

# Social Studies of Science

<http://sss.sagepub.com>

---

## **The 'Book of Life' in the Press: Comparing German and Irish Media Discourse on Human Genome Research**

Patrick O'Mahony and Mike Steffen Schäfer

*Social Studies of Science* 2005; 35; 99

DOI: 10.1177/0306312705046542

The online version of this article can be found at:  
<http://sss.sagepub.com/cgi/content/abstract/35/1/99>

---

Published by:

 SAGE Publications

<http://www.sagepublications.com>

**Additional services and information for *Social Studies of Science* can be found at:**

**Email Alerts:** <http://sss.sagepub.com/cgi/alerts>

**Subscriptions:** <http://sss.sagepub.com/subscriptions>

**Reprints:** <http://www.sagepub.com/journalsReprints.nav>

**Permissions:** <http://www.sagepub.com/journalsPermissions.nav>

**Citations** (this article cites 19 articles hosted on the SAGE Journals Online and HighWire Press platforms):

<http://sss.sagepub.com/cgi/content/refs/35/1/99>

**ABSTRACT** The essay compares German and Irish media coverage of human genome research in the year 2000, using qualitative and quantitative frame analysis of a print media corpus. Drawing from a media-theoretical account of science communication, the study examines four analytic dimensions: (1) the influence of global and national sources of discourse; (2) the nature of elaboration on important themes; (3) the extent of societal participation in discourse production; (4) the cultural conditions in which the discourse resonates. The analysis shows that a global discursive package, emphasizing claims of scientific achievement and medical progress, dominates media coverage in both countries. However, German coverage is more extensive and elaborate, and includes a wider range of participants. Irish coverage more often incorporates the global package without further elaboration. These findings indicate that the global package is 'localized' differently due to national patterns of interests, German participation in human genome research, traditions of media coverage, and the domestic resonance of the issue.

**Keywords** biotechnology, discourse analysis, frame analysis, globalization, human genome, mass media, science journalism

## The 'Book of Life' in the Press: Comparing German and Irish Media Discourse on Human Genome Research

*Patrick O'Mahony and Mike Steffen Schäfer*

This essay explores how human genome research (HGR), which had the goal of developing a complete sequence of human DNA, was represented in the German and Irish mass media. The sequencing of the genome was mainly conducted by two organizations: the international Human Genome Project (HGP)<sup>1</sup> and the private company Celera Genomics. Their initially competing efforts culminated in a co-operative, joint presentation of a 'working draft' human genome sequence on 26 June 2000. The completion of the working draft has been hailed as the scientific event of the decade (Pennisi, 2000: 2220) and has been widely claimed to have radical implications for human embodiment and the human condition generally.

The genetic manipulation of elementary life forms plays a central role in the public image of contemporary science. More than many other current scientific fields, genomics inspires both enthusiasm and concern. While areas of the biosciences such as HGR appear to have enormous capacity to transform human and natural life, many advances currently

*Social Studies of Science* 35/1 (February 2005) 99–130

© SSS and SAGE Publications (London, Thousand Oaks CA, New Delhi)

ISSN 0306-3127 DOI: 10.1177/0306312705046542

[www.sagepublications.com](http://www.sagepublications.com)

lack ethical assent and commercial viability. As illustrated by the case of genetically modified (GM) plants, the societal diffusion of GM products and processes often faces unanticipated obstacles from recalcitrant and critical public opinion (O'Mahony & O'Sullivan, 2004). The negative climate of opinion towards some, though not all (Eurobarometer, 2002), biological innovations complicates the perception that science can proceed with substantial autonomy from wider society. It is proving difficult in many fields to argue for the unimpeded freedom of scientific inquiry, because research outcomes, often aimed at relatively rapid commercial innovation, have potentially profound social and natural implications. In the face of these implications – whether actual, potential or perceived – broader moral and regulatory concerns generate questions about acceptable limits to scientific progress. Areas such as human and animal cloning, GM plants, and many medical applications have natural, ethical and social implications that require more than after-the-fact deliberation (Reiss & Straughan, 1996; Pellizzoni, 1999; Nowotny et al., 2001). Such implications, in turn, motivate non-scientists to become involved at an earlier point in efforts to shape the trajectory of scientific innovation.

The increasing need to legitimate science in the context of enhanced public awareness of its implications has made communication about science more central. Public disquiet and activism have led to increased scepticism of the dominant model of public communication about science, which stresses public understanding of scientific advances rather than critical scrutiny (Dierkes & von Grote, 2000). The mass media have emerged as a crucial arena for science communication. On the one hand, scientists, research corporations and public sponsors of research seek to use the media as a tool of public persuasion, emphasizing wide-ranging benefits, negligible risk and thorough monitoring and assessment regimes (Dreyer, 1999). On the other hand, critics and activists seeking to stir controversy depend on the media to mobilize public pressure on governments and corporations (Nelkin, 1992).

The greater centrality of science as a public and media issue invites increased social scientific attention. This essay takes up the challenge, first by drawing on media theory to develop a strategy for analysing media content. Second, it addresses the implications of enhanced global media coverage of science in two national contexts, Germany and Ireland.<sup>2</sup>

Media communication addresses the *mass public sphere* and hence it must use abstract cultural codes that are understandable to a large and diverse audience. These cultural codes can be called 'frames': generalized standpoints, contents and styles, which provide the raw materials of mediated communication. This essay deploys frame analysis to reconstruct these codes. The codes mediate the production and reception of messages. This relationship is stabilized by the fact that media producers anticipate the reception of particular messages by distinct publics. Producers and their audiences achieve resonant communication by means of these shared cultural codes. This essay explores how a variety of journalistic, political,

scientific, economic and other societal actors use generalized cultural codes in building the media agenda, and it further explores the conditions under which this agenda resonates in the cultural contexts of Germany and Ireland.

The way the mass media operate with abstract cultural codes cannot be seen as a homogeneous entity exerting a linear 'effect' on its readership. Such views characterized early mass media communication models and also early 'Public Understanding of Science' communication models, which conceived communication as the linear process of transferring information from a sender to one or several receivers (see Maletzke, 1963; Gregory & Miller, 1998). It was assumed that the 'same' information passed unchanged between sender and receiver through a neutral media channel. These early models have been radically revised. First, critical scrutiny was directed at the genesis of media agendas, and the associated idea that the media are an independent force with substantial autonomy in setting such agendas. Agenda-building studies showed how societal actors battle for representation in media coverage and actively try to build the media agenda (Cobb & Elder, 1976; Protess et al., 1992). Second, the image of the media as a neutral information channel was challenged, and mass media characteristics were identified that result in the manipulation of information. Studies on news value theory (for example, Galtung & Ruge, 1965), inter-media agenda setting (Noelle-Neumann & Mathes, 1987) and instrumental actualization (Kepplinger, 1989) stressed that journalists' and mass media procedures change information substantially, according to structural, ideological, financial, technological and other needs and assumed readership preferences. Mass media communication was now understood as co-constructed between journalists and other discourse producers. Third, the idea of passive recipients taking up media information in a uniform and non-reflective way was abandoned. Studies of media effects highlighted the different ways that people engaged with media messages and negotiated media content in social contexts (McQuail, 1984; Schenk, 2002).

Current communication models of the media suggest that the construction of an issue is open to multiple influences which form specific 'issue cultures': public beliefs, issue cycles, journalists' and media orientations, the interests and resources of societal actors, wider processes of inter-media and inter-textual knowledge production. An important issue culture has formed around bioscientific advances, raising questions about what it means to be human and how humanity relates to its environment. Government institutions, media organizations and publics divide in their opinions of controversial innovations such as stem cell research, plant genetics and cloning. The governance vacuum and general climate of uncertainty surrounding the biosciences, together with the fact that public communication is frequently adversarial, suit media routines and have correspondingly made media coverage of these issues highly salient. The media step in as a vital part of the general process of societal deliberation.

The media are also pivotal in orienting public opinion towards the far-reaching global implications of advances in the biosciences. The globally networked media system parallels the corresponding globalization of science and business. Various studies have drawn attention to the accelerating globalization of science over the course of a century (Stichweh, 1999; Drory, 2003). Drory argues that science's cultural authority more than its instrumental efficacy propelled it to a global status. One of the interests of the current paper is the manner in which a global construct of HGR sought to re-enforce the cultural authority of a relatively new scientific field, a point also noted by others (see Nerlich et al., 2002). While it can be argued that over the relatively long haul of the last century the 'scientification' of all social spheres has proceeded apace (Stehr, 1994), the very success of science – and technology – in shaping social life is partly responsible for a mounting critique of its social, cultural and environmental implications (Ezrahi, 1990). It results in a proliferation of science-critical themes and discourse-producing associations capable of amplifying them. This critique of science has taken on a more global aspect in the last decade, as it merges with the general critique of globalization.

The globalization of the media has major implications for comparative research, both for its overall relevance and also for its research strategies. Gurevitch & Blumler (1990) claim that the flow of political messages has been 'dramatically' globalized and call for the prioritization of *comparative* communication research. Accordingly, since no country can any longer be regarded as a detached island, 'national communication systems may have to be examined partly as sub-systems of an emergent global one' (Blumler et al., 1992: 12). Furthermore, a renewed interest of the humanities and social sciences in culture as a creative and dynamic force has given impetus to comparative communications research. Lamont & Thévenot (2000: 9) call for a comparative cultural sociology to contextualize the dominant, structurally oriented comparative sociology on macro-economic, political and institutional differences. They wish to direct attention to national cultural repertoires that are intrinsic to a multiplicity of social practices. In general, comparative cultural sociology has emphasized how apparent sameness in national institutional structures is belied by pronounced differences at a cultural level, thereby shifting the emphasis of comparative research from, in the catchphrase, difference-in-sameness to sameness-in-difference.

The shift from comparing institutional structures and systems to comparing cultural repertoires has significant methodological and empirical implications. While this sub-field is gathering momentum, there is not much existing research from which to draw, nor are there stable approaches to various research interests. However, these absences actually serve as an argument for more comparative research that should move in tandem with wider developments in sociology and related disciplines. The emphasis on culture as a dynamic force also entails the need for a more creative conception of agency as not normatively foreclosed, but open to the influence of situated, practical reason, and hence itself both more

situated and varied as explored in recent sociology of science and technology. The emphasis on the cultural mediation of the relationship of structure and agency has led to a re-evaluation of the scope and variety of various kinds of collective and individual agency (Joas, 1996; Delanty & O'Mahony, 2002). The comparative study of constellations of culture and agency has strongly emerged in areas such as social movement research and research into the various relationships between beliefs, discourses and practices.

