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Two normative models of science in the public sphere: human genome sequencing in German and US mass media

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The public sphere and particularly the mass media have become increasingly important for the legitimation of science. Many publications on the issue explicitly or implicitly deal with the question of how science should be treated in the mass media, putting forward normative models of an ideal "scientific public sphere." In this article, we first present two ideal types of normative models identified in the literature: the "science-dominated scientific public sphere" and the "contextualized scientific public sphere." Whereas the first model calls for scientific dominance in mass media debates, the second model argues that science should be contextualized also with non-scientific actors and arguments. The second part of the article outlines how these two models translate into specific demands for mass media debates and proposes how to measure whether concrete cases of science coverage correspond with one of the normative models. We confront the two normative models with the example of media coverage on human genome research in Germany and in the United States in the third part of the article. Our findings show that the mass media debate on this issue is dominated by bio-scientists, affirmative positions, and scientific and medical frames in both countries. Hence, human genome research as an empirical case corresponds to the demands of the scientific dominance model, while failing to meet the demands for more contextualized mass media coverage.

Keywords: public sphere, media, discourse, public understanding of science, participation, biotechnology, human genome.

1. The importance of the public sphere for science

The public sphere is widely acknowledged as a core element of modern democracies. Its importance relates to a basic mechanism of democratic societies in which citizens elect political elites, thereby indirectly determining political decisions. In order to elect their representatives, citizens require access to information about the candidates, their policies and possible societal problems. The public sphere facilitates this access to information and, accordingly, enables citizens to participate. In other words, the public sphere enables citizens to observe decision-makers, to form judgments of societal developments, to articulate their views and opinions and to enact their freedom of speech. In modern societies mass media can be seen as the "master forum" of the

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various public arenas, such as town hall meetings, judicial courts, church services etc. (Ferree et al., 2002b: 10; cf. Gerhards and Neidhardt, 1991). The mass media facilitate and institutionalize a continuous societal communication between members of science, politics, the economy, churches etc., in which different perspectives can be applied to a variety of topics. The importance of the mass media is underlined further by the fact that they have become the primary source of information on a large number of issues for many people owing to processes of social differentiation, thereby enabling them to monitor multiple societal fields.

The fundamental importance of the public sphere in democratic societies has led many authors to ask what characteristics the public sphere should exhibit to adequately fulfill its tasks and obligations. These authors aim to formulate normative theories that define the ideal role of the public sphere in society, apply these theories to specific countries or cases and often base criticism or demands for changes on their normative groundwork. The best-known of these normative theories may be the work of Jürgen Habermas, who advocated a discursive, deliberative public sphere (1985a, 1985b, 1991, 1998), but also several other normative theories can be distinguished that differ in terms of who should speak in the public sphere, what content is desirable, how debate should be carried out, and the relationship between the desired (or feared) debate and decision-making outcomes (Gerhards, 1997; Ferree et al., 2002b: 255ff.; cf. also Gerhards, 2006). The general importance of the public sphere, and particularly of the mass media, also applies to science. As Peter Weingart and several others have shown, public and mass media debates are of considerable importance for science, and have become increasingly so in recent years (Weingart, 2002, 2003, 2005). The main reason for this development is that research, especially costly "big science," relies on public legitimation. The mass media are the primary forum in which this legitimation is generated or in which the de-legitimation of entire branches of research can occur, as was the case for nuclear research in Germany (Weisker, 2003), or agri-food biotechnology and cloning in Britain (e.g. Bauer, 2002; Holliman, 2004, respectively).

Similar to general normative theories on t he public sphere and on mass media, the question also arises as to which form public debate on science should take. Publications occasionally formulate explicit answers, but more often propose implicit normative models for the scientific public sphere. In this article, we first present two ideal types of these normative models from the literature: the "science-dominated scientific public sphere" and the "contextualized scientific public sphere" models. Second, we outline how these two models translate into specific demands for mass media debates and propose how to measure whether concrete cases of science coverage correspond with one of the normative models. Third, we report on findings from a research project in which we analyzed the mass media debate on human genome research in Germany and the United States between 1999 and 2001. We then compare our empirical results with both models, analyze which model corresponds most closely with our empirical findings, and discuss the possible implications of adopting one of the normative models.

