Mia Liinason
Editor GJSS
editor@gjss.org

Just don't make yourself too comfortable in the chair: Curiosity in the academy

This issue of the GJSS seeks to explore and provoke the boundaries between science and society, focusing on the intersections between technologies and society and tracking the mutual influence of expectations and practices in technological developments and social change. It is a theme deeply involved with problematising one of the basic convictions of the GJSS, formulated by Sabina Leonelli in 2004 as "the conviction that different tools for the acquisition of knowledge should be confronted, compared and brought together in order to analyse the most complex aspects of our social reality".

This is an issue acknowledged as deeply important today by a number of important actors in the academic sector, such as the European commission. It is nevertheless difficult to put into practice. Despite a widely spread official rhetoric on the importance of interdisciplinary work in diverse European academic contexts, it is seldom transferred into everyday-work in academia – resulting in obstacles when it comes to the distribution of teachers and of financial resources across disciplinary borders. The conviction of an interdisciplinary search for knowledge, as above addressed by Leonelli, has implications for several areas of academia, such as the organization of knowledge, the relation between science and society, and, not least, for the individual scholar's methodological decisions.

One of the motives behind the conviction that knowledge cannot fruitfully be discharged and obtained within the borders of one discipline is *curiosity*. As a cognitive occupation, pushing the limits of our understanding and of our methodological habits, curiosity is continuously busy with calling comfortable ignorance in the academy into question. This point of view is well framed by the Swedish postcolonial gender studies scholars Kerstin Sandell and Diana Mulinari in a reference to Cynthia Enloe's book *The Curious Feminist. Searching for Women in a new Age of Empire* (2006:10). "I've come to think", Enloe writes, "that making and keeping us uncurious must serve somebody's political purpose. I have also become convinced that I am deeply complicit in my own lack of curiousity. *Un*curiosity is dangerously comfortable if it can be dressed up in the sophisticated

attire of reasonableness and intellectual efficiency: 'We can't be investigating everything!'" (2004:3).

This curiosity is one crucial reason to why the GJSS is devoted to interdisciplinary methodology, as an arena for young scholars to exchange knowledge and to develop a meta-level discussion of methodological considerations and their relations to and across borders of other disciplines.

This issue of the GJSS is composed by two thematic sections, occupied with investigations of the relation between science and society. Although addressing different concerns, both sections conceptualize scientific developments as inherent parts of the social process itself.

The first thematic section, titled *Genomics & Society*, is guest edited by Maud Radstake and Bart Penders. In this section, Wietse Vroom present technologies as value-laden aggregates of socio-technical ensembles rather than as neutral tools, thus stressing the idea that technologies cannot simply be handed over from one context to another. In the second article in this section, Bart Penders argue for an ethical agenda that addresses the politics of nutrigenomic practise, rather than merely focus on nutrigenomic expectations. He investigates "the personalized diet" as a specific controversy in nutrigenomics through a comparison between scientific and societal expectations and practices.

The second thematic section, titled Formal Methods of Temporal Analysis*, is guest edited by Jeffrey Roberts. Via the example of a specific technological development, Gindo Tampubolon and Ronnie Ramlogan focus on social network development in their piece on radical medical treatment. Using a bibliographic database from the past 25 years of medical journal articles focusing the topic, they develop ideas around how main path analysis makes it possible to identify the problem sequence characterising medical innovation.*

Tracking changes over time is also in focus in the article by Nicole Akai Hala, introducing two general patterns of postcommunist political change in the Czech Republic and Slovakia. Hala presents political claims analysis as a formal method to track changes over time in the salience of different political identities. In contrast to linear and unidirectional socialization models, she present this coding as capable of giving a complex picture of political identities, among other things pointing out the connections between international institutions and the shaping of political identities.

The last paper in this section demonstrates the differences between environmental movement networks at visible and latent times. Here, Clare Saunders use data from surveys at two different points of time, in order to compare social movement dynamics. By that, she presents networking not only as an important precursor to effective environmental movement action, but also as an outcome of it.

Coming from the field of Gender Studies, I am particularly interested in the element of transgression in practises of interdisciplinary knowledge seeking, where scholars are occupied with serious and difficult research, showing complexities and non-linear stories. As being the new editor of the GJSS, I have the privilege to take over the editorship of a very well managed journal from Sabina Leonelli, whose intellectual integrity and curiosity have given its imprint on the GJSS as a scientific project ever since the first issue in 2004. I am convinced that she will make her next project a similar success as the GJSS. In addition, I would also like to acknowledge the interdisciplinary and multicultural teamwork, whose joint work brings the journal into existence. Without the dedicated hard work of this group of people, it would not have been possible to produce and develop the GJSS. Finally, I would like to thank all contributors for taking part in the making of this journal as a curious intellectual space.

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Maud Radstake
Centre for Society & Genomics
Institute for Science, Innovation & Society ISIS
Radboud University Nijmegen, P.O. Box 9010, NL-6500 GL, Nijmegen
tel. +31-24-3652731
radstake@society-genomics.nl

Bart Penders
Department of Health, Ethics & Society
Care & Public Health Research Institute CAPHRI
Maastricht University, P.O. Box 616, NL-6200 MD Maastricht
tel. +31-43-3882457, fax. +31-43-3670932
b.penders@zw.unimaas.nl

Inside genomics: the interdisciplinary faces of ELSA

Editorial for the thematic section on Genomics & Society

Obesity, malnutrition, cancer, crime, poverty and global warming are only a few examples of the many societal issues currently addressed by scientific research. Research into mechanisms of bodily fat storage, biotechnological improvements of food quality, the use of DNA-techniques in forensic science, the study of possibilities for crop improvement or for bio-fuels all involve *genomics*: the large-scale study of genes, proteins and metabolites (of humans, animals, plants or micro-organisms) and their functions and interactions among each other and with their environment. Life scientists from various fields and disciplines are involved in genomics research. The Human Genome Project was one of the first examples of 'big biology', involving sophisticated instruments, large sums of money, and many researchers thinking and working together in (often large) interdisciplinary projects.

With the launch of the Human Genome Project in the USA in the early 1980s, scholars from the social sciences and humanities became part of the genomics infrastructure. James Watson, the first director of the Human Genome Project, not only discovered the structure of DNA (Watson & Crick, 1953) but also invented ELSA[1]: the study of the ethical, legal and social aspects of genomics. It has been suggested that Watson advocated ELSA in the Human Genomics Project "not to set ethical standards but to let the science proceed

[1] Also known as ELSI: ethical, legal and social issues.

unimpeded" wanting "a group that would talk and talk and never get anything done"(Fortun, 2000, p.3).[2] Indeed, ELSA programmes have been widely criticized for being non-confrontational handmaidens of genomics research, with little (if any) effect on policy making.

The idea of ELSA genomics, however, found fertile ground and has travelled around the globe. The Netherlands Genomics Initiative,[3] for example, has included research into and communication on societal aspects of genomics from its start in 2002. ELSA has been included in the interdisciplinary field of genomics that covers genetics, microbiology, bio-informatics and epidemiology, among others. Like its object of study – genomics – ELSA has been institutionalized as an interdisciplinary field. It involves scholars originating from various social sciences and humanities, including (bio-)ethics, law, social psychology, sociology and science & technology studies. Its 'double' interdisciplinarity (i.e. in terms of both research object and subject) is what makes ELSA genomics a particularly *happy hunting ground* for the GJSS.

Naively, one might consider ELSA research to be part of the social sciences and humanities, and genomics to be part of the natural sciences. Yet discriminating between social and natural sciences is not always self-evident. Epidemiology, for instance, is part of genomics, yet it exists on the boundary of social and natural science. ELSA genomics is not merely 'the next in line' in the social studies of science. One of its most interesting characteristics is its intricate entanglement with its object of study. ELSA genomics, being funded as a *part of* genomics research programmes, is as much the subject as it is the object of its own research.

In this thematic section on genomics and society we present two research papers and a book review. The papers result from presentations given at the CORSAGE Winter Meeting *Genomics and Society: chances for true love?*,[4] organized by Bart Penders, Rens Vandeberg, Wouter Boon and Erik Aarden. CORSAGE is a Dutch group of young researchers studying social aspects of genomics. It is a thematic cluster of GeNeYouS, the Dutch Genomics

[2] These and other 'Watsonisms' are included and - more importantly - analysed, in Fortun (2005).
[3] The Netherlands Genomics Initiative or Nederlands Regie-Orgaan Genomics (NGI) is a taskforce that coordinates and stimulates genomics research in the Netherlands and manages the bulk of the Dutch research budget for genomics research.
[4] Organised in Utrecht (NL) on December 16, 2005 by the Cooperative Researchers on Society and Genomics (CORSAGE) and the Postgraduate Forum on Genetics and Society (PFGS)/Benelux Region.

Network for Young Scientists. Here again, junior researchers in humanities and social science are part of a network of mainly young life scientists.

In her book *Designs on Nature. Science and Democracy in Europe and the United States*, reviewed in this issue by Erik Aarden, Sheila Jasanoff discusses societal debates around biotechnological developments as articulations of political culture in different countries. An important issue is the formation of boundaries between 'science' and 'society'. It provides a relevant background to the research papers by Penders and Vroom, who challenge the boundaries between social and natural sciences. Both papers are about food: an issue that has evoked descriptive as well as prescriptive approaches, presenting knowledge about the relationship between people and their diet, as well as suggesting to people what (not) to eat.[5] Furthermore, food has always been distributed asymmetrically among geographical areas and social classes. Both Vroom's interest in agricultural food production and Penders' focus on nutrition exemplify the cultural, social and economic importance of food.

In his paper, Wietse Vroom (2007) explores how critical and constructivist theories of technology development articulate the political and ideological nature of agricultural biotechnology development in less developed countries. To approach technologies as value-laden aggregates of socio-technical ensembles rather than as neutral tools, implies a particular approach to development, which can be applied to the (trans)formation of local biotechnological practices. It is an approach that puts endogenous technology development over technology transfer, and participatory methods over advice and consultancy. Technologies cannot simply be handed over from one context to another. That is not only a matter of socio-economical, historical and cultural context; it lies in the material design of a technological application as well. Although the paper largely reflects the idea that technology development is an "inherently social process", we think that Vroom's approach is particularly promising because of the multidisciplinary training of the author. Trained as a life scientist, Vroom has the expertise to deal with biotechnological matter, which he takes into his work as a social scientist. Although the idea that technologies 'act' goes without saying in most of contemporary science and technology studies, it takes more than social science or ethics to describe and understand technological agency and politics, and even more to find a 'room for

[5] For historical examples and anecdotes, see Shapin (2002, 2004, 2006).

maneuver' to (trans)form biotechnology and genomics developments – by not *merely* attending to ethical or social aspects.

The next paper (Penders, 2007) presents an example of ELSA genomics research in western practices of nutrigenomics research. Bart Penders focuses on a specific controversy in nutrigenomics, being the development of 'the personalized diet'. He reviews scientific and societal expectations and practices to find out whether and how they fit. He concludes that they do not. In his analysis of this mismatch, Penders also take ELSA genomics as his object of research. ELSA researchers have actively been involved in the (ethical) debate around 'personalised nutrition'. Penders argues that the debate has not kept pace with scientific developments that have shifted the notion of 'personalised'. He describes the political agenda of nutrigenomics research as a 'politics of classification' and argues for an ethical agenda that addresses the politics of nutrigenomic practice, rather than merely nutrigenomic expectations. As Vroom, Penders has been trained as a life scientist. Is this why he was able to identify the weak spots in ELSA research on this issue?

The interdisciplinarity of Penders' and Vroom's contributions is more profound than their research object and focus. Both authors are ELSA researchers with a disciplinary background in the life sciences. Both advocate a participatory methodology, although not very explicitly in Penders' paper.[6] As cultural insiders, they appear able to 'unlock' a larger part of genomics practices than ELSA researchers outside of genomic practice. To clarify this point, we have included figure 1. It shows a conceptual matrix with four quadrants, loosely drawn from one presented earlier by Pearson (2001, p.59). Each quadrant represents a portion of the information or empirical material contained in a practice. The full circle represents all information in the practice and the division in four equal parts is completely random. Quadrant 1 represents ubiquitous information, readily accessible to all, whereas Quadrant 4 represents information hidden, accessible to none. The quadrants of interest are 2 and 3, representing the information accessible only to insider or outsider, respectively. Penders and Vroom are both insiders and outsiders to the practices they study. They have spatial, material, cognitive and normative access to the culture of genomics, i.e. the ability to participate, yet they also act as observing outsiders. Hence, they have access to, as well as the ability to act in three quadrants, whereas insiders or outsiders are restricted to two.

[6] Penders' work is based on extended periods of participant observation in various nutrigenomics practices (see Penders, 2006).

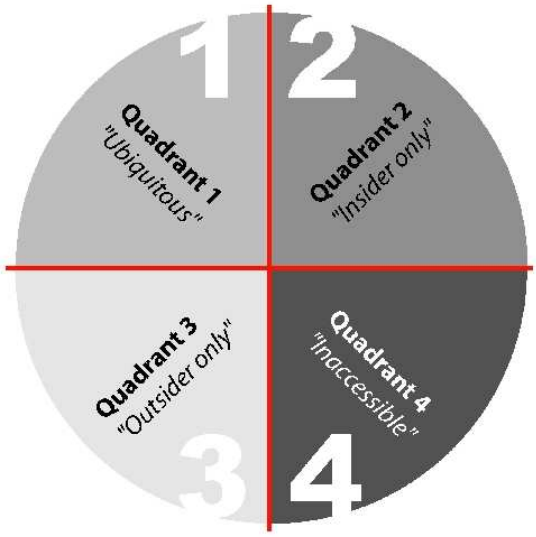

Figure 1, Access to practices. **Four quadrants representing different levels of access to a research practice can be distinguished. Figure redrawn from and based upon figure 1 entitled 'the insider-outsider position' (Pearson, 2001, p.59).**

Interdisciplinarity is a frequent topic for discussion in the ELSA genomics community, referring both to interactions between scholars from various social sciences and humanities, and to interactions between ELSA research and life science. Ultimately, ELSA's mission is transdisciplinary, including societal actors in science and technology development. Of those, interactions between life scientists and social scientists seem to be among the hardest to achieve.[7] Yet for ELSA to actually get something done – despite Watson's intentions – it is vital. Scholars like Vroom and Penders can serve as role models here. Considering science and technology as social and political practices, they do not neglect their materiality. More than their colleagues with degrees in ethics or social science, they are equipped to address genomics not only as a matter of people, papers and ideas, but also of food products, personalized diets and plant crops. Their work shows that being a (good) life scientist is an advantage in doing ELSA research. That advantage may outweigh possible disadvantages such as blind spots or unchallenged self-evidences.

Penders' insiderness allows him to be a reflexive observer of both nutrigenomics and ethical research. What is more, his results are taken seriously by life scientists, considering

[7] Cf. Snow (1993).

his recent publication of a critical discussion paper in a nutrition science journal (Penders et al., 2007).[8] Something similar could happen in the next stage of Vroom's project. Working interdisciplinarily fosters a critical approach to commonly accepted scientific, social-scientific and ethical methods, theories and concepts, since the focus is on the *issues*.[9] For the purpose of not merely describing but also improving relations between genomics and society, reflexive 'handmaidens' could contribute more to the social robustness and scientific relevance of ELSA genomics than critical outsiders could. Both Vroom and Penders explore methods and theories for an interactive social science, which is a condition for the societal embedding of genomics. Moreover, they present original, challenging and exciting research that presents the actual matter of genomics in its multifaceted setting..

We neither argue that all ELSA researchers should have a background in life sciences, nor that all ELSA research should be embedded or interactive. To prevent becoming instrumental and uncritical ('going native'), ELSA also needs conceptual clarification and imagination. Therefore we advocate the co-existence and continuous co-development of 'traditional' critical outsider approaches by social scientists and ethicists, and of innovative insider-approaches as taken by Penders and Vroom, within the ELSA framework. Embedding genomics in society requires the mutual inclusion of life sciences, social sciences and humanities, evoking innovative scientific approaches as well as comprehensive strategies for coping with contemporary societal issues.

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[8] Doing interdisciplinary research does not necessarily imply writing for interdisciplinary audiences. Penders demonstrates this by publishing two papers with a comparable argument for two different audiences: the paper in this issue targets social scientists, whereas the paper referred to, addresses nutrition scientists.
[9] See e.g. Leonelli (2005, p.2).

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Ir. Wietse Vroom, PhD Fellow
Critical Technology Construction (CTC)
Dep. of Social Sciences, Wageningen University &
Athena Institute (A.I.), Vrije University Amsterdam
Wietse.Vroom@wur.nl

Prof. Dr. Guido Ruivenkamp
CTC, Dep. of Social Sciences, Wageningen University &
A.I., Vrije University Amsterdam
Guido.Ruivenkamp@wur.nl

Dr. Ir. Joost Jongerden
CTC, Dep. of Social Sciences, Wageningen University &
A.I., Vrije University Amsterdam
Joost.Jongerden@wur.nl

Articulating alternatives: Biotechnology and genomics development within a critical constructivist framework

This paper explores critical and constructivist theories of technology, and discusses the political and ideological nature of (bio)technology development. The importance of a conceptualization of technologies as value-laden 'socio-technical ensembles' is discussed, rather than as value-neutral objects, or tools. These conceptualizations are then used to sketch a continuum of development approaches which extends from their relation to a 'transfer of technology approach', to an 'endogenous technology development approach'. This continuum inspires a rethinking of the possibilities to reconstruct biotechnologies and to tailor them to processes of endogenous development. In doing so, the value of participatory methodologies in coming to a contextualized biotechnology development is re-evaluated.

Keywords: biotechnology, endogenous development , participation, socio-technical ensemble, technical code

1. Introduction: new ways of approaching an old debate

The development of agricultural biotechnologies for less developed countries (LDCs) is a widely debated issue. Many researchers have indicated potential benefits that modern biotechnologies may provide to agriculture, also for resource poor farmers in small scale

agricultural systems. For example, the ability to adjust crops to their natural environment, in terms of resistance to both biotic (pest insects, fungi, viruses) and abiotic stresses (drought, salinity), has been claimed to provide opportunities to reach farmers in marginalized and underdeveloped areas[1].

At the same time a lot of criticism has been voiced regarding the appropriateness of currently existing biotechnologies for resource poor farmers. Critical evaluations of the social impacts of the Green Revolution in the 1960s and 1970s (e.g. Pearse 1980)[2], analyses of the industrial and commercial context in which these technologies have been developed (Kloppenburg 1988, 2004), and analyses of the farming systems in LDCs (Bindraban and Rabbinge 2003) strongly indicate that the current technologies 'on the shelf' are badly attuned to the needs of resource poor farmers. Others indicate that modern biotechnologies may provide advances in terms of production, but will fail to address issues of food security and poverty for rural poor.[3]

This observation is the basis for a critical reflection upon the development of modern biotechnologies. The contradiction between the acclaimed potentialities the technologies have to offer, and the actual situation in which these potentialities are *not* being materialized, leads to questions regarding social or historical elements structuring the development of biotechnologies in certain specific directions, based upon an instrumental conceptualization of technologies as solution to social needs.

Acknowledging the controversies over biotechnologies in a development context, this paper is part of a larger research effort which is concerned with processes of tailoring modern biotechnologies and genomics for a very specific context and target group, namely resource poor farmers in developing countries[4]. Instead of engaging in an unfruitful and polarized pro-contra debate over modern biotechnologies, the project sets out to investigate to what extent a

[1] E.g. Prem Bindraban at ICAD conference, Wageningen, The Netherlands, October 2006. In addition, consider the biotech projects of ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) that aim to use genetic engineering in their mandate crops that are specifically targeted at resource poor farmers (see http://www.icrisat.org/gt-bt/gt-bt.htm).
[2] For a large number of references to critical studies of various aspects of the Green Revolution, as well as studies representing the opposite point of view, see: (Shrum and Shenhav 1994).
[3] This was specifically argued by Niels Lauwaarts at ICAD conference, Wageningen, The Netherlands, October 2006. In addition, see (Leach and Scoones 2006) who argue that technological innovations (such as modern biotechnology) may potentially be development solutions, but are in practice often incapable of reaching their target due to the complex set of factors contributing to a problem they are supposed to solve (p. 20-26).
[4] The overarching research project, written by Guido Ruivenkamp, goes by the name "Genomics, between prescriptive code and social construction: an analysis of the constraints and possibilities for social choices in genomics for developing countries".

reconstruction of current biotechnology development is possible, in order to allow (bio)technologies to be shaped and reshaped in specific context and socio-political circumstances. These questions in turn require a further elaboration of a conceptual framework that rejects a vision of technology as *'fait accompli'*, and instead sketches room for manoeuvre to constantly reconstruct technologies to meet social needs.

A critical constructivist framework as proposed in this paper will not focus on the appropriateness of existing biotechnologies and ways to select 'the most appropriate technology'. Rather the focus is on processes of *endogenous technology development*[5], which are believed to be better attuned to local needs and circumstances and processes of sustainable development. This perspective moves beyond a mere technical agenda in terms of biotechnology development, as well as beyond notions that technology development has a certain 'impact' on social structures that needs to be managed. Rather, (bio)technology development is conceptualized in a larger historical framework in which technology development is part of a deeply social process (e.g. Ruivenkamp 1989, 2005). This process involves change at various levels, both in terms of practices, techniques, and efficiency, as well as in redefining social roles and relations of dependency and power. Because of these social aspects, the process in which technological innovations take place is fundamentally political, or rather *sub-political*[6], in terms of Ulrich Beck (Beck 1994).

An exploration of new approaches to (bio)technology development in LDCs will specifically aim at challenging political dimensions of technology development and at revealing the 'social choices' that are present in the process of technology development; i.e. the choices that relate to the shaping and changing of social roles and relations as part of the process of technological development. The central question is whether it is possible to envisage practices of technology development, in which a redefinition of social roles as part of technology development is not a passive side-effect that stakeholders have to adapt to, but rather a central and conscious part of development.

More concretely, in this paper constructivist and critical theoretical frameworks are being explored, to reach an appropriate and useful conceptualization of biotechnologies for development. The importance of a conceptualization of technologies as 'socio-technical ensembles' is discussed, rather than as mere objects. Moreover, technologies are claimed to

[5] The notion of endogenous development will be further elaborated later in this article.
[6] Sub-politics, the 'shaping of society from below' covers activities which take place outside the apparent political structure (Beck 1994, p.23).

feature important political dimensions, being value-laden, rather than having any 'neutral' status. This conceptualization of technologies is argued to be relevant in development studies. It is therefore taken as a starting point to rethink possibilities for tailoring technologies to processes of endogenous development. In doing so, the value of participatory methodologies in coming to a contextualized biotechnology development is re-evaluated. Aiming to take the proposed theoretical conceptualization of technologies seriously, an extension and refinement of participatory approaches is proposed.

2. A critical constructivist theory of technology development

In this section, two concepts are introduced that play an important role in conceptualizations of technology. They are (1) the notion of *co-construction* of technical and social aspects of technologies (as indicated by the idea of technologies as *socio-technical ensembles*), and (2) the notion of a *technical code*, relating the technology in technical terms to the larger social, political and economical regime it is a part of.

The relation between technological development and a social context has been elaborated by constructivist studies showing the social contingency of technology development. These studies have refuted technological determinism by emphasising that technology development is not a unilinear process, progressing from primitive technologies to advanced technologies, entirely according to some sort of internal logic and within a social vacuum. Rather, social constructivists have generally argued that technology development is the outcome of negotiation processes between social, economic and political stakeholders, while at the same time being restricted by technical limits and potentialities. Debates over the extent to which technologies are socially shaped (Bijker, et al. 1987, MacKenzie and Wajcman 1999), and on the other hand the extent to which technologies behave as social structures, having important impacts on social life (e.g. Sclove 1992), has resulted in a thesis of *co-construction* of technical and social elements, which are co-produced in the same process and therefore fundamentally interrelated. One concept introduced to indicate this nature of technology, is *'socio-technical ensemble'*, as has been introduced and elaborated by Wiebe Bijker and Trevor Pinch in their Social Construction of Technologies (SCOT) approach (Bijker 1995, Bijker, et al. 1987, Bijker and Law 1992). Bijker states:

> The sociotechnical is not to be treated merely as a combination of social and technical factors. It is sui generis. … Society is not determined by technology, nor is technology determined by society. Both emerge as two sides of the sociotechnical coin during the construction process of artefacts, facts and relevant social groups. (Bijker 1995, p. 274).

While acknowledging the valuable contributions in conceptualizing technology development from social constructivism, one aspect that deserves more emphasis in the conceptualizing of technological development is the idea that any social negotiation process (also when concerning technology development) takes place within certain structural historical and cultural settings which structure the negotiation process. Such an approach closely resonates with a critical theory of technology, which introduces the second key concept in this conceptual framework: *the technical code.*

Critical theory, as originated in the Frankfurter Schule[7], but more recently revised by authors such as Feenberg and Ruivenkamp (Feenberg 1999, Ruivenkamp 2005), has been an important theoretical framework for studying technological development within a wider social, political and historical framework. Critical theory has received significant attention for its critique on modern societies and the role of technology, but it has also suffered some severe criticism for overemphasizing structuring tendencies that marginalized human agency in technological development. Because of this lack of human agency, it appeared to be unable to offer a way out of the pessimistic, gloomy visions of future technological developments its followers described. Recent revisions of critical theory that inspire this research project aim to move beyond such an impasse, and try to bring back human/user agency in technology development (Feenberg 1999). This revised form of a critical theory of technology has some important things to say about technology development as social and political process.

Critical theory takes a more normative stand than social constructivism and has stressed the need to move away from a politically neutral, instrumental conceptualization of technology development. If technologies and social context are co-constructed in the same process, questions emerge regarding the social and political nature of technologies

[7] For more information about the Frankfurter Schule, see for example (Wiggershaus 1995)

themselves. More specifically, the following two questions are at the very heart of a discussion of the political nature of technology development: *'to what extent are technologies ideological or political, in the sense that they are able to structure or mediate social relations in a specific context?'*, and secondly, '*to what extent is a reconstruction of these ideological or political aspects of technologies possible?'* These questions cannot fully be answered in this paper; they reflect fundamental questions in theories of technology. However, a short outline will be given of the way in which these questions have been answered by scholars working on a modern revision of a critical theory of technology, and what they mean in light of this paper.

Langdon Winner is one of the scholars who has explicitly taken up the question to what extent technological artefacts are political[8] (Winner 1985). He has made two types of arguments regarding this political nature of technology. First, he describes instances in which the invention, design, or arrangement of a specific technical device or system becomes a way of settling an issue in a particular community. For example: the construction of parkways around New York, with low hanging overpasses prevented busses from using these parkways. This design contained an inherent bias giving preference to the richer (predominantly white) upper class that could afford their own automobiles, and therefore easily reach the recreational areas around the city.[9] Secondly, he states that there are cases of what can be called inherently political technologies, man-made systems that appear to require, or to be strongly compatible with, particular kinds of political relationships. Winner's example here is the use of nuclear energy, which he claims is highly compatible with hierarchical and centralized control, and an inclination by governments to infringe civil rights.

[8] While Winner formulates the question whether artefacts are political, Ruivenkamp introduced the notion of "politicizing" products (Ruivenkamp 1989, p. 354). Both terms are somewhat similar in the sense that they refer to an inherently political dimension of technologies. However, the term 'politicizing' stresses the processual nature of this political dimension, and therefore the inherent potentiality to redirect this process. However, the term 'policitizing' is also commonly used to refer to the act of 'making things subject to party politics and thereby obscuring a discussion of its proper features'. I thank an anonymous reviewer for this comment. In order to avoid confusion, in this paper the term 'political' is used, rather than 'politicizing'. The next section will further elaborate this political dimension of technologies.

[9] Winner's seminal article has not been uncontroversial, and especially the example of the parkways with low hanging overpasses has raised some debate (Joerges 1999, Woolgar and Cooper 1999). Moreover, the precise way in which artifacts can be said to 'have politics' remains question of debate (Latour 2004). Nonetheless, Winner's introduction of the notion that technical artifacts can reflect and reinforce social relations remains important for the argument presented here.