These orientations inspire the comparative research reported here. A primary motivation of the paper is the task of establishing connections between global media constructs and national contexts, emphasizing the elaboration of specific themes in 'local' acts of discourse production and the extent to which national cultural conditions of resonance affect such production. A second important motivation is to consider the extent and nature of societal participation in such local discourse production across establishment and civil society, affirmative and critical positions on HGR. One of the premises of comparative cultural research of the kind proposed here is the difficulty of specifying a priori a comprehensive rationale for conducting the comparison – since the comparative cultural approach is justified more by what emerges as a result of the analysis of the variable, dynamic and perspective-laden nature of cultural practices and evaluations than by the stable structures of more hypothesis-driven investigations.

The selection of the German and the Irish case for this essay was motivated, aside from pragmatic considerations of prior knowledge and data access, by the presence of institutional and long-established cultural differences. Generally, both countries provide different 'discursive opportunity structures' (Ferree et al., 2002) on HGR: different social and cultural conditions that affect the likelihood and resonance of specific communicative acts. Germany can be assumed to offer favourable conditions for extensive communication about HGR. The country includes many actors participating or potentially utilizing its results. Three German research institutions are involved in the international HGP and supported by domestic politicians. Moreover, it is a large country highly influenced by the enlightenment, but no less by enlightenment scepticism, contained within its religious, philosophical and sociological heritage and by left-wing critique of capitalism. Further, the collective memory of the eugenics programme of the Nazis is an important backdrop, increasing the salience of communication on human genetics. There are two religious denominations, Catholic and Protestant, which prevented the dominance of one confessional worldview and morality, a dominance that can inhibit communication on genetic issues. Germany has a well-developed public sphere and a mass media system with strong and ideologically diverse mass media. Its constitutional framework and political culture have also been amenable to some degree of innovation in citizen participation.

In contrast, Ireland does not provide particularly receptive discursive opportunity structures for the HGR issue. Crucially, no Irish research

institutes directly participate in HGR. It is a small country whose transition from predominantly rural to urban social forms has occurred late in the European context, resulting in a reduced status for science and formal knowledge in the national culture. In addition, the impact of the Enlightenment was minimized by a strong nationalist romanticism and the dominant Catholic confessional allegiance (see O'Mahony & Delanty, 1998). While it might be anticipated that sceptical views towards science, which have some historical provenance in Catholic and nationalist anti-modernism and anti-industrialism, might increase communication, this only works for issues such as stem cell research that fall within the Catholic moral compass. However, the last decade has seen the gradual emergence of a more influential role for science in the national economy, a development that has been accompanied by increasing public interest in science. Notwithstanding, this development is too recent to radically increase the relatively low level of public communication on national and international scientific issues. The Irish mass media system is well developed, though somewhat smaller than in Germany and ideologically more concentrated in the political centre and right. There have been opportunities for citizen participation on controversial scientific issues in the past, but on the whole these have had little influence on institutional practices.

Within this comparative framework, the essay outlines the analytic approach in the next section, drawing off the basic categories of frame analysis and the analysis of discourse coalitions. Then, the outcomes of the research are presented along the dimensions of: first, the structural characteristics of HGR discourse; second, the range of participants and their characteristic messages; and, third, the cultural conditions affecting the resonance of such messages. The resonance conditions that shape specific patterns of domestic coverage will be analyzed. In the concluding section, the essay's guiding questions are revisited.

## **The Frame Analysis of Public Discourse**

Theoretically informed methodological approaches to research on public discourse are manifold, ranging from linguistic to historical, structural, political and sociological approaches (for an overview, see van Dijk, 1997). Some of these approaches use intensive linguistic methods on small corpora, whereas others work on large corpora using quantitative content analysis. The former approaches are limited in generalizability while relying on rich contextual information; the latter are powerful in generalizability by abstracting from textual and communicative details. The methodological bridging of these two traditions is urgently required. In the last decade, frame analysis has made some promising beginnings, occupying a space that in its qualitative orientation has affinities with discourse analysis and yet offers an approach also amenable to quantitative or qualitative content analysis. The frame tradition, used extensively in social movement analysis (for example, Gamson, 1992; Benford & Snow, 2000), has only

seldom been methodologically extended to integrate quantitative approaches to its predominant qualitative orientation (for exceptions, see Gerhards et al., 1998; Ferree et al., 2002; Kohring & Matthes, 2002). The approach employed later uses a qualitative coding process and then quantifies the results of this operation.

The corpus includes German and Irish HGR coverage during the year 2000, the year the first draft of the human genome sequence was presented. The largest-selling national broadsheets were selected for analysis: the German *Süddeutsche Zeitung*, *Frankfurter Allgemeine*, and *Die Welt*, and the *Irish Independent*, *Irish Times*, *Irish Examiner*, and the *Sunday Business Post*. These broadsheets were selected for a number of reasons. First, they reach a large readership (Audit Bureau of Circulations, 2000; Informationsgemeinschaft zur Verbreitung von Werbeträgern, 2000). Second, they also reach a highly significant readership, being read by journalists of other media, influencing other publications' coverage, and reaching political, economic and other societal elites more than other newspapers (Herzog et al., 1990; Wittkämper et al., 1992). Third, broadsheets were chosen for pragmatic reasons. They have extensive archives and are predominantly textual resources. Other, more visually oriented media forms, such as tabloids or television news, would be more difficult to analyse.

The sample was constituted through keyword search in the papers' electronic archives, and includes 444 German and Irish newspaper articles in which almost 900 actors issued some 2,000 statements.<sup>4</sup> This corpus was systematically coded in two steps. In the first qualitative–interpretative step, the basic building blocks of the entire analysis were constructed. Clearly identifiable statements about aspects of HGR were selected, interpreted and clustered into groups with similar content. These clusters were then aggregated into the higher-level cultural categories of 'frames', understood as basic types of discourse such as economic, regulatory and others. The aggregated clusters were then again crosschecked with the original material to ensure accuracy. This process inductively generated a map of discourse content that provided a matrix for the second coding step, a quantitative–statistical content analysis of media discourse. In this second step, the following four dimensions of coverage were analysed, addressing important aspects of content and participation.

1. *The dimension of discourse structures.* This includes time, place and reason for publication, that is, information about the quantitative patterns of coverage over time.
2. *The dimension of discourse producers.* This is examined by using the concept of 'standing' (Gerhards et al., 1998; Ferree et al., 2002), which refers to public recognition, hegemonic interpretations and general influence on given topics. Discourse producers acquire standing when cited directly or indirectly in the mass media. Of course, the media also has its own voice, and journalists themselves are discourse producers who can acquire standing. Only a few of the wide range of potential discourse producers are able to translate their efforts into

significant media representation. Journalists act as ‘gatekeepers’, who select the actors to whom they give standing. Representation in the mass media validates an actor’s public status (Gamson & Wolfsfeld, 1993). Standing therefore can be interpreted as a measure of discursive success.

3. *The dimension of discourse content.* This is understood through the prism of ‘framing’ (Gerhards et al., 1998; Ferree et al., 2002). Actors communicate their distinctive ideas through the media. They aim to embed their viewpoints in public consciousness, to influence decision-making elites and various publics (Snow et al., 1986; Gamson, 1992; Donati, 1996). Constraints on relevance restrict the range of possible content. Mass media depend on reaching wide constituencies, which accordingly constrains their freedom to pursue esoteric issues or idiosyncratic framing strategies. Public debate is necessarily limited by criteria of relevance, which do not include many otherwise meaningful public arguments. Frames reduce variation in the coverage. The concept of frame has become prominent in discourse analysis, drawing originally from Goffman (1986) and further developed by Gamson and others (Gamson, 1992; Benford & Snow, 2000). Frames refer to stable patterns of experience and perception, which structure social reality (Eder, 1996) and are central organizing ideas for understanding events (Gamson & Lasch, 1983). Our qualitative analysis inductively reconstructs frames that, we assume, have latent communicative functions for orienting media communications about HGR.
4. *The dimension of ‘discourse coalitions’.* This dimension refers to typical discursive syndromes that combine actors and arguments (Hajer, 1995; O’Mahony & Skillington, 1999). Discourse coalitions are culturally structured networks of communication. The identification of discourse coalitions reveals patterns of *discourse structuration* and may also reveal processes of *social structuration*, depending on whether a social logic characterizes the interlocking roles of communicating actors. Discourse coalitions demonstrate the symbolic power of ideation, whether made up of short-term alliances or enduring ideological structures. Gottweis (1998) emphasizes the need to move beyond a dichotomous actor–structure perspective, and points to narratives and discourses in the larger semiotic order of a society. This suggests a fluid conception of change and stability in discursive orders, especially in innovative, volatile contexts and at the margins of disputed issues where ‘idea bargaining’ is most intense. It is here that the social logic is most amenable to being re-shaped by communicative processes. In our analytic reconstruction of discourse coalitions, the individual actor remains the elemental unit, but is aggregated into a collective standpoint, a coalition. Coalition formation may transcend pre-established *social* positions: not all actors of a given social category (for example, scientists or politicians) hold similar *argumentative* positions. Rather, statements by specific discourse producers, when clustered with other similar statements by other actors, exhibit relatively stable structures.

Such argumentation positions may be homogeneous within similar institutions and actor groups, but they also may cut across institutional cultures and milieus. The concept of discourse coalitions is operationalized through statistically identifying clusters of actors using similar arguments in the national newspapers analysed.

In the following section, the four analytical dimensions guide our comparative analysis of German and Irish discourse. In a later section we explore the cultural resonance of specific themes, which provide insight into German and Irish discourse on HGR.