2. Two normative models of science in the public sphere

Normative theories function as bases from which to judge or criticize concrete events or developments, and to demand or justify certain actions. To enable these processes, normative theories must be clear in their demands and empirically accessible so that they may be applied to specific cases.

However, normative models of science in the public sphere and specifically of science in the mass media do not yet meet these criteria. Basic assumptions often remain implicit and are somewhat scattered over the relevant literature. The first step of our article is therefore to systematize normative elements of various publications into ideal-type normative models of

science in the mass media. Excluding some theoretical variations, one can distinguish two ideal-type models: the "science-dominated scientific public sphere" and the "contextualized scientific public sphere."

The science-dominated scientific public sphere

The science-dominated model has a clear idea of how the ideal scientific public sphere should look. Scientific events should be portrayed and assessed in the public sphere and by mass media according to scientific criteria. These criteria should decide which topics are important in the mass media, which information is correct and which perspectives are fundamentally permissible. Deviations from these criteria are labeled as deficits. A common outcome of this model is the criticism that scientific topics are not adequately or correctly represented in the public sphere.

The groundwork of this model was laid in the 1980s, primarily through "Public Understanding of Science" (PUS) concepts. PUS programs were initially set up in Britain, followed by many other countries, with the aim of discovering suitable ways for successfully imparting science to the public sphere, to improve the image of science, to further the scientific literacy of the people and eventually to legitimatize science (cf. Felt et al., 1995: 244; Gregory and Miller, 1998; Lewenstein, 1995).

PUS has held many normative ideas and assumptions about the correct relationship between science and the public since the beginning of the programs. One crucial element is the idea that scientific knowledge is superior to other forms of knowledge (cf. Kohring, 1997). This results in the assumption that every citizen who is adequately informed about the origins and content of scientific knowledge will also support science. The fact that certain scientific developments have been rejected and protested against by the population is thus attributed to their inadequate knowledge: "The field of risk perception research, for example, was defined by the assumption that the public opposed technologies like nuclear power because they misunderstood the 'real' risks as known to science" (Wynne, 1995: 363). It was assumed that if deficits in the scientific literacy of citizens were erased, their approval of science would increase (the so-called "deficit model," cf. Irwin and Wynne, 1996).

PUS regards the mass media as the most important channel for improving scientific literacy. Supposedly superior scientific knowledge should be communicated by the mass media in such a way that nothing is changed—scientific knowledge should be merely "transported" or, at best, adequately "translated" to the public (MacDonald, 1996). Controversy or lengthy discussions about scientific knowledge in the public sphere are not considered desirable: "Even criticism and control must be based first and foremost on scientific criteria" (Kohring, 1997: 83).[1]

The contextualized scientific public sphere

The science-dominated, or "Public Understanding of Science", model for the scientific public sphere has not been without its critics (cf. for example Gregory and Miller, 1998; Irwin and Wynne, 1996; Miller, 2001; Wynne, 1992, 1996). Terminological and conceptual problems aside (Felt, 2000; Yearley, 2000), such criticism relates to the question of how science is anchored in society and the role the public sphere should play. Several authors dispute, or at least question, the special epistemological status of scientific knowledge. As the "Social Studies of Science" and related schools of research have shown, the generation and communication of scientific findings is not purely objective nor does it proceed in an entirely neutral manner; rather, it also depends on social and environmental factors (cf. Knorr Cetina, 1981, 1998). According to this argument, science has no special status in epistemological terms. The insistence on the special status of scientific knowledge is even treated with suspicion

as being a strategic device used by the scientific community. Some authors "come to the conclusion that discriminating against non-scientific forms of rationality mainly serves to confirm science's authoritarian leadership claim as the definitive producer of orientational knowledge in society" (Kohring, 1997: 174).