In a similar vein, Andrew Feenberg discusses the political content of technologies. In his critical theory of technologies, he describes technologies as having a 'technical code'. This technical code describes the technology in strictly technical terms, but in accordance with the social meaning it has acquired (Feenberg 1999). The technical code is that aspect of a technology that allows the embedding of social norms, cultural values, or a certain ideology within technology design. Considering that also unequal power relations will become embedded in and reinforced by technology design, technology development has been considered to have *an inherent bias towards social and ideological domination*. Technology has been claimed to be 'materialized ideology', because of the ability to embed and thereby reinforce unequal social relations, without being questioned by the ones that are dominated by it (e.g. Feenberg 1999, 7).

This supposed ideological dimension of technology is rarely being made explicit in contemporary discussions over technology development, but based upon the work of scholars like Feenberg, it may be expected to play an important role in processes of innovation and technical change. In this context, the notion of ideology can be described as a relatively coherent system of ideas and concepts, embodied in institutions, and which welds together social actors in pursuing prescribed goals. The precise meaning and function of 'ideology' has since long been ground for debate, the complexity and repercussions of which extend far beyond the scope of this paper[10]. However, one crucial notion is that 'the basic function of all ideology is to interpellate/constitute individuals as subjects' (Althusser in Laclau 1977, p. 100). This implies that the notion of an ideology cannot be reduced to some abstract ideas in society, but should be considered as a structuring force, concretely influencing actors' thoughts and actions. Ideology defined this way constitutes the basis of a hegemony of technological rationality, and legitimises existing structures of social domination.

Remarkably, these aspects of technologies normally remain invisible, since like culture, they appear self-evident. Feenberg states that 'the legitimating effectiveness of technology depends on unconsciousness of the cultural-political horizon under which it was designed.' He strikingly compares a feudal system in which the King was perceived as the natural source of power, with modern cultures in which technical rationality is unquestioned

[10] For example, compare notions of ideology and hegemony by Marx with those of Gramsci, Althusser and Laclau.

and accepted. This relates to a notion of hegemony, as once elaborated by Antonio Gramsci. Hegemony refers to the phenomenon that particular ideas, values, attitudes, beliefs are considered as *the* ideas, values, attitudes and beliefs and a natural order of how we have to think and do things. As such, hegemony is to be considered an 'organizing principle' of social practices, or in this case: technological practices (Gramsci 1971, Raphael 2003). In other words, it is an all-pervading type of domination which appears so natural to the ones dominated that they accept it.

This notion of hegemony seems to endanger an optimistic answering of the second question that was posed here: 'to what extent is a reconstruction of this technical code possible?' However, Feenberg adds that 'a critical theory of technology can uncover, demystify the illusion of technical necessity, and expose the relativity of the prevailing technical choices.' (Feenberg 1999, 87). This project of exposing the relativity of technical choices implies indicating the potentiality for social choices and therefore a re-introduction of human agency into technological development. This in turn is the main goal when implementing a critical constructivist framework. It is not only intended to provide a critical analysis, like Feenberg proposes, but also includes a constructivist element that uses the room for manoeuvre to actively propose a redesign of technologies.

3. Reinterpreting biotechnology development in less developed countries: the political dimension

This section relates the rather abstract theories of technology to more concrete studies of (bio)technologies in the context of development studies. Several authors have described elements of agricultural technologies that are problematic for groups of farmers in developing countries (Goodman, et al. 1987, Kloppenburg 1988, Pretty 2002, Ruivenkamp 1989), and have thus illustrated the need for a reconstruction of biotechnologies for LDCs. Their analyses move beyond identifying straightforward technical problems, but rather stress the political nature of modern biotechnologies and their power to redefine social roles internationally.

Goodman and colleagues have discussed processes of 'substitution' and 'appropriation' as part of an industrializing agricultural system. Substitution refers to the

process in which (bio)chemical substances replace agricultural products as raw materials for the food processing industry. As a result, farm products are being reduced to 'semi-manufactured industrial goods' that can in time themselves be replaced by synthetic industrial products. Appropriation refers to the gradual take-over of the controllable biological activities from farming practice by external institutions, especially by industry. These activities may include the production of seed, the breeding and selection of new crop varieties, managing the fertility of the soil, and pest management.

These processes are part of a development in which farmers increasingly lose control over aspects of the farming practice and are being reduced to 'workers in the open air' for a distant food processing industry. Researchers are argued to increasingly exercise remote management of farming practices, via the distribution of knowledge-intensive farming inputs such as seeds, fertilizer and biocides, which render the farmer dependent on external scientific or technological knowledge (Ruivenkamp 2003b).

Ruivenkamp has argued that these processes are taking place against a background of three main disconnection processes that are taking place in agricultural development in general (Ruivenkamp 1989, 2003a, 2003b, 2005). First a disconnection of the agricultural production and the natural environment has been widely described and criticized for its perceived unsustainability. Secondly, a disconnection process between agricultural products and food products is present, since many food products have become a mixture of chemical ingredients (protein, lipids, carbohydrates, vitamins, and additives) of which the original agricultural source is no longer visible, nor relevant. Of course, this process precisely allows the process of substitution as described above and elaborated by Goodman *et al*. Thirdly, partly as a result of the previous disconnection process, agricultural production becomes disconnected from food chains altogether, since the chemical compounds that constitute the agricultural products become ingredients for not only a food processing industry, but also for a chemical industry, or for the production of biofuels. These latter two disconnection processes are important constitutive elements of globalising food chains, in which a final type of disconnection process is salient: the disconnection of local production from local processing and consumption. Instead of dealing with local markets, farmers increasingly produce for very distant markets and therefore become vulnerable to international market fluctuations, trade barriers, and international competition with producers in entirely different

parts of the world. These processes are problematic for their associated loss of control of local farmers over their own livelihoods, and autonomy.

This analysis of disconnection processes has on the one hand led to pleas for a reconnection of 'people, land and nature' in order to achieve sustainable agricultural production (Pretty 2002), as well as to visions of multi-local agro-food networks which introduce new ways of thinking about producer/consumer relations (Manzini 2005). Alternatively, rather than reconnecting what has been increasingly separated in processes of economic globalization, active attempts to re-establish a certain level of autonomy and control in the hand of local communities, as part of internationalized food networks may be taken as a way forward.

4. Implications for thinking about technologies for development

The theoretical visions of technologies as socio-technical ensembles (as opposed to a common image of technologies as mere artefacts or objects), and as political entities[11] (as opposed to the generally widespread treatment of technologies as inherently neutral phenomena or tools) are not without repercussions. The notion of technologies as *socio-technical ensembles* implies that considering the introduction of technologies in development should not merely look at effects and risks, but should explicitly take on board the social relations around the technology. However, when looking at existing programmes, a continuum of different approaches to technological innovation as part of agricultural development can be recognized. The various positions along this continuum reflect different conceptualizations of technologies.

On one extreme one can position the rather widespread notion of a 'transfer of technologies'. In traditional versions of this approach, technologies are generally treated as relatively isolated, neutral tools. Successful technologies, developed in richer parts of the world, are transferred to developing countries to perform similar functions in the new

[11] These two dichotomies in thinking about technologies are of course interrelated: a conceptualization of technologies as objects is compatible with an instrumental view on technology development, while seeing technologies as partly social phenomena introduces sensitivity to the social and political dimensions of technological change.

context[12]. This model, which has characterized much of Western development strategy, has been widely criticized, e.g. for systematically imposing a uniform image of 'one good practice' developed by agricultural science on often diversified agricultural practices (Van der Ploeg and Long 1994). That said, the notion that transferring technologies *always* involves considering changes in their design, is generally well established. It is the *extent* to which transfer of technologies involves a redesign of technologies that may vary.

On the other end of the continuum, one can distinguish an alternative route which strengthens stakeholders' efforts to develop strategies for endogenous developments. In this strategy the aim is to elaborate the potentialities of local knowledge and natural and social resources with several stakeholders. This point has been elaborated by Van der Ploeg and Long, who stress the heterogeneity in styles of farming (Van der Ploeg and Long 1994) and state:

> '… endogenous development can revitalize and dynamize *(these)* local resources, which otherwise might decline or become superfluous. Furthermore, endogenous development practices tend to materialize as self-centred processes of growth: that is, relatively large parts of the total value generated through this type of development are re-allocated in the locality itself (Van der Ploeg and Long 1994, p. 2).

The technological developments that arise from such an approach could be regarded as 'born from within', rather than a scientific model imposed from outside.

Various other approaches can be found in between the extremes of a traditional 'transfer of technology' approach and fully endogenous technology development. One compromise may be the tailoring of new technologies such as genomics to the potentialities of local agriculture and food production. This approach would involve both elements of a transfer of technology, as well as explicit attempts to 'endogenize' the technology. The differences among the various approaches along the continuum then do not so much concern the malleability of technological *objects*, but relate to the level and extent to which the technology is being 'redesigned' as *socio-technical ensemble*. Note that participatory

[12] See e.g. the ABSP I (Agricultural Biotechnology Support Project) and ABSP II programmes that explicitly aim for a 'transfer of technology' approach. In linking up companies or research institutes from developed countries, owning a certain biotechnology, with local stakeholders in developing countries, the projects aim to make hi-tech agricultural solutions available to stakeholders in developing countries. See http://www.iia.msu.edu/absp/ and http://www.absp2.cornell.edu/ for more information about the projects.

methodologies -commonly applied in programmes of pro-poor biotechnology development today- can play a role at both levels and may be used within various strategies. In some cases, participatory design may refer to rather technical issues, while in other cases participation of end users redefines their social role as *receivers* into a role of *innovators* of technology.

The previously elaborated notions of technical code and the political dimensions of technology imply that *we cannot restrict ourselves to choosing the most appropriate technology from a list of available technological solutions, by whatever methodology*. The critical constructivist framework introduced here therefore strongly argues for technological innovation as part of endogenous development processes. Concretely, this may involve challenging social relations that are introduced by a further scientification of agriculture, challenging the conceptualization of agricultural problems in terms of genetics, challenging reductionist and monofactorial approaches to problem solving of complex problems and challenging the idea that adopting increasingly restrictive regulatory frameworks to accommodate increasingly complicated and risky technology is inevitable.

The notion of endogenous development can now be understood to have two important dimensions. The first relates to the idea that technology development cannot be considered in isolation of highly diversified local contexts, both in terms of farming systems, as well as in socio-economical and cultural context. Endogenous development therefore refers to technologies that are well grounded in specific localities. Secondly, endogenous refers to a sense of 'ownership', not necessarily in terms of actual property rights, but in terms of 'being in charge' of the developments that takes place. Rather than merely adopting technologies to local environmental, climatic or economic conditions, this calls for an active enrolment of local actors as innovators, rather than as receivers of (bio)technologies.

This second point stresses that 'endogenous' does not necessarily mean that technologies have to be developed in a specific local region. While geographical parameters may actually be of decreasing importance, it is the combination of local grounding and control that constitutes the ability to *endogenize* a technology.

5. Reconstruction: rethinking participatory methodologies in technology development

The critical analysis of the political bias in technology development invites us to take a closer look to the second question posed in this article: 'to what extent is a reconstruction of technologies possible?'. Taking the above into account, this question in fact refers to the extent that endogenous development of agricultural biotechnologies is possible, and to the extent that current approaches to development allow a redesign of these technologies.

The notion of endogenous development fits into a wider theoretical perspective on development that moves away from primarily economic analyses of development, a linear path to development, and a focus on urban growth centres. The 'alternative development approach' has instead aimed at taking local conditions and social relations as starting point for an analysis, not of how national economies can be encouraged to grow, but on how to alleviate poverty in marginalized (often rural) areas (Potter, et al. 2004).

One of the central elements in studies or programmes of 'alternative development' has been the use of participatory methods to ground development in a specific local situation, and to ensure sustainable learning, change and empowerment of communities. Next to practical goals in terms of improving the innovation process, this approach may serve an important social and political purpose in challenging the marginalization of poor farmer communities. Those who may be considered to be passive receivers of technological innovations, delivered to them by a supposed 'trickle down' effect, are now redefined as active participants in the process with legitimate demands, experiences and useful knowledge[13].

However, different levels of participation have been described[14]. Depending on the project and aims of involving stakeholders, users or consumers, various methodologies have been applied. The issue here is in what ways participatory methods are operationalized and whether this influences their ability to actually allow technological redesign.

These questions are addressed by studying the case of the Andhra Pradesh Netherlands Biotechnology Programme (APNLBP), in the Indian state of Andhra Pradesh.

[13] Important works addressing the issue of appropriate biotechnology development and the use of participatory processes in biotechnology development for resource poor farmers, are (Bunders 1988) and (Bunders and Broerse 1991). This paper relies strongly upon this essential groundwork, while attempting to move beyond it by asking additional questions about the political dimensions of biotechnology development in LDCs.

[14] Jules Pretty *et al* provide a 'typology of participation' in (Pretty 1995, p. 61), as well as some critical remarks on the value of some levels of participation for sustainable development.

The programme has been set up as a 'Special Programme on Biotechnology for Development' of the Dutch government and after a pre-project phase, work on projects has started in 1996. The programme was suggested as a potential mechanism to close the North-South gap through technology development, and was remarkable in its setup, since it embodied a conscious effort to build capacity and instil concern for biosafety issues within the recipient country, and to focus explicitly on 'resource-poor farmers in a participatory manner' (Clark, et al. 2002)[15].

In starting up, the programme encountered a challenge in having to deliver relatively rapid results to the group of involved stakeholders in order to maintain momentum and to gain legitimacy among local farmers as a helpful programme. However, the development of some modern biotechnologies that might be useful to address some of the problems that had been identified and prioritized in earlier workshops, would take considerable time. Therefore, the programme has made a strategic decision in focusing on traditional biotechnologies, like tissue culture, vermiculture and biopesticides, in its first operational phase. In doing so, the programme aimed to build support for the projects. Moreover, it was expected that the need for more sophisticated technologies would emerge along the way. In practice, a small number of advanced biotechnology projects were started in parallel, some of which involve transgenic technology. This situation provides an interesting starting point for comparing both types of projects that were part of the same programme. With respect to the conceptualization of technology, as operationalized in the innovation process, important differences emerge.

The commonly followed participatory approach within the APNLBP is to have a workshop with local farmers, NGOs and scientists in which priorities for farming innovations, or pest management are determined. These priorities are studied to determine whether ready-made solutions can already be found. If not, the demand articulated in the workshop will be translated into a scientific question which will allow (molecular) scientists to work on a specific topic and to come with potential solutions. These solutions are then incorporated into new products or crops and evaluated with the end-users[16].

[15] The review of Clark et al provides a great overview of the various phases in the programme and how bottom-up learning processes fit into thinking of innovation systems. More information about this programme can also be found online at http://www.apnlbp.org/
[16] Prof. Pakki Reddy in personal communication, November 2005

One of the projects that involved the development of modern biotechnologies, is the project working on isolating stress inducible genes from pigeonpea (Cajanus Cajan L.). This project showed a typical feature that emerges in some participatory projects, which is an implicit *separation of phases of priority setting, technology design, and evaluation of the technology*. Starting from the prioritized aim to develop crops that would be better able to cope with the arid conditions in the state of Andhra Pradesh, the project set out to isolate genes responsible for drought resistance in pigeonpea that may be isolated, characterised and later transferred to target crops like groundnut, castor or sorghum[17]. This implies that a trajectory has been set out to battle drought tolerance in these target crops, through a transgenic approach, since crossings of pigeonpea and the target crops are not possible. The participatory element in the project, identifying both priority traits and crops did not extent to the long-term strategies taken and the repercussion of this strategy for biosafety issues, regulatory affairs or the redefinition of social roles that goes along with these strategies.

A key point in the participatory process adopted for this project is the translation of certain user (farmer) needs or desires, into a scientific problem statement. After solving the identified problem at the scientific level, the solution can be disseminated to farmer groups again, accompanied by participatory evaluation schemes. This process is clearly executable and can result in extensive communication between scientist and farmer. However, it shows a conceptualization of the innovative technology as an object or tool that will solve the problems prioritized in communication. This will usually not be considered problematic, as long as there is enough communication between scientists and end-users to guarantee a technology design that is attuned to their needs and circumstances. However, the approach does imply clear limits regarding the extent to which technology development can be steered in different directions; if only because the translation of farmer/consumer needs into a scientific problem is not challenged in a participatory vein. In fact, the scientist and his vocabulary of possible solutions is never being challenged as 'obligatory point of passage'[18] in coming to new, improved technologies or farming practice. Neither is the implicit ideology of a rather reductionist approach to technological progress in farming practices challenged in any way.

[17] Interview data

[18] The term 'obligatory point of passage' is borrowed from actor-network theory in which a central actor attempts to stabilize a network, aligning other actors in the same network, while becoming an 'obligatory point of passage' for all actors in the network. See e.g. (Callon 1986).

The failure to challenge the position of the scientist in translating the farmer's need into a scientific research question is related to the conceptualization of the technological solution as an object, rather than as socio-technical ensemble. The introduction of transgenics in the farming systems of resource poor farmers in Andhra Pradesh can be expected to go along with much more fundamental changes in farming practice and regulatory regimes. While a conceptualization of technologies as objects places the technological solution centre stage and will deal with the socio-economic effects afterwards, a conceptualization of technologies as socio-technical ensembles would choose to involve end-users or stakeholders in the entire process of innovation and technology design, since the integration of new technologies is as much a social affair, as it is a technical affair. The reasons for stakeholder involvement are then to reach a process of iterative, reflexive technology design, in which the distinction between phases of design and evaluation is fading. A much more fundamental challenging of positions of central actors is a result of such a dynamic. Farmers or other end-users are not only addressed as 'consumers' of technology, but are recognized as innovators themselves. This in turn would qualify the resulting technology development as much more 'endogenous', since the technology is not only grounded within the specific local context, but also attributes a powerful role to the farmers themselves.

Although the methodological separation of phases of prioritizing, design and evaluation may occur in any programme, especially the development of modern biotechnologies (genomics, genetic modification), which demand a higher level of scientific expertise, seem to stimulate such separation of phases of design and evaluation. The extent to which farming innovations are not only about introducing new technological artefacts or tools, but are explicitly engaged in the production of new social roles, becomes clear from the study of some other projects within APNLBP, focusing on more traditional biotechnologies.

Some projects have focused on vermiculture production, which can be carried out at household level, and gives rise to biological fertilizer which can be used to increase the fertility of the soil. The same product can be used for the rooting and hardening of tissue culture plantlets, which is traditionally a step that is carried out under controlled laboratory conditions, in agar medium. The transformation of this step from the laboratory to the field, and from lab assistant to farmer has significant implications for the social roles that are being shaped around this technology. Next to the much cheaper production of virus-free plantlets, bringing them within reach of resource poor farmers, farmers gain a central role in the

production of tissue culture plants, redefining them from passive receivers, to active innovators. Similarly, as part of the same program, the production of a Bt-spray (to be used as bio-pesticide[19]), shows a process of redesign that allows a decentralization and an active involvement of villagers. Traditionally, the production of Bt required specialized equipment and a continuous power supply. By redesigning the production process, allowing the fermentation to take place in a solid medium rather than in liquid medium, cheap and locally available materials can be used. This allows the process to take place at village level, where the farmers themselves are actively involved in producing their bio-pesticide (Puente, et al. 2006, Vimala Devi and Rao 2005).

Also in these projects, the methodological separation of phases is apparent. Still, where the drought resistance project marginalized the farmer's role in the innovation process, by taking the project to that lab and treating the technology in relative isolation of the wider socio-economic repercussions of embarking upon the use of transgenic crops, the other projects enabled farmers to be more involved in the process of innovation itself. By doing so, the concrete products developed in these projects of the APNLBP programme serve an important sub-political function. This demonstrates how technologies may be conceptualized as socio-technical ensembles, but how at the same time the concrete characteristics of the technological artefact itself remain highly relevant.

Summarizing, participation with respect to 'technologies as objects' runs the risk of framing the participatory issues too narrow, allowing a smoothly running participatory process, but limiting the range of potential outcomes. Therefore, the ability to distinguish between levels of participation, and to apply the appropriate one with respect to the goals set, is crucial. Participation *can* be a powerful part of articulating and developing alternative technology development trajectories, but it needs to operationalize a conceptualization of technologies as socio-technical ensembles, rather than as objects. It needs to open up the black box of what in effect technologies are, revealing the relevant social and political dimensions that need to be addressed if a reconstruction of (bio)technologies is to take place.

[19] Bt is an abbreviation of Bacillus thuringiensis, a bacterium that produces certain proteins that are toxic for pest insects. Local strains of Bt are isolated, multiplied and processed into a spray that can be used in safe, sustainable and affordable pest management.

6. Synthesis: moving beyond uncritical approaches to biotechnology development in LDCs

The stakes in technology development in, or for less developed countries are high. Treating technology development as a process with important social and political dimensions, we have raised the question whether more attention should be paid to the ability of technologies to redefine social roles and relations. Concretely, theoretical discussions about the nature of technological development and its relation to social and political relations have led to a discussion of possibilities for reconstruction and a rethinking of participatory methodologies in development programmes.

While several approaches to participation and increasing innovation capacities may be legitimate in different situations, in this paper an explicit argument has been set up to consider a fundamental reconstruction of technologies that does not only address the technical level, but also reconfigures political aspects of technologies. This involves both *acknowledging* and *challenging* the political dimensions in technology development. However, highlighting these social and political dimensions of technology development does not mean that negotiations at the level of the technical object have become obsolete. On the contrary, acknowledging the political elements as part of the technical code of technological objects is part of opening the black box of agricultural biotechnologies. Challenging these dimensions, inscribing technologies with a different technical code, and reconstructing them to fit local needs and circumstances can explicitly and particularly take place at object level. The challenge is all about taking up the sub-political dimensions of technology development and using them to develop biotechnologies as part of processes of endogenous development.

Achieving such a sub-political technology development requires a further elaboration and refinement of methodologies of participation, as they are considered indispensable in taking up the proposed sub-political technology development. In practice, this means that a number of new and additional research questions needs to be asked. Of course questions regarding priorities and the technical appropriateness of technologies in certain contexts are still necessary and legitimate. But they should be complemented with questions about how technology is conceptualized in various development programmes and what the consequences are for the involvement of stakeholders in technology development. Will a

conceptualization of technologies as socio-technical ensembles allow a different involvement of stakeholders in which they are not only involved in phases of priority setting and evaluation, but are actively involved in an iterative process of technology design? Can a conceptualization of technologies as political phenomena gather momentum to create room for manoeuvre to develop alternative trajectories of biotechnology and genomics developments? Can these conceptualizations of technologies ensure that values in technology development are the central point of focus, rather than procedures and formal structures?

Asking these additional questions in effect implies an infusion of a critical dimension into current and commonly applied frameworks in technology development. *Finding answers* to these questions may provide the room for manoeuvre needed to develop, reveal, or even to simply recognize alternative trajectories to biotechnology and genomics development. Such approaches to agricultural development would treat technology development as inherently social process and may include values such as autonomy, independence and long term sustainable development.

Lifting the veil of an ideology of technical rationality shows the presence of social choices, prevalent in any technological development process. Tensions or contradictions in current development processes can provide momentum to making other choices. That way, the sub-political element that is so pervasive in technology development, is no longer an unpleasant side-effect, but can be taken up as a new arena of political struggle and the formation of new identities.

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Bart Penders
Department of Health, Ethics & Society
Care & Public Health Research Institute CAPHRI
Maastricht University, P.O. Box 616, NL-6200 MD Maastricht
tel. +31-43-3882457, fax. +31-43-3670932
b.penders@zw.unimaas.nl

Aligning nutrigenomics and ELSA

Towards a politics of classification

Expectations and laboratory practices in nutrigenomics often vary significantly, especially when considering the challenge of personalising nutrition. This paper analyses both expectations and laboratory practices, and their relationship. It argues that both are relevant for the advancement of nutrigenomic practice, however, that the differences between them need to be taken into account. Ethical, legal and social aspects (ELSA) research of nutrigenomics has focussed primarily on the expectations uttered by nutrigenomicists for various reasons, thus constructing an ethical agenda that does not fully correspond to nutrigenomic practice. This paper argues for a new ethical agenda that takes into account both expectations and laboratory practice, thus (re-)aligning ELSA with nutrigenomic practice.

1. Introduction

Recent research in life sciences has shifted away from a reductionist focus on single, genes, proteins or metabolites. The emergence of high-throughput biology, combined with the development of computational tools for analysis, has presented an opportunity for life scientists to simultaneously measure and consider tens of thousands of variables (e.g. Fox Keller 2005). This approach has been coined the 'omics' approach (Weinstein 1998). Albeit of slightly different ages, proteomics (the 'omics approach' directed at proteins), transcriptomics (directed at mRNA transcripts) and metabolomics (directed at metabolites), as well as the object directed integrated versions such as pharmacogenomics (drug-centred) and nutrigenomics (nutrition-centred) are still in their infancy. This is something we need to keep in mind when reviewing expectations and practices of the field and their relation. Here, I do not intend to give an extensive historical overview of the emergence and advancement of nutrigenomics. Instead, in this paper, I will discuss the co-evolution of nutrigenomics and

research into ethical, legal and social aspects of nutrigenomics as two distinct but very interrelated practices.

The longer term 'nutritional genomics' had been around for quite some time when at the turn of the century several scientists coined the shorter 'nutrigenomics' (see e.g. Fogg-Johnson and Meroli 2000). Some discussion exists about whether nutritional genomics is the *genomics of the eaten* while nutrigenomics is the *genomics of the eater*. In this paper I will limit myself to the *genomics of the eater* part. The even shorter term 'nutrinomics' never really became an accepted term (Arab 2004). I do refer to it because it is an attempt to rename what is now still called nutrigenomics as a reaction to the incorporation of other classes of molecules next to the gene. When I, and many others, refer to nutrigenomics, we do not strictly refer to the genome-nutrient interaction but also to nutrient-transcriptome, nutrient-proteome, nutrient-metabolome, nutrient-epigenome interaction and a number of other nutrient–'ome' interactions that I have not mentioned, do not know of, or that might not even exist yet.

Personalised nutrition is one of the subsets of problems nutrigenomics addresses. Whereas nutrigenomics targets gene-nutrient interaction (or 'ome'-nutrient interaction), personalised nutrition focuses on the differences in genes, related to nutrient intake. In this paper, I would like to address the promises and expectations of personalised nutrition, the (laboratory) practice of nutrigenomics and the ethical, legal and social aspects of nutrigenomics research[1]. I will focus on the theme of personalised nutrition to demonstrate how these three areas relate, what the differences between them mean and how we can deal with them.

2. Promises and expectations

One of the most clear and presumably more radical expectations of personalised nutrition has been voiced by German and Watzke, when they state that 'it is not a question as to whether personalized foods will become a part of the food marketplace, but simply when they will become the rule rather than the exception' (German and Watzke 2004).

[1] For a general introduction and comments upon research into the ethical, legal and social aspects of genomics, see Radstake and Penders (2007).

German and Watzke use the term 'personalised', but the same idea of nutrition specific to individual needs is also called 'individualised', or 'tailored', two terms Hoolihan and Harlander (Hoolihan and Harlander 2004) use, distinguishing between all single individuals:

> This growing body of nutrition science research, combined with the rapidly accelerating genomics movement has shown undeniably that everyone is a unique individual with specific needs. We have thus entered the stage of *individualized, or tailored, nutrition* […]. We are developing the capacity to make dietary recommendations aimed at optimizing health and reducing risks of the diseases to which one is genetically predisposed, based upon knowledge of one's nutritional status, lifestyle, disease risk and genetic make-up. […] We are at a point in the history of nutritional sciences where we have expended our knowledge of nutrition and are ready to utilize what we know for the better health and well-being of not just the population as a whole but *every single individual* (Hoolihan and Harlander 2004) (my emphasis).