## German and Irish Media Discourse on Human Genome Research

### *Discourse Structures*

The most striking structural feature of the German–Irish comparison is an enormous difference in quantity of HGR coverage. German discourse is extensive: a total of 395 articles, on average more than one article per day, were published in the three German newspapers in 2000. The HGR issue entered mass media discourse and ignited one of Germany's largest biotechnology debates to date. The increase in coverage was significant when compared with the early 1990s (see Ruhrmann et al., 1992). In Germany, HGR no longer is an issue 'in waiting' (Kitzinger & Reilly, 1997). A very different picture emerges in Ireland: in four national quality newspapers, 49 relevant articles were found, less than one article per week. Such discrepant coverage might be expected, given Germany's participation and Ireland's non-participation in HGR, and differences in the sizes of national readership. However, Irish coverage is small, even for a non-participating, smaller country.<sup>5</sup>

A further difference between the two national media shows up in the way they responded to HGR, as measured by two criteria: which events were covered, and how long a debate lasted after its initial introduction. German HGR coverage was initiated by various events, mainly arising within the scientific arena, and the coverage persisted for a relatively long time. Most media coverage was triggered by Celera Genomics' announcement on 6 April 2000 that the company had sequenced one person's genome and would soon present the final human genome sequence based on five people's DNA (Celera, 2000). German media covered the announcement immediately and extensively. Within 2 days, 41 articles were published, and another 40 articles appeared in the following week. Although coverage decreased over time, Celera's announcement was discussed in German media for about 10 days. The second important event was the joint presentation of the 'working draft' genome sequence on 26 June by the international HGP and Celera (see *Science*, 2000b: 2294). The German newspapers published 35 articles in the first 2 days after the event, and another 35 articles in the following 3 weeks, representing another long and intensive debate. Several other developments also received coverage:

Bill Clinton's and Tony Blair's appeal, mainly directed towards Celera, to publish the human genome freely (on 15 March 2000; see *Science*, 2000a: 1903); the publication of the *Drosophila* genome (on 24 March 2000; see *Science*, 2000c: 2181); the publication of human chromosome 21 by German and other HGP scientists (on 8 May, see *Nature*, 2000: 311); and Craig Venter's visit to Germany in October 2000.

In contrast to the intensive coverage in the German papers, Irish coverage mainly focused on one event. More than half of the entire Irish coverage was triggered by the presentation of the human genome sequence on 26 June 2000. Within 2 days, the four Irish newspapers published eight articles on the topic, and another seven in the following week. The event remained a media topic in the first half of July, with ten more articles referring to it. Only one other development received coverage, and this was much less extensive than in Germany: three articles in the Irish papers covered the joint statement by Clinton and Blair on 15 March 2000.

A structural explanation for the enormous German–Irish differences may be found in the interplay of global discursive input and national contextualization. Media discourse on HGR is symptomatic of the rise of global scientific networks and the global integration of science, together with international economic interest in new innovation paradigms. Distinct global actor-networks can be identified that seek to interest both national and global audiences. These networks include HGP scientists from six participating countries and their supporting politicians, such as Clinton and Blair, along with Celera Genomics' representatives. Participants in these networks have sought to introduce arguments and framings into HGR discourse, using professionalized media strategies and large resources (see Nerlich et al., 2002). The media respond in relation to their selection routines and the news value that they associate with HGR events. In other words, actors with global interests cooperate and compete, providing a global interpretation package on a given topic. If this package is perceived as relevant by national mass media, it can be transmitted to national audiences, a process further eased by the recent expansion of global media networks that develop and amplify global themes. In the HGR case, global efforts of powerful actors such as the HGP network, combined with the perceived significance of the HGR topic for humanity as a whole, guaranteed a certain amount of global media coverage. But global input is not a sufficient explanation for differing German or Irish discourse patterns. Rather, an explanation must be sought in the manner in which the global package was localized in the two countries. In contrast to the hypothetical standard of an evenly diffused global package, shifts may emerge on a local level, involving a different range of participating actors. Frames advanced at the global level may or may not be emphasized, and new perspectives may be added. The nature and scale of coverage therefore depend upon global inputs as well as upon national factors, including the output capacity of domestic discourse producers, traditions

of science and risk coverage, existing cultural interpretation systems and the penetration of the issue across a range of communication arenas.

This interplay between global and national factors goes some way toward explaining the very large differences in the size and responsiveness of German and Irish media coverage. The extensive German coverage represents a case in which the global package was taken up and contextualized. The higher degree of responsiveness in Germany can be viewed as a product of national resonance with the global package. In contrast, Ireland is a case in which the global package was introduced into the national discourse but lacked extensive national resonance. Consequently, Irish discourse was relatively restricted.

*'Standing': Discourse Producers*

'Standing' underlines the quantitative difference between German and Irish newspaper coverage. While approximately 800 actors – producers of media statements on HGR, whether journalists or others – participate in Germany, only about 100 do so in Ireland. In Germany, two-thirds of these participants are domestic actors, while in Ireland domestic and non-domestic international actors are almost equally represented (Table 1).

In both countries, many different actors generate discourse. Nevertheless, dividing these actors into different groups shows significant variations. In Germany, scientists constitute the largest group of discourse producers (41%). Human genome researchers in particular, that is, members of the HGP and Celera, make up 16% of all discourse producers. Secondary scientific experts such as other bioscientists, and medical or natural scientists, participate equally strongly. In contrast, social scientists, philosophers and other scientists are weakly represented. With journalists representing another one-third of all actors, German newspapers show a

**TABLE 1**  
'Standing': discourse producers

	Germany (N = 795)			Ireland (N = 93)		
	Domestic	Non-domestic	Total	Domestic	Non-domestic	Total
Scientists	16	25	41	1	24	25
Journalists	31	1	32	43	4	47
Economists	8	5	13	5	4	9
Politicians	4	4	8	0	13	13
Civil society	4	0	4	4	0	4
Law actors	1	0	1	0	0	0
Total	64	35	99	53	45	98
Total without journalists	33	34	67	10	41	51

*Note:* Identifiable individuals, organizations or institutions were coded as discourse participants if they made statements on human genome research in media coverage. The values given indicate percentages of the total number of discourse participants per country.

heavy reliance on scientists and journalists that other studies also demonstrate (Kepplinger et al., 1991; Hampel & Renn, 1998; Görke et al., 2000). Such reliance is also found in Ireland, but with the relative proportions of journalists and scientists reversed. Journalists make up almost half of the Irish discourse producers. The second biggest group, but clearly outnumbered by the journalists, is made up of scientists, mainly HGP scientists and secondary experts and only few actors from Celera Genomics. In addition to journalists and scientists, other institutionally established actors dominate both countries' coverage: representatives of the economy, such as corporate spokespersons, and political leaders, such as Tony Blair and Bill Clinton. By contrast, spokespersons for civil society, such as representatives of non-governmental organizations, churches, artists, or citizens, are only marginal participants.

Another interesting feature of German and Irish discourses becomes obvious when comparing domestic with non-domestic discourse production. The German 'standing' pattern is clearly more localized, with domestic actors playing a stronger role than in Ireland, undoubtedly reflecting the different levels of national participation in HGR. While in German coverage, national figures account for almost two-thirds (64%) of all actors, national discourse producers make up 53% of Irish coverage. Moreover, unlike the German coverage, the Irish domestic actors are almost all journalists. When journalists are excluded from consideration, Germany presents a balance between domestic and non-domestic actors, while in Ireland the overwhelming proportion is non-domestic.

#### *'Framing': Discourse Content*

After identifying the structure of participation in German and Irish HGR discourses, we now turn to the content of the discourse. Content analysis showed that six frames were recurrently used in both countries (Table 2).

There is striking consistency between the two countries in the coverage accorded to the six frames. The 'progress' frame dominates, presenting HGR as a historical–scientific achievement and referring to its potential for bringing about medical progress. The 'economy' frame is second, dealing with economic implications of HGR, questions of profit, stocks and competition. These two frames, mainly used by actors in favour of HGR, account for more than half of all statements. The other four frames compose the complementary half of the statements: 'transgression', framing HGR as an artificial manipulation of nature, and invoking the conceptual divide between genetic and social explanations of human behaviour; '(in)equality', highlighting common roots of ethnic groups, humanity, or all life-forms, and warning against genetic inequality and discrimination; 'property', addressing questions of ownership of supra-individual and individual genetic information; 'regulation', dealing with political, legal or civil societal controls over science. However, while German and Irish discourses are similar in their uses of frames, such

consistency may mask national differences in the detailed presentation and reception of frames. This possibility is explored later.

From the figures given earlier, it should be apparent that HGR discourse has controversial dimensions in both national discourses. In Germany and in Ireland, HGR is not treated as a purely scientific topic, but is subjected to philosophical, economic, political, legal and other arguments. To clarify how frames are organized into collective standpoints, we now turn to the elaboration of discourse coalitions.

### *Discourse Coalitions*

In order to reconstruct discourse coalitions in German and Irish HGR coverage, we statistically identified typical discursive actor clusters and combined them with their characteristic frames. We distinguished four German and three Irish discourse coalitions. The German coalitions form

**TABLE 2**  
'Framing': discourse content

Germany	Frame	Ireland
35	'Progress': representing HGR: (1) as historical–scientific progress, employing metaphorical and hyperbolic language such as 'wonder', 'revolution' and so on; or (2) as influencing medical progress, affecting pharmaceuticals, diagnosis, therapy and long-term effects	37
22	'Economy': dealing with: (1) economic implications of HGR, its potential to generate profit, new firms, stock-market gains, or new jobs; and (2) ideas of international economic or scientific-economic (often specifically of HGP versus Celera) competition	19
11	'Transgression': discussing: (1) HGR as an artificial approach to the natural world, perceiving nature as a transcendental principle that has to be preserved, sometimes religious, and touching on limits of research; and (2) the conceptual divide between genetic and social explanations of human behaviour, thereby negotiating the relative importance of social and natural sciences	10
6	'(In)equality': (1) envisaging the genome as an indicator for common roots of specific ethnic groups, humanity, or all life-forms; and (2) stressing the notion of genetic inequality and discrimination, either prenatal by selecting abnormal embryos, post-natal by schools, employers or insurances, or financial against people or countries unable to afford genetic measures	15
10	'Property': discussing: (1) the general possibility of owning genetic information and material; (2) ownership of supra-personal genetic information such as genes; and (3) ownership of personal genetic information about certain individuals	10
8	'Regulation': negotiating norms and regulation between society and science, putting forward positions on: (1) political or legal regulation; or (2) public participation	4

*Note:* The values given indicate percentages of the total number of statements per country. HGR, human genome research; HGP, Human Genome Project.

relatively distinct clusters, which we labelled 'economic rationality coalition', 'scientific progress coalition', 'counter-scientific coalition' and 'fundamental critique coalition'. Although they represent distinct clusters, all but the 'economic rationality coalition' are linked with each other, indicated by the fact that actors and arguments sometimes appear in the same articles. Three of these discourse coalitions also were found in Ireland, while the 'economic rationality coalition', addressing purely economic implications of HGR, was absent. Perhaps due to the small amount of national coverage, Irish coalitions are generally not as clear and distinct as their German equivalents. Furthermore, little connection between them is apparent; they appear to exist in separate worlds.