In this model, science is only one source of knowledge among many, and the experiences of citizens and non-scientific actors are accepted as equally relevant. Accordingly, science requires society's legitimation—decisions regarding science and its outcomes cannot be based on scientific criteria alone; rather, they must be the result of public negotiation processes in which different actors can and should participate (Logan, 1977, quoted in Kohring, 1997: 177). In other words: science in the mass media should be contextualized. The idea of a contextualized scientific public sphere has been developed in the "Public Engagement with Science and Technology" program as well as other participatory models of science and technology assessment (cf. Abels and Bora, 2004; Joss, 2003; Joss and Bellucci, 2002; Kreibich, 2004; Science, 2003). According to this model, the primary interest of the scientific public sphere must not be to serve the promotion of scientific statements, but rather to enhance societal discussions on science and technology. This may lead to acceptance of and support for certain kinds of research, but may also lead to their rejection. Thus scientific knowledge's claim to superiority is not automatically jettisoned, but is certainly put into perspective.

This model has become increasingly important in research into media reporting and the public sphere in recent years. Many comments by scientists and in political documents still contain statements which fall under the science-dominated model, but most authors writing on the science-media relationship agree on the development "from PUS to PEST," that is towards a contextualized discussion of science (Science, 2003; cf. similarly Durant, 2003; Kohring, 1997; Weingart, 2003: 118, 2005: 23ff.).

The implications of these models for mass media debates on science

Normative theories formulate ideal scenarios and function as blueprints for the evaluation or critique of concrete empirical cases. In order to apply the two models presented above to concrete cases, one has to specify what they imply for mass media debates: what would supporters of the science-dominated model and those of the contextualized model consider to be an ideal mass media debate on science?

When looking for answers in the literature on public and mass media communication of science, it becomes clear that many publications lack clarity on such questions. Although the literature does describe some functions the public sphere or the mass media should fulfill, no clear and empirically accessible dimensions are found that would allow for the measurement of whether specific cases match the normative demands outlined above.

It is safe to say that both models focus on the mass media to varying extents. The science-dominated model treats the mass media as the most important channel of communication by far (cf. Gregory and Miller, 1998), whereas the contextualized model also encourages debates in other public arenas, such as "consensus conferences," workshops, public discussions, etc. (cf. Joss and Brownlea, 1999; Mittman et al., 1999; Finney, 1999; Durant, 1999). However, both models contain statements about the form which mass media debates on science should take, although they differ in their interpretations.

We propose to systematize these statements by using a framework whose reliability has already been proven in analyzing mass media debates (cf. Ferree et al., 2002b; Gerhards and Schäfer, 2006). With this framework it becomes possible to adapt statements from the normative models in connection to the mass media and to operationalize them empirically. This is a necessary precondition for evaluating specific cases.

We first explain the dimensions of our framework and then relate them to both normative models. When describing public debates and assessing the influence of actors on mass media debates, we distinguish three dimensions:

a. *Standing:* Being able to have one's say in the mass media is already a considerable success for an actor, keeping the media's elaborate modes of selection in mind. If an actor is able to have his say, regardless of specific content, we refer to this as "Standing."
b. *Positioning:* Standing measures whether actors are able to express their views via the mass media, but it remains open as to which contents the actors communicate. The first aspect of these contents is the positions, i.e. the evaluations of a given topic that actors communicate. The actors can welcome or reject a topic, or adopt an ambivalent or neutral position. If they succeed in making their position on a certain topic into the dominant public opinion, then one can interpret this as a success for these actors in the mass media.
c. *Framing:* After adopting a position on an issue, most actors interpret it in a specific way, availing themselves of so-called "frames" (cf. especially Benford and Snow, 2000; Gamson and Modigliani, 1989; Gamson, 1992; Snow and Benford, 1988, 1992; Snow et al., 1986). Frames determine which aspects of an issue are important and which perspectives are deemed appropriate for viewing them. Frames also influence whether a certain issue is defined as a problem and which solutions are possible. Actors can achieve considerable successes in this dimension, too; via framing they are able to define the corridors of the discursively possible and can play a decisive role in narrowing down or extending the decision-makers' options for action.