However, people do not only write down their expectations, they express them in interviews and at conferences. In an interview, the project leader of a Dutch nutrigenomics research project assured me that:

> I still am convinced that we will, in the end reach a personalised dietary advice, based upon nutrigenomics. Because I remain to be convinced that the effects of nutrition are immensely different between people and that can only be, based upon differences in genes and constitutions […]. It might be very complicated, but in the end one must be able to find the right combinations that can predict why one's cholesterol rises and the other's doesn't. And […] with the calculation power and the immense acceleration at which several things are being analysed […] that sort of information becomes available faster […].
>
> I think that nutrigenomics will, and this obviously is oversimplified, that in your food disc […] radials[2] will shift a bit like this and mine will shift a bit like that [arm

[2] In the Netherlands, the nutritional education model is not a pyramid, but a compartmentalised disc (the *schijf van vijf*) indicating overall the same recommended daily intakes as other models such as the US MyPyramid. The 'schijf van vijf' (disc of five) was recently updated and reintroduced November 16, 2004. It was first designed in 1953 and in 1981 it was redesigned into the 'maaltijdschijf' (the 'dinner disc' or 'disc of four'), grouping meats and dairy into one compartment. In 1991 it was remodelled again, into the 'Voedingswijzer' (the food guide). In 2004 the 'drink' compartment was added to make it a 'disc of five' again. A disc-like model is also used in

> gestures]. So certain compartments will grow bigger and other smaller, depending on what nutrigenomics will tell you[3].
> *Interview M001, 20050316.*

In their expectations, these senior scientists are presenting a certain image of what 'personalised nutrition' is going to be like. They voice the conviction that 'personalised nutrition' is, indeed, the future. This future nutrition is going to be tailored to the unique needs of every individual, whether based upon 'difference in genes and constitutions' as the Dutch project leader stated above, or 'based upon nutritional status, lifestyle, disease-risk and genetic-makeup' as Hoolihan and Harlander state. At the centre of these claims lies the shift from a 'one size fits all' approach towards the focus on individual genetic differences:

> The previous 'one-size-fits-all' approach to diet and dietary recommendations of the distant past is limiting and may even be erroneous […]. This new paradigm and way of viewing foods and their components will ultimately shift broad population-based nutrient recommendations to ones more tailored to the individual. (Hoolihan 2003).

The scientific and popular press have not ignored such promises and expectations. They have used catchy phases such as 'Eat right for your genotype' or 'the DNA diet' (or the Dutch 'elke eter de juiste hap'[4] (van Ommen 2001) to explain the tailoring of nutrition to individual needs (Grierson 2003a; 2003b). In such newspaper articles, mini scenarios are used to illustrate and to monitor this trend away from 'one size fits all'. I intentionally say 'away from *one size fits all*' and not 'towards *something*', because it is not entirely clear towards what this trend is leading us. In these mini scenarios we read about someone pricking their finger, sending the blood to a lab and receiving an email indicating the recommended diet for the next month, which 'doesn't look too bad: lots of salmon, spinach, selenium supplements and bread with olive oil' (Grierson 2003b).

Germany (the *Ernährungskreis*), currently used in combination with a pyramid form (see e.g. Geerts 2004; Hammink 2005).

[3] Excerpts from interviews, notes and lectures have – where relevant – all been translated from Dutch and German into English by the author. Part of the empirical material has been used in a previous publication (Penders et al. 2007).

[4] English: 'Every eater the right bite'.

Expectations are – by their very nature – about the future and have the luxury of being able to abstract from certain practical requirements that actually doing the experiments in a laboratory may introduce. Many of these can be *reasoned away* by assuming technological advancements, or are simply ignored. Even though expectations and promises serve their purpose – many do so very well – finding out what science is actually about, requires more than just listening to its promises. Let us turn to the laboratories where nutrigenomics is performed, the conferences where nutrigenomics is discussed and the journals where findings are reported: let us turn to the sites where nutrigenomic science is performed and personalised nutrition is (becoming) a practice.

I have travelled to and through these sites, spending several months in Dutch genomics, proteomics, microbiology and bioinformatics laboratories, attending dozens of meetings, half a dozen conferences and have interviewed nearly thirty laboratory researchers during the last two years. These scientists cannot avoid practical problems by assuming that they will be solved. They have to solve them *themselves*.

3. Nutrigenomic practice

The practice of nutrigenomics is an interdisciplinary one. At one of the conferences I went to last year, one of the speakers said to the audience: 'Look to your left and to your right. Chances are high that your neighbour is from an entirely different discipline than you are'[5]. Even though colleagues tend to sit together – her overall message was true. Out of all of these disciplines, one in particular is very much involved in diet-genotype interaction, the base of personalised nutrition: epidemiology.

Epidemiologists are correlating several parameters – such as genotypic variation and dietary intake - measured in large cohorts of patients or volunteers. Even though historically a very fruitful line of investigation, there are upper limits to the number of variables, as Ben van Ommen argues:

[5] Observation Sîan Astley, 20050913.

> The current way people work, from epidemiology, the manner at which cohorts are screened do not allow us to reveal complicated relations for more than a few genes at a time, or for more than a few genetic differences at a time.
> *Interview Ben van Ommen, 20060125.*

Ben van Ommen is the grant holder for NuGO, the European Nutrigenomics Consortium: one of the largest programs in the European 6th Framework program. He is part of international nutrigenomic practice and through NuGO aware of the issues addressed and the limitations encountered in the various disciplines in the consortium, epidemiology amongst them.

In order to ever reach the unique diet for every individual, it is imperative to incorporate gigantic numbers of variables. At a previous occasion Van Ommen gave a quantitative example, illustrating where he thinks practical limits will be encountered:

> Imagine a cohort of 10,000 people. If polymorphism A exists in 2% of all people, and B in 20% and C in 3% of all people, you will end up with 1 person in your population who has all three. That is not enough. Even if you screen the whole world you will not find enough people and you will not find out, and that with only a few genes.
> *Observation Ben van Ommen, 20050330.*

The task of 'doing the maths' with respect to these correlations, that comes with these large studies, lies upon the shoulders of bioinformaticians. In their work, they too cannot abstract from the practicalities that come which their type of work. One of the genomics computational experts tells us that 'the number of combinations and permutations of genes and environmental factors are so huge that one will never be able to evaluate all such interactions' [6].

Van Ommen restricts himself to gene-gene interactions and identifies that set of variables to be too large. Parnell includes environmental factors – amongst them, diet – thus increasing the number of possible combinations even more. Both Van Ommen and Parnell identify obstacles on the path towards unique nutrition for individual genotypes: practical obstacles such as the huge numbers of volunteers needed and the huge number of variables to be considered. They do not contest the notion that all people are different, but what they are

[6] Observation Larry Parnell, 20050910.

telling us is that they think finding out how all of that is relevant in terms of nutritional requirements, is subject to practical limitations.

Van Ommen takes up this point to show that this way of approaching the diet-genotype interaction is not only impractical, but also that there is no reason for unique diets tailored to single genotypes:

> If you reason the other way around, there are a number of pathological deviations known from differences in genotype. There are lethal mutations and there are a number of mutations that make people truly obese, pathologically obese. But there are only six of them. If you go to the more subtle deviations … at a certain moment the relevance of the difference between the trees in the forest disappears. The art is not to wander to deep into the forest but still notice the use of your work. […] It matters that one is capable of separating sense from nonsense and useful from the useless and find out for which nutritional parameter it is useful to keep looking for differences.
> *Interview Ben van Ommen, 20060115.*

Van Ommen argues, that with health in mind as the sole driver for the tailoring of nutrition to individuals, there is no reason to regard everyone individual as unique because the major differences on a genotypic level are irrelevant.

Van Ommen identifies practical (or logistical), as well as theoretical reasons for personalised nutrition not being directed at the individual, but at groups. The personalised diet is not about tailoring to the individual:

> We do not tailor every article of clothing to the individual, we live comfortably with the fact that clothing sizes exist. This is the way in which I see genotyping. In the end we will be able to match a clothing size 42 to a genotype size 42. That means that we do not have to go down to the individual level, but we can also stay on the level of clothing size cohorts.
> *Interview N002, 20051211.*

The personalised diet is about groups, about assigning certain diets to certain groups or subpopulations. As Jim Kaput, one of the leading US nutrigenomicists, stated at the Personalised Nutrition Conference 2005: ‘the better word for personalised nutrition would be

group nutrition. Lets be practical about that. [That is] the way to better health'[7]. His position both as a senior scientist and the Chief Scientific Officer of the biotech firm Nutraceuticals enables him to consider both scientific and commercial limitations to individualisation.

Scientist N002 compares these groups to clothing size cohorts and because the word 'tailoring' is prominent in the nutrigenomic vocabulary, the clothing metaphor is used a lot. Scientist I007 takes it up as well. He is an R&D scientist working a large dairy company in the Netherlands. To him these groups have to be large groups:

> What we actually do with products, is that we make confection products, like in the clothing industry. One has no tailors anymore, just plain confection clothing. That means one uses several sizes, for its own size, a group has to be big enough. We are talking about larger groups here, to which […] one can sell a large quantity of products.
> *Interview I007, 20051221.*

He uses an economic argument to restrict the personalised diet to groups, large groups. Where scientist N002 explicitly mentions the genotype as the entity to tailor to, I007 tailors to the individual, not exclusively mentioning the genotype. As I mentioned in the beginning of this paper, there is more to nutrigenomics than genes and genotypes. A large part of nutrigenomics is neither about genes nor about gene expression at all:

> The fields of clinical chemistry and clinical biochemistry are very well developed. They can tell you precisely what optimal cholesterol values are, without measuring the expression of 300 genes involved in cholesterol expression. So I think one has to be pragmatic here too and that is why I'd like to loose the term genomics, as being linked strictly to genes or gene expressions, let alone the difference in genes.
> *Interview Ben van Ommen, 20050125.*

That is why people such as Ben van Ommen and Michael Müller, presumably the two main Dutch nutrigenomic 'champions' increasingly refer to their field as 'molecular nutrition studies' or 'biomics in nutrition research'.

[7] Observation Jim Kaput, 20051103.

The genotype does not 1:1 reflect the phenotype. Earlier, Parnell included environmental factors as relevant modifiers as well and Bruce German has summarised the relationship of genotype and environment in what he calls 'the equation of life' (German and Watzke 2004):

$$Phenotype = Genotype + Environment + \int_{now}^{birth} Genotype \times Environment$$

Summarised, it states that genotype is relevant, but at every moment in life the environment one has been exposed to up to that moment is *equally important*. The same formula can be found in which environment is substituted by lifestyle.

What does all of this show us? Nutrigenomics in practice is increasingly less and less about genes and more and more about other molecules, and so is personalised nutrition. These other molecules are measured in high-throughput systems as well and they provide nutrigenomicists with lots of information about both genotype and environment, but in an integrated way. In their quest for the healthy phenotype, understanding the relationship between nutrition and the genotype enables intervention. At the centre of nutrigenomic enquiries is not the eaters' genome, but the foodstuff. With the human genotype only subject to limited relevant variation, as Van Ommen told us earlier, reaching the healthy phenotype is all about environment, about lifestyle.

A recent review paper, co-authored by 88 nutrigenomic professionals[8], lists several examples of non-nutrient environmental factors or lifestyle related factors that might be of importance: sleep time, altitude, non-prescription drugs, water intake related to other beverages, physical activity, stress, allergens and pollutants, circadian rhythm and seasons changes as well as energy balance (Kaput, Ordovas et al., 2005) and scientist W001 expresses himself quite clearly when saying that he is convinced 'that when one eats varied and with moderation and exercises a bit, that – with the exception of a few unfortunate people – one does not need any nutrigenomics to stay healthy' [9].

I suggest rephrasing 'Genes load the gun, environment pulls the trigger' - a statement accredited to many people in genomics - into 'Genes load the gun, but lifestyle pulls the

[8] These 88 professionals include mainly academic scientists and R&D scientists, but also ethicists and social scientists that address nutrigenomics in their research.
[9] Observation scientist W001, 20051005.

trigger'. What we can learn from watching Crime Scene Investigation is that (nutrigenomic) research may look for the bullets mobilising every piece of technology in their labs, but only to find the triggerman. The acronym NuGO, originally meaning 'European Nutrigenomics Organisation' is also said to mean: Never Use Genomics Only' (Müller 2005).

4. ELSA in nutrigenomics

Social scientists, ethicists, philosophers and lawyers have been interested in nutrigenomics almost from the very beginning. Nutrition science is an interesting subject, where description and prescription are very close. And genomics technologies introduce their own set of interesting problems and issues. In their report on the subject, the Utrecht Ethics Institute explains why it is relevant for ELSA researchers, to look into nutrigenomics early on:

> It is not too early to review and discuss the ethical consequences of the development towards tailor-made diets, even though currently no such diets are available. Ethical questions are not questions that are only related to the application of certain knowledge or technology but are often already implicitly present in the research stage […]. Even though we are not yet confronted with tailor-made dietary advice offered in the medical sphere, it is possible to imagine topics that are likely to become morally relevant when food is tailored to an individual person's genetic makeup (Ethics Institute 2005).

Many ethical, legal and social aspects have been identified related to nutrigenomics, to name but a few: the shift from curing to preventing to enhancement (Korthals 2002b), the creation of new risks and uncertainties, issues surrounding the screening and sampling of every individual (Korthals 2002b), the loss of the meal as a moment for sharing and gathering (Korthals 2002a; Swiersta et al. 2002), the relation of identity to nutrition (Meijboom et al. 2003), the abundance and availability of genetic information (Korthals 2002b; Chadwick 2004) and the conflict between whether it is legitimate to consider health as the main, or even sole, value relevant to food choice (Korthals 2002b; Lemke 2002; Chadwick 2004; Görman 2006). Certainly not all, but many of these issues are related to the presumed individualising effects of genomics (Korthals 2002b; Swiersta et al. 2002; Chadwick 2004).

As Michiel Korthals notes in his book: 'Individualising effects of genomics are being identified by nutrition scientists and nutrition journalists […]' (Korthals 2002b). He continues by telling us that:

> This individualised approach means that individuals are to be screened and sampled, that their information needs to be stored and that individualised prescriptions need to be given. Of course this can mean an enhanced control; furthermore it burdens the individual with new responsibilities with respect to their kin, their partners and networks (Korthals 2002b).

In his work he draws from the expectations expressed by scientists and press and in fact he uses the exact same mini-scenario I have listed in the first section of this paper both in his 2002 book and again 2006 in a short paper (Korthals 2002b; 2006).

I have chosen the example of personalised nutrition exactly because many of the ethical, legal and social aspects of nutrigenomics are connected to a fear or worry that nutrigenomics will somehow *hyper-individualise* society, or at least add some scientific momentum to the ongoing trend when '[c]ommon meals threaten to disappear, simply because my DNA profile prescribes a different menu from yours' (Swiersta et al. 2002).

This individualising effect of genomics and nutrigenomics has an empirical foundation. The material used by the ELSA researchers to draft their first normative agendas with respect to personalised nutrition, is derived from the context of expectations and promises, simply because in the beginning, the personalised diet existed only in those terms. However, nutrigenomics has moved on from existing only in the realm of expectations into actual scientific practice, and research into the ethical, legal and social aspects of nutrigenomics should stay in touch with these developments. This implies that ELSA research has to acknowledge the way genomics technology is actually used and the effects it has on the relation between nutrition and genes and the notion of personalised nutrition. The normative agenda set up by the ELSA researchers, empirically rooted in the expectations uttered by nutrigenomic professionals, is in need of some revision. Rooting ELSA in nutrigenomic practice means making two significant shifts: first, shifting the focus from genes to almost all other molecules and acknowledging that these other molecules reflect not only genetics but lifestyle as well. Second, a shift from the issue of individualisation to the issue of making groups.

5. Towards a politics of classification

While many of the issues brought forth by ELSA researchers are still very relevant, rooting the normative agenda in nutrigenomic practice implies that new issues have to be discussed. The loss of the meal as a moment for sharing is indeed under pressure from existing trends towards individualisation of lifestyle – but not as the result of a nutrigenomics prescribed individual diet:

> If one would issue a [population-wide] advice with respect to healthy nutrition, only very few people would get uncomfortable from that. So, again, it is merely a fine-tuning for segments of the population. I do not think food industry wants to produce ten million different confections, but I do think it is good that everyone of those ten million people thinks about – and has the means available to find out – what is healthy for him or her. For a professional athlete, something else is healthy then for a baby… that type of personalisation has existed for a long time. That it gets more firmly rooted in science, fine… that more target nutrition arises, that is merely logical.
> *Interview Ben van Ommen, 20050125.*

Genomic information might not be relevant in all cases and despite talk about the 1000$ genome, experts consider screening the whole population irrelevant:

> I actually am convinced that it is not necessary to sequence each an everyone's genome to find out that this person has a nutritional problem. [...] Let's phrase it this way: nutrigenomics is not needed for such applicated questions; I am convinced about that. I have expressed that in Mallorca [*Personalised Nutrition Conference, BP*], when I said that the solutions to the large nutritional diseases, from adipositas, diabetes type II and cardiovascular disease, do not need nutrigenomics. They need *political steering*.
> *Interview N002, 20051112.*

Furthermore, as Ben van Ommen explained earlier, looking into other molecules and variables may be much more enlightening. He used the well-known example of cholesterol, but others

exist as well, varying from blood pressure to blood free fatty acid levels. Although the threat of hyper-individualisation appears not to be that great as was thought by ELSA researchers in the beginning, issues of personal responsibility remain relevant. When lifestyle becomes the focus of nutrigenomic research, pressure towards *healthy living* may grow and the question whether health is the only value worth pursuing though food remains unchanged.

The Food Ethics Council conceptualises personalisation as a 'political project' in which both food industry and government are actively involved (*Food Ethics Council* 2005, p.5-6). In the part of their report that addresses nutrigenomics, the quoted scientific and ELSA research is, however, also largely based upon expectations (p.24-30). I argue that nutrigenomic ELSA research needs to shift their agenda away from the politics of personalisation and look into the *politics of classification* that the practice of personalised nutrition generates. New questions arise from such a politics with respect to nutrition and society. I would like to end by suggesting a few of these questions. Nutrigenomic practice is creating group related nutrition. Who is going to be in a group at all? No classification is perfect and every classification has some sort of 'left-over' category. What advice do people in that group get? Which groups are getting their own advice and based upon which criteria? And do the categories created by science match the categories created by industry through the products and options they supply? What if not?

Who will pay for issuing an advice when it is not individual? What are the consequences of being in a certain category? And how do you get into a different one? Is there a reason to try? Is there going to be pressure towards being in a certain category? By health insurance companies, by the government or from ones own drive towards health? Does every category get the same health insurance, or any insurance at all? Is there a top category? Who says so? Can it be full? What if I choose unhealthy living? Who gets to know that? Furthermore, in the light of increasing international alliances (Kaput, Ordovas et al., 2005), will the classifications be global, national or local? What consequences does this have for worldwide public health?

The normative agenda initially drafted by ELSA research identified several relevant issues based upon expectations by nutrigenomics professionals. Many of them remain relevant when based upon practice; however, many also require a shift of focus, from genes to lifestyle and from individuals to groups. ELSA researchers should keep in mind that 'science is a

moving target and those that study that target simply have to move along', as Helga Nowotny recently reminded us (Nowotny 2006).

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Gindo Tampubolon
ESRC Centre for Research on Socio-cultural Change
University of Manchester
gindo.tampubolon@manchester.ac.uk.

Ronnie Ramlogan
ESRC Centre for Research on Innovation & Competition
University of Manchester
ronnie.ramlogan@manchester.ac.uk.

Networks and temporality in the development of a radical medical treatment

Discovered around 1979, coronary angioplasty has emerged to be one of the principal treatments for advanced coronary artery disease. This paper uses methods from social network analysis to understand how this mode of treatment developed. By using a bibiliographic database of over 11,000 medical journal articles related to coronary angioplasty spanning the 25 years of its history, a large citation network was constructed. The powerful but relatively unknown main path algorithm was then used to capture the underlying change in structure of this network and identify the major streams of events that define this specialised field of coronary medicine. This method was first used in the study of historiography of DNA theory (Hummon and Doreian, 1989) and later by Carley et al. (1993) to explore the social and intellectual factors in the then emerging field of conflict resolution. We believe that main path analysis enabled us to identify the problem sequence that is characteristic medical innovation. We have also identified from the network, periods of exploration by the medical community and periods of consolidation as the emerging field of coronary angioplasty took shape. In leading to this comparison we identify the issue of complementarity among methods and reflect upon the theorizing of knowledge in social science.

1. Introduction

Cardiovascular disease is a major health problem for Western economies (American Heart Association, 2000; British Heart Foundation, 2004). Perhaps this is why this area of medicine has been the focus of enormous innovative effort (Steinwachs et al., 2000) and one of the most important innovations to emerge over the past three decades has been a revolutionary new approach for the treatment of coronary artery disease called coronary angioplasty. It was first introduced into clinical practice in the late 1970s and has become a highly regarded

innovation within the profession, being ranked third behind MRI and CT scanning in a recent survey of internists (Fuchs and Sox, 2001).

The task of this paper is to understand how coronary angioplasty developed using methods from social network analysis. By any account the development of this technology is not a solitary event. Although the breakthrough was made and championed in the early days (around the late 1970s) by Andreas Gruentzig, a German clinician working in Zurich, its prominent status today reflects the work of thousands of medical scientists, practitioners, firms and patients who have been involved in the course of its development, use, improvement and diffusion over the last two and a half decades. It is would not be unrealistic to suggest that coronary angioplasty is the outcome of an innovation network and one of the key issues that innovation scholars have begun to become interested in is how such networks develop and how they evolve over time. To this end, the literature suggests various approaches that could be used for analysing network evolution. For example some authors favour agent based modelling- in-silico laboratories where rule based agents are used to replicate stylized facts observed in reality.[1] In these models the concern is with the macro-structure that emerges as time unfolds. They are about how simple but predictable local interactions among many individuals can generate familiar but perplexing aggregate patterns, such as stock market crashes, revolutions or fads. Other approaches focus instead on the relative movements and importance of agents within the network as it evolves. Stark and Vedres (2006) for example use a novel combination of social network analysis and sequence analysis to study inter-enterprise network formation of Hungarian firms and their relationship with foreign investment from 1987 to 2001. They followed the trails made by enterprises as they make, break, and reshape ties to other firms to identify distinctive pathways where firms make use of network resources to buffer uncertainty, hide or restructure assets, or gain knowledge and legitimacy.

In this paper we also employ methods of social network analysis but in a different way to Stark and Vedres (2006). Using a bibiliographic database of 11,240 medical journal articles related to coronary angioplasty spanning 25 years of its history, we construct a large citation network as the start point of our analysis. We then use the powerful but relatively

[1] Although quite clearly associated with the work of the much celebrated Santa Fe Institute, one of the forerunners to this genre is the model devised by game theorist Thomas Schelling (1971) to demonstrate how extreme segregation tends can emerge even in populations that prefer ethnic diversity, and in the absence of any institutional pressures.

unknown main path algorithm to capture the underlying change in structure of this network and identify the major streams of events that define the field. This was first used in the study of historiography of DNA theory (Hummon and Doreian, 1989) and later by Carley et al. (1993) to explore the social and intellectual factors in the then emerging field of conflict resolution. We believe that main path analysis enables us to identify the *problem sequence* that is characteristic medical innovation (Tampubolon and Ramlogan, 2004; Metcalfe et al., 2005; Mina et al., 2004). Moreover our analysis also leads us to conclude that the coronary angioplasty community can be characterised by the features of exploration and exploitation characteristic of organisational learning (March 1994). We have identified from the network periods of exploration by the medical communities and periods of consolidation as the emerging field of coronary angioplasty took shape. We see below that Gruentzig's innovation of PTCA was pivotal in that, to a large extent, it influenced subsequent history of how to deal with the clinical condition. In other words, this created path-dependency in the history of PTCA. As suggested by March and others (see e.g. March 1994; Senge 1990; Argyris and Schön 1978) exploration and exploitation are essential for the successful accumulation of knowledge or learning. Exploration is understood in terms of search, variation, risk taking, experimentation, flexibility, discovery and innovation whereas exploitation involves refinement, choice, production, efficiency, selection, implementation and execution. We can succinctly delineate/depict these periods of exploration and exploitation by following paths or sequences of important papers as these serve as a proxy for accumulation of knowledge within the scientific community working on PTCA. We can understand the history of PTCA over the last 25 years in these terms as we observe paths or sequences of citations that together suggest variation or experimentation or *breadth* which expresses exploration; we also see paths or sequences of citations that resemble further refinement or implementation or *depth* which expresses exploitation.

We turn now to providing a brief historical overview of the developments surrounding coronary angioplasty and later on we present data and methods that independently capture these ideas and present them visually.

2. A brief overview of the development of coronary angioplasty

In this section we propose to give only a flavour of the historical development of coronary angioplasty and the context in which it emerged. Coronary artery disease (CAD) is the most common cause of death in developed countries. It is the end result of a process called atherosclerosis that occurs when atheroma or plaque forms on the inner layer of the coronary artery and impedes the flow of blood to the heart. In the early stages, the build up of these deposits is silent (symptom-less) but as the disease progresses chest pains of varying degree (angina) as well as shortness of breath occur; the eventual outcome could be a heart attack.[2]

As recently as the decade of the 1960s treatment options for angina (chest pain) or acute myocardial infarction (heart attack) consisted of few medications (mainly nitroglycerin in use from the mid to late 1800s to provide transient relief from angina by dilating vessels and enabling more blood to get to the heart), rest and hope. In the 1960s and 1970s respectively, two new classes of drugs (beta-blockers and calcium channel blockers) were added to the cardiologist's arsenal for dealing with angina. But the 1960s heralded a new surgical treatment modality - coronary artery bypass surgery, which at the time was regarded as being truly revolutionary. This was based on the idea of stopping a heart, using a vessel harvested from another part of the body (upper leg) to restore the blood flow between those areas of the heart that were separated by the occlusion, and then restarting cardiac activity.

The technique spread rapidly[3] although the diffusion of this procedure was not without controversy and this was primarily related to the evidence base on which bypass surgery was being promoted. A debate raged throughout the 1970s about the quality of evidence that was being assembled about the efficacy of bypass surgery relative to medical therapy. In a review of the medical literature at the time Mullins and Lipscomb (1977) noted that analyses were based on incomplete studies or that some studies were less that ideally designed. Given the weight of evidence available they were hesitant to unambiguously recommend surgery other than in special cases.

2.1. The development of a new treatment modality

[2] It only becomes painfully evident when the vessel is approximately 70% occluded (blocked). At this level of closure, the oxygen-enriched blood that the heart receives is only adequate when the body is at rest.

[3] Figures about the volume of procedures undertaken in the early period are patchy. In 1973 around 25,000 operations were performed in the US and this increased to 70,000 by 1977 (OTA, 1978). Elsewhere, the absolute numbers of procedures was small in comparison. In the UK for example 2,297 operations were carried out in 1977 and this increased to 4,057 by 1980 (British Heart Foundation, 2004)

It is against this background of uncertainty about the efficacy of coronary bypass surgery that coronary angioplasty (formally, percutaneous transluminal coronary angioplasty or PTCA) was developed. While this achievement secured Gruentzig's name in the annals of medical history, his key insight of using a balloon tipped catheter to dilate the diseased coronary artery was built around cardiac catherisation and transluminal angioplasty, already established medical techniques. The former is a diagnostic procedure in which a catheter (a thin flexible tube) is inserted into the right or left side of the heart. This could be then used to produce angiograms (x-ray images) of the coronary arteries and the left ventricle, the heart's main pumping chamber, and/or used to measure pressures in the pulmonary artery and to monitor heart function. But by the 1950s, following the work of Cournand, Seldinger and others, diagnostic catherization had become established as the main technique for investigating cardiac function.