German and Irish discourse coalitions span a continuum between pro-HGR and anti-HGR standpoints. At one extreme is the 'economic rationality coalition', which appears only in Germany. It is the country's second biggest coalition, mainly constituted by business and industry actors as well as by some journalists. Its trademark is to weigh research costs against economic benefits within the 'economy' frame, typically combined with a generally positive interpretation of HGR. This coalition often refers to HGR-based profit-creation as a result of the stock market implications for pharmaceutical companies. In addition, it refers to the capability of HGR to create jobs and new firms, thereby strengthening the international competitiveness of the national economy. Ideas of economic competition such as the 'race' between the publicly funded HGP and privately funded Celera Genomics are also of concern. Moreover, the 'economic rationality coalition', using the 'progress' frame, depicts HGR as a historical and scientific achievement with positive medical implications. In contrast, the coalition ignores critical arguments associated with the '(in)equality' frame and ideas of genetic discrimination. It does not refer to the possibility that HGR illegitimately transgresses boundaries within the 'transgression' frame, nor does it consider regulatory issues. Instead, it tends to treat profit as intrinsically positive and does not examine possible tensions between profit and societal risk. This coalition is thematically isolated in Germany, as it is the only discourse coalition systematically using the 'economy' frame, and it avoids many frames that are typically used by other coalitions. In Ireland, however, though the 'economy' frame is used, no such discourse coalition can be identified. Instead, the 'economy' frame pervades the discourse of different actor groups, although there is little or no *autonomous* economic coalition in the sense described earlier for Germany.

The second coalition, the 'scientific progress coalition', is the most common discourse coalition in both countries. Since it typically incorporates an international set of actors involved in HGR, such as members of the HGP, politicians from different countries who provide financial and infrastructural resources for the HGP, and members of Celera, it embodies the archetypal global HGR package. Accordingly, the frames used by this coalition are especially pervasive.

All actors in the 'scientific progress coalition' approve of HGR, and express such approval through the two variants of the 'progress' frame. First, they view sequencing the human genome as a scientific and historical achievement, praise it enthusiastically as 'revolution', 'wonder' or 'milestone' and hail it as being as important as the moon landing or the invention of the wheel. The most prominent analogies for the genome itself are a 'map' and the 'book of life' (cf. Hedgecoe, 1999); other, more technical analogies include 'blueprint', 'instruction for life' or 'tool kit'. The sequence is seen as a benefit to humanity – the use of the unifying pronoun 'we' is noticeable (Torrönen, 2001) – and, according to James Watson as one of the HGP's prominent proponents, a 'child of biology, of science, of mankind'. Second, the coalition perceives the sequencing as a basis for further medical progress. In pharmaceuticals, new drugs are expected, 'tailor-made' for the patient's genotype and therefore highly effective. In diagnostics, genetic testing and genetic screening instruments are anticipated, enabling medicine to identify individual risk factors and helping to minimize them. In relation to therapeutic benefits, the coalition's scientists identify prospects for effective treatment or even 'eradication' of certain diseases, particularly cancer. Scientists invoke eventual long-term benefits, such as increased life expectancy, whereas politicians favour the idea of improving public health. While using the 'progress' frame, this coalition rejects the 'transgression' frame, which draws attention to potential limits on research. Such rejection is the logical outcome of the coalition's support for HGR and its implicit advocacy of research freedom. In some articles, this is underlined by actors stating that scientific progress enables humankind to 'improve nature' or 'improve evolution', a standpoint that implicitly carries with it the idea of a moral imperative to improve the human condition.

Common elements of the 'scientific progress coalition' are accompanied by an internal dichotomy, equally visible in German and Irish discourse. This dichotomy is given polarized form in a conflict with the HGP and its supporting politicians on one side and Celera Genomics on the other, representing publicly and privately funded research. Notwithstanding basic agreements on the benefits of the respective research programmes, HGP supporters characterize Celera as purely profit-oriented, the company's commercial projects as dangerous, and their methods as unreliable. In contrast, Celera sometimes pictures the HGP as bureaucratic, slow, and conservative in their scientific approach. Accordingly, HGP members and politicians stress the need to regulate HGR through the 'regulation' frame, intending to diminish Celera's status and opportunity.

The first sign of these intra-coalitional differences are debates about the ownership of genetic information in the 'property' frame. When the ownership of supra-personal genetic information, such as the human genome sequence, is at stake, HGP members and politicians emphasize that this information should be public property – being part of the 'heritage of humanity' – and therefore freely published. In contrast, proponents of

Celera Genomics stress the need for companies to secure their research results via patenting in order to recoup investment. When personal genetic information is debated, the question is whether research and insurance companies should be allowed to own and use genetic information about individuals. HGP scientists and politicians state that individuals should exclusively own their genetic information according to the precepts of informational self-determination (*'Informationelle Selbstbestimmung'*), while Celera Genomics seeks to legitimate commercial ownership of such information. Another internal difference within this coalition, occurring only in German discourse, concerns the importance of HGR. Participants in the project themselves sometimes relativize the importance of the genome sequence and thereby diminish Celera's achievement, even at the cost of diminishing their own accomplishments. They depict the genome sequence as purely descriptive and stress that the fundamental task of identifying gene functions has yet to be done. Moreover, they raised doubts about the quality of Celera's work, whose 'shotgun' method of splitting the entire genome, sequencing the parts and reassembling them later, was compared to a 'puzzle' or 'jigsaw', suggesting an unsystematic, long, tedious, and possibly useless search. A third internal difference is that the HGP and its supporting politicians emphasize the need to steer HGR, and thereby Celera Genomics, using the 'regulation' frame. At the same time, they stress the international and semi-official, and thereby more legitimate, nature of the HGP.

Essentially, the HGP's position within these intra-coalition debates is ambivalent. It does not wish to discredit HGR as such, while at the same time drawing attention to negative aspects of Celera's research. Celera Genomics' counter-strategy is to emphasize positive outcomes of its own research and of HGR generally. It is the strongest advocate of medical progress made possible by HGR and draws attention to the fact that HGR illustrates the genetic similarity of all human beings. In Ireland, this universal similarity is taken up more often than in Germany. In addition, the idea of common evolutionary and ethnic roots is more prominent in the Irish coverage. In the context of this intra-coalitional cleavage, it is understandable that, in contrast to the 'economic rationality coalition', few actors refer to economic uses of HGR. Although the 'economy' frame might provide positive interpretations, the HGP avoids that frame in its attempt to present itself as a purely scientific actor without commercial interest, while Celera also avoids it, perhaps because of its struggle against its image as a purely commercial actor.

In Germany, the 'scientific progress coalition' is composed equally of domestic and non-domestic actors. It draws from a non-domestic core of US and international HGP actors and politicians, and also includes German HGP scientists and politicians. In Ireland, the 'scientific progress coalition' consists only of non-Irish actors, presumably because Ireland is not participating in HGR. In Ireland, the coalition thus derives from an international context, and lacks domestic elaboration.

The third coalition, the 'counter-scientific coalition', includes scientists not involved in HGR, and typically combines natural scientists, social scientists and philosophers. Although these actors occasionally acknowledge positive aspects of HGR, mainly in terms of the 'progress' frame, they more commonly criticize it. Nevertheless, their criticism is not fundamental. The coalition's actors, experienced scientists themselves, generally place high value on freedom of research and societal progress through science. They accept HGR as an important scientific milestone, though one that is not as important as commonly promoted. In addition, they emphasize problematic aspects of HGR that need to be addressed. Accordingly, they specify principles that would eliminate undesirable consequences in accordance with the 'regulation' frame in German discourse. As noted earlier, the regulatory frame is not prominent in Irish discourse.

In both countries, attention is drawn to some undesirable consequences of HGR through the 'transgression' frame. To some extent, this tends to revitalize the socio-biology debate (Nelkin, 1995). The argument that human behaviour is genetically determined is opposed with a humanist emphasis on the social construction of humanity, an opposition reminiscent of the 'two cultures' debate (Snow, 1959). The 'transgression' frame also is used to criticize how the biosciences manipulate nature. A religious variant of this argument portrays 'God playing' scientists as interfering with 'God's creation', in order to artificially create 'perfect humans' and 'designer babies'. This discourse emphasizes the dissolution of established ethical, religious and other borders, and the possibility of re-establishing new borders. Several German counter-scientists translate this critical view into an argument to impose limits on research, stating that scientific options should not be followed simply because they are possible – which is characterized as '*Machbarkeitswahn*'.

Again in both countries, but more strongly in Ireland, the coalition uses the '(in)equality' frame to focus attention on genetic discrimination. One concern is prenatal genetic discrimination, which is rhetorically connected to the abortion debate (Gerhards et al., 1998; Ferree et al., 2002). The coalition fears that genetic tests on fetuses and embryos will lead to an unnatural selection of completely healthy children. References appear in both countries to Nazi Germany's eugenic and euthanasia programmes, in which genetic rationales were given for life-and-death discriminations. Another concern is about potential discrimination on the basis of genetic characteristics by employers, schools and health insurance companies.

A third criticism is advanced in Germany, and is similar to one of the criticisms of Celera mentioned earlier. Counter-scientists critically assess the promotion of HGR as a scientific achievement, questioning the quality of the sequence data and pointing out their purely descriptive status.

Although German counter-scientists criticize more extensively than their Irish counterparts, they also emphasize the need for problem-solving procedures, using the 'regulation' frame. Their recommendations for societal steering of science focus on different geographical and governmental

levels – regional, national and international. In contrast, the Irish ‘counter-scientific coalition’ makes few procedural recommendations, and more often expresses moral criticism.

The ‘counter-scientific coalition’ is a predominantly domestic coalition in both countries. Only a few international social scientists, with Jeremy Rifkin being a prominent example, voice their opinions pervasively enough to gain mass media standing in Germany or Ireland. This coalition has different prominence in the two national contexts: in Germany, it is a rather small but still significant coalition, while it is marginal in Ireland.

