion that we see," Reed-Tsochas comments.

"At a social policy level that's important, and as social policy questions arise I hope that CABDyN will be leading the way to the answers."

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This visualisation shows the contraction of payments between designers and contractors in the New York garment industry from 1985-2003