The second technique, transluminal angioplasty also known as 'dottering' after its developed Charles Dotter, consisted in the dilatation of occluded peripheral arteries by means of a catheter that inserted into the vessel to break the plaque. Gruentzig learned of the Dotter method during a seminar given by Zeitler, one of the European followers of Dotter, at the Ratchow Clinic in Darnstadt, Germany in the mid 1960s. He later moved to the University of Zurich and there, collected and evaluated a small series of 'dotter' cases. By the 1970s he was actively considering how this technique could be applied to the heart recognising that 'any application of the dilatation procedure to other areas of the body would require technical changes' (King 1996: 1624). Encouraged by his colleague and Joint Head of Cardiology, Wilhelm Ruttishauser, Gruentzig went on to develop a prototype balloon catheter, the foundation for PTCA. One of the challenges he had to overcome was to find the right material for the balloon. He experimented with several and by 1972 settled on a PVC balloon as he found this to be a tough, less compliant material than latex which he also considered. In 1975, he developed a single and then more importantly a double lumen catheter – one for inflating the balloon and the other for injecting contrast media and monitoring intravascular pressure. The following year (1976) he presented results based on animal experimentation to a less than enthusiastic audience at the American Heart Association meeting. Undaunted he succeeded in performing first PTCA on a human patient in Zurich in 1977. The technique gained credence and spread quickly thereafter particularly in the US.

The growth of practice was naturally associated with several improvements in devices and in practice including the invention of the steerable balloon catheter by Simpson in the early 1980s (Simpson, et al. 1982).[4] However, the structure of these many contributions to the innovation sequence also reflects the shift in the nature of the dominant problem. The solution to the catheter problem and Greuntzig's balloon device to compress the plaque opened up new territory but it was soon found that restenosis - the re-narrowing of the artery after it has been treated - occurred in a significant number of patients drastically reducing the efficacy of the treatment and raising its real cost. The solution to this problem was the invention and innovation of the stent, an expandable metal device to give support to the blood vessel wall (Eeckhurst, Kappenbergen and Goy, 1996). Stenting cuts residual restenosis by over 50% and is a major complementary development in PTCA technology. However even this solution is not complete as restenosis can occur on the inside of the stent and subsequent attention shifted to the design of drugs to coat the stent that will prevent this occluding process (Serruys, et al, 1991; Lincoff, 2000; Suwaidi, et al, 2000).

3. Data, Methodology and the idea of the Main Path

Clinicians regularly publish papers that report on more localised trials and this information base is of crucial significance in understanding the growth of understanding in the community of PTCA practitioners. This literature provides for us an effective and innovative way to trace the emergent problem sequence. The data we used were retrieved by searching the Institute for Scientific Information (ISI) database using a number of search words determined after extensive discussions about the key developments in the field with medical practitioners and scholars at the University of Manchester. This search procedure yielded a database of 11,240 articles titles between 1979 and 2003 and these contained over 300,000 references.

A number of scripts written in Perl were used to extract information to help us understand the dimensions of the data. Profiles are given in Figure 1. The data is also used to create of a citation network; this is further discussed below. Starting with two articles

[4] We explore these developments in other papers (Mina et al. 2004, Ramlogan et al. 2006)

published in 1979, the number of articles that delineate the field increased annually reaching a peak in 1996 and declined slightly thereafter.

Table 1.

Year	Publications	Cumulative Authors	Institution	Of which Firms	Countries/US states
1979	2	4	2	0	2
1980	9	28	15	0	8
1981	19	130	30	0	15
1982	29	209	54	0	20
1983	40	252	74	1	26
1984	80	501	120	1	34
1985	125	862	191	1	41
1986	111	1140	232	1	45
1987	143	1493	291	3	49
1988	154	1866	355	5	53
1989	175	2320	422	7	58
1990	222	2831	513	12	66
1991	460	4131	716	27	70
1992	504	5690	942	39	76
1993	584	7195	1174	60	83
1994	608	9071	1473	82	92
1995	669	10790	1754	101	95
1996	845	12786	2021	131	98
1997	937	15772	2445	159	102
1998	934	18008	2953	195	105
1999	987	20445	3484	229	108
2000	996	23295	4035	277	110
2001	892	25633	4531	336	113
2002	901	27849	5006	389	116
2003	814	29883	5469	416	118

Source: Calculated

Some 29,883 authors contributed to this body of scholarship over the period and as the table shows the cumulative author count increased from 4 in 1979 to 29,883 by 2003. It is also

interesting to note that single authors accounted for only 6 percent of publication and in fact 46 percent of all publications involved teams of more than 5 co-authors. In coronary angioplasty, like in other areas reporting medical research there is clearly a lot of teamwork as these are essentially communities of practice in the Brown and Duguid (1991) mould, where formal and informal institutional bases become important loci for the development of new knowledge.

Further analysis of the data enabled us to uncover other attributes. For example, one might assume a priori that publications in this area would be dominated by public institutional authors from universities, hospitals and research organisations. While this is the case we however find that co-authorships from firm affiliations show up in the database from 1983 and by 2003 account they account for 7.6 percent of all institutional authors. We explored the dimensions of these firm related collaborations using patents in a related paper (Mina et al, 2004). Further insights relate to geographical distribution of the research activities. The ISI data does not easily facilitate a one to one mapping of author and address as these are listed in separate or unconnected fields. However from the address field we can identify and extract those papers that were collaboratively written across institutions or geographical domains. Annual publications are shown in the top left panel and map a sigmoid curve indicative of a near complete life cycle of knowledge growth in the field (Figure 1). Note also that the top right panel shows the cumulative number of authors contributing to field increasing exponentially. This is indicative of the growing pool of codified ideas and clinical study as researchers formulate and test hypotheses and record and share the evidence within their community.

Figure 1

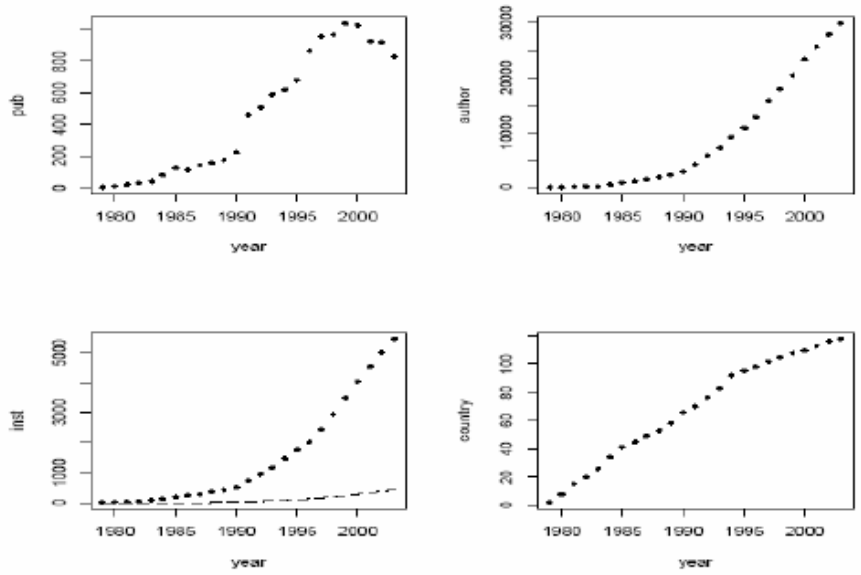

Figure1. Various aspects of growth during the 1970 – 2003, clockwise from top-left panel (1a) Growth of publications (1b) Growth of authors (1c) Growth of institutions (public institutions in thick dots, firms in dashes) and (1d) Growth of contributing countries.

As mentioned above, our principal use of the data was for the construction of a large citation network where papers are used as nodes and are linked through their citations. Network analysts have long suggested that such networks are a fruitful avenue for exploring ideas related to the sociology of science. Indeed citations have been acknowledged as explicit linkages between papers that have some important content in common since Garfield's pathbreaking analysis in the 1950s and 1960s (Garfield, 1955: Garfield et al., 1964). De Solla Price (1965) proposed a network of scientific papers model by which scientific advances could be traced by analysing citation patterns in published journal articles.

The greater the number of citations to an earlier work, the greater the likelihood that this paper may be a milestone or key event in that subject field (Garfield, 1970). Studying citation patterns between articles, journals and other publications can therefore help in

providing new insights about the interaction between disciplines and individuals in relation to the growth of understanding. There are of course obvious limitation in taking bibliographic citations at face value. Differences exist in propensity to cite across countries, cultures and disciplines (MacRoberts and MacRoberts, 1989) as well as authors' use of self-citation. Inappropriate, indirect and negative citation, window dressing and politically motivated flattery can, if widely practiced, severely undermine such modes of analysis (Hummon and Doreian, 1989). Other problems recognised by users of bibliometric data include typographical errors, incorrect spelling of authors' names or unsystematic citation for example citing Smith, T. W. as Smith T. in some instances or Smith T.W.[5] Moreover, the citation provided by the ISI credits only the first named author for any multi-authored paper and this could biases the allocation of credit in any analysis.

With the above caveats in mind we make the assumption that if a publication is taken as an event of the reporting of (new) knowledge then its citation by subsequent scientific publications can be taken as a follow-up event which in some way has been affected by the original publication. In pursuing this line of approach we conceived the corpus of codified knowledge, i.e. scientific publication, on coronary angioplasty as a large directed acyclic graph (DAG). By keeping this duality of event-publication and effect-citation in mind we can think of the traditional citation network made up of publications linked by their citations as a ***directed acyclic graph***. It is directed because any publication can only be cited by a subsequent publication, in other words the graph is *weakly ordered* in time or it has a direction parallel with time. In certain cases a publication can be cited contemporaneously but this does not change the properties of *weak* ordering. Moreover the graph is also *acyclic* in that an earlier publication cannot cite a later publication to form a cycle. In our case the network we are analysing comprises around 94,400 nodes including the lead authors of the 12, 400 primary references plus each unique cited article connected by 300,000 arcs.

[5] It might have been assumed that journal, year and page would together uniquely identify a paper. However, we found out in this reasonably large corpus that this is not the case. We then resorted to make use of author names as part of the identification scheme. This decision in particular imposes a considerable time burden on the researcher in data cleaning to ensure some reasonable level of consistency. In our case, we identified the top two hundred authors and systematically checked data entries.

3.1 Main Path

In the area of social network analysis, the idea of the main path was first proposed by Hummon and Doreian (1989) in their analysis of the development of DNA theory. In this research and in a subsequent study of the literature on measures of centrality in social networks research (Hummon and Carley, 1993) distinctive pathways through the respective citation networks were found to be related to the key intellectual developments that defined the respective fields (see also Carley et al., 1993).

The main path captures a structural feature of a network that contrasts with the orthodox approaches such as bibliometric coupling or co-citation, used for studying structure, in that these latter approaches focus on the clustering of nodes. The novelty Hummon and Doreian's proposed is to make use of the links of the network rather than the nodes, that is, on the network's connectivity. Recall from above that our citation network is a DAG and even though there is a temporal ordering we are not yet in a position to say too much about its structure. For all intents and purposes it is still very much a set of nodes connected by links of equivalent value. However with this in mind it is relatively easy to visualise that it is possible for one to start at any early located article (position) in this network and attempt to find a route (or routes) that will link this node (article) to another published later in time. Hummon and Doreian used this basic idea which is called a *traversal path* to propose a solution to valuing the network so that the most important parts of it and especially its main path can be extracted for further analysis.

The main path of the network refers to the 'structurally determined most-used path' in a network; it is the path with the *highest traversal counts* (Batagelj and Mrvar, 1998). This measures the number of times that a tie or link between articles is involved in connecting other articles in a citation network (Hummon and Doreian, 1989). The main path analysis then determines all possible search paths through the network starting with an origin article through to endpoint articles, and calculates the traversal counts of each link in the network. Main path analysis thus provides for a longitudinal examination of how a citation network or research field has evolved through their citation patterns.[6]

[6] For more technical explanations of the main path see also de Nooy et al, 2005 and Verspagen , 2005.

The algorithm for extracting a main path is embedded in the software Pajek, a tool for visualising and analysing large network (Batagelj and Mrvar, 1998).[7] Batagelj (2002) implemented algorithms to efficiently compute a number of indices suggested by Hummon and Doreian (1989) in Pajek so that they can be used with networks of very large dimensions – up to several thousands of nodes or vertices. These three indices (NPPC, SPLC, SPNP)[8] or weights of edges provide us a way to computationally identify the (most) important part of the citation network – the main path.

It is rather unfortunate that the algorithm is called the *main*-path algorithm. This label unnecessarily prejudices our expectations about understanding the dynamics of the network of knowledge accumulation as captured by citations. The main-path algorithm, in fact, not only presents *the* main-path but also other paths which are explored and compares those paths. In this sense, the main-path algorithm indeed clearly presents paths of *exploration* and paths of *exploitation* evident in any knowledge accumulation or learning process (March 1994). However we stick to the label due to its well-known designation.[9]

4. Coronary Angioplasty Research: The results

The results of the main path exercise are presented in Figures 2a and 2b. Figure 2a shows the connectivity between documents among the most important pathways through the network as determined by the Hummon and Doreian procedure. This sub-network represents a highly synthetic quantitative summary of development in the angioplasty community over the thirty years covered by the study. It is made up of 758 papers, arguably the most important pieces of research.[10] In some respects we can perceive of this diagram as representing part of the angioplasty search space in which we locate and link the research activities as they evolved

[7] Pajek is available from http://vlado.fmf.uni-lj.si/pub/networks/pajek/.
[8] We use the *search path link count* (SPLC) method, which is a simple count of the number of times a link between articles is found along all possible search paths through the citation network
[9] While it is also possible to do blockmodelling to identify bifurcations in the network, we deem it superfluous because both processes of exploration and exploitation (March 1994) are necessary and ever present at any moment in time in any accumulation of knowledge or learning process. The emphasis may be different at different times.
[10] We used an arc cut of 0.0011 to partition the network. We tried different cut-off points without significantly altering the results. In cases where there were reciprocal citations for example papers citing each other in the same year we removed them from the network by combining them into a single node with combined citations. We chose also not to label the nodes as this would make the diagram incomprehensible.

over time. Notice that overall there seems to be a pattern consistent with what might be considered to be a phase of exploration in the bottom part of the diagram, a phase of convergence towards the middle and finally a second period of exploration. The significance of this will be discussed further on.

Figure 2a

The Coronary Angioplasty Network 1979- 2003

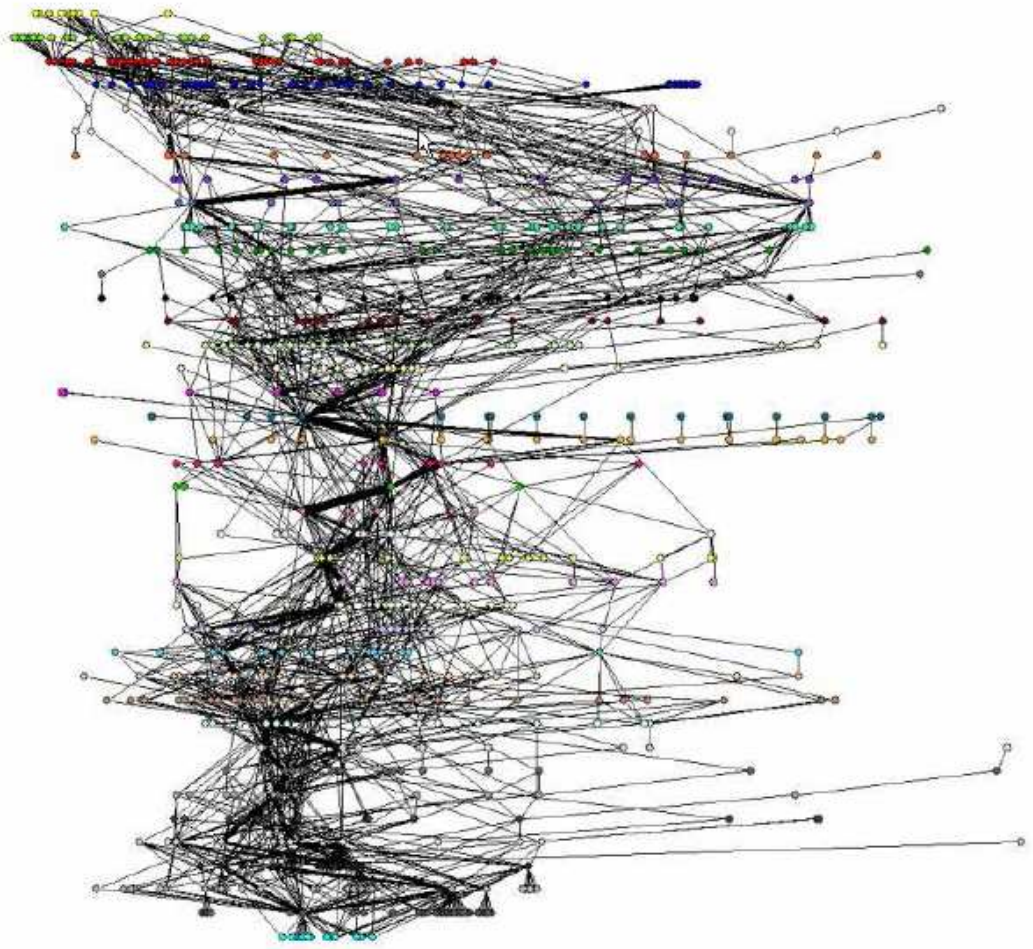

Figure 2b

The Main Path through the Coronary Angioplasty Literature

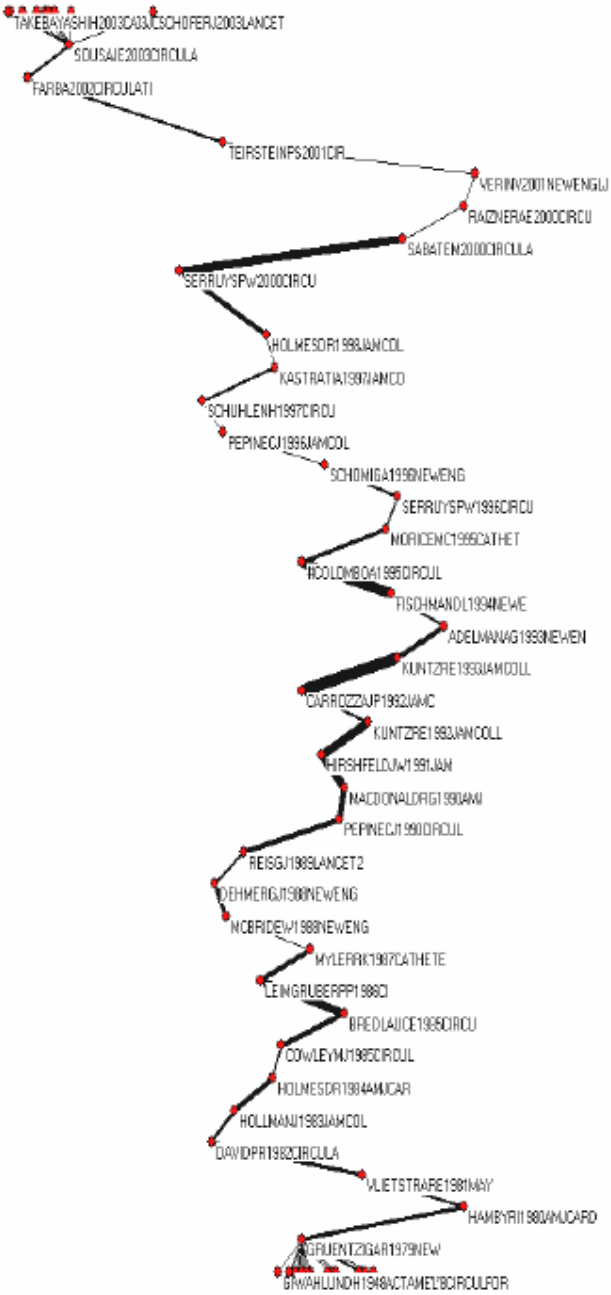

Figure 2b shows the main path that we have extracted from sub-network. This path connects 61 nodes.[11] We studied the paper abstracts associated with each node and have concluded that in general they confirm interview and other qualitative accounts of the key developments in angioplasty that have been reported in several review studies (Mueller and Sanborn, 1995, Myler, 2002, King, 1996, 1998).[12] The story of course largely begins with Gruentzig's 1979 paper which he co-authored with Ake Senning and Walter Siegenthaler, colleagues from Zurich. This lies to the lower end of the main path diagram. Some of the nodes below Gruentzig represent the foundation from which the angioplasty community emerged. Nodes to the top of the diagram on the other hand are a sample of the state of the art by 2003.

Following Gruentzig's breakthrough, the concerns of practitioners were with identifying the medical conditions under which this new technique would provide benefits to patients under tolerable margins of risk. The study by Cowley et al., 1985 is one of a number of foundation papers that was produced under the sponsorship of the National Heart Lung and Blood Institute in the US in this early period. These provided early evidence from a Registry set up in 1979 to collect, analyse and disseminate the results from using the balloon angioplasty procedure in medical centres across the US and in other countries (Mullin et al., 1984).

As operational experience was gained, the medical community began to recognise a number of problems. First, in a small but significant number of cases, the procedure resulted in weakening and collapse of the internal structure of the artery which would subsequently require emergency bypass surgery. Thus in the early days, the practise of coronary angioplasty was contingent on having emergency coronary artery by-pass operating facilities available. Second, tissue trauma at the site of the procedure sometimes triggered blood clotting which, depending on severity, would require major invasive treatment. Over time however the occurrence of this would be addressed with anti-thrombolytic drugs. The third problem was restenosis – the appearance of a new constriction in the artery. This tended to occur during the first 3 to 6 months after the procedure. It is not atherosclerotic in nature but results from the outgrowth of "endothelial" cells that normally line blood vessels. It has been

[11] In the discussion that follows we limit the discussion to just a small number of the 61 publications that characterise the main path. The respective bibliographies are available from the authors upon request.
[12] Abstracts were obtained from the Medline database and for those that were not electronically available, we studied the hard copy.

likened to “over exuberant” tissue healing and regeneration similar to scar formation after the trauma of angioplasty.

Between 1986 and 1995 (marked on the main path with papers by Leimgrubber et al, 1986 and Colombo et al, 1995) together with developments in equipment (Mina et al. 2005) and with accumulated practical experience of the procedure dealing with the problem of restenosis became increasingly important issue that would determine successful adoption of angioplasty. This technique had the potential to be a serious competitor to bypass surgery. Certainly in these early days it was proving to be so in some specific medical circumstances. However restenosis would undermine any perceived (economic) advantage simply because its occurrence would necessitate repeated procedures. This prompted the exploration of a number of possible complementary treatments to be implemented pre and post procedure in the hope of ameliorating restenosis. For example, Dehmer et al. (1988) investigated whether there were any benefits taking n-3 fatty acids prior to or subsequent to the angioplasty procedure. This was found to be of ‘limited success’ for a small population segment. Reis et al. (1989) investigated fish oil supplementation and concluded that did not influence post angioplasty restenosis. Pepine et al. (1990) in another study found corticosteroids to be ineffective on the development of restenosis after angioplasty.

During the latter part of the 1980s, one solution gathered momentum. This was the application of a stent – a scaffolding structure, applied either with balloon angioplasty or on its own (self expanding stent). The stent was a solution to two problems. First, it would act as a support structure to prevent the collapse of the inner vessel which sometimes occurred. This would ultimately limit the requirement for the procedure to be conducted in an area co-located with emergency surgical facilities. And second, it would reduce the impact of restenosis by mechanically maintaining the artery patency and thus the need for multiple angioplasty procedures. By the mid 1990s studies were being published that confirmed the beneficial deployment of stents: The study by Fischman et al. (1994) and Colombo et al. (1995) were pivotal in this respect. The former compared the effects of stent placement and standard balloon angioplasty on restenosis and found that the placement of an intra-coronary stent outperformed ‘simple’ balloon angioplasty resulting in an improved rate of procedural success and a lower rate of angiographically detected restenosis. The latter study showed that better stent placement with the use of high-pressure final balloon dilatations would reduce problems with anticoagulation that had periodically been occurring. This technique

contributed to significantly reducing hospital time and vascular complications. Subsequent studies along the main path followed another problem the emerged, one that was quite unexpected. While the use of stents greatly improved the outcome of angioplasty it was soon found that scarring occurred within stents (in-stent restenosis), restricting blood flow. Among the various solutions that have been explored are drug eluting stents (Serruys et al., 1996), medical therapies before and after stenting (Schomig et al., 1996) and radiation (Sabate et al, 2000 and Verin et al, 2001). Of these treatments and based on current evidence it appears that drug eluting stents offer the most promising new treatment for coronary artery disease. This involves coating the outer surfaces of the standard coronary stent with a thin polymer containing medication that inhibits formation of scar tissue intervention site. Accumulating medical evidence shows this to dramatically decrease the chance of restenosis

5. Summary and Conclusions

In this paper we used the idea of the main path analysis to test our understanding of the development of a novel treatment for coronary artery disease. This technique has previously been proven to be useful in understanding the development of DNA theory conflict resolution research and the growth of the social network literature. Carley et al. (1993: 444) observed that the main path mapped the intellectual influences and cross fertilisations that are important to cumulative scientific process. They further noted that technique the main path when combined with historical analysis provides a rich and detailed understanding of a historical period because while historical analysis has the advantage of locating and describing institutional context, tools of structural analysis such as the main path has the advantage of controlling for the powerful influence of institutional contexts.

We believe that the application of main path analysis to the area of innovation research allows us to discover an interesting dynamic. While out main path map represents a highly synthetic quantitative summary of the evolution of this medical community, it is also provides firm evidence of the flux within the community as the new method for combating the debilitating effects of severe coronary artery disease was introduced. Our results lend credence to the notion that medical innovation is driven by the idea of a problem sequence and that this is the central concept around which we can build an understanding of how

innovation processes are instituted. Innovations as we have expressed previously are rarely if ever uniquely circumscribed events and outcomes. From the analysis above we clearly observe that as problems were solved, extending the range of application and improving practice, new problems would be defined requiring further exploration of the broad cardiology search space in the search for new solutions. Thus we can account for what we described earlier as phases of exploration and consolidation and show the development overtime of the network of relevant scientific contributions.

The findings here also speak to the literature on learning in general (March 1994). The method applied here clearly captures both exploration and exploitation observed over the last 25 years in the development of PTCA. This particular case study also extends the literature in its treatment of the scope of where learning is observed. Previously, learning is to be understood as an individual and, more recently, organisational phenomenon (Argyris, C. & Schön, D. 1978, March & Olsen 1975). One important feature of these subjects (individual or organisations) is the presence or availability of an overarching cognitive guide or director. Here we see that among independent groups of scientific researchers, the phenomenon of learning is also observed. In a sense there is a self-organising mechanism that is taking place at the community level without the presence of a cognitive guide/director.

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Nicole Akai Hala
Dept. of Sociology, Columbia University
nh21@columbia.edu

Representing the Nation and Others: A Formal Method for the Analysis of Political Identities

This paper presents a formal method to track changes over time in the salience of different political identities: political claims analysis (PCA). Identities are operationalized as collective public claims, made in a specific place and time. While linear and unidirectional socialization models work with a substantialist conception of identity, a claims-centered approach assumes political identities are collective and relational, shaped through public claim making interaction. Coding discrete identity claims, researchers can sort them by actor types and capture the distribution of claims across the political field. The specific relations asserted in claims -- the 'we' and 'they' – can also be recorded. The coding of temporally situated claims reveals a far more dynamic picture of political identity than what is implied by socialization models – and it shows more clearly how relations with 'others,' such as international institutions, shape political identities.