The fourth discourse coalition, very small in both Germany and Ireland, is the ‘fundamental critique coalition’. As a coalition composed of domestic actors representing civil society in both countries, it typically includes non-governmental organizations, churches, artists and single citizens along with some, but very few, social and natural scientists. This coalition opposes HGR in a variety of ways. First, it explicitly argues against widely used pro-HGR frames: it asserts that particularistic and self-interested economic motives are HGR’s driving force and strongly opposes the patenting of genetic information, thereby opposing the legitimacy of the ‘economy’ frame. Moreover, it criticizes the idea of medical progress, and thereby the ‘progress’ frame, not because medical applications are illegitimate, but because it perceives such promises as eradicating cancer as unrealistic and misleading. Second, when drawing attention to problematic aspects of HGR, the ‘fundamental critique coalition’ stresses the need for ethical, moral or religious limits on research. It thus deploys the ‘transgression’ frame, and makes little reference to possible problem-solving procedures. In addition, when using the ‘regulation’ frame, the coalition favours citizen participation over institutionalized regulation.

#### *Media Discourse on Human Genome Research: A Summary*

In structural terms, media coverage in Germany is much more extensive, responds to more events, and persists for longer after those events. Accordingly, with its more extensive coverage of HGR, German media includes many more actors than Irish discourse, though the average number of actors per article is equal in both countries. Among actors, scientists dominate German coverage while journalists dominate Irish coverage. Furthermore, most actors in German discourse are domestic, while the Irish discourse features only few domestic actors apart from the – significant – number of domestic journalists.

In both countries these actors use the same range of scientific, economic, philosophical, ethical, social, legal and political arguments, coded in the same six frames. The range of these arguments underlines the general controversy in HGR discourse. Pro- and anti-HGR positions occur in both countries, yet are more elaborate in Germany. Furthermore, in German media coverage, extreme positions that exclude the possibility of argumentative engagement are rarely expressed. In Irish media, in contrast, pro- and particularly anti-HGR positions are formulated in more

polarized fashion, without concessions to opposing arguments. Occasionally, very strong positions are formulated – like the fear that 'global capitalism is raping the earth, it's raping us' (John Sulston, quoted in the *Irish Times*, 27 June 2000). On the other side, non-critical positions generally do not acknowledge potential dangers or difficulties, leaving few openings for dialogue between the two sides. This comparative pattern applies especially to four German and three Irish discourse coalitions. German coalitions are more highly differentiated, as they involve many actors who produce elaborate, inter-linked arguments and problem-solving routines. In contrast, Irish discourse coalitions are rather roughly sketched clusters, which express more polarized arguments.

### The Cultural Resonance of Media Discourse on the Human Genome

The previous section outlined the structure of media coverage and represented its structure and cognitive content through the prisms of standing, framing and discourse coalitions. This section considers the cultural structures that underpin discursive opportunities for media messages. This is not done through empirical comparison of media content with people's attitudes (as done by Nisbet & Lewenstein, 2001) or by an empirical exploration of the relationship between media framing and audience re-framing (Scheufele, 1999). Rather, we interpret our empirical findings in terms of *ideational resources*. Such resources, on the one hand, regulate media production, the selection and elaboration of particular discursive frames; and, on the other hand, they condition the reception of such discourse via the meaning-making capacities embodied in German and Irish socio-cultural life-worlds (Skillington, 1997; Benford & Snow, 2000). This context of reception might be characterized as a matter of cultural resonance. Other forms of resonance would include that of a message for specific publics or the impact of public discourse on institutions such as state and law. Cultural resonance appears as the most revealing, exploring the anchorage of the issue culture within wider cultural orders. Cultural resonance is here our main concern, since the emphasis is on the embedding in wider cultural orders of the specific 'issue culture' of HGR emerging in the media. We will reconstruct this resonance in relation to the frames presented earlier. The first to be discussed is the progress frame, followed by the economy and property frames. The predominantly critical frames of 'regulation', 'inequality' and 'transgression' are then discussed together.

#### *Conceptions of Progress*

A general characteristic of HGR discourse is its almost transcendent tone. The discourse is embedded in a temporally extended past, understanding human progress as the history of accumulated rational knowledge. The discourse also implicates a temporally extended future, forecasting a

transition to a new epoch in natural knowledge and human self-understanding. Medical applications catalyse this knowledge and apply it to the common good. Consequently, media coverage in both countries expresses a conviction of ongoing progress through science.

The 'progress' frame gets to the heart of the semantic organization of cultural themes in both countries. It is emphasized primarily by the 'scientific progress coalition' and underlined by catchphrases of innovation and wonder. Images of progress are largely introduced through the global package of HGR and to a significant extent the media in Germany and Ireland take up these images. Moreover, the German branch of the HGP emphasizes them. Notwithstanding the common emphasis on progress, there are substantial differences between coverage in the two countries, which has to do with different degrees and kinds of localization.

German coverage is influenced by the global HGR discourse, but is also strongly localized. It is embedded in relevant historical developments, especially the ambivalent reception of the Enlightenment (Marcuse, 1964; Horkheimer & Adorno, 1997), the genetic experiments and eugenic programmes of the Nazis (Weingart et al., 1992), and the persistence of heterogeneous secular and religio-moral constituencies. In contrast, broader German traditions of natural scientific and bioscientific research – which exist and could be employed to support current research (Förger, 2000) – were less salient. German discourse is conditioned by financial and research interests, and by political and moral opposition to HGR. However, even among actors in the 'scientific progress coalition', the 'progress' frame is qualified by the 'property' frame, stressing possible dangers emanating from the privatization of science for economic gain – the critique of Celera – and the related need to police the uses of discovery, the 'regulation' frame. Furthermore, the 'progress' frame in Germany is qualified by a complex scientific critique of the scale of the HGP achievement itself. This critique concerns the quality of the genome sequence and its scientific benefit, thereby reflecting a public sphere with a strong (and occasionally critical) interest in scientific knowledge. Questioning the achievement is closely related to the dispute between the HGP and Celera. Animus is directed toward the progressive privatization of science in developed countries, the profit-orientation of private laboratories, the expanded scientific capacities of multi-national corporations, and the residual core of public science with its different relationship to the legitimacy, accountability and role of science. The German media, in a country with a strong legacy of public science, devote more coverage to the HGP-versus-Celera dispute than the Irish media. German coverage is contextualized by the concern that if profit-oriented science were to escape societal regulation, science no longer would serve the common good. The sizeable participation of German politicians in this debate indicates the scale of these sensitivities and their normative tenor.

The Irish media construction of the 'progress' frame is less localized, more abstracted and generally more affirmative. The global HGR package, intended to legitimate a major and costly scientific endeavour, is more or

less taken over and re-presented as an achievement for all humanity. Partly, embracing the 'progress' frame may derive from enthusiasm in a society that is developing large-scale scientific research for the first time in its history (Edmondson, 1998: 71), albeit not HGR per se. It is also connected to the rational values associated with building a technologically proficient and economically advanced society – a rationality that opposes the impracticality and socio-economic weaknesses attributed to the previous model of protectionist self-sufficiency, with its anti-utilitarian, anti-modern morality (O'Mahony & Delanty, 1998). The current political climate, reflected in public policy support for research programmes, also emphasizes the positive contribution of the biosciences. Beyond this, Irish non-participation in HGR may have allowed a certain degree of freedom for rhetorical enthusiasm that is less troubled by concerns for regulation or appropriation. Consequently, the HGP generally is not contested in Ireland. The HGP-versus-Celera debate, more heavily covered in Germany, receives some coverage in the Irish media, but largely as a reported controversy taking place elsewhere.

### *The Theme of the Economy*

As mentioned earlier, the global HGR package does not offer elaborate economic arguments. The HGP pictures itself as purely scientific with no commercial interest. Celera avoids economic arguments, perhaps to counteract the image of being merely profit-oriented. Nevertheless, the economic interpretation of HGR is a substantial part of both nations' media discourse. Since economic interpretations do not derive from the global package, they largely stem from domestic contexts. Accordingly, different economic contexts result in different patterns of economic argument.

In Germany, a distinctive 'economic rationality coalition' indicates how the respective social spheres of science, civil society and economy are, compared with Ireland's, more differentiated and specialized. The German 'economic rationality coalition' ignores the practical and moral questions associated with HGR in favour of economic rationales. However, precisely because of their relative lack of interdependency with other frames and discourse coalitions, economic rationales for HGR do not easily gain legitimacy.

Economic rationality also pervades Irish media coverage, although it differs significantly from German coverage. No distinct 'economic rationality coalition' is present in Ireland. Nonetheless, Irish actors from all discourse coalitions extensively express economic views. Paradoxically, it is easier for economic views to gain wide acceptance in Ireland, and to provide legitimacy for HGR. The economic framing of issues tends to be widespread in Irish media and is difficult to constrain (Edmondson, 1998: 109ff.; Allen, 2000), except in cases that impinge upon the still powerful Catholic ethical code. International scientific developments such as abortion or embryonic stem cell research encounter powerful, largely negative, resonance in Ireland.

### *The Property Debate*

The 'property' frame is largely confined to the 'scientific progress coalition' in both Germany and Ireland. As described earlier, much of its impetus derives from the conflict between the HGP and Celera. Consequently, the property debate mainly derives from the global package and is localized differently.

The 'property' frame is developed extensively in German discourse, and addresses the patenting of human life, data ownership and privacy. Overwhelmingly, German media discourse promotes free publication of the genome and of genetic data. The opposite views remain marginal: neither the 'scientific progress' nor the 'economic rationality' coalition explicitly favours the establishment of genetic property. Instead, the implicit and sometimes explicit criticism is that social discrimination ('bottom-up eugenics') may result from private control of both money and genetic information. Germany's collective memory of eugenic solutions further sharpens the question of control over genetic information and intensifies the property debate. Accordingly, the question of private versus public goods gains much weight. Normatively regulated public research institutions have public responsibility as their constitutional mission, whereas private sector corporations are assumed, at least on one side of the debate, to be less concerned with their societal responsibility than with private appropriation. Moreover, Celera also invited suspicion since the company seemed to epitomize the Anglo-American model of free-market capitalism.