The dimensions of Standing, Positioning and Framing, together with some fundamental structural characteristics, can be applied to both normative models presented here. The two models differ in all dimensions in their expectations of what constitutes a desirable public debate.

Supporters of the science-dominated model would consider the following conditions as a desirable outcome: in terms of the basic structural characteristics of mass media reporting, two demands are common. First, citizens need to have access to a large number of relevant articles in the mass media, as they require detailed information about the respective area of research. Second, media reporting should above all refer to events in science. Concerning Standing, scientists—not other "experts," politicians or actors from civil society—should dominate the debate. The same applies in the case of journalists playing an over-dominant role; journalists should first and foremost function as chroniclers, not as critics, of science. With regard to Positioning, a positive portrayal of science would seem favorable, especially considering that only those areas of research which are relevant from a scientific point of view and which, accordingly, have already been authorized by the scientists themselves should be presented. In the Framing dimension there should be a preponderance of scientific interpretations; non-scientific interpretations should be excluded when possible.

Supporters of a contextualized scientific public sphere would speak of a successful portrayal of science in the media if the following conditions were met: reporting should not only come about on the basis of scientific events, owing to the fact that other areas of society also have a legitimate right to initiate debates. It is not the public sphere's job to serve as an advocate for science, but rather to reflect various perspectives in society, whether they be political, economic, ethical, moral, scientific, etc., so that citizens can form their own opinions based on the different perspectives. It is entirely legitimate and desirable if a large number of actors from different areas of society take part in the debate, resulting in a varied Standing structure and also in an evaluation and interpretation of science which is similarly pluralistic and potentially controversial.

	Science-dominated public sphere	*Contextualized scientific public sphere*
Structure	Public communication on science should be foremost initiated by science.	Public communication on science does not necessarily have to be initiated by science; other areas of society have the right to initiate debate as well.
Standing	Scientists should be the principal actors in public discussions of scientific topics. The principal role of journalists is to chronicle or translate.	Scientific actors have no privileged status in the public sphere; actors from other areas of society and citizens' representatives should be equally well represented.
Positions	An informative and positive portrayal of science is desirable.	The evaluation of scientific topics is open; according to the opinions of the actors in society, positive or negative evaluations are equally legitimate.
Framing	Scientific interpretations of scientific topics should have precedence and dominate the debate.	Other interpretations are also possible, not only scientific ones. Different perspectives are desirable and help to promote a critical approach to science.

Figure 1 Normative models of the "Scientific public sphere" and their implications: Overview

The requirements of both models as regards media reporting on science can be summarized as in Figure 1.

3. Media coverage of human genome sequencing: an empirical example

Each normative model is grounded in different assumptions and makes different statements as to how mass media reporting on science should be. When applied to specific, concrete cases of science reporting, these models fulfill their purpose and serve as guidelines for the evaluation of the cases (cf. Ferree et al., 2002a; Gerhards, 1997). This application allows one to judge a given mass media debate from the respective model's perspective, and deduce recommendations to improve debate according to the chosen normative model.

In the following section, we illustrate one such comparison between the normative models and a specific case. In doing so, we do not wish to associate ourselves with one of the models; rather, our comparison serves as an example to show how the outlined normative models and their operationalization could be put to use by adopting a normative model.

We have chosen a bio-scientific topic, which is an especially suitable example for our analysis. In recent years biological science has been the fastest developing and probably most prominent field of science (Strydom, 1999). Moreover, the biological sciences have received considerable attention in the public domain and in the mass media (cf. Nelkin, 1995: 35ff.). "Red," "green" and other biotechnologies have been debated at length and in controversial ways (e.g. Bauer, 2002), which makes it an interesting field for the study of public debates. Normative standpoints are also highly relevant, in that mass media debates on bio-sciences all raise similar fundamental questions: what are the limits to the scientific search for knowledge? Where does the taboo area begin that biological sciences are not allowed to touch upon?