1. Introduction

Early political forecasts of persistent ethnic conflict and nationalism in postcommunist Eastern Europe have given way over time to more optimistic prognoses. While the first streams of scholarship after 1989-90 tended to focus on obstacles to 'democratic consolidation,' such as ethnic diversity and 'un-civic' cultural dispositions, the latest research emphasizes the transformative impact of 'international socialization.' By 2002, ten former Warsaw Pact states had joined NATO, and by the end of 2006 all of them had become members of the European Union. In the brief period between communism's collapse and accession, these Central and East European countries (CEECs) managed to transform their planned economies and single-party polities into capitalist democracies, framed by rules and regulations typical in the West. Although the speeds and trajectories of change varied, today the CEECs feature similar minority rights and protection regimes, which are more far-reaching than those of many Western democracies.

Western policymakers and academics generally describe these policy shifts as 'adoption of liberal norms,' a behavioral change commonly associated with declines in ethnic tensions and reductions in the political salience of ethno-national identities. Socialization theory predicts that ongoing engagement with international institutions will promote the *internalization* of liberal norms, a belief change. The greater degree of internalization, the more likely is 'normative convergence' among community members, new and old. Some anticipate the eventual eclipse of national identity (e.g., Hass 1958), while others expect progressive blurring between or blending of national identities and European identity (e.g., Lewis 2005; Risse 2005; Johnston). Socialization theory generally works with a substantialist conception of identity. Whether conceptualized as (zero-sum) 'eclipse' or (positive-sum) 'blurring' or 'blending,' identity change is viewed as a developmental process involving the change of properties (in this case, beliefs).

Unfortunately, prevailing research designs lack clear and operational definitions of identity and identity change, as Zürn and Checkel (2005, 1062) observe in a recent review of socialization scholarship. This makes it difficult to gauge 'progress' (toward a particular endpoint or toward convergence). And it makes problematic the basic assumption of directionality in European identity change. Fundamentally, assessment of identity change requires attention to temporality. And formal methods discipline our inquiry, beginning with the generation of evidence. Observation of identity change -- no less than explanation – benefits from formalism, defined by Tilly (2004) as 'the explicit representation of a set of elements and of relations among them.' The goal here is to represent identity in relation to the elements of time.

This paper presents a formal method to track changes over time in the salience of different political identities: political claims analysis (PCA). Identities are operationalized as collective public claims, made in a specific place and time. While linear and unidirectional socialization models work with a substantialist conception of identity (usually focusing on a single, monolithic 'state' identity; e.g., Wendt 1999), a claims-centered approach assumes political identities are collective and relational, shaped through public claim making among multiple, often competing, actors. Coding discrete identity claims, researchers can sort them by actor types (e.g., ruling parties, opposition parties, or extra-parliamentary actors) and capture the distribution of claims across the political field. The specific relations asserted in claims -- the 'we' and 'they' – can also be recorded. The coding of temporally situated claims

reveals a far more dynamic picture of political identity than what is implied by socialization models – and it shows more clearly how relations with 'others,' such as international institutions, shape political identities.

I apply the PCA method – first assembling and then interpreting evidence -- to two cases, which conform to two general patterns of postcommunist political change in the CEECs: the 'liberal' pattern Czech Republic and the 'mixed' (or 'illiberal') pattern Slovakia (Snyder and Vachudova 1997; Schimmelfennig 2005; Vachudova 2005). After the breakup of Czechoslovakia in 1992 its successor states seemed headed in starkly different directions: while the Czech Republic quickly earned a reputation as a consolidated democracy based on civic values, observers questioned Slovakia's commitment to political pluralism and free markets, worrying that its ethno-national divisions would undermine the development of democratic institutions. A decade later, it appeared the Slovaks had 'caught up' with the Czechs. Judged to be in compliance with the political and economic conditions for accession, Slovakia joined the Czech Republic in NATO in 2002, two years before both states officially entered the EU. The question is: did political identities in the Czech and Slovak polities change in tandem with policy liberalization?

I begin with an overview of key differences and similarities in Czech and Slovak domestic politics and in their relations with international institutions over their first decades of independence. I then outline a theory about the generation of evidence of political identities, explaining the construction of the Czech and Slovak Ethno-national claims (CSENC) catalog. As others have observed, the process of coding claims, indeed, the generation of any kind of evidence, simultaneously involves theory construction (Tilly 2002; Franzosi 2004). Thus, I start by sketching out a relational ontology of political identity and nationalism, contrasting it with a substantialist perspective. While the ideal research design for assessing identity change in Western-integrating CEECs would cover the complete range of political identity claims, including claims of supra-national identity, the event catalog presented here is limited to ethnic and national identity claims; but coverage is relatively extensive and intensive, spanning a ten-year period of daily claim making in two states. Presenting my coding strategy, I highlight how the CSENC catalog captures the relational features of ethnic and nationalist claim making. Displaying the historical claims data in graphical form, I discuss how they test the assumptions of linearity and unidirectionality in European identity change.

2. The question of Czech-Slovak convergence

Not long after the fall of communism, states across Central and Eastern Europe had significantly expanded protections for the equal rights of minorities and even provisions for collective rights. As Judith Kelley (2004, 6) observes, these outcomes were 'more comparable with international norms than with the preferences of the dominant domestic actors, even when domestic opposition was quite strong.' Liberal policy outcomes incompatible with domestic preferences thus call for explanation. In cases where the disjuncture between domestic and international norms was greatest – where domestic opposition to minority rights and protections was strongest – explaining liberal outcomes presents an even greater challenge. Comparisons of the newly independent Czech Republic and Slovakia often pivot on the extent of this normative gap, relatively small in the Czech case and large in the Slovak.

While the right-leaning government of the newly independent Czech Republic seemed to move swiftly ahead with political and economic reform, earning prompt recognition as a consolidated democracy, sovereign Slovakia's leftist government stalled on marketization and showed little respect for the rule of the law. Czechs were represented on the world stage by former dissident and playwright, Vaclav Havel, hero of Western liberals, whereas Slovakia's first Prime Minister, Vladimir Mečiar, an ex-communist and former boxer, became internationally known for his pugnacious political style. Perhaps the most significant difference between the two new states was the centrality of ethno-national divisions in the Slovak polity and their relative marginalization in the Czech. The Slovak parliament contained nationalist parties of two kinds: those committed to building Slovak nationhood and others vowing to strengthen the collective sovereignty of the state's Hungarian minority, which made up around 10% of the total population. By contrast, the departure of the disgruntled Slovaks appeared to remove ethno-national divisions from the Czech political field.

The divergence in the state's independent political paths came as little surprise to area observers. Even before Czechoslovakia's peaceful separation at the end of 1992, there was significant international concern about Slovak nationalism, which was widely considered the principal cause of the country's breakup and a threat to its Hungarian minority. Nationalism, viewed as the primary obstacle to democracy and stability in the region, seemed to dominate

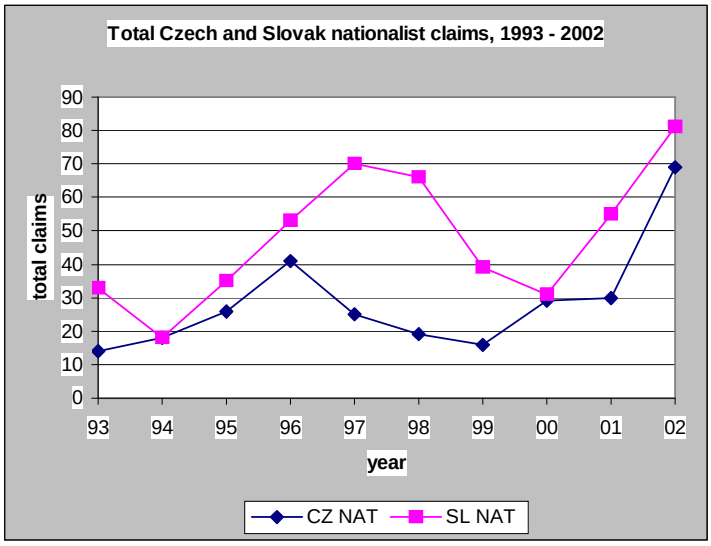
Slovak politics – thereby seriously jeopardizing the Western integration that was both states' foremost foreign policy goal.

Circa 1997, when its applications to begin entry negotiations with both NATO and the EU were rejected, the prospects for Slovakia's 'return to Europe' seemed bleak. But by 2002, Slovakia was invited to begin accession negotiations with the EU, five years after the Czechs. The invitation closely followed Slovakia's entry into NATO, three years after the Czech Republic's. The EU and NATO feature centrally in stories of Slovakia's turnaround, which is commonly viewed as a case of *delayed* normative adaptation (e.g., Schimmelfennig 2005, 855). In other words, it took longer for EU/NATO incentives and/or persuasion to be effective. Indeed, many analysts contend that the ultimate internalization of liberal norms in the CEECs may still take time (ibid. 857; Zürn and Checkel 2005).

While we wait for normative convergence, however, other significant – and more easily observable – changes go unnoticed. After alternations of ruling parties in both states in 1998, there were signs of *political* convergence between them. Both polities featured fervently 'internationalist' ruling parties confronting nationalist opposition parties, both major and minor. Both of these new programmatically 'minority-friendly' governments eventually faced pressure from outside, from 'co-ethnics' representing 'historical minorities' of their states (the Sudeten German minority of the Czech Republic and the Hungarian minority of Slovakia).[1] After a period of almost unconditional compliance with Western recommendations and cooperative relations with neighbors, ruling parties from both states responded defensively to perceived threats, affirming the priority of national interest and identity over supra-national affiliations and against 'intrusive' neighboring states and 'disloyal' minorities. After 1999, nationalist claim making escalated in both states, reaching comparable levels by the end of 2002. By the measure of nationalist claim making, it was the Czech Republic that had 'caught up' with Slovakia. Figure 1 below displays annual time series of total Czech and Slovak nationalist claims from 1993 – 2002.

[1] Accused of collaboration with Nazi occupation of the Czech lands during the Second World War, Czechoslovakia's Sudeten German minority (some three-million large, making up almost a quarter of the country's total population) was collectively deported at the war's end, their property confiscated. Representatives of the Sudeten Germans in Germany and Austria continue to press for restitution, against fierce resistance from virtually the entire political spectrum in the Czech Republic (Leff 1998: 42).

Figure 1



Over this ten-year period of considerable negotiation over sovereignty and minority policy, political claim making in the name of the nation did not show a downward trend compatible with international socialization. Instead, we see significant flux in claim levels over the period. However, some may argue it is too early to expect norm internalization and related changes in identity. Socialization may be working at the behavioral level but not *yet* at the level of belief (Checkel 2005, 804-5). After discussing the concept of socialization in more detail in the following section, I review the process by which textual data were transformed into the line graph above.

3. Getting socialized

Ascendant theories in the study of international relations, as well as European integration, attribute liberal policy shifts to the 'socializing' effects of international institutions. While rationalist explanations of liberal policy change in the CEECs focus on cost-benefit calculations structured by EU/NATO membership conditionality (e.g., Schimmelfennig; Vachudova 2005), constructivists emphasize the power of normative persuasion.[2] Drawing on

[2] See Finnemore and Sikkink (1998) for an excellent review of international relations approaches to norms.

Durkheimian sociological theory and symbolic interactionism, researchers conceive of socialization as a process of inducting actors into the norms and rules of a given community (Dawson and Prewitt 1969, Alderson 2001, Checkel 2005). According to Checkel,

> Its outcome is sustained compliance based on the internalization of these new norms. In adopting community rules, socialization implies that an agent switches from following a logic of consequences to a logic of appropriateness; this adoption is sustained over time and is quite independent from a particular structure of material incentives or sanctions. [Checkel 2005, 804]

International relations constructivists call for a more expansive conception of rationality that moves beyond the instrumental rationality typical of neorealist approaches and the bounded rationality of neoliberal perspectives (Checkel 2005, 805). Many constructivists see international institutions, particularly the European Union, as sites for the development of Habermasian 'communicative rationality' (Joerges and Neyer 1997a, 1997b).[3]

While constructivism and rationalism are commonly seen as mutually incompatible approaches to explanation, recent attempts at 'bridge building' between the schools have emphasized their complementarities (e.g., Fearon and Wendt 2002, Zurn and Checkel 2005). For example, Checkel (2005, 808-9) suggests we consider how 'strategic calculation' (a favored rationalist mechanism) may serve as a trigger for socialization. The sine qua non of socialization, however, is norm internalization (Risse, 1997; Johnston 1998; Checkel 2005) and it is driven by non-instrumentalist mechanisms such as 'role playing' and 'normative suasion' (Checkel 2005 808-813).[4] Again, socialization outcomes are determined by the 'switch' from a logic of consequences to a logic of appropriateness, when rules and norms are followed 'unconsciously' (March and Olsen 1998). But recognizing the difference between the two in empirical data – measuring our dependent variable – presents a challenge.

To date, empirical investigation in the domestic arena has largely been limited to measuring government compliance with international standards. A recent issue of *International Organization* assessing the state of the art of socialization research critically

[3] Since Haas (1958) advanced a neo-functionalist theory predicting European integration would effectively replace national loyalties with supra-national ones, specialists on international institutions and socialization have paid particular attention to Europe.

[4] Examples of social psychological mechanisms promoting socialization are 'cognitive dissonance' (Festinger 1957) and 'rhetorical self-entrapment' (Risse and Sikkink 1999, 16).

addressed a range of operational issues. Zurn and Checkel (2005, 1068), its editors, found that 'In all of this work, systematic attention to, let alone explicit theorization of, domestic politics is notable mainly by its absence.' The editors also called for more careful attention to the conceptualization and measurement of causal variables, namely, links between international institutions and domestic politics (Zürn and Checkel 2005, 1068).

Although many current research designs tend to leave the links between external 'socializers' and domestic 'socializees' obscure, the academic consensus seems to be that international/external pressure, in one form or another, had critical effects on policies, political identities, and democratization in the CEECs – and that those effects were 'positive' for democracy. When positive effects are not found, the conclusion is usually 'nil effect.' The values of these variables, of course, depend on how analysts define them. This apparent overdetermination may be a sign that our selection of evidence is biased. In any case, it recommends consideration of the conventions that guide the construction of evidence.

One possibly worrisome convention in the literature on international institutions and socialization is the tendency to take for granted a common definition of '*liberal* norms.' Variations on Peter Katzenstein's (1996, 5) general definition of norms (as 'standard(s) of appropriate behavior for actors with a given identity') are quite standard, but how determine which standards 'count' as liberal is not always clear. In practice, policy changes compliant with European and Western demands are usually designated as the 'adoption of liberal norms.' Content aside, the temporal scope of norm adoption is often unclear. It is more expansive than an event (or claim) and seems to have an ongoing quality to it, but it does not imply a durable change of state (like a transformation of belief). Other scope conditions are often vague. In comparative studies, a change in governmental behavior tends to be considered as representative of state elites as a group or of the polity as a whole. Yet it is well known that norm-conforming behavior by governments is often countered by norm-violating behavior by government challengers. Governmental compliance with certain external recommendations, on minority policy, for example, may itself be accompanied by other governmental behavior contrary to liberal norms, including nationalist claim making (Tesser 2003; Ram 2003; Kelley 2004,). Equally problematic are conventional interpretations of noncompliance. In such cases, international pressure is typically labeled as 'ineffective.' But the record of political claim making suggests that during such periods outside pressure may be having the significant effect of *stimulating* contention along ethno-national lines, promoting ethnic and national

political identification. These observations suggest that 'external pressure' may have dynamic effects on domestic political contention and identities. They recommend a method sensitive to the dynamics of politics and identity.

4. The Relations of Nations

Political identities may be organized around gender, class, religion, race, ethnicity, nationality, or any number of other categories. As recent work on collective identities demonstrates, actors claim different identities at different points in time, foregrounding one, and leaving others in the background (e.g., Mische and White 1998, Kalb 1997, Somers 1994, Calhoun 1991).[5] Identities are increasingly understood, not in a substantialist sense as durable traits of actors,[6] but as products of interactive contexts or social relations.[7]

Relational understandings of ethnicity and nationality, though less common than substantialist approaches, are not new. Fredrik Barth (1969) has long argued that 'the contrast between "us" and "others" is what is embedded in the organization of ethnicity: an otherness of the others that is explicitly linked to the *assertion of* cultural differences' (1995, italics in original). Here, ethnicity is understood in relational terms, defined not by timeless inner substances, but by changeable outer boundaries.

Identities are answers to the questions 'Who are you?' and 'Who are they?'. Political actors take action in the name of identities, which specify relations to others. Charles Tilly, whose recent writings on identities have a distinct relational grounding (1998, 2003), proposes that identities consist of the following:

a) a boundary separating me from you or us from them
b) a set of relations within the boundary
c) a set of relations *across* the boundary
d) a set of stories about the boundary and relations

[5] For reviews of scholarship on identities, see Cerulo (1997), on identities in social movements, see Polletta and Jaspers (1997), and on identities and boundaries, see Lamont and Molnar (2002).
[6] According to Emirbayer (1997, 281), this ontological choice constitutes a 'fundamental dilemma' for sociologists today. The question is 'whether to conceive of the social world as consisting primarily in substances or in processes, in static "things" or in dynamic, unfolding relations.'
[7] For example, Somers (1994) calls these contexts 'relational settings.'

Identities are defined through pairing, by comparing, contrasting, and relating two categories. For example, under communism, Czechoslovak leaders typically identified with the 'international socialist community,' against 'the capitalist West.' Dissidents, however, identified as 'the kidnapped West,' against 'Soviet imperialism.'[8] After Czech and Slovak entry into the EU and NATO - and with the creation of the post-9/11 Euro-American rift -- the category 'West' has lost the political salience it once had in Czech and Slovak politics.

When boundaries fall along ethno-national lines, we encounter ethnic and national identity claims. McAdam, Tarrow and Tilly (2001) classify these claims as part of an important subset of social identities that are 'categorical.' A social category consists of a set of sites that share a boundary distinguishing all of them and relating all of them to at least one set of sites visibly excluded by the boundary. Besides separating 'us' from 'them,' categorical identities imply distinct relations among us, among them, and between us and them. The sites on either side of the boundary create a 'categorical pair.' The mechanism of *category pairing* creates ethnic and national identities (McAdam et al. 2001, 142-3).

Ethnic and national identity claims do not always invoke political interests. The CSENC catalog concentrates on *contentious* claims, collective, public expressions of support for or opposition to a political program. The term *ethno-national claims* used throughout this article refers to contentious claims in the name of ethnic or national categories. It covers both nationalist claims (in the name of national identities) and ethnic claims (in the name of ethnic identities). Below, I describe both types.

4.1. Nationalist claims, majority and minority

National identity always depends on relations between the nation and others, but expressions of national identity turn into nationalism when they explicitly link national identity/difference with distinct political interest and assert the priority of national interest. Nationalism is the claim that the political and the cultural (or national) unit should be congruent, that nations

[8]The term comes from a well-known essay by the Czech émigré intellectual and anti-Communist, Milan Kundera (1984).

have a rights to control states and states have a right to control nations, and that obligations to nations should supersede other obligations (Breuilly 1993, 3; Gellner 1983, 1; Hobsbawm 1990, 9; Conner 1999, 413; Tilly 1999).

Claims qualify as nationalism *insofar as* they call for nation-state correspondence and for national loyalty above all other kinds (Tilly 1999, 413). This definitional approach is general enough so that it includes both titular (majority) and non-titular (minority) nationalism. Titular or majority nationalism involves claims on behalf of the state-bearing nation, aiming to impose a particular definition of the nation on inhabitants of the state. Non-titular or minority nationalism features claims on behalf of ethno-national minorities, which can range from limited demands for distinct political rights and privileges based on ethnicity to calls for outright secession.[9] Nationalist claims may be made by members or by 'non-member' third parties; the former qualify as identity claims, the latter, as advocacy claims.

All nationalist claims, at least implicitly, make *attributions of threat*, drawing boundaries between the nation and some other categorical identity. Like opportunities, threats are socially constituted, not given in the objective political environment (McAdam et al. 2001, 46-7). They form through interactive claim making, as different political actors try to make sense of -- and to control -- the political environment. Threats fall into two main categories, ethno-national and international. Ethno-national threats relate to internal ethno-national minorities or other nations, usually neighboring nation-states. International threats are usually associated with international authorities, for example: international institutions such as the EU or NATO, powerful states like the US and sometimes with influential international NGOs. McAdam et al. (2001, 121) call these actors 'certifying agents.' As Sidney Tarrow (1998a, 23-24) suggests, such framing 'defines the "us" and "them" in a movement's conflict structure.' By drawing on inherited collective identities and shaping new ones, challengers delimit the boundaries of their prospective constituencies and define their enemies by real or imagined attributes or evils.'

[9] The label nationalism tends to be restricted to the mobilization of 'titular' nations. I try to use the term in a more value-neutral way, while recognizing differences in the structural positions of collective actors. Coding claims strictly on the basis of minority status is also problematic because it neglects a crucial difference between *calls for* distinctive treatment based on ethnicity and *protests against* distinctive treatment based on ethnicity. The latter are citizenship claims, the former nationalism.

4.2. Ethnic claims

A subset of ethno-national claims is 'anti-nationalist.' Claims made in the name of ethnic or national minorities, which protest discrimination based on ethnicity or nationality are considered citizenship claims. Whereas minority nationalist claims call for special rights based on ethnicity or nationality, citizenship claims protest against distinctive treatment based on ethnicity or nationality.

4.3. Internationalist claims

Claim making around international institutions featured another set of 'anti-nationalist' claims. Internationalist claims, including European identity claims, challenge the nationalist principle that legitimate authority resides in a nation-state. Throughout this period, political actors in the Czech and Slovak states claimed an identity of interests between the nation and supra-national collectives such as the EU, the West, and the international community. Unlike ethno-national claims, these claims were not coded systematically as part of the CSENC catalog.

5. Political claims analysis

I adopt an event-centered approach to national identity and nationalism. Events are observable interactions among political actors in a specific place and time. Political event analysis is a way of tracking over time the rise and fall of particular types of events and the features associated with them (Beissinger 2002, 43). Event-based approaches to social and political analysis come in many forms, both quantitative and qualitative. They rely on various kinds of data and employ a range of methods, characterized by varying degrees of formalism. Some researchers, like the historian William Sewell (1996a, 1996b), probe the meanings of a single 'great event,' while 'event-history' analysts, such as Susan Olzak (1992), rely on statistical

techniques to describe change and variation in a whole class of events over long time periods, across multiple spatial contexts.[10]

Analysts of 'protest,' 'collective action' and 'contentious gatherings' look to identify the claims made in non-routine, collective events.[11] Rather than attempt to discern what political actors 'really' believe, what their interests 'really' are, or who they 'really' are, researchers document claims about interests and identities. The public claims of collective political actors, whether verbalized or 'acted out,' represent the strategic dimension of politics, which is often the object of research (Koopmans and Statham 1999, 4). Compared with other sources, such as attitudinal surveys or personal interviews, event data captures the interactive, performative character of political contention. Political analysts interested in macro-historical questions assemble datasets that span multi-year periods and feature numerous observations. As Mark Beissinger (2002, 43) observes, the advantage of large-n research strategies like these is 'that they can uncover in a sea of action patterns of regularity which are not easily visible through examination of a single case or event.' At the same time, such data provide a basis for more qualitative process-tracing, which may involve subsequent, more detailed investigation of specific critical events. .

Students of protest events have traditionally limited objects of analysis to public gatherings by government challengers, as Beissinger (2002) did in his study of nationalist mobilization around the collapse of the Soviet Union. Ruud Koopmans and Paul Statham (1999) advocate an extension of analytic scope to include events from entire 'multi-organizational fields.'[12] They propose 'political claims analysis' (PCA) as a way to integrate the distinctive strengths of protest event and political discourse approaches. In a PCA framework, the units of analysis are claims, in the form of both 'physical protest' and 'speech acts,' by challengers as well as polity members. In addition to protest events or contentious gatherings, less 'disruptive' forms of expression are analyzed as well. Polity members have a whole range of regular platforms from which to make claims, from governmental proceedings to public meetings to press briefings. Even political actors without regular access to political institutions issue claims in standardized forms such as public statements. PCA maintains the

[10] For reviews of scholarship based on the analysis of events, see Tarrow (1998b) and Rucht, Koopmans, and Neidhardt (1998).
[11] Examples include Tilly on popular mobilization in Europe (1978), Franzosi on Italian strikes (1995), Beissinger (2004) and Stroschein (2000) on ethno-national mobilization in postcommunist Eastern Europe, and Ekiert and Kubik (2001) on popular protest in postcommunist Poland.
[12] The PCA approach is exemplified by the Mobilization on Ethnic Relations, Citizenship and Immigration project led by Ruud Koopmans (Koopmans and Statham 1999).

rigor of protest event analysis, observing similar conventions for collecting and coding data. It captures 'qualitative' elements of discourse while employing formalisms (Tilly 2004) to discipline evidence, facilitating comparisons and generalizations.

5.1. Cataloguing Events

Data on political events are organized into catalogs. Charles Tilly (2002, 249), a pioneer in the use of event catalogs for political analysis, describes them 'as a set of descriptions of multiple social interactions collected from a delimited set of sources according to relatively uniform procedures.' Such registers of events are used to sort and arrange data on a range of social phenomena. Their use is especially common among analysts of collective action and contention. Most researchers gather their data from public media, particularly daily newspapers.[13] Texts are reviewed for information on events of particular types, for features such as timing, location, forms, actors, actions, and objects.

Such standardization facilitates aggregation and comparison across space. The chronological nature of the data makes possible observations of variations over time, that is, of *change* in a type of political phenomenon. Catalogs can also be used to identify recurrent sequences of events and connections among events, across space and time (Tilly 2002). Relational event data, in particular, facilitate identification of these connections.

6. The Czech and Slovak Ethno-national Claims (CSENC) catalog

Tracking ethno-national claim making over a ten-year period in two states presents a challenge for the average researcher working under considerable resource constraints. The selection of sources involves a number of considerations such as access and the sources' selectivity, reliability, continuity and ease of coding (Rucht and Neidhardt 1998). Weighing these considerations, I determined that the British Broadcasting Company Monitoring service would serve as the optimal source. BBC Monitoring selects and translates information from press,

[13] For discussions of the relative strengths and weaknesses of different types of sources, see Franzosi (1987), Olzak (1989), Rucht and Ohlemacher (1992), McCarthy et al. (1996), Koopmans and Rucht (1999).

radio, television, news agencies, and the internet from 150 countries in more than 70 languages.[14] The BBC archive was accessible via LexisNexis and offered continuous coverage of both country cases for the ten-year period of the study. The electronic format allowed for easy retention of all text, which facilitated coding, and (inevitable) re-coding.

The sample includes all BBC news reports from January 1, 1993 – December 31, 2002 generated by a search of 'headlines, lead paragraph(s) and terms' using the keywords 'Czech Republic' or 'Slovakia.' The keyword search produced a list of headlines (averaging around 7,000 annually, per country, including duplicates). Only the reports whose headlines mentioned the following were read:

- contentious claims by organizations (domestic and external) on behalf of ethno-national categories identifying residents (past or current)
- nationality/minority policy
- contentious claims involving foreign governments
- interactions with external political authorities (e.g., the EU, NATO, the US, IGOs, and certain NGOs)

The CSENC catalog is not a re-creation of the totality of ethno-national politics in the Czech and Slovak states from 1993 to 2002. Rather, the catalog represents ethno-national politics that were 'on the media radar.' The catalog is based on a sample of media coverage of the Czech Republic and Slovakia selected by BBC monitors. BBC Monitoring routinely consults a range of public and private news sources from both countries. The majority of reports on the Czech Republic came from its national news agency (CTK); a smaller portion came from Slovak and German media. The dominant source for Slovak news was the Slovak national news agency (TASR), although reporting from private press, radio and television outlets, including Hungarian-language outlets, also appeared frequently, as did reporting from Hungary-based and Czech-based media organizations.

[14] The agency was formed in 1939 as the BBC Summary of World Broadcasts (its name until 2000) to provide the British Government access to foreign media and propaganda. It supplied the government with valuable information during World War II, particularly in places where foreign journalists were banned. The organization played an important role in helping observers keep track of developments during the Cold War, the anticommunist revolutions and the collapse of the Soviet Union.