The fact that Irish media treatments of science and economic development reinforce one another may explain why the 'property' frame receives no significant domestic criticism. The debate within the 'scientific progress coalition', though, is strongly represented in Irish media discourse, but mainly as a controversy between foreign actors. This might seem surprising, because there is notable attachment to property in many other areas of Irish life, as in the constitutional protection for private property rights. Nevertheless, the issue of *intellectual* property rights does not receive much attention. This may be due to the Irish model of development based on inward multi-national investment, a model that leaves ownership and patent rights unquestioned, and emphasizes the employment benefits of such investment. Much scientific research in Ireland is still private and non-indigenous, reflecting the dominance of multi-national corporations and the relatively poorly developed scientific infrastructure. This may change in the coming decades, due to a more pronounced emphasis on domestic development and strenuous attempts to develop a national innovation system.

### *Critical Frames*

Finally, we shall consider the cultural embedding of the three critical frames of 'transgression', '(in)equality' and 'regulation'. As discussed

earlier, the actors delivering the global HGR package reject the 'transgression' frame. Therefore, the use of the critical frames and their variants depends largely on domestic processes in the two countries. Accordingly, the respective treatment of the 'transgression' frame in both countries is mainly an output of the 'counter-scientific' and 'fundamental critique' coalitions. The way in which it is used reflects the two nations' differing tendencies toward argumentative polarization. While transcendental or quasi-transcendental interpretations of nature are expressed in media discourse in both countries, the Irish 'counter-scientific coalition' and the 'fundamental critique coalition' are more polarized. Criticism tends to adopt a more moral, transcendent tone, as critical reflection about science is squeezed between the pre-eminent importance attached to economic development and the restricted range of a still powerful Catholic moral code (O'Mahony & Delanty, 1998). Yet there are also similarities between Irish and German media discourse, in so far as transcendental critique of scientific reason is part of the enlightenment reception in both cases. Receptiveness to critical enlightenment is more vibrant in Germany: excesses of enlightenment rationalism are culturally linked to National Socialism, and critiques of enlightenment science can draw on social theory connected to the '*Frankfurter Schule*' (Marcuse, 1964; Habermas, 1968).

In Ireland, there is a different historical momentum: the absence of enlightenment rationalism in a traditional and religiously-oriented nation in the first half of the 20th century is sometimes held responsible for deficient social and cultural development. Given this absence of critical engagement with 'development' and its downside, science is idealized and the critique of science diminished. In these circumstances, the Irish 'transgression' frame, which sets moral and also religious boundaries to research and thereby partly reflects the diminished effectiveness of religious critique of science, tends to be used to the extreme. In Ireland a view persists in the public sphere that there is a transcendental essence to human and non-human nature. The German 'transgression' frame is more secular and nuanced. The perception of an ongoing dissolution of boundaries between science and society (Weingart, 2001, 2002) creates uncertainty about which quasi-transcendental limits can possibly be imposed upon the conduct and utilization of science.

The '(in)equality' frame is of some, although not much, relevance for the global HGR package. Celera's statement that racism lacks scientific substance, brought forward late in HGR discourse to legitimate the company's research, was taken up in both national discourses. Beyond that incident, the '(in)equality' frame is prevalent in Germany and also in Ireland, especially in the 'counter-scientific coalition'. In both countries, recent social, political and cultural changes have brought about some weakening of the general symbolic coherence and ideological power of the '(in)equality' frame. Continuing high levels of social inequality persist in Ireland, which may partly explain the salience of this frame in that country's media discourse. In both Irish and German media coverage,

connections between equality and genetic discrimination draw from cultural discourses on abortion and eugenics. The ‘transgression’ and ‘(in)-equality’ frames may also gain more prominence in the ‘scientific progress coalition’ when future applications of HGR such as pre-implantation diagnostics move closer to practical utilization.

As with the first two critical frames, the global ‘regulation’ frame exerts minor influence on the German and Irish media coverage. The global discourse of the HGP aims to limit HGR regulation, although it also intends to diminish Celera’s chances of controlling genome data. Therefore, the issue of regulation is seldom raised at the global level, and when it is raised, it is done very carefully. The ‘regulation’ frame, addressing appropriate arrangements for implementing downstream benefits of HGR, including the argument between the HGP and Celera, without being a critique of HGR as such, gained the attention of the German and Irish ‘scientific progress coalition’. It is also taken up by both critical coalitions in Germany. On the one hand, this is another indicator for the generally lesser polarization between affirmative and critical positions on HGR in Germany. On the other hand, it also shows the relevance of regulation in a country participating in HGR. To the contrary, ‘regulation’ is the weakest frame in Ireland. Here, the lack of regulatory need in a country not participating in HGR is certainly an important consideration. However, ‘regulatory need’ is also relative to the issue, not simply national participation in research. Occasionally, successful demands by critical publics may mobilize Catholic moral codes and institutions. For example, in the case of stem cell research there has been a significant national debate, partly because of the constitutional implications of an abortion debate that has raged for over 20 years. When couched in these terms, demands for regulation in Ireland in some measure depend on whether an issue is seen as primarily rational and utilitarian – as with HGR – or as morally transgressing such as with embryonic stem cell research.

## Conclusion

In general, German and Irish newspaper coverage on HGR show some strong similarities, especially in relation to the content and to the nature of participation. As discussed earlier, much of the similarity in content may be attributed to the global packaging of key events, which is incorporated into national media reportage. National adoption of global themes was assisted by the fact that the global package portrayed the outcome of HGR as a universal good and an achievement of all humanity. Global packaging seems to have been more characteristic for HGR discourse than for most other public issues in the biosciences. In Ireland, the global construct predominates in HGR coverage. This distinguishes Irish HGR coverage from coverage on other bioscientific issues. Stem cell research and plant genetics, for example, also have strongly marked global dimensions – global scientific action impinging on local discretion, the prominence of

global commercial interests, global communication campaigns and internationalized patterns of coverage.<sup>7</sup> In contrast to HGR, however, potential applications in these areas are likely to be available within relatively short time scales, an immediacy that has already given impetus to extensive *national* debates in Ireland and elsewhere. As opposed to this, HGR in Ireland is represented as basic research with possible long-term, but not immediate applications, a representation that removes situated, ethical urgency from the coverage. In addition, in Germany, although the global package generally plays a comparatively smaller role than in Ireland, HGR discourse is initiated more on a global level than is the case for issues such as stem cell research, pre-implantation diagnostics or cloning.

The second similarity is that both countries' HGR discourses show the agenda-building success of political leaders and other authoritative actors, especially scientists and journalists, who seek to build public legitimacy for a scientific endeavour. Much of these actors' mobilization efforts occur at the global level. Politicians such as Bill Clinton and Tony Blair, who sought to ally themselves with global processes and to occupy a global space that appeals beyond their own national media, acquired significant standing. Furthermore, in both German and Irish media coverage, critical voices are present but not especially prominent: HGR discourse does not include major input from the societal periphery. While lines of controversy and disagreement exist, controversy is not the most prominent feature of the discourse, which is generally characterized by a positive tone, accompanied by concerns about some aspects of implementation.

Beyond these similarities, clear German-Irish differences can be observed. First, there is much more extensive coverage in Germany. This may be due to newspaper characteristics, as German newspapers address a significantly larger readership, and possess a larger staff, including numerous specialized science journalists. However, this does not explain the striking quantitative difference in coverage. The differentiation of the German public sphere appears to be a crucial factor, both in terms of discourse producers and of different kinds of recipients. Fed by the historical, institutional and socio-cultural factors outlined earlier, these aspects seem to be a more important explanation for the significant difference between German and Irish coverage.

Second, journalists dominated the coverage in Ireland. Irish coverage was mainly descriptive, consisting of a re-translation of the global script with occasional commentary. In contrast, there was a larger range of voices in Germany, and greater proportionate balance between them. Purely descriptive coverage – taking over the global script – is less important in German discourse. Hence, critical elaboration in both natural and social scientific fields takes place in Germany, whereas intellectual critique from philosophers, social scientists and critical natural scientists is almost absent from Irish discourse. Critical voices embodied in the 'counter-scientific' and 'fundamental critique' coalitions also are weaker in Ireland.

Third, in Germany, the global HGR discourse is more strongly localized, perhaps reflecting a greater degree of critical elaboration. In Germany

and Ireland, the 'scientific rationality coalition' is substantially a product of frames generated by such global players as the HGP, Celera and international politicians. However, in Germany other favourable commentaries, for example on the potential contribution of HGR to domestic competitiveness, can arise in the domestic discourse. This does not occur in Ireland. Generally, Irish coverage is largely affirmative, with its combination of descriptive, journalistic style, and its heavy borrowing from the global package. The tendency to simply incorporate the global package is less strong in German media, and coverage includes more differentiated voices and dimensions. German coverage also is predominantly affirmative, but it involves a greater dispersal of voices, more sceptical views of science and scientific achievement and greater capacity for localization.

Overall, while argumentation is more apparent in the German coverage, there is also freer exchange. Frames such as 'property', 'regulation' and '(in)equality' demonstrate more capacity for exchange between coalitions, even if this exchange is argumentative. Irish media discourse is less oppositional in its structure and yet, paradoxically, more polarized. Different voices appeal to different constituencies without clear indication of how exchange could take place between them. More strongly than in Germany, political and cultural elites believe that science coverage should support science research and science-based industry. This is perhaps most clearly indicated by the low profile of an Irish 'counter-scientific coalition' in the HGR issue. Yet, the future freedom of Irish scientific practice and policy from public pressure may not be so secure. In spite of strong institutional support, areas closer to application like GM plants and stem cell research have been constrained by public pressure.

The domestic resonance of HGR discourse was significantly greater in Germany than in Ireland. German discourse was more differentiated in its production – as described in discourse coalitions – and also appealed to wider audiences. In Ireland, resonance remained relatively low. No pronounced controversy was visible as in the case of plant genetics. Generally, discourse projected an affirmative image of HGR, and gave high status to science, especially for its contribution to a knowledge-based economy. To this extent, Irish HGR coverage reinforced a growing rationalism in the country's life-world and institutional order. The absence of organized critical voices also helps to explain low resonance. The Irish Catholic Church, traditionally the dominant culture producing organization beyond the state and science–industry complex, is prominent in the Irish stem cell debate, but did not engage itself in HGR discourse during the period studied.