Our chosen topic for analysis is human genome research or "sequencing genomics," which refers to the sequencing of human DNA.[2] The debate on this issue occurred around the year 2000, was one of the most extensive of its kind and undoubtedly influenced subsequent

discussions on similar topics, such as stem cell research or pre-implantation genetic diagnosis (cf. Schäfer, 2009; Weingart et al., 2006). We also chose this topic, because in our view it seemed likely to ignite a contextualized debate. First, human genome research might be controversial due to the fact that it had to assert itself in competition with other areas of research (for the USA cf. Abels, 1992; for Germany cf. Schulze, 2005); and the public need for legitimation, as well as the need for legitimation within the scientific community, is always considerable for new fields of research. Second, human genome research is "big science," which means that it is long-term, financially and organizationally resource-intensive, internationally structured research (cf. Felt et al., 1995: 48ff.). Such projects mean that priorities must be changed and resources must be re-allocated, which usually creates "losers", who may become potential opponents. Correspondingly, the public and in-house scientific need for legitimation is considerable. Third, human genome research is done on humans. This makes the public need for legitimation even larger, considering that it is an area of research which touches upon basic questions of human existence. Fourth, major players, including the Human Genome Project itself, devoted significant resources to support further research on the "ethical, legal and social implications" of human genome sequencing, which initiated both scientific and societal debates (cf. Murray and Mehlman, 2000). Thus, human genome sequencing is a potentially controversial and societally contextualized debate. In the following section we describe media reporting on human genome research and relate the results to the two normative models.

Data and methods

The following description is based on a research project financed by the German Ministry for Education and Research that compared mass media debates on human genome research in Germany and the USA (cf. Gerhards and Schäfer, 2006). For our research, we carried out a content analysis of the mass media debates in both countries.[3] The content analysis was divided into two phases: first we carried out a qualitative analysis in which we specifically explored the contents of the debate. We then conducted a standardized, quantitative content analysis by looking into the reporting of quality German and US broadsheet newspapers. This content analysis also formed the basis for the analysis of Standing, Positioning and Framing.

Quality broadsheet newspapers were chosen because they are most likely to be read by elite groups, decision-makers and journalists, thereby influencing the decision-making process and providing topics for other media outlets (cf. Wilke, 1999). We chose the following papers to include in the analysis: the *Süddeutsche Zeitung*, the *Frankfurter Allgemeine Zeitung*, the *Washington Post* and the *New York Times*, which are the national quality dailies with the largest circulation in both countries.[4]

The material was coded on the following levels: first, the article served as a unit of analysis; second, the various speakers within the article (Standing); third, the evaluation expressed within certain statements (Positioning); fourth, the interpretations expressed on human genome research (Framing).

Results

Reporting on human genome research was extensive in both countries. There was a total of 1,040 articles in the German newspapers during 1999–2001, and 868 articles in the US newspapers. This translates to an average of one article per day in each country over the three-year period. Such high-density reporting exceeds that of most other bio-scientific topics.[5] The function of the mass media as society's central self-observation system has enabled citizens to acquire extensive information on genomics. But mere frequency does not tell us anything

Table 1. Standing in the debate on human genome research (in %)

	Germany	USA	Total
Scientific actors	**56.1**	**54.5**	**55.4**
Bio- / natural scientists	39.1	48.9	43.7
Social sciences/arts and humanities	10.4	3.1	7.0
Scientific administration	3.5	1.2	2.4
Other scientists and academics	3.1	1.3	2.3
Economic actors	**9.8**	**21.9**	**15.4**
Biotechnical/pharmacological companies	6.1	16.4	10.9
Stockbrokers / fund managers	2.6	3.6	3.1
Other economic	1.1	1.9	1.4
Centre of politics	**17.8**	**10.1**	**14.2**
Executive (government, ministries)	10.1	5.6	8.0
Legislative	1.3	0.7	1.0
Judiciary	1.6	0.7	1.2
Parties	0.8	0.4	0.6
Other politicians	3.9	2.7	3.3
Periphery of politics: civil society	**6.7**	**3.4**	**5.1**
Church	1.2	0.1	0.7
Social movements/NGOs	1.1	0.5	0.8
Patients/disabled/charity organizations	0.6	0.3	0.4
Artists	2.5	1.6	2.1
Other civil society	1.4	0.8	1.1
Various	**4.2**	**3.4**	**3.8**
Readers	3.8	3.4	3.6
Other actors	0.5	0.0	0.3
External journalists	**5.4**	**6.8**	**6.1**
N	*849*	*745*	*1594*

about the way in which the reporting was carried out, nor do we learn which normative model the media corresponded to. This subsection looks at the three analytical dimensions Standing, Positioning and Framing.