There is now a large literature on the use of news sources for political analysis, especially for analysis of collective contention.[15] Selection bias has been a central concern, particularly when researchers rely on a single news source whose coverage may be politically partial. This could result in the over-representation or under-representation of certain types of events.[16] Depending on the questions researchers aim to answer, the general media bias problem may be overstated. 'If our interest lies in analyzing protests that are potentially relevant for social and political change,' Dieter Rucht and Friedrich Neidhardt (1998) contend 'there is good reason to focus only on those events that are, or can be, registered by the wider public.' Rucht and Neidhardt maintain that 'In this regard, event analysis based on the mass media is not only a pragmatic choice, but a theoretically grounded imperative' (1998, 76).

7. Coding claims

Table 1 below presents the coding scheme, which is modeled on the coding scheme of the European Protest and Coercion Data assembled by Ron Francisco (2006). It has five general categories: context, actor, claim, object, and other information.

[15] Rucht and Neidhardt (1998) provide a comprehensive discussion of methodological challenges in the use of news data. Also see .McCarthy, McPhail and Smith (1996).
[16] Researchers have also worried that event catalogs constructed from national news sources will underestimate local and regional protest. This does not present a problem for this project, since the object of explanation is national-level contention.

Table 1: Basic CSENC coding categories

Context	Actor	Claim	Object	Other information
-Date -Day -Location -Source	-Actor type -Organization -Representative -Features -Identity category -Member or advocate?	-Claim type -Categorical pair -Event type -Claim text	-Object type -Organization -Representative -Features -Identity category	-Event details -Police involvement? -Arrests? -Property damage? -Violence?

The following kinds of claims were coded:

- contentious claims by organizations (domestic and external) or public gatherings of five or more people on behalf of ethno-national categories referring to residents (past or current)
- policy recommendations and expressions of concern from international institutions that refer to political, social and economic behavior in the Czech or Slovak states
- all domestic claims addressed to international institutions

Domestic actors/objects were divided into the following types:

- government: prime minister and other cabinet officials
- ruling party: the party or coalition of the majority in parliament
- major opposition party: the largest opposition political party or coalition of opposition parties, capable of forming a government
- minor opposition party: smaller opposition party in parliament, incapable of forming a government
- extra-parliamentary actors: non-parliamentary political parties, nongovernmental organizations and contentious gatherings involving at least five people

External actor/object types were the following:

- government, political party or extra-parliamentary actor from neighboring state
- external authorities (international institutions, powerful states, and select NGOs)
- international/Western NGOs

Organization names or organizational departments/divisions were recorded, as were the names of particular representatives when provided. When data were available, other demographic characteristics were recorded (e.g., number of individuals, age cohort, etc.). The identity categories *on whose behalf* claims were made were coded, as were the identity categories *in whose name* claims were made. These are sometimes the same, but in cases of third-party advocacy, actors speak on behalf of a particular ethnic or national group, yet not in the group's name.

Claims were made in the course of the two types of events: speech acts and contentious gatherings. The speech act category includes: public pronouncements (made in press briefings, political meetings, and interviews); written statements (including reports); government/parliamentary proceedings (including resolutions); and diplomatic actions (correspondence, boycotts of meetings, recalls of ambassador). Contentious gatherings include: marches (moving demonstrations); rallies (stationary demonstrations); commemorations (memorial gatherings that feature contentious claims); occupations (illegal takeovers of space); and blockades (illegal occupations of roadways by motor vehicles). A single event may feature multiple nationalist claims.

The catalog contains both majority nationalist and minority nationalist claims. Table 2 presents a typology of majority nationalist claims, which all feature attributions of threat. Often, though not always, nationalist attributions of threat have specific objects. The table indicates the type(s) of threat attribution and the objects of threat attribution (internal or external) associated with different types of nationalist claims. A brief description of each type of claim follows.

Table 2: Majority nationalist claims

Majority nationalist claim	Threat type	Actor location	Object location
National affirmation	Ethno-national / International	Internal	None
Disloyalty	Ethno-national / International	Internal	Internal
Interference	Ethno-national / International	Internal	External
External co-ethnic support	Ethno-national	Internal	External

National affirmation claims draw a boundary between the nation and some other political category, attaching distinct sets of political interests to the two sides. Interests may be characterized as merely distinct or conflictual; the distinction in interests may be characterized as situational or fundamental (the latter are specially coded as 'fundamentalist'). National affirmation claims affirm the priority of national identity and interest over some other collective identity/interest without specifying an object. Terms such as 'integrity,' 'unity,' 'indivisibility,' 'tradition,' and 'custom' frequently figure in national affirmation claims**.**

Disloyalty claims have internal objects who are accused of placing non-national obligations ahead of national ones, with treason charges at the extreme. In charges of disloyalty, the categorical pair features the nation and the alleged 'foreign' loyalty of the accused internal party. The rival loyalty group may be inside the state or outside. For example, it could be an object's local ethnic community or it could be a supra-national community. Actors commonly accuse objects of 'servility,' subversion,' 'collaboration,' as well as 'disloyalty.'

Interference claims always have an external object and charge that an external actor has violated the nation's sovereignty in some way. More often than not the word 'interference' appears in nationalist claims of this type. Other code-words are 'meddling,' 'intruding,' 'intervening,' 'dictating,' 'patronizing,' and 'violating sovereignty.'

External co-ethnic support claims have external objects: members of the nation who reside abroad. Such claims rest on the nationalist principle that nationality overrides citizenship and that state authorities should defend and promote the identity and interest of co-ethnics abroad, towards preserving national integrity. The category paired with the nation in these claims is usually the titular nation of the state where co-ethnics reside.

Table 3 below diagrams the set of minority nationalist claims. As the table shows, minority nationalists, like majority nationalists, make ***national affirmation*** claims. The most common type of claim is a ***demand for minority/national rights***. Claimants call for distinct rights or privileges based on nationality, all the way up to control of their own state. The claims are

addressed to the government of the state where they reside. Minority nationalists may also address claims to external parties, international organizations or co-ethnics in neighboring states. The final two types of claims are made by external actors. ***External co-ethnic support*** claims are expressions of support for minority/national rights by co-ethnic actors. General ***external minority support*** claims come from outside actors that are not members of the particular ethno-national group.

Table 3: Minority nationalist claims

Minority nationalist claim	Threat type	Actor location	Object location
National affirmation	Titular nation	Internal	None
Demand minority/national rights	Titular nation	Internal	Internal
Appeal for external support	Titular nation	Internal	External
External co-ethnic support	Titular nation	External	Internal
External minority support	Titular nation	External	Internal

Table 4 below lists ethnic claims, which are made on behalf of ethnic minorities. These claims are not nationalist and, thus, do not involve the pairing of national identity with threats. ***Discrimination protest*** claims challenge unequal treatment on the basis of ethnicity. ***Appeals for external support*** call on outside actors, such as international institutions and powerful states, to use their influence to promote the citizenship rights of ethnic minorities. ***External minority support*** claims are instances when outside actors express support for equal citizenship rights for minorities.

Table 4: Ethnic claims

Ethnic claim	Actor location	Object location
Discrimination protest	Internal	Internal
Appeal for external support	Internal	External
External minority support	External	Internal

Figures 2 and 3 below display *all* ethno-national claims made by domestic actors in the Czech and Slovak states 1993-2002, divided into majority nationalist claims (MJY NAT), minority nationalist claims (MNY NAT), and ethnic claims (ETHNIC).

Figure 2

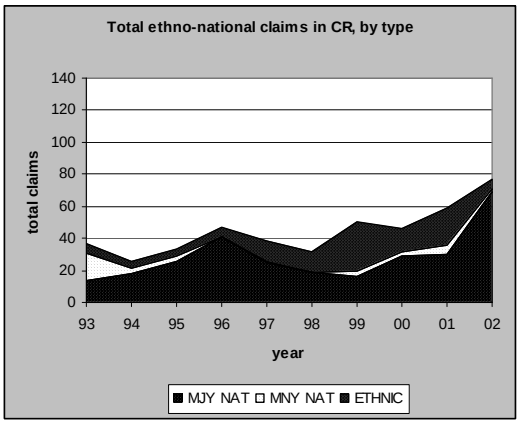
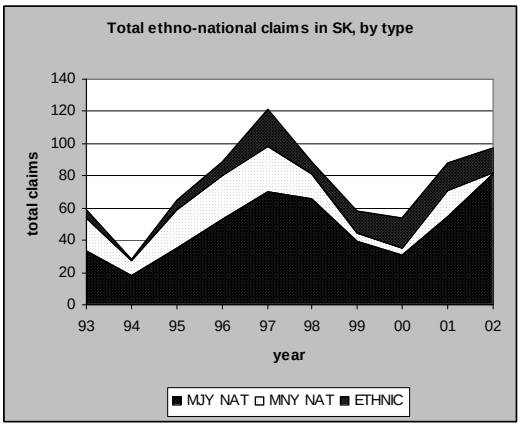


Figure 3



These very basic graphs reveal a basic, important fact of ethno-national politics in most places, its interactive nature. While popular conceptions of ethno-national politics in other states (especially non-Western/East European states) conjure an image of undifferentiated ethnic strife, the images above convey the lines of conflict. Majority or titular nationalists defend the right of the state to promote common culture, without external interference. Minority nationalists deny the territorial state unlimited jurisdiction over culture and make claims for autonomy. Ethnic minority activists protest against culture-based discrimination and demand equal protection from the state. Interaction among – and within -- these sets of actors shapes political identities. Figures 4 and 5 add another crucial set of actors to the picture of ethno-national claim making, external actors. Outside actors make political claims on behalf of internal ethno-national minorities. Again, they divide mainly into political actors from neighboring states, international authorities, and (challenging/non-certifying) international NGOs.

Figure 4

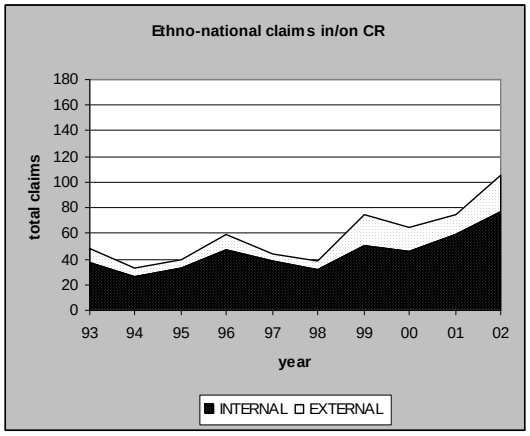
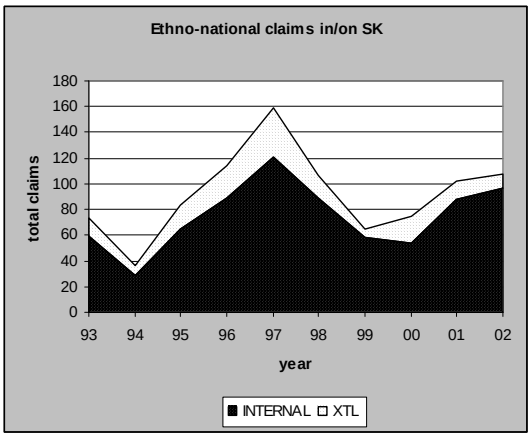


Figure 5



8. Representing relations, categorical and organizational

Political claims analysis can reveal the unanticipated, '*anti*-social' effects of engagement with international institutions. Similarly, the method can uncover evidence of unintended consequences of political conditionality on domestic political identities. The records of ethno-national claim making show that international institutional integration was *politicized* in both the Czech Republic and Slovakia.

EU/NATO membership was not universally valued or uniformly welcomed as an opportunity for rewards. Frequently, domestic actors attributed *threat* to political conditionality and its international agents, whose recommendations and criticisms were seen as encroachments on national sovereignty. At times, external demands for improved treatment of ethnic minorities were met with escalations of anti-minority claim making, which linked *international* threats to these *ethno-national* threats. In other words, domestic actors responded to international pressure with nationalist claims. Speaking in the name of the nation, actors drew boundaries between the nation and others. By specifying changes in these relations – categorical and organizational -- over time, we can represent identity change. The Czech and Slovak Ethno-national claims catalog provides a chronological map of these social relations.

National identity and nationalism are commonly conceptualized in substantialist terms, as properties of groups. Even the typical constructivist understanding of identity construction is substantialist: identity formation is understood as a change in individual or group properties, namely their beliefs**.** A relational perspective, by contrast, focuses on boundary drawing or category pairing in political claims. Again, ethno-national threat refers to relations with ethnic and national groups, usually ethno-national minorities and neighboring nation-states. International threats concern international authorities. Figures 6 and 7 below break down total Czech and Slovak nationalist claims by these two kinds of threat attribution.

Figure 6

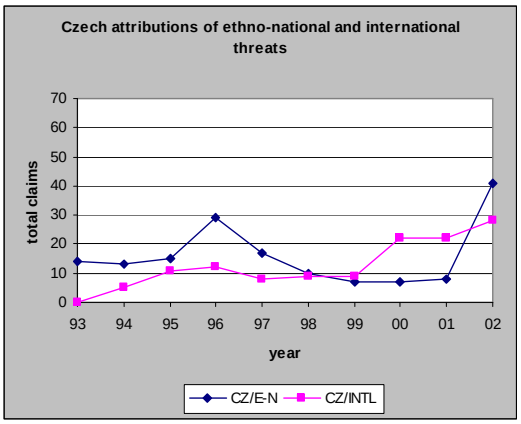
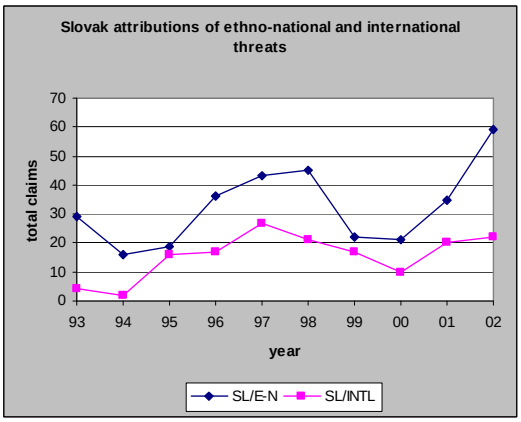


Figure 7



We see how Slovak attributions of ethno-national threat and Slovak attributions of international threat trended similarly over the entire decade, whereas in the Czech case there is no consistent relation between the two kinds of threats. We also notice that Czech and Slovak claims of ethno-national threat conformed to a similar wave-like pattern over the decade, dropping a year after independence, rising in a wave, dropping again, and ending at peak levels, on an upward trend. While Slovak attributions of international threat reached their height in 1997 (nearly matching it in 2002), Czech attributions of international threat were highest at the end the decade, beginning their climb to unprecedented levels.

The CSENC coding scheme captured further distinctions in threat attribution, specifying the threats named in claims. Figures 8 and 9 disaggregate claims of international threat into the following categories: the EU, NATO, the US, and a fourth category for all other attributions of threat with international scope (*INTL). Threats attributed to other international

institutions and international NGOs are included here, as are all general claims of 'Western,' 'international,' and 'foreign' threat.

Figure 8

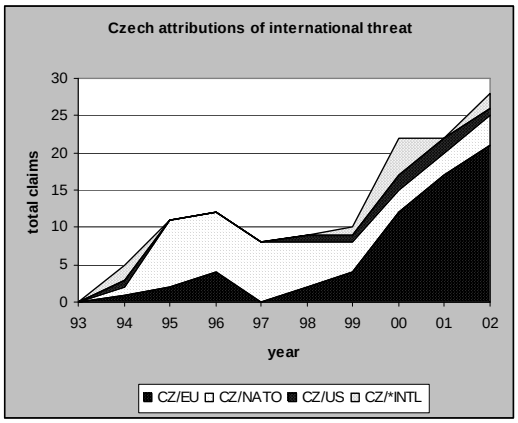
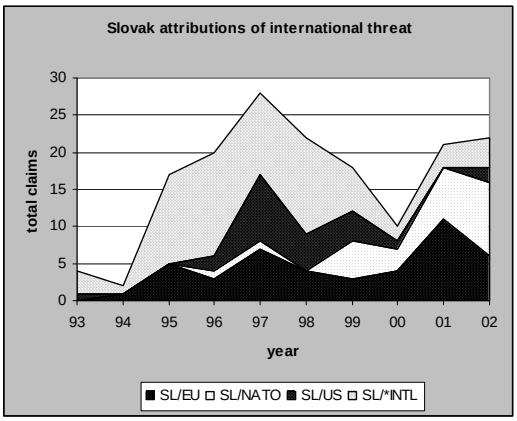


Figure 9



When nationalist claims of international threat are presented in the form of area graphs, the same wave-like patterns we noticed in both Czech and Slovak attributions of ethno-national threat and in Slovak attributions of international threat becomes visible in the Czech case in Figure 8: there is a modest wave, peaking in 1996, a drop in claim-making in 1997, then an upward trend until the end of the period. By contrast, Slovakia's first wave of nationalist claim making was more intense than the second.

The main purpose of the area graphs above is to represent the distribution of international threat attribution, by particular categories of threat. Figure 8 shows that until 1999 Czech attributions of international threat most frequently focused on NATO; then they shifted to the EU. Figure 9 indicates that through 1999, Slovak claims of international threat most frequently concerned international collectives in general, not the EU, NATO or US specifically. Such generic attributions of international threat were uncommon in the Czech case. The Slovak graph also indicates that claims of US threat rose dramatically in 1997 and were frequent until 1999. In 1999, claims of NATO threat suddenly rise and seem to displace anti-US claims thereafter. Claims of EU threat increase sharply in 1997 as well, before bottoming out in 1999 and rising to their peak in 2001.

Global measurements of variations in threat attribution over time reveal the changing salience of different national boundaries and relations. Threats to the nation, as represented by nationalists, change over time. But nationalist claimants – how they are organized in the

political field -- also change over time. Sometimes they are concentrated in the government, sometimes on the political fringe, within NGOs or loosely organized public assemblies; or they may be spread across the political field. Figures 10 and 11 display the distribution of nationalist claims among actor types in the Czech and Slovak states. Actors divide into the following: ruling parties (RP), opposition parties (OPP), and extra-parliamentary actors (XP).

Figure 10

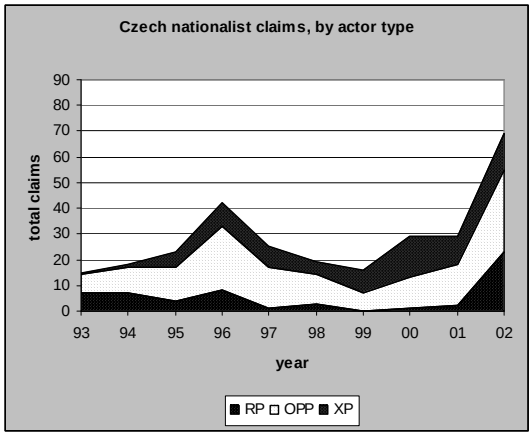
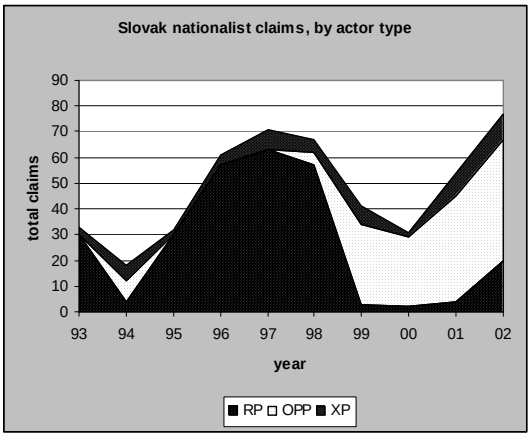


Figure 11



The graphs reveal a key difference between the states. The relative distribution of claims among actor types changes radically in Slovakia but is relatively stable in the Czech case. In interpreting the graphs, it is important to consider how changes in government potentially change actor type assignments and the organization of the political field. The replacement of the Mečiar government with a pro-integration coalition in Slovakia in 1998 explains the subsequent shift in nationalist claim making away from the ruling parties to the opposition. The slight reversal in claim distribution in 1994 similarly corresponded to a period during which Mečiar's party was briefly thrust into the opposition (replaced by a 'Western-oriented' caretaker before winning early elections six months later). During Mečiar-led governments no nationalist claims came from the opposition. By contrast, nationalist claim making from the opposition was a consistent feature of the Czech political field, with opposition nationalism always more vigorous than ruling party nationalism. Figure 10 also indicates that for most of the period, extra-parliamentary actors accounted for a substantial proportion of nationalist claimants. Starting in 1999, similarities between the states become apparent. Nationalist claims from ruling parties virtually disappear. After 2000, nationalist claim making from

opposition parties and extra-parliamentary actors begins to escalate (In the Czech Republic, the formerly-ruling Civic Democratic Party accounts for most of the increase in opposition claim making after 1999; notably, when it was positioned as part of the government, the same party seldom made nationalist claims). And in 2002 ruling parties from both states got involved in nationalist claim making.

As already noted, fervently pro-Europe, internationalist governments gained control in both states after elections in 1998. The new governments acted quickly to adopt liberal policy recommendations from international institutions, focusing especially on minority rights and protection policy. Nationalist claim making declines significantly over the next two years in Slovakia, suggesting that policy changes may have affected political identities. But Czech nationalism intensifies after 1999. And a year later, Slovak nationalist claims rise as well. In 2002, we find ruling parties involved in increasingly vigorous nationalist claim making interaction in both states.

9. Conclusion

By the measure of public political claim making, the Czech and Slovak polities converged – not in *internalizing* liberal and Western norms, but in *contesting* them. In this contest, it was the Czech Republic that had 'caught up' with Slovakia, not the other way around. The track-meet metaphor, however, is most inappropriate to describe identity change in the independent Czech and Slovak states**.** Political identities did not move along a single track from illiberalism to liberalism, or in the opposite direction. A relational perspective sees multiple identities in Western-integrating CEECs and it sees multiple actors making claims in the name of the same identities – all at the same time.

This observation does not mean that generalizations about political identities are impossible or inappropriate, only that they should be applied to the right 'bits' of reality. If we assume that social interactions have an efficacious reality of their own, then it makes sense to look for evidence of interaction. But whether we choose a relational or substantialist ontology of political identities, the application of formalisms help guide our search for evidence, making our usually implicit theories about evidence explicit.

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Clare Saunders
University of Kent

Comparing environmental movement networks in periods of latency and visibility[i]

The environmental movement is a network of organisations and individuals working for environmental improvement or the prevention of environmental degradation using institutional, semi- and non-institutional channels. This network consists of a variety of types of organisations that have a range of conservationist to radical strategies and beliefs, and are active from the very local level right up to the transnational level. The shape and form of this network, however, varies considerably from time to time. During 'latent' periods – temporary phases during which movement activity is invisible to the general public – movement organisations tend to become more isolated and local groups will be moribund or inclined to infighting, as ideological differences and differing fields of action prevent interaction. During 'visible' phases, during which movement activity is highly noticeable as a result of engagement in protest, the need to win a campaign may reduce ideological chasms and create denser networks of interaction. This paper demonstrates the stark differences between environmental movement networks at visible and latent times using data from surveys at two different points in time of the networks of environmental organisations in southeast London. During 2001, when the local community was fighting a proposal for a multiplex cinema to be built at Crystal Palace, the movement was relatively dense, and there was even evidence of networking between the most unlikely bedfellows of middle class residents' associations and dreadlocked tree-dwellers. Two years later, when this campaign had been won, the movement had become much more fractured, and radical groups and residents' associations had virtually disappeared from the network, burning the bridges they had created in the network as they evaporated. These differences are demonstrated using some basic social network analysis measures including network mapping.

1. Introduction

According to most definitions of social movements, networking is a key, if not defining, feature. The environmental movement, for example, is often cited as being a network of individuals and organisations with a concern to protect or enhance the environment, engaging in semi- or non-institutionalized forms of collective action (Diani 1995, Rootes 2001). This paper seeks to compare the dynamics of environmental movement networks between latent

and critical campaign times. During periods of latent movement activity, movement organisations are virtually invisible to the public eye. However, this does not signify a lack of movement activity, but rather involves much behind the scenes work, allegedly including 'the daily production of alternative frameworks of meaning, on which networks themselves are founded and live from day to day … [and] potential resistance or opposition is sewn into the very fabric of life' (Melucci 1989:70-1). Melucci implies that periods of latency strengthen networking potential. Even if this is so, it is clearly critical campaign times that bear witness to the manifestation of actual networking potential. A critical campaign time is deemed to be a period of time in which intensive campaigning is undertaken to attempt to prevent the imminent construction of an unwanted land use. Critical campaign times usually occur when the political opportunities offered by conventional campaign strategies have been exhausted and committed campaigners have little alternative but to support or engage in physical direct action.

Conventional political sociology suggests that the relatively closed electoral system in Britain is balanced by a relatively open administrative structure (Rootes 1992:171-192). Arguably, the relative openness of the government to representations by environmental organisations has impacted the shape and form of the wider movement. In his argument on British exceptionalism[ii], Rootes (1992) for example, suggested that unconventional protest activity was lacking in the British environmental movement (as it was until just after the article was published) because the polity had accepted it. That the 'opportunity structure' in Britain has been quite open to moderate green groups since the 1980s is indeed widely recognised, being 'sufficient for them [environmental organisations] to remain well-ordered and non-disruptive' (Rawcliffe 1998:55), despite, in the main occupying a 'more pragmatic threshold' – balancing insider and outsider strategies according to the issue and the policy arena in question. As part of their quest to remain reputable in the eyes of the government, we would therefore expect moderate environmental organisations to be wary of alliances with radical environmental organisations that might tarnish their organisational image, or otherwise jeopardise their constructive links with governmental actors.

However, this political sociology approach assumes that the government is not only open to comments from environmental organisations, but also acts upon them. In practice, the relationship between environmental organisations and the government is not so cosy as this implies. Although the British polity is (at least relatively) 'open' to moderate (but not radical)

environmental organisations, this does not automatically guarantee success for moderate environmental organisations. Unfortunately, an open polity creates competition within the wider movement sector by increasing access for others. This can result in what Rauch (1995) and Jordan (1999) call 'demosclerosis', whereby the policy arena has become so over-crowded and unresponsive to changing circumstances that it cannot effectively incorporate demands of pressure groups. For instance, the Organic Foods & Targets Bill proposed by Friends of the Earth (2000) has been suppressed due to pressure from Government whips, and even when EMOs' Bills become law, they often lack adequate enforcement – as with the Road Traffic Reduction Act of 1997. Contrary to the aims of the Bill, the government has refused to set targets for traffic reduction, and it can be considered as little more than lip-service in the light of the pro-car Ten Year Transport Plan that followed (DfT 2000).

Another problem with the political sociology approach to predicting trajectories of movement activity on the basis of national political systems, is the lack of attention paid to policies and planning decisions that are at least the brainchildren of local political actors, indeed, if they are not decided by them. Local borough councils have considerable weight in local planning matters, and can present themselves as an insurmountable political barrier to local environmental organisations, especially when they have the support of the judiciary system and the Secretary of State, as the Bromley council did, in its support for the Crystal Palace multiplex proposals. Whether it be due to a bottlenecking of issues and action at the national level, or a blocking of the arteries of positive change by a local council, 'demosclerosis' - a lack of positive political action on a popular demand - is the net result.

'Demosclerosis' is likely to have at least one of two effects; it may make radical organisations highly skeptical of the value of conventional campaigning, widening the gulf between radical and reformist organisations, or it may radicalize reformist groups by triggering realization of the inefficacy of conventional campaigning. The former effect is the more likely outcome of periods of 'latent' movement activity, during which conventional environmental organisations are engaged mostly in private discussions and consultations with government ministers, and appear to be increasingly distant from, and ineffective to, the grassroots and/or radical part of the movement. The latter is most likely during critical and 'visible' campaign times, which are frequently the result of conventional campaigning failing to deliver the desired outcome.