The greater resonance in Germany owed much to the way in which HGR became intertwined with other debates (see Graumann, 2003). For example, the exchanges between the HGP and Celera raised questions about the institutional status of science. Debates about the completed sequence raised questions about the material significance and the scientific value of the project. And, of course, there were manifold references to ethical implications of the HGP. In general, the German debate was more

argumentatively open, more strongly integrating a wider range of participants. This owes much to the longevity of an established and differentiated science system, with accompanying media specialization on science issues, and it is supported by the existence of a more science-receptive public. In Ireland, science communication is not developed to the same extent, reflecting the low significance attached to science up until the last decade or so.

The degree of resonance is also connected to the different ideological orientations influencing the reception of scientific advance in both countries. Ideological orientation in Germany includes strong suspicions of rationalist excess, a secular as well as religious ethos of science criticism, and a strong attachment to publicly supported science. In Ireland, religious opposition to utilitarian modernism steered the reception of scientific advance, and continues to have some influence in 'moral' issues such as stem cell research. Recently, economic and research interests together emphasize the necessity of an indigenous science base, and such indigenous research interests increase the conflict potential with Catholic moral codes, as the stem cell debate illustrates. Irish oppositional voices on scientific issues are both secular and Catholic, but on most issues they do not combine at either an organizational or discursive level.

Apart from the manifest similarities and differences between media discourse on HGR in the two countries, some more general conclusions may be suggested. First, concerning the significance of global and local relations, HGR discourse can be viewed as a manifestation of the growing prominence of global discourse. Such discourse is partly a product of expanding international scientific co-operation, trans-national public funding, growing privatization of scientific research, and the formation of globalized science-industry corporations, represented in this instance by Celera Genomics, and the inclusion of intellectual property issues in international trade relations. Such trends also involve a substantial displacement of research from the public laboratory from which science historically drew much of its authority. And they are accompanied by broadening and increasing critical challenges to science. Due to the significance accorded to the sequencing of the human genome and the degree of international cooperation it involved, it serves as an especially prominent example of this rising trans-national scientific discourse. But as the failures of the Monsanto Corporation in plant genetics in and beyond Europe amply demonstrate, this global science discourse does not mean that discourses that work in the USA will be embraced globally. Instead, national dynamics still play a large part in the reception and elaboration of global discursive packages.

A second general conclusion concerns the relationship between content and discursive agency. Apparent similarities in discourse content can be qualified by the extent and nuance of usage, as well as by differentiated patterns of resonance. Accordingly, it is important for researchers to move beyond the general semantics of textual corpora, in order to ask questions

about social semantics: who bears which meanings, and to which audiences and cultural constellations do such meanings appeal? The analysis of semantic levels in this paper revealed different connections between global and national levels in Irish and German media coverage, which could only be explained by internal differences in structures of participation and conditions of resonance between them.

The overall impression gained from the study of HGR discourse is that it reveals a number of significant operating tendencies. The most significant are the presence of global interests, the emergence of a crisis of orientation – public versus private – over the future direction of science, the corresponding democratic status of science, and the resulting ethical implications and consequences. Notwithstanding these tendencies, HGR discourse remains constrained by its uncertain implications: it is difficult to take a position for or against it when the horizons are unclear. Accordingly, the analysis of HGR discourse concerns an issue, which is unclear in its implications, but potentially profound in its consequences. This combination of significance and uncertainty is the most general hallmark of contemporary HGR discourse.

## Notes

The authors wish to acknowledge the contribution of the Editor and reviewers of *Social Studies of Science* to the development of this paper.

1. The term 'Human Genome Project' includes the US, British, French, German, Japanese and Chinese Human Genome Projects.
2. See Einsiedel et al. (2002) for a study on the cloning of Dolly the sheep that similarly explores the relation between 'the first real global news story on biotechnology' and its elaboration in 12 countries (11 European countries and Canada). See Hallon & Mancini (1992) for an analysis of planned media events in a global setting and their implications for understanding developments in the national and supra-national public spheres.
3. Characterizing the mass media as global does not contradict the existing ethno-centrism in coverage; that is, the concentration on the Western world in media reports. In addition, it does not mean that the individual media outlets are trans-national or global in their reach. Instead, mass media are characterized as a global system that potentially and often factually reaches beyond national borders and addresses global problems.
4. A more detailed description of sampling, sample characteristics and statistical frequencies is provided by Schäfer (2001).
5. In Austria, for example, the two largest quality newspapers published significantly more articles than their Irish counterparts: *Der Standard* published 68 articles in 2000 while *Der Kurier* published 42.
6. Nevertheless, this morality remains institutionally powerful. Another biotechnological issue, the controversial case of stem cell research, generated a higher level of national debate and criticism.
7. A peak of Irish coverage on stem cell research coincided with the US debate on President Bush's compromise decision on federal funding for stem cell research in August 2000.

## References

- Allen, Kieran (2000) *The Celtic Tiger? The Myth of Social Partnership* (Manchester: Manchester University Press).
- Audit Bureau of Circulations (2000) *Audit Bureau of Circulations – Newspaper Data*. <www.abc.com> (accessed 10 September 2000).

- Benford, R.D. & D.A. Snow (2000) 'Framing Processes and Social Movements: An Overview and Assessment', *Annual Review of Sociology* 26: 611–39.
- Blumler, J.G., J.M. McLeod & K.E. Rosengren (1972) 'An Introduction to Comparative Communication Research', in J.G. Blumler, J.M. McLeod & K.E. Rosengren (eds), *Comparatively Speaking: Communication and Culture across Space and Time* (Newbury Park, CA: SAGE): 3–18.
- Celera (2000) *Celera Genomics Completes Sequencing Phase of the Genome from One Human Being: Company Begins Sequencing Mouse Genome* (Rockville: Celera Genomics).
- Cobb, R. & C.D. Elder (1976) 'Agenda Building as a Comparative Political Process', *American Political Science Review* 70(1): 126–38.
- Delanty, Gerard & Patrick O'Mahony (2002) *Nationalism and Social Theory* (London: SAGE).
- Dierkes, Meinolf & Claudia von Grote (2000) *Between Understanding and Trust: The Public, Science and Technology* (London & New York: Routledge).
- Donati, Paolo R. (1996) 'From Political Discourse Analysis to the Analysis of Action and Political Narrative'. *4th International Social Science Methodology Conference*, 1–5 July.
- Dreyer, Marion (1999) 'Biotechnological Communication and the Socio-Cultural Embeddedness of Economic Actors', in P.O'Mahony (ed.), *Nature, Risk and Responsibility. Discourses on Biotechnology* (London: Macmillan): 87–99.
- Drory, Gili S. (2003) *Science in the Modern World Polity: Institutionalization and Globalization* (Stanford, CA: Stanford University Press).
- Eder, Klaus (1996) *The Social Construction of Nature: A Sociology of Ecological Enlightenment* (London: SAGE).
- Edmondson, Ricca (1998) *Gesellschaften in Europa: Irland* (Hagen: Fern-Universität).
- Einsiedel, E., A. Allansdottir, N. Allum, M.W. Bauer, A. Berthomier, A. Chatjouli, S. de Cheveigne, R. Downey, J.M. Gutteling, M. Kohring, M. Leonarz, F. Manzoli, A. Olofsson, A. Przystalski, T. Rusanen, F. Seifert, A. Stathopoulou & W. Wagner (2002) 'Brave New Sheep – the Clone Named Dolly', in M.W. Bauer and G. Gaskell (eds), *Biotechnology: The Making of a Global Controversy* (Cambridge: Cambridge University Press): 313–47.
- Eurobarometer (2002) *Eurobarometer 58.0 – Europeans and Biotechnology in 2002* (Brussels: European Union).
- Ezrahi, Yaron (1990) *The Descent of Icarus* (Cambridge, MA: Harvard University Press).
- Ferree, Myra Marx, William A. Gamson, Jürgen Gerhards & Dieter Rucht (2002) *Shaping Abortion Discourse: Democracy and the Public Sphere in Germany and the United States* (Cambridge: Cambridge University Press).
- Förger, Dirk (2000) 'Die Geschichte der Gentechnik', *Die Welt*, 27 June: Section 'Wissenschaft'.
- Galtung, Johan & Mari Holmboe Ruge (1965) 'The Structure of Foreign News: The Presentation of the Congo, Cuba and Cyprus Crises in Four Norwegian Newspapers', *Journal of Peace Research* 2: 64–91.
- Gamson, William A. (1992) *Talking Politics* (New York: Cambridge University Press).
- Gamson, William A. & Kathryn E. Lasch (1983) 'The Political Culture of Social Welfare Policy', in S.E. Spiro & E. Yuchtman-Yaar (eds), *Evaluating the Welfare State: Social and Political Perspectives* (New York: Academic Press): 397–415.
- Gamson, William A. & Gadi Wolfsfeld (1993) 'Movements and Media as Interacting Systems', in *The Annals of The American Academy of Political and Social Science*, vol. 526: 114–25.
- Gerhards, Jürgen, Friedhelm Neidhardt & Dieter Rucht (1998) *Zwischen Palaver und Diskurs. Strukturen öffentlicher Meinungsbildung am Beispiel der deutschen Diskussion zur Abtreibung* (Opladen: Westdeutscher Verlag).
- Goffman, Erving (1986) *Frame Analysis: An Essay on the Organization of Experience* (Boston, MA: Northeastern University Press).
- Görke, Alexander, Matthias Kohring & Georg Ruhrmann (2000) 'Gentechnologie in der Presse. Eine internationale Langzeitanalyse von 1973–1996', *Publizistik* 45(1): 20–37.