The trajectory of the environmental movement in the 1990s illustrates these differences between visible and latent times. The end of the 1980s and the early 1990s were a period of latent movement activity, during which there was a huge gulf between the views and activities of radical environmental organisations and their more reformist counterparts. By the time of the Rio Earth Summit (1992), a large swathe of the environmental movement, including environmental organisations that only a few years prior had been regarded as radical – such as Greenpeace and Friends of the Earth – 'had lost its critical voice, as states, corporations, and environmental organisations all appeared to share the same language, the same commitments and the same appeal to management as the way to solve environmental problems' (McNaughten & Urry 1988:65). The language they all spoke was that of sustainable development, a term sufficiently flexible to allow for it to be twisted in favour of economic development by business and government (cf Sachs 1991). This combination of ineffective policy change and apparent incorporation of the environmental movement, led to a perception amongst die-hard activists and radical youth that the mainstream environmental organisations were impotent. The founder members of Earth First! - the direct action network that became (in)famous for its physical, yet resolutely non-violent, opposition to road construction - were motivated by their disillusionment with moderate environmental organisations with which they had previously been involved. Later, direct activists claimed that one reason for their discontent with conventional environmental organisations was because they tended to exclude mass participation. Indeed, the animosity was mutual; Friends of the Earth was initially openly hostile towards direct action networks, actively encouraging its local groups to keep them at a safe distance (Rootes 2002:33).

However, by 1992, the seeds of cooperation between radical and reformist organisations were sewn in the form of the British government's controversial nationwide road expansion and 'improvement' program. This resulted in high levels of public campaigning, mostly beginning with a series of independent conventional local campaigns, with some support from national environmental organisations like Friends of the Earth. Many local campaigning groups fought tirelessly against locally unwanted road expansion projects. Nevertheless, despite their hard slog, the battle against road expansion culminated in 141 lost public inquiries, out of a total of 146 (Must in McKay 1996:128). Activists of all persuasions, witness to a democratic dead-end after losing well-fought public inquiries, were realizing the inefficacy of official channels for halting roads, and began to look for alternative means. One

of the most surprising outcomes was an unexpected alliance between anti-road campaigning groups consisting of folk from Middle England and youth from radical subcultures. At the height of the roads protests, even the highly-reputable Pedestrian's Association joined ranks with radical anti-roads protesters in order to bounce illegally parked cars off pavements (Jordan & Maloney 1997); its unfruitful battle using conventional protest activities over the previous 66 years appeared much less effectual.

Friends of Earth's attitude towards direct action had changed considerably – from open hostility, to hospitality. Although Friends of the Earth and the Campaign to Protect Rural England (CPRE) both have to consider their political reputation (CPRE especially so), and therefore aim to remain moderate, both can see the virtues of direct action when it remains the only channel open to protesters. De Zylva told the *Telegraph* that:

> When the normal decision-making methods fail to deliver, it's time to get off your backside and do something about it. We are very sympathetic to people who take practical action to show up the absurdity of our planning laws (*Telegraph Weekend*, 28th February 2004).

Even CPRE has displayed sympathy towards direct action protesters campaigning to protect the Nine Ladies megalithic complex and nature conservation site in the Peak District from quarrying. A CPRE spokesperson is recorded as saying that:

> if it weren't for the eco-warriors, the quarrying would have already started … We applaud them for what they are doing. OK, they might not wash very much and they may look a bit strange, but we have had nothing but cordial relations with them (ibid).

The purpose of this paper is to systematically explore the hypothesis that closed political opportunities in tandem with a critical and highly visible campaign, like those that the anti-roads lobby witnessed in the 1990s, can create dynamic and unexpected alliances between environmental organisations that would, at non-critical and latent times, usually dissociate from, and perhaps even be critical of, one another. In the past, key campaigns in a perceived or objectively closed polity (whether local or national) have brought local, regional and national groups together across ideological divides. This has been witnessed at several junctures in the history of the environmental movement, most notably during campaigns

against road building (Bryant 1997, North 1997) and airport expansion (Griggs and Howarth 2002). However, to date, there has been no systematic evaluation of the differences between networking at such critical and visible times and during latent periods.

This paper seeks to redress this lack of comparative analyses of movement networks between visible and latent movement times. It is based on a comprehensive survey of environmental organisations in southeast London, conducted at two different points in time. In January 2001, environmental organisations in southeast London were engaged in a huge, visible and critical, campaign against a proposal to build a 20-screen cinema multiplex on Crystal Palace Park. The proposed multiplex had nine bars / diners and retail outlets, but also unsightly ramps leading to a rooftop car park with capacity for 950 cars. Campaigners were concerned not only about the loss of part of this Grade II listed park which is on the English Heritage Register of Historic Parks, but also about the anti-social proposed opening hours, and the additional traffic that it would bring to an already congested and polluted urban area. Almost immediately after the development was proposed, a conventional campaigning outfit, the Crystal Palace Campaign, was established. It sought to use all legal means to challenge this locally unwanted development, including petitions, and a number of legal challenges against Bromley Borough Council's decision to grant planning permission to the development. It proposed that an alternative development, which it dubbed 'the Peoples' Palace', be built on the site. It wanted this to consist of an ecology and statue park, housing a replica of the original Palace. The 'People's Palace' was supported by the local amenity societies of Dulwich, Sydenham and Croyden, as well as by London Wildlife Trust and Friends of the Earth. Other key groups that were campaigning against the development were the Ridge Wildlife Group, which wanted a nature reserve rather than a People's Park, and the radical Crystal Palace Protest, which founded the Big Willow Ecovillage. The Big Willow Ecovillage was a direct action camp consisting of occupied tree houses and tunnels to prevent the felling of trees and the manoeuvre of heavy machinery. The purpose of the direct action camp was fourfold: to physically prevent the development from taking place, to support local people (many direct action protesters claimed to be local themselves), to provide valuable media coverage, and to clean up the site which had become a focal point for fly-tippers. In addition, a small group of protesters established an organic vegetable garden.

The network at that point in time is compared with the network as it existed in February 2003. Although southeast London, at that time, hosted the campaign against the

Thames Gateway Bridge, this campaign was not at a critical level. A critical level is reached when the decision to proceed with a LULU (locally unwanted landuse) has been made and construction appears almost imminent. The Crystal Palace Campaign had reached this stage because Bromley Council had granted planning permission, and the eco-villagers were facing impending eviction. In contrast, the Thames Gateway Bridge Campaign was only at the consultation stage. Bates, the coordinator of London Friends of the Earth, confirmed in interview that the Thames Gateway Bridge campaign was at an early stage, was not yet critical, and had yet to mobilize much support, unlike its 1990s predecessor at the height of the Oxleas Wood (anti-road) Campaign of the 1990s: (interview, November 2003):

> Basically that [Oxleas Wood campaign] took a long time to build up. It is only when it gets serious. It was, you know, actually approved. I mean they had to get it revoked as far as I remember… it started off as local and it took ages I think before they really got people involved from … the national organisations … so I don't think hardly anybody was involved at the early stage then …

Thus the Thames Gateway Bridge campaign was largely invisible, and latent; working on honing its arguments, and developing its networks in preparation for the more visible and critical campaign period that would follow if the battle could not be won through conventional campaigning activity. This meant that the 'latent' time lacked a critical campaign. Especially, the absence of the Crystal Palace mobilisation meant that some of the groups no longer considered themselves to be a part of the environmental movement as they now lacked an environmental aim, participation in a network and a collective action foci. Others, such as the Ridge Wildlife Group and Big Willow Ecovillage, had folded. Local amenity societies (such as the Dulwich Society and the Peckham Society), local branches of Friends of the Earth and Greenpeace, and local Friends of Parks groups were still present in the movement, at the latent time, although they had considerably fewer network links.

2. Methodology

All known and apparently active environmental organisations in southeast London, identified by internet searches, community databases and snowballing with local activists were sent a

questionnaire at these two points in time and were asked to list the top ten environmental organisations with which they collaborate (up to five local organisations and five national organisations)[1]. Organisations were only asked to provide network data if they met certain criteria. If they did not have a main aim that was environmental, or did not consider themselves to be part of a network of a network of environmental organisations, no further survey questions were asked of them. Thus all organisations that provided network data claimed to: a) be part of an environmental movement network, b) have a shared concern to protect the environment, and c) were engaged in collective action to achieve environmental improvement / protection, and were therefore part of the environmental movement.[2] The environmental movement, so defined, includes conservationists, whose remit is the protection of *nature*, reformists, who seek to *reform* policy in a pragmatic fasion, and radicals, who seek *direct change* making use of direct action and pre-figurative politics.[3] The networks at these two very different points in time are compared by qualitative analysis of sociograms, and network measures including in- and out-degrees, closeness and betweenness.

3. Movement networking in practice

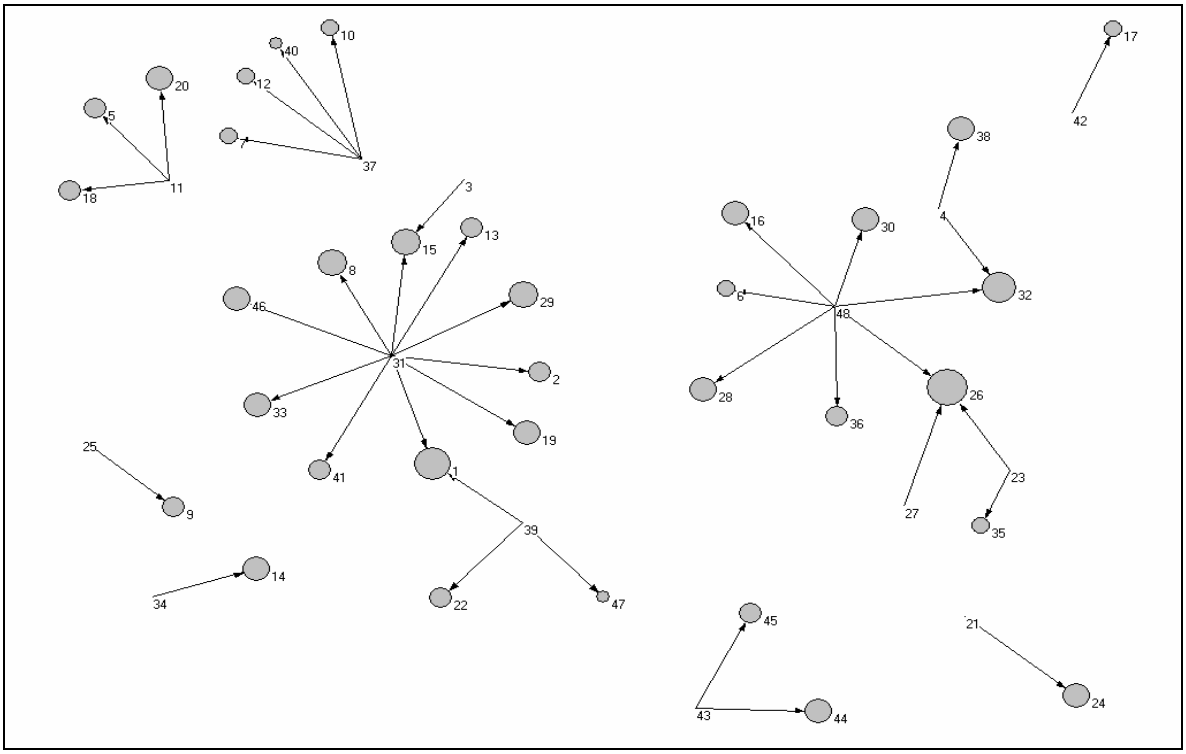
A component analysis, a necessary preliminary step in social network analysis, shows that the network was considerably less connected in 2003, at a latent time, than it was in 2001, when the critical Crystal Palace Campaign was underway. A component is a group of connected actors (in this case organisations) in which each has at least one network link to others. Organisations that are not in the main, largest, component are relatively isolated from the bulk of the movement. In the 2003 sample, only 31% of the environmental organisations that

[1] Although restricting organisations to listing only their top 10 collaborators might be expected to distort the data, the average in- and out-degrees for all organisations surveyed is less than 10.
[2] However, it is certainly the case that the environmental movement overlaps with other movements and realms of civic activity such as the peace movement, leisure/tourism, amenity / architectural protect and others. For a discussion of 'blurred boundaries' in the environmental movement, see Saunders 2003.
[3] Some scholars (e.g. Doherty 2002) suggest that the schism between conservationist and radical groups is so great that the latter should not be considered part of the 'green' movement, mostly because they are not oriented towards social change. Other research by Saunders (2004) shows that the collective identity of conservationists is much weaker than reformist and radical green ideologies. However, it is still fair to view conservationist organisations as part of the movement if they are engaging in collective action, are networked to other environmental organisations and are oriented towards protecting or enhancing the environment. The threat of a locally unwanted land use takes conservationists away from static nature resource enhancement towards networking and real collective action, thus drawing them, albeit temporarily into movement dynamics.

returned completed questionnaires were part of the main component. This stands in stark contrast to the survey conducted during the critical campaign, when 72.1% of nodes were part of the main component. Although the response rate is much lower for the latter survey (38% vs. 62%), opportunities for responding to the questionnaire were virtually equal. This suggests that not only has the network fragmented substantially, but also indicates that a number of organisations that formed specifically to campaign against the development at Crystal Palace folded when the campaign was won in September 2002. Indeed, the volatility and high rates of attrition of local development-specific environmental organisations are well documented (see Rootes *et al* 2001).

Figure 1 shows all eight components of southeast London's environmental movement network in January 2003, in the absence of a critical and visible campaign. This can be compared to Figure 2, which shows just the *main* component of the network in February 2001 during the Crystal Palace Campaign.

Figure 1. Southeast London's environmental movement network at a 'latent' time, January 2003



(See Appendix 1 for key to diagram)

During the latent point in time, the once relatively central Crystal Palace Campaign, which did answer a questionnaire but claimed to no longer be part of a network of environmental organisations, was only tangentially linked to the network, being nominated as an important collaborator by only three local societies (Figure 1). In the network in Figure 2, which conveys a moment at which the Crystal Palace Campaign was very active, it was connected to many more organisations with broader remits, including Ridge Wildlife Group, a few societies, national Friends of the Earth, Southwark Friends of the Earth, London Wildlife Trust, RSPB, Southwark Open Spaces Society, Friends of Great North Wood and the Environment Office. In Figure 2, the green nodes represent those organisations that were active in the now ceased Crystal Palace campaign. When these campaigning organisations ceased to exist, and the radical subculture associated with the campaign fell back into latency, the network became considerably more fragmented. The Environment Office was the key broker between the reformist and conservation interests and radical environmentalism and its

DiY culture which features so prominently in the top right hand corner of the network diagram, but which is missing in the more recent network survey. This is because there was no longer a focal point in southeast London for radical protesters in the absence of the Big Willow Ecovillage. What had happened, then, to the radical subculture? A radical activist explained:

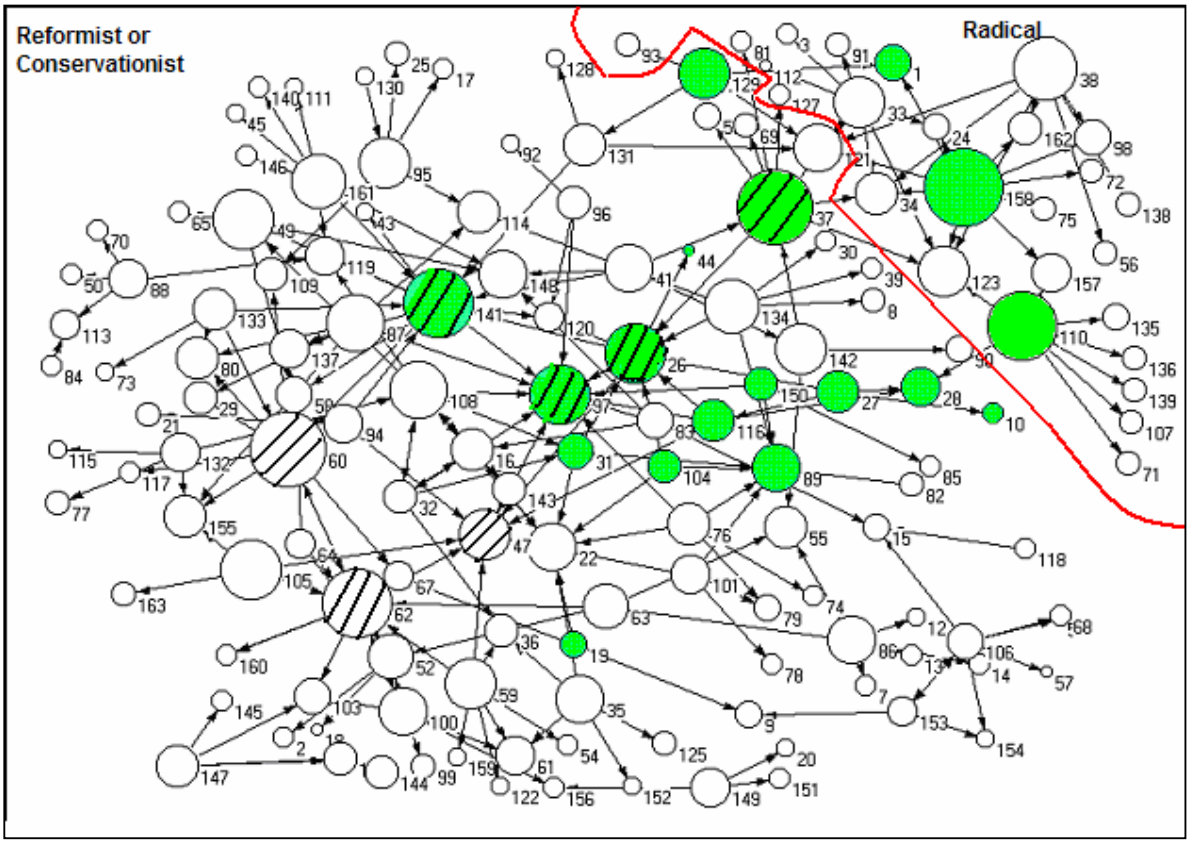
> Most of them moved into local squats … party squats, reclaim the streets squats. There is a reclaim the streets squat just up the road …I could introduce you to some of them if you like, but they probably wouldn't want me to, and I don't think they would answer your questionnaire either, because they are not proper organisations, just a bunch of like-minded people (Storm Porum, radical environmental activist in interview, May 2003).

Clearly these networks had become fragmented, dispersed and invisible to the public eye, and no longer had, or indeed required, the nomenclature that develops during critical movement moments, which is essential both for activists constructing a collective identity, and for researchers seeking to analyse interorganisational linkages. That is not imply that radical activism had become moribund, but rather that it lost its rooted environmental referent. Indeed, there was plenty of evidence in 2003 of a thriving subcultural 'underground' party scene, and instances of resistance to evictions of squatted social centres and homes. The act of squatting was seen by activists as part of their struggle to protect the environment from what they regarded to be thousands of unnecessary new-build homes. The difference was that these networks were working more behind the scenes, and were not connected to others via a common campaign. Additionally, they were no longer in the media spotlight.

Although the Crystal Palace Campaign claimed on its website that it 'did not condone or incite any illegal activity', there were in practice links between it and the direct action camp. Figure 2 shows indirect links between them via brokers, but more interesting is the fact that the postal address that appeared on the Crystal Palace Campaign Newsletters and the address for donations to the Big Willow Ecovillage were identical. The Boycott UCI campaign also brought together radical and more reformist campaigners together. Boycott UCI involved mass boycotts of UCI cinemas, in an attempt to dissuade the developers from pursuing the development as UCI was planned to be the main leaseholder.

Despite the high degree of networking between environmental organisations at the 'critical' campaign time, we should not assume that all of the relationships were consistently cordial. The most prominent campaign organisation, the Crystal Palace Campaign, rigorously pushed for its 'People's Park' alternative, against the wishes of local nature conservationists, who would have much rather preferred to site to become an ecologically oriented nature reserve. And radicals felt sidelined when, in May 2001, the Crystal Palace Campaign held a 'victory press conference', which the radicals were not informed about, let alone invited.

Figure 2. Southeast London's environmental movement network at a 'critical' time, February 2001



Key

Key brokers[iii]

Organisations campaigning at Crystal Palace

(See Appendix 2 for key to names of organisations)

4. Quantitative network measures

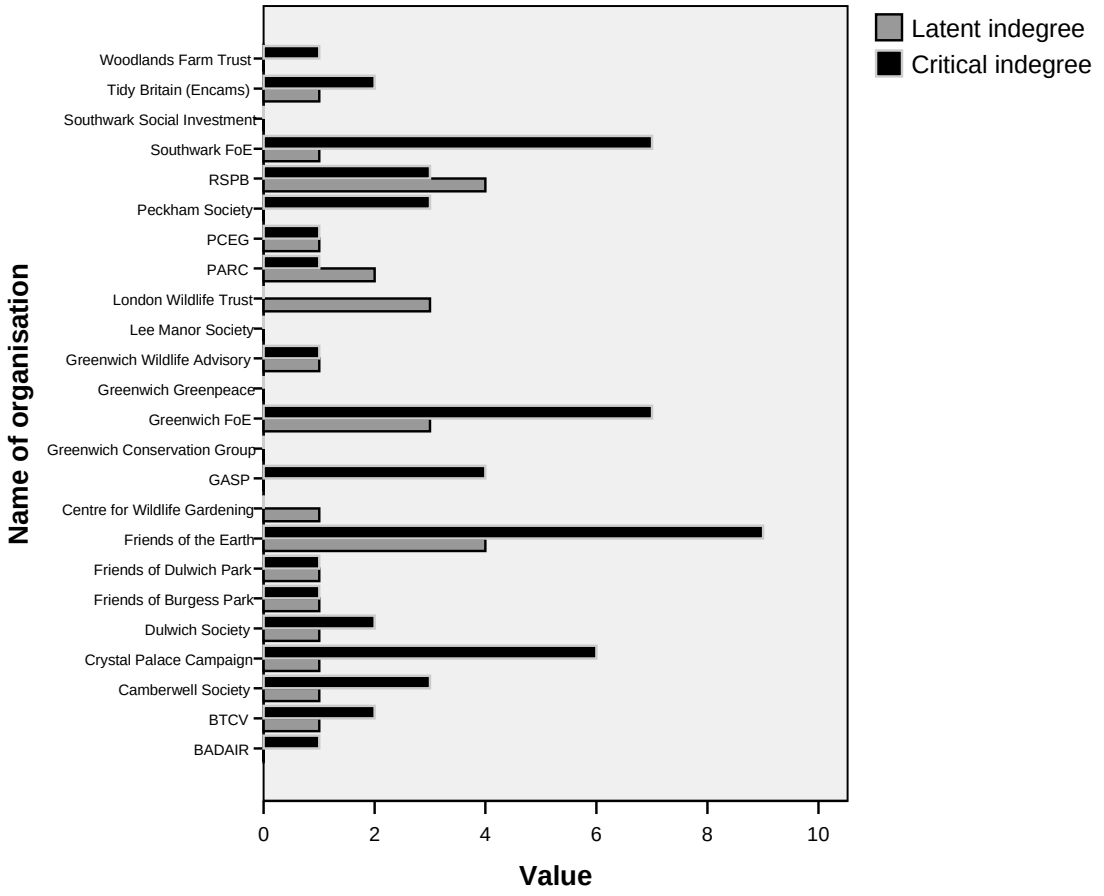
This section of the paper compares quantitative network measures[iv] in order to more systematically assess the differences between the movement network at the latent and critical times. The in-degree, out-degree, closeness and betweenness scores are compared for each of the twenty-four environmental organisations that responded to both surveys. Each of these measures are indicators of 'centrality'; they give an indication of the 'importance' of an organisation within a network. Thus, generally speaking, an organisation with a higher centrality score is more important in the network because a higher number of others have rated it as important, or because it performs an important brokerage role.

The simplest and most frequently used indicator of centrality is the 'in-degree', which is simply an indicator of popularity; an 'in-degree' counts the number of times an organisation has been directly nominated by another as an important collaborator. Although the environmental organisations in both samples were only given the opportunity to list up to ten important collaborators, we can see from Figure 3 that they quite often listed considerably fewer. The most popular organisations, at the critical time, were all heavily engaged in the campaign against Crystal Palace Park – Friends of the Earth had an in-degree of nine, two of its local groups had an in-degree of eight, and the Crystal Palace Park Campaign itself had an in-degree of six. In comparison, in the latent period, the highest in-degree was five. Indeed, a paired samples T-test reveals statistically significant differences (at the 0.18 level) in the means of the in-degrees of the latent and critical samples (Table 1).

It is interesting to note that during the latent period, RSPB (Royal Society for the Protection of Birds) was as popular as Friends of the Earth. At the critical time, conservation organisations such as RSBB and the London Wildlife Trust were relatively *less* prominent. The fact that conservation organisations are concerned with protecting a constant resource, and do not rely on a LULU-type campaign could go someway towards explaining this considerable difference. Flora and fauna is always being conserved in the capital, even in the absence of a critical campaign. The Centre for Wildlife Gardening, which has an in-degree of one in the latent period, does not score at all in the critical period, possibly because its contemporaries were engaged in the political struggle against the multiplex cinema, over and above any desire to conserve 'background' wildlife. Although there are many passionate nature lovers, a mere love for (directly) unthreatened nature does not cause environmental

groups to galvanise to the extent that the direct threat posed by an unwanted landuse does.[4] Of course, unwanted land uses also have the potential to disrupt communities, and their ways of life, which may help to explain why they are such great mobilizers.

Figure 3. Comparing in-degrees at 'latent' and 'critical' times



The 'out-degree' is, simply put, an indicator of the 'gregariousness' of actors within a network. Rather than indicating the popularity of organisations, it indicates the extent to which an organisation makes itself known to, and contacts, others in the network; it is a measure of the number of nominations an organisation *makes* rather than *receives*. Again, we

[4] This is not to say that wildife groups are not important. They are certainly highly influential and important agenda setters for the movement. However, it is certainly the case that the average member of a local Wildlife Trust or conservation group will become more *politically* active in the environmental movement during periods of visibility, when they have something to protect with some urgency (e.g. the felling of 140 mature trees as described on p.18). Conservation work, especially at the local level, more often involves physical management of nature reserves and education than political campaigning.

can note that there is more networking at the critical time compared to the latent one (Figure 4). Environmental organisations are more likely to both seek and receive contact with other organisations when there is a perceived need to unite. At the critical time, the most central organisations under the measure of 'out-degree' were, again, mostly primarily concerned with the proposed Crystal Palace development. The Camberwell and Dulwich Societies, which supported the Crystal Palace Campaign both had an out-degree of four at the critical time, and no out-degree whatsoever at the latent time. A paired samples T-test shows that there is a significant (0.11) difference between the means of the out-degree scores at the latent time compared to the critical (Table 1), being almost universally significantly higher in the latter.

However, People Against the River Crossing (PARC), the organisation that formed during the late 1980s-early 1990s Oxleas Wood campaign against a new road that would cross the Thames and carve a path through the ecological haven that is Oxleas Wood, and which was, at the time of data collection, re-embarking upon its campaign against a similar but differently named 'Thames Gateway Bridge' had a relatively high out-degree. Although the Thames Gateway Bridge campaign was not at a critical stage, the organisation was clearly seeking to build network links, as we would expect during a latent struggle, as preparation for a possible critical struggle at a later date. Surprisingly, PARC's out-degree dropped to zero once the Crystal Palace Park campaign had ended. Perhaps PARC was competing with the Crystal Palace Campaign for attention, or else attempting to garner support from those it supposed would be sympathetic to its cause. The Woodlands Farms Trust, which purchased and ecologically farms a patch of land that would have been subsumed by the Oxleas Wood road had the initial anti-road campaign failed, shares a high degree of membership with PARC. Despite this, it was able to maintain its gregariousness during the 'latent' period – it did not have a major anti-LULU campaign to compete for attention with, and, rather like nature conservation more generally, is more easily able to be sustained given the lack of an unwanted landuse because its focus is resource conservation rather than protection from an external threat.