- Gottweis, Herbert (1998) *Governing Molecules: The Discursive Politics of Genetic Engineering in Europe and the United States* (Cambridge, MA: MIT).
- Graumann, Sigrid (2003) 'Die Rolle der Medien in der öffentlichen Debatte zur Biomedizin', in S. Schicktanz, C. Tannert & P.M. Wiedemann (ed), *Kulturelle Aspekte der Biomedizin. Bioethik, Religionen und Alltagsperspektiven* (Frankfurt & New York: Campus): 212–43.
- Gregory, Jane & Steve Miller (1998) *Science in Public. Communication, Culture, and Credibility* (New York: Plenum Press).
- Gurevitch, Michael & Jay G. Blumler (1990) 'Comparative Research: The Extending Frontier', in David L. Swanson & Dan Nimmo (eds), *New Directions in Political Communication: A Resource Book* (Newbury Park, CA: SAGE Publications): 305–25.
- Habermas, Jürgen (1968) *Technik und Wissenschaft als 'Ideologie'* (Frankfurt: Suhrkamp).
- Hajer, Maarten A. (1995) *The Politics of Environmental Discourse: Ecological Modernization and the Policy Process* (Oxford: Oxford University Press).
- Hallon, D.C. & P. Mancini (1992) 'The Summit as Media Event: The Reagan/Gorbachev Meetings on U.S., Italian and Soviet Television', in J.G. Blumler, J.M. McLeod & K.E. Rosengren (eds), *Comparatively Speaking: Communication and Culture across Space and Time* (Newbury Park, CA: SAGE Publications): 1–15.
- Hampel, Jürgen & Ortwin Renn (1998) *Kurzfassung der Ergebnisse der Verbundprojekts Chancen und Risiken der Gentechnik aus Sicht der Öffentlichkeit* (Stuttgart: Akademie für Technikfolgenabschätzung Baden-Württemberg).
- Hedgecoe, Adam M. (1999) 'Transforming Genes: Metaphors on Information and Language in Modern Genetics', *Science as Culture* 8(1): 209–29.
- Herzog, Dietrich, Hilke Rebenstorf, Camilla Werner & Bernhard Weßels (1990) *Abgeordnete und Bürger. Ergebnisse einer Befragung der Mitglieder des 11. Deutschen Bundestages und der Bevölkerung* (Opladen: Westdeutscher Verlag).
- Horkheimer, Max & Theodor W. Adorno (1997) *Dialectic of Enlightenment* (London & New York: Verso).
- Informationsgemeinschaft zur Verbreitung von Werbeträgern (2000) *Informationsgemeinschaft zur Verbreitung von Werbeträgern – IVW-Praxis* (Bonn: IVW).
- Joas, Hans (1996) *The Creativity of Action* (Cambridge: Polity).
- Kepplinger, Hans Mathias (1989) 'Instrumentelle Aktualisierung: Grundlagen einer Theorie publizistischer Konflikte', in M. Kaase and W. Schulz (eds), *Massenkommunikation* (Opladen: Westdeutscher Verlag): 199–220.
- Kepplinger, Matthias, Simone Ehmig & Christine Ahlheim (1991) *Gentechnik im Widerstreit. Zum Verhältnis von Wissenschaft und Journalismus* (Frankfurt & New York: Campus).
- Kitzinger, Jenny & Jacquie Reilly (1997) 'The Rise and Fall of Risk Reporting: Media Coverage on Human Genetics Research, "False Memory Syndrome" and "Mad Cow Disease"', *European Journal of Communication* 12(3): 319–50.
- Kohring, Matthias & Jörg Matthes (2002) 'The Face(t)s of Biotech in the Nineties: How the German Press Framed Modern Biotechnology', *Public Understanding of Science* 11(2): 143–54.
- Lamont, M. & L. Thévenot (2000) *Rethinking Comparative Cultural Sociology* (Cambridge: Cambridge University Press).
- McQuail, Denis (1984) *Mass Communication Theory: An Introduction* (London: SAGE Publications).
- Maletzke, Gerhard (1963) *Psychologie der Massenkommunikation: Theorie und Systematik* (Hamburg: Verlag Hans-Bredow-Institut).
- Marcuse, Herbert (1964) *One Dimensional Man: Studies in the Ideology of Advanced Industrial Society* (London: Routledge).
- Nelkin, Dorothy (1992) *Controversy: Politics of Technical Decisions* (London: SAGE Publications).
- Nelkin, Dorothy (1995) *Selling Science. How the Press Covers Science and Technology* (New York: W.H. Freeman and Company).
- Nerlich, B., R. Dingwall & D.D. Clarke (2002) 'The Book of Life: How the Completion of the Human Genome Project Was Revealed to the Public', *Health* 6(4): 445–69.

- Nisbet, Matthew C. & Bruce V. Lewenstein (2001) 'A Comparison of U.S. Media Coverage of Biotechnology with Public Perceptions of Genetic Engineering 1995–1999'. Paper given at the International Public Communication of Science and Technology Conference, Geneva, 1–3.
- Noelle-Neumann, Elisabeth & Rainer Mathes (1987) 'The "Event as Event" and the "Event as News": The Significance of "Consonance" for Media Effects Research', *European Journal of Communication* 2: 391–414.
- Nowotny, Helga, Peter Scott & Michael Gibbons (2001) *Re-Thinking Science: Knowledge and the Public in an Age of Uncertainty* (Cambridge: Polity).
- O'Mahony, Patrick & Gerard Delanty (1998) *Rethinking Irish History: Nationalism, Identity and Ideology* (London: Macmillan).
- O'Mahony, Patrick & Siobhan O'Sullivan (2004) 'Procedure and Participation: The Genetically Modified Plants Controversy in the UK and Ireland', in Alfons Bora & Heiko Hausendorf (eds), *Communicating Citizenship and Social Positioning in Decision-Making Procedures: The Case of Modern Biotechnology* (Amsterdam: John Benjamins) (In the Press).
- O'Mahony, Patrick & Tracey Skillington (1999) 'Constructing Difference: Discourse Coalitions on Biotechnology in the Press', in P. O'Mahony (ed.), *Nature, Risk and Responsibility: Discourses of Biotechnology* (London: Macmillan): 100–13.
- Pellizzoni, Luigi (1999) 'Reflexive Modernisation and Beyond: Knowledge and Value in the Politics of Environment and Technology', *Theory, Culture and Society* 16(4): 99–125.
- Pennisi, Elizabeth (2000) 'Breakthrough of the Year: Genomics Comes of Age', *Science* 290: 2220–21.
- Protest, David L., F. Cook, Jack Doppelt & James Ettema (1992) *The Journalism of Outrage: Investigative Reporting and Agenda Building in America* (New York: Guilford Press).
- Reiss, Michael J. & Roger Straughan (1996) *Improving Nature? The Science and Ethics of Genetic Engineering* (Cambridge: Cambridge University Press).
- Ruhrmann, Georg, Thomas Stöckle, Frank Krämer & Christian Peter (1992) *Das Bild der 'Biotechnischen Sicherheit' und der 'Genomanalyse' in der deutschen Tagespresse (1988–1990)* (Bonn: Büro für Technikfolgenabschätzung).
- Schäfer, Mike Steffen (2001) *Diskurse über Humangenomforschung in Deutschland und Irland* (Leipzig: Universität Leipzig).
- Schenk, Michael (2002) *Medienwirkungsforschung* (Tübingen: J.C.B. Mohr).
- Scheufele, Dietram A. (1999) 'Framing as a Theory of Media Effects', *Journal of Communication* 49(1): 103–22.
- Science* (2000a) 'Clinton and Blair Back Rapid Release of Data', *Science* 287(5460) (24 March): 1903.
- Science* (2000b) 'Rival Genome Sequencers Celebrate a Milestone Together', *Science* 288(5475) (30 June): 2294–95.
- Science* (2000c) 'The Universe of Drosophila Genes', *Science* 287(5460) (24 March): 2181.
- Skillington, Tracey (1997) 'Politics and the Struggle to Define: A Discourse Analysis of the Framing Strategies of Competing Actors in a "New" Participatory Forum', *British Journal of Sociology* 48(3): 493–513.
- Snow, C.P. (1959) *The Two Cultures* (Cambridge: Cambridge University Press).
- Snow, David A., E. Burke Rochford Jr, Steven K. Worden & Robert D. Benford (1986) 'Frame Alignment Processes, Micromobilization, and Movement Participation', *American Sociological Review* 51(4): 464–81.
- Stehr, Nico (1994) *Knowledge Societies* (London: SAGE Publications).
- Stichweh, Rudolf (1999) 'Globalisierung von Wirtschaft und Wissenschaft: Produktion und Transfer wissenschaftlichen Wissens in zwei Funktionssystemen der Modernen Gesellschaft', *Soziale Systeme* 5: 27–39.
- Torronen, J. (2001) 'Between Public Good and the Freedom of the Consumer: Negotiating the Space, Orientation and Position of US in the Reception of Alcohol Policy Editorials', *Media, Culture and Society* 23: 171–93.
- van Dijk, Teun (1997) *Discourse Studies* (London & Thousand Oaks: SAGE Publications).

- Weingart, Peter (2001) *Die Stunde der Wahrheit? Zum Verhältnis der Wissenschaft zu Politik, Wirtschaft und Medien in der Wissensgesellschaft* (Weilerswist: Velbrück).
- Weingart, Peter (2002) 'The Moment of Truth for Science: The Consequences of the "Knowledge Society" for Society and Science', *EMBO Reports* 3(8): 703–06.
- Weingart, Peter, Jürgen Kroll & Kurt Bayertz (1992) *Rasse, Blut und Gene: Geschichte der Eugenik und Rassenhygiene in Deutschland* (Frankfurt am Main: Suhrkamp).
- Wittkämper, Gerhard W., Jürgen Bellers, Jürgen Grimm & Michael Heiks (1992) 'Pressewirkungen und außenpolitische Entscheidungsprozesse – Methodologische Probleme der Analyse', in Gerhard W. Wittkämper (ed.), *Medien und Politik* (Darmstadt: Wissenschaftliche Buchgesellschaft): 150–68.

**Patrick O'Mahony** is lecturer in Sociology at the National University of Ireland, Cork. His research interests include public discourse on science, technology and the environment and comparative and theoretical issues associated with nations and nationalism. Recent publications include (as editor), *Nature, Risk and Responsibility: Discourses of Biotechnology* (Macmillan, 1998) and (with Gerard Delanty) *Nationalism and Social Theory* (SAGE Publications, 2002).

**Address:** Department of Sociology, National University of Ireland, Donovan's Road, Cork, Ireland; email: p.omahony@ucc.ie

**Mike Steffen Schäfer** is a lecturer at the Department for Sociology at the Freie Universität Berlin, where he works in a research project comparing German and US media coverage on human genome research. His working interests include the sociology of science, the sociology of the media and comparative research. He holds an MA in Sociology from the University of Leipzig.

**Address:** Freie Universität Berlin, Institut für Soziologie, Garystrasse 55, 14195 Berlin, Germany; email: msschae@zedat.fu-berlin.de