Figure 4. Comparing out-degrees at 'latent' and 'critical' times

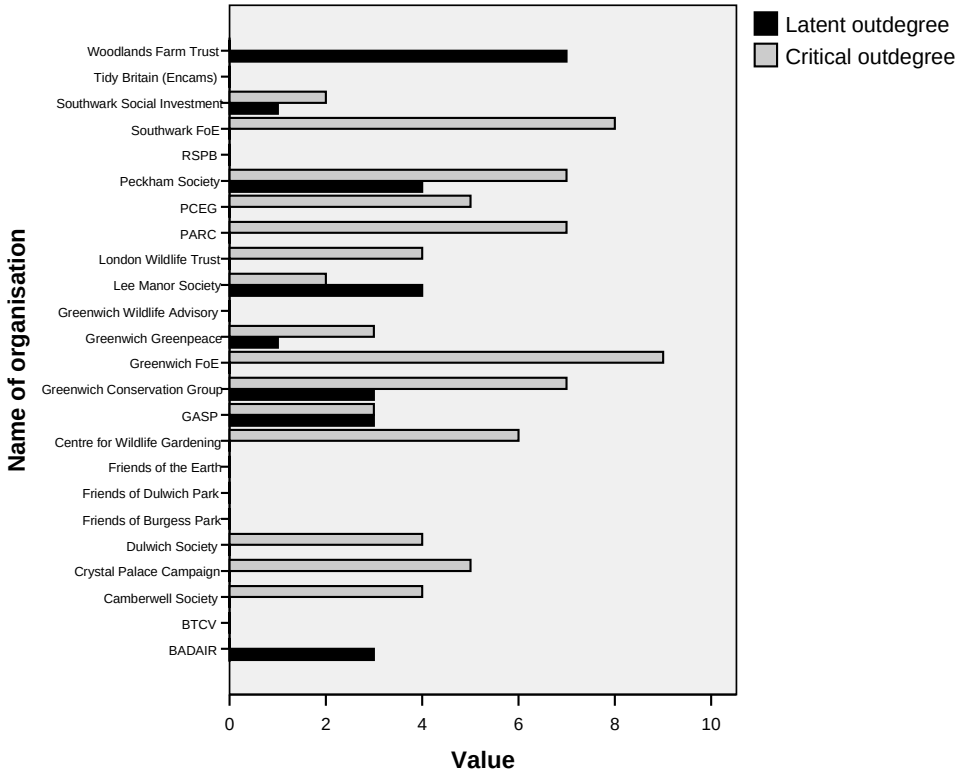


Table 1. Paired samples Test

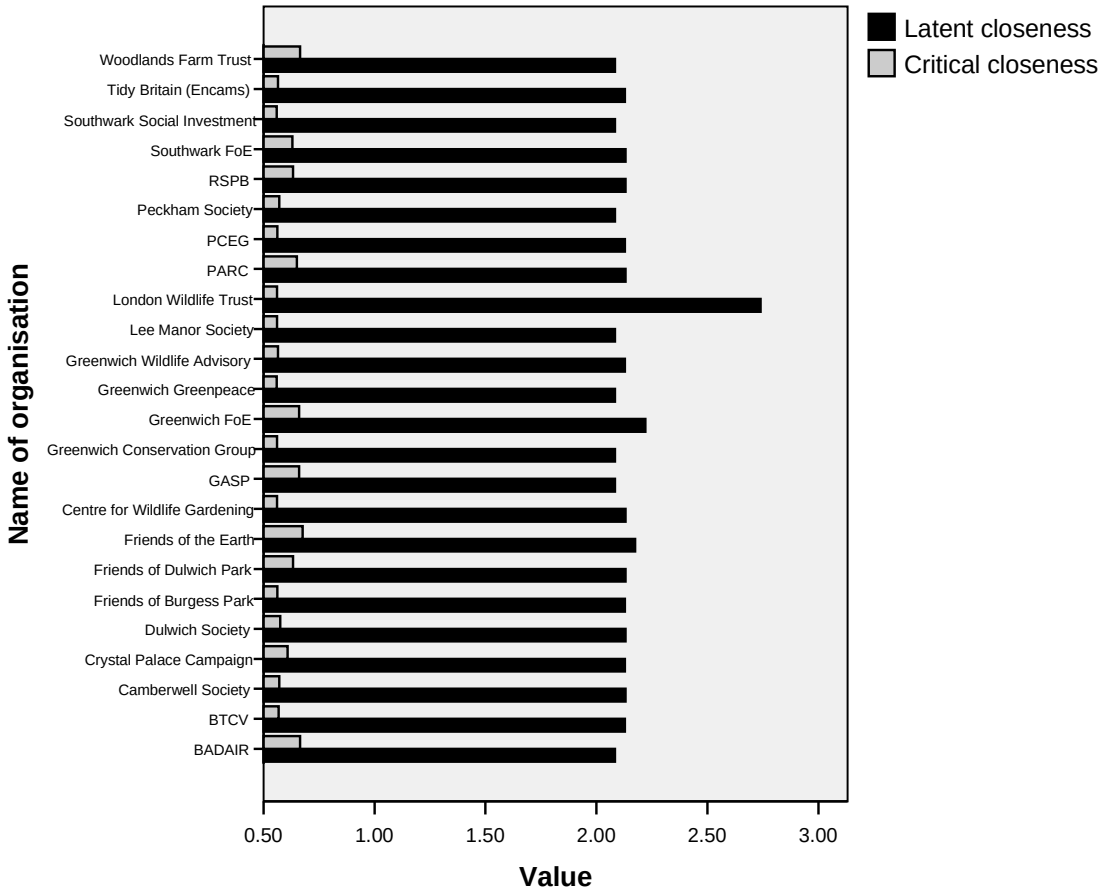
Comparing latent and critical …	Paired differences			t	Significance
	Mean	Standard Deviation	Standard Error of Mean		
In-degree	-1.17	2.24	0.46	-2.55	0.018
Out-degree	-2.08	3.71	0.76	-2.75	0.011
Betweenness	-77.16	161.46	32.96	-2.34	0.028
Closeness	1.55	0.14	0.03	53.03	0.000

'Betweenness' (Freeman 1978) or 'structural holes' (Burt 1992) measure the extent to which an actor is a network is in a position of control. An organisation that is 'between' several other actors in a network has the information and ideas channelled through it, giving it, in theory a 'gatekeeper', or 'brokerage' role, thus providing it with additional opportunities for

access to information and control. In the 'latent' sample, all of the environmental organisations score zero on the betweenness index. This contrasts significantly with the 'critical' sample, in which the Friends of the Earth groups and the Crystal Palace Campaign groups and the Dulwich Society have very high betweenness scores (over 100). Thus, it is not surprising to see that the paired samples T-test confirmed a statistically significant difference between the latent and critical scores (Table 1). The environmental organisations in 'control' of the network at the 'critical' time were very much embedded in the local struggle against the multiplex cinema. At the 'latent' time, the absence of a struggle yielded an absence of leadership and power in the network.

In contrast to betweenness, closeness measures how 'close' an organisation is to others in the network. In fact, it is better to regard the outcome of the measure of 'closeness' as an indicator of the average distance that an organisation is from others, because a higher score is indicative of a greater degree of isolation from the bulk of the network. Therefore, we should not be surprised to find that the distances between organisations was greater during the latent time, yielding considerably higher closeness scores (Figure 5). The case of London Wildlife Trust (LWT) shows why it is important to consider the various measures of centrality in tandem. In the latent network, LWT scored relatively high on its in-degree (Figure 3), suggesting that it was a fairly central actor. However, it has the highest closeness score in the latent sample, suggesting that, despite its popularity, it is at more a distance from the bulk of the network than its contemporaries. Greenwich Friends of the Earth behaves similarly in the network. Yet again, there is a statistically significant difference (0.00) between the latent and critical networks (Table 1)

Figure 5. Comparing closeness at 'latent' and 'critical' times



5. Discussion and conclusion

Even though the Crystal Palace Campaign persevered with conventional campaigning right through to the end of the campaign, local campaigners certainly felt that many of their attempts to thwart the proposed development at Crystal Palace Park were in vain. From the start, back in 1997, campaigners had branded Bromley Borough Council as 'profit oriented', and they felt that the local community had been excluded from the decision-making processes. Campaign literature cites that Bromley Borough Council's emphasis was on 'attracting developers … to increase any premium from the site' and therefore it was deemed

the case that 'the market' rather than the local community 'would be allowed to determine the leisure mix'. According to the Crystal Palace Campaign, this resulted in a closure on community involvement. Excluded from all but a 'token' consultation, how did the campaign respond? It did not immediately give recourse to direct action, if indeed it ever directly did, but appealed for a public inquiry to challenge the planning proposal. Unfortunately for the campaign, the Secretary of State refused the appeal, after which Bromley Council gave the development outline planning permission. After initially being refused leave, the campaign Chairman, barrister Philip Kolvin eventually instigated an unsuccessful judicial review against the decision to grant planning permission. Still not daunted by the apparent lack of progress in pursuing conventional campaign strategies, the campaign unsuccessfully petitioned the House of Lords in an attempt to reverse the outcome of the judicial review. In January 1999, the Campaign instigated proceedings against Bromley Council in the European Court of Justice, due to its failure to carry out an obligatory Environmental Impact Assessment. It wasn't until October 2000 that the European Commission sent a formal letter to the British authorities for breeching the EIA Directive prior to granting planning permission, but in the meantime, the campaign had broadened its repertoire, becoming increasingly less conventional. In March 1999 it held a large demonstration in Leicester Square in front of the Empire UCI Cinema, which was followed up with the national Boycott UCI campaign. Local people were encouraged to write to UCI and to phone them out of hours to block up their answer machines with a message saying 'I don't want you on our park'. Additionally, the Big Willow Ecovillage was established, silent vigils were held (coordinated by the Ridge Wildlife Group), and public meetings were staged at which the organisations involved could step-up on their networking.

Indeed, it appears that it was only after virtually all feasible legal challenges had been made, or at least commenced, that the Campaign made a significant gear-change towards publicly visible actions that involved considerable networking with other concerned organisations. Although the construction of the multiplex was not imminent because the outcomes of some of the legal challenges were unknown, there were other factors that made the situation appear more critical to local people than it actually was. In January 2001, at the time of data collection for the 'critical' network, the campaign had heard rumours that Bromley Borough Council was planning to fell the 140 mature trees that were growing on the 'ridge' of the proposed development site. After being bombarded with hundreds of letters

from concerned local people, the leadership of Bromley Borough Council announced in February that they had listened to the people, and would not remove the trees in the 'immediate future'[v].

Thus there was both a perception of diminishing, if not closed, political opportunities – a sense of approaching, or having reached a democratic dead end -- combined with what was at least perceived as a critical campaign time. This resulted in a multi-faceted affront to Bromley Council's rumoured decision to fell some locally revered trees, and networking between radical and reformist campaigners. The strategy and the networking would most probably not have materialised had there been other political openings for realising campaign aims, or if there had not been a sense of urgency to halt the development.

In May 2001 Bromley Borough Council announced that it was no longer supporting the proposals for the multiplex, allegedly due to the developer's failure to complete the lease within the prescribed period. The intense public pressure, legal challenges and the opposition of neighbouring borough councils may also help to explain why Bromley Borough Council was so quick to drop the proposals that it had previously defended so rigorously. The campaign slowly drifted from the public eye over the next few months, to the extent that by January 2003 it was engaged mostly in dialogue workshops and committees with Bromley Borough Council, the Government Office for London, and the Mayor of London. The result of its latency was fragmentation of the local environmental movement network, which no longer had a visible campaign to attach itself to, or a development that it perceived to be in need of urgent opposition. The radical activists that were involved in the eco-village dispersed into small unnamed groups of squatters, conservation organisations became relatively more important than single-issue protest groups, and all of the key organisations became less well-connected – they reduced their gregariousness, popularity and brokerage roles significantly. There is some evidence during the latent point in time of 'meaning construction work'. For radical activists, their squatting was a form of resistance against new-build housing, which had, as Melucci (1989:70-1) predicted involved the 'sewing [of] opposition into the very fabric of [their] lives'. For the less radical activists involved in the Crystal Palace Campaign, dialogue and consultations with the council became a mundane and publicly invisible but important part of their lives.

Network analysis has helped to demonstrate the quite stark differences that we can expect to find as local environmental movement networks develop and evolve over time.

Most importantly, this paper has illustrated that environmental organisations are significantly better networked when political opportunities are perceived as closed, and when a campaign appears to have reached a critical stage. These two conditions result in visible movement activity, which makes it easier for environmental organisations not only to contact one another, but to have opportunities for collaborative campaigning. Thus, networking is not only an important precursor to effective environmental movement action, but is also an outcome of it. Perhaps it was the degree of networking that made the Crystal Palace Campaign such a pervasive and persuasive political force, and this might well have been the real reason why Bromley Borough Council decided suddenly to drop the multiplex proposal in May 2001.

This research has showed how local environmental movement networks at critical campaign times manifest as broad coalitions embracing conservationists, reformists and radicals. Thus, it may be tempting to suggest that such a phenomenon – the social movement dynamic - is specific to critical stages of campaigns rather than the basis of broader and durable intra-movement networking, and therefore to suggest that southeast London's environmentalism represents a series of coalition dynamics rather than a social movement dynamic. However, a conservationist organisation, London Wildlife Trust, was the most central environmental organisation in the collaboration network at the latent time despite having low levels of resources and not being actively involved in site battles or critical campaigns. This means that we can neither exclude conservationists from the movement, nor say that the 'movement' only exists at critical campaign times. Even in the absence of the critical campaign, there would be links at the very least between conservationists and reformists, and between radicals and reformists. And even when temporary instrumental coalitions fold, latent links remain and can be drawn upon for later campaign episodes. This has happened with the network links that evolved during the anti-roads movement. These networks have recently been revived for aviation campaigning through the Airport Watch coalition. Further, it is clearly wrong to assume that all coalitions and site-battle networks are short-lived and have no bearing on a movement's future. The Ilusi Dam campaign members turned their attention to the Baku Ceyhan Campaign after they had won the former campaign, and have since become members of the No New Oil coalition. This shows that the coalition networks that develop during the course of a single campaign are durable beyond the life of a single campaign, and can therefore be considered part of a movement. Even though there is

much less networking at latent times, we could suggest, as Rootes (2004a:611) argues on a grander scale for Western Europe, that in London there is indeed 'sufficient engagement in collective action and sufficient shared concern to warrant continued use of the term "environmental movement"'.

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Appendix 1

Key to Figure 1

1 Bankside Open Spaces Trust
2 BTCV
3 Badair
4 BromleyRSPB
5 Crystal Palace Campagin
6 CPRE
7 Camberwell Society
8 Centre for Wildlife Gardening
9 Creekside Forum
10 Dog Kennel Hill Campagin
11 Dulwich Society
12 East Dulwich Society
13 Encams (previously Tidy Britain
14 Forum of Conservation and Amenity Societies
15 Friends of the Earth
16 Federation of City Farms
17 Forum for Stable Currencies
18 Friends of Belaiv Park
19 Friends of Burgess Park
20 Friends of Dulwich Park
21 Friends of Greenwich Park
22 Friends of Jubilee Gardens
23 Greenwich Action to Stop Pollution
24 Greenwich Wildlife Advisory Group
25 Greenwich Conservation Group
26 Greenwich Friends of the Earth
27 Greenwich Greenpeace
28 Greenwich Wildlife Trust

29 Groundwork
30 Groundwork London
31 Groundwork Southwark
32 London Wildlife Trust
33 Learning Through Landscapes
34 Lee Manor Society
35 People Against the River Crossing
36 PCEG
37 Peckham Society
38 RSPB
39 Roots and Shoots
40 Southwark Friends of the Earth
41 Sustainable Energy Action
42 Southwark Social Investment Forum
43 Vauxhall Society
44 Vision for Vauxhall
45 Walk First
46 Walworth Garden Farm
47 Waste Watch
48 Woodlands Farm Trust

Appendix 2.

Key to Figure 2.

1. 56a
2. Alarm
3. Anti-Terrorism Act
4. Archway Alert
5. Association for Monetary Reform
6. BADAIR
7. Barrydale Allotments Association
8. British Horse Society
9. Blackheath Society
10. Boycott UCI
11. Brixton Greenpeace
12. Brockley Society
13. Brockley Cross Action Group
14. Bromley Greenpeace
15. BTCV
16. Camberwell Society
17. CAST
18. Centre for Alternative Technology
19. Charlton Society
20. Chernobyl Children
21. Christian Ecology Link
22. Civic Trust
23. CND
24. Corporate Watch
25. Countryside Agency
26. Crystal Palace Campaign
27. Crystal Palace Foundation
28. Crystal Palace Protest

29. Cyclists Tourist Club
30. Dog Kennel Hill Society
31. Dulwich Society
32. East Dulwich Society
33. Ecotri[p
34. Earth First!
35. Eltham Society
36. English Heritage
37. Environment Office
38. Fareshares
39. Friends of Burgess Park
40. Friends of Camberwell Park
41. Friends of Dawson's Hill
42. Friends of Dulwich Park
43. Federation of City Farms
44. Friends of Great North Wood
45. Flora and Fauna
46. Friends of Nunhead Cemetery
47. Friends of the Earth
48. Forum for the Future
49. Friends of Peckham Rye Park
50. Friends of Beckenham Park
51. Greenwich Action Plan
52. Greenwich Action to Stop Pollution
53. Gene Concern
54. Georgian Group
55. Green Party
56. Green Anarchist
57. Green Lanes
58. Greenpeace
59. Greenwich Conservation Group
60. Greenwich Cyclists

61. Greenwich Environment Forum
62. Greenwich Friends of the Earth
63. Greenwich Green Party
64. Greenwich Greenpeace
65. Greenwich Local History Society
66. Greenwich LA21
67. Greenwich Society
68. Greenwich Wildlife Advisory Group
69. Hastings Bypass Campaign
70. Hillyfields Action Group
71. Huntington Life Sciences Campaign
72. Justice?
73. Lambeth Cyclists
74. Lambeth Environment Forum
75. Lambeth Green Party
76. Lambethians Society
77. Lambeth Transport Users Group
78. Lambeth Walk First
79. Lambeth Local History Society
80. London Cycling Campaign
81. Legal Defence and Monitoring Group
82. Lee Manor Society
83. Lettsom Gardens Association
84. Lewisham Cyclists
85. Lewisham Environment Trust
86. Lewisham Green Party
87. Lewisham Pedestrians Association
88. Lewisham Wildlife Trust
89. London Forum of Amenity Societies
90. London Forum of Green Parties
91. Liberty
92. London Natural History Society

93. London Anarchy
94. London SCARE
95. London Walking Forum
96. London RSPB
97. London Wildlife Trust
98. May Day Collective
99. MedACT
100. Greenwich Sustainable Millenium Network
101. Minet Conservation Association
102. Monetary Justice
103. New Economics Foundation
104. Norwood Society
105. People Against the River Crossing
106. PCEG
107. Peace camps
108. Peckham Society
109. Pedestrians Association (now Living Streets)
110. Pirate TV
111. Plant Life
112. Primal Seeds
113. Quaggy Waterways Action Group
114. Residents Association [unspecified]
115. Rail Passengers and Commuters Association (SE)
116. Ridge Wildlife Group
117. Road Peace
118. Rockingham Estates Play Area
119. Royal Society for Nature Conservation
120. RSPB
121. RTS
122. SAVE
123. *SchNEWS*
124. South East London World Development Movement

125. South Greenwich Forum
126. Simon Wolfe Charitable Foundation
127. Siren Sound System
128. Socialist Alliance
129. Sounds of Dissent
130. South Bank Ramblers
131. South London Collective
132. South London Link
133. Southwark Cyclists
134. Southwark Open Spaces Society
135. spc.org
136. Stonehenge Campaign
137. Sustrans
138. Socialist Worker
139. Southwark Animal Rights
140. Southwark Environmental Forum
141. Southwark Friends of the Earth
142. Southwark Green Party
143. Southwark Groundwork
144. Southwark Heritage Association
145. Southwark LA21
146. Southwark Park Rangers
147. Southwark Social Investment
148. Southwark Wildlife Trust
149. Sydenham CND
150. Sydenham Society
151. Sydenham UN Association
152. Transport for London
153. Tidy Blackheath
154. Tidy Britain (now ENCAMS)
155. Transport 2000
156. UN Association

157. Undercurrents
158. Urban 75
159. Victorian Society
160. World Development Movement
161. Wildlife Gardening Initiative
162. Wombles
163. Woodlands Farm Trust

Endnotes

[i] This paper draws on surveys conducted as part of two different projects: the Transformation of Environmental Activism Project, funded by the EC Environment and Climate Research Programme, contract number ENV4-CT97-0514, and an ESRC-postgraduate training award, number R42200134447.

[ii] By British exceptionalism, Rootes (1992) was referring to the (then) exceptionally moderate character of British Environmental organisations in comparison to other Western democracies.

[iii] The top seven brokers, calculated using Freeman's betweenness (1979) all have scores well-exceeding ten. The eighth highest broker has a score lower than four. In January 2003, not one organisation's brokerage score exceeds 8.

[iv] For a comprehensive yet concise introduction to social network methods, please see Scott (2000).

[v] See the Crystal Palace Campaign website for an in-depth history of the Campaign. (http://www.crystal.dircon.co.uk/ accessed 15/03/03, 20/05/06).

Erik Aarden
Faculty of Health Sciences
Maastricht University
e.aarden@zw.unimaas.nl

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The last decades of the twentieth century have witnessed quite a number of debates about developments in biotechnology. Controversies have been raised over issues as diverse as the acceptability of research on human stem cells, procedures to produce so-called designer babies and the safety and desirability of genetically modified crops and their use in food products. Even though controversies about similar issues have arisen in different countries, they have been remarkably different, and resulted in a variety of policy outcomes in each of these countries as well. In her book *Designs on Nature. Science and Democracy in Europe and the United States* Sheila Jasanoff, professor of Science and Technology Studies (STS) at Harvard University and long-standing expert on the relation between science and policy, delves into the question why these differences occur. Her specific interest in this book is how science and democracy relate and how this relation can produce such different outcomes in each of the countries she studies. She claims that a revaluation of the concept of "political culture" can help her in this respect.

Her analysis spreads across two comparative axes. First, it contains a comparison between three countries that are sufficiently similar yet different. These are three industrialized western democracies, each with their own specific characteristics; the U.S., Britain and Germany (discussing the role of the European Union as well). Second, the comparison also covers most of the broad areas a topic such as 'biotechnology' covers. Biotechnology is politically interesting because both great promises and threats are perceived in it, both fighting for a place in the spotlight. Apart from that, biotechnology covers a vast amount of fields, both in terms of scientific disciplines and of political domains. Thus Jasanoff's chapters include case studies ranging from discussions and policies concerning GM food and assisted reproduction to patenting of biotechnological innovations and the rise of professional bioethics as a tool in policy making.

In order to track down the "political culture" in these debates, and to enable "a kind of story-telling that does justice to the ambiguity of […] experiences, and to their richness (p. 11)" Jasanoff is looking for, the approach chosen to compare the three countries is based on a conceptual language reflecting Jasanoff's background in STS. The aspects of the debates she thus specifically focuses on are they way in which issues are framed in order to present them as *political* issues (or not), the way boundaries are formed between what counts as science, politics or other domains, the discourses and reasoning presented by relevant institutions and the roles and identities of relevant actors. This approach allows the author to understand (the meaning of the term here is based on Max Weber's concept of *verstehen*) the differences between the approaches these countries take to biotechnological developments, without trying to explain them in reductionist terms referring to an essence of each of these countries.

For example, Jasanoff most clearly analyses the way biotechnology is framed in the first of the empirical chapters, showing how court cases in the U.S. used existing patent law and were mostly concerned with the products resulting from biotechnology, rather than the process from which these products resulted. In Britain, on the other hand, partially because of the BSE crisis attention was much more directed towards the process, and in Germany biotechnology was understood in terms of a program in which the state played a significant role. The BSE crisis again played a role in the debate on GM foods in the UK, yet this debate was also influenced by a statement of the Prince Charles asking ten important questions on GM food, which was followed by a broader involvement of the British public in a large debate named GM Nation. In the U.S. GM Foods were judged to be safe by scientists and allowed onto the market. Protests after problems with GM food occurred were framed in a similar way; safety, health and the good life based on the consumption of organic food. Germany, finally, had no public debate and GM food was controlled through both European and national rules and regulations. In the end, Jasanoff argues, the debates about GM food were not only about safe foods, but as well about the question whether citizens should have the right to intervene in technological development.

A third example of the elaborate case studies figuring in the book is the way these countries deal with developments in technologically assisted human reproduction and embryo research. In this field several new natural entities occurred and were accepted through different routes. In Britain a distinction was made between an embryo and what was called a pre-embryo, meaning an embryo in its first fourteen days of gestation. Until the fourteenth

day, it was argued, the cells would not yet have specific functions, and therefore up until that moment an embryo could be seen simply as a clod of matter. This solution was then given authority in a scientific, political and religious sense by invoking support from authoritative figures in the House of Lords who spoke out in favour of the embryology act based on the idea of a pre-embryo. Likewise, the debate in Germany resulted in a ban on embryo research, with an important role for another entity, the supernumerary embryo. These would be embryos that were left after IVF, which were considered to need protection from ending up in a grey zone where protection of human life could be under pressure. In the U.S. there is no federal legislation on assisted reproduction and disputes concerning it were thus regulated through court decisions. Social considerations could be presented as natural ones, as can be seen in the *Johnson v. Calvert* case. In this case two couples claimed parenthood over a child. One of the couples were the genetic parents of the child, whereas the woman of the other couple was a surrogate mother, thus carrying the child to term. In the end the judges decided that one couple's wish to have a child of their own genes presented their urge to procreate, and therefore they were the 'natural' parents. Another aspect of this case, however, Jasanoff points out, is that this outcome does not only define what is natural motherhood, but aligns this with the fact that genetic parents tend to be higher on the social ladder than surrogate mothers. What is seen as natural is thus linked to socio-economic status.

In the debates on assisted reproduction there are four main actors (the state, science, women and the unborn child), but non of them are considered to be equally important in each of these countries. In Britain, science, the unborn and the state influence the debate, which is explicitly not about women's rights. In Germany, the state, the unborn and women are included and the freedom of scientific enquiry is left out. In the U.S. the debate was mainly between women and the state, with pro-life activist groups trying to include the rights of the unborn. Jasanoff elaborates these four 'corners' in three figures (p. 169, partially these are based on debates about abortion included in the same chapter). These, then, are representations of how political culture works, how preceding debates, the role of actors in these debates, their discourses and framing all influence current debates about biotechnology, and the role of science in these debates. This role of science in public debates, which is Jasanoff's main theoretical interest, should therefore not be analysed in terms of traditional ideas about the public understanding of science, focusing on how much 'good' science the public knows. Rather, science's role in public debates is very much shaped and pushed in a

certain direction through what Jasanoff calls *civic epistemologies*. These are a conceptual tool pointing out that scientific knowledge and the way it is presented will have to adhere to its social context; civic epistemology is a "public way of knowing". Science in public debates thus is just as much a social affair as the other aspects of such a debate.

This claim is an important one in understanding the role of science in present day policy-making. If science is understood in this way it cannot be the panacea for public controversies it is sometimes considered to be. Scientific claims are claims like any others, heavily depending on their ability to perform a credible role in the specific staging of a debate. But the idea of civic epistemology does not only provide a better understanding of science's role in public debates, when understood in a broader sense it can have great value for comparative studies as well. The concept of civic epistemology describes how culture, when not understood in static terms, is more than just context. Different elements of a culture interact in a given situation, and shape – yet never determine – the outcomes of a debate. The concept provides a useful alternative for comparisons based on certain markers, or in terms of styles, regimes or pathways through its ability to account for how a culture can influence new developments, without losing sights of some of its contrastive ironies. Especially the attention for these ironies makes *Designs on Nature* an entertaining just as much as an informative read.