In the Standing dimension, debate is dominated by established societal actors in both countries (Table 1). Scientists by far make up the largest percentage of Standing. Within this category, it is biological and natural scientists, in other words the specialists in the field, who are the biggest actors. Only after a considerable margin do we find the political and economic actors. Actors from civil society, i.e. from the political periphery, are only marginally represented. These figures apply equally to both the USA and Germany. However, there are also some significant differences: political actors, actors from civil society, arts scholars and social scientists are more strongly represented in the German coverage than in the USA's. On the other hand, economic actors are more strongly represented in US reporting.

As far as Positioning in the debate is concerned, we see a largely uniform picture in both countries, with most actors supporting human genome research (Table 2). Supporters in both countries include representatives of the economy above all, followed by actors from the political, biological and natural science realms. Representatives from civil society, social scientists and arts scholars tend to be more critical. There are, however, small differences between the two countries. For example, there are lower levels of support and more critics in the German debate. We have shown elsewhere in more detail that such country differences can be traced back to differences in Standing structures (Gerhards and Schäfer, 2006: 230f.).

Table 2. Assessment of human genome research (in %)

	Germany	USA	Total
Positive	49.6	72.9	60.4
Ambivalent	30.9	20.6	26.2
Negative	19.5	6.4	13.5
N	*508*	*436*	*944*

Owing to the fact that economic actors and (biological and natural) scientists, who tend to evaluate the research positively, are over-represented in US media, human genome research is reported on more positively in the USA as compared to Germany. Civil societal actors, social scientists and arts scholars tend to be more critical of human genome research. These actors are over-represented in Germany, and human genome research is thus reported on more negatively as compared to the USA.

The range of possible interpretations in the Framing dimension is indeed quite extensive. We have distinguished four frames, each with several sub-frames (cf. also Durant et al., 1998: 288; Kohring and Matthes, 2002):

1. *Scientific-medical frame:* This frame consists of the conditions and restrictions on scientific work and also to its progress and results. Six sub-frames can be distinguished:
   a. Scientific progress: This includes all interpretations that interpret human genome research as a scientific and/or historical achievement and/or discuss the significance of developed methods and human DNA sequencing for biology.
   b. Medical progress: This sub-frame refers to the interpretation of human genome research from a medical point of view (i.e. discussions about which illnesses are of genetic origin and the discussion of possible diagnoses and therapies).
   c. Freedom of scientific research: This includes questions relating to the normative foundations of science, above all to freedom of research and the scientific community's own responsibility for the use of their results.
   d. General accessibility of scientific knowledge: We include in this category all questions relating to the accessibility of discoveries. The question was raised in this debate specifically as to whether the sequence of the human genome should be published free of charge or whether it could be patented for commercial use.
   e. Research funding: This refers to the financial and infrastructural promotion of human genome research.
   f. The self-regulation of science: Questions relating to the internal regulation and control of science, such as "peer review," ombudsmen or commissions make up this sub-frame.
2. *Economic frame:* We have summarized this second group of interpretation patterns into an economic conceptual framework, consisting of two sub-frames.
   a. Business management effects: This sub-frame refers to the economic consequences of human genome research for individual companies as well as to their profitability and developments in the stock market.
   b. Economic effects: The macroeconomic effects of human genome research fall into this category, such as strengthening the national economy, competition with other economies, or setting up new companies.

3. *Political frame:* This third group brings together political patterns of interpretation. Regulatory and participatory dimensions correspond to the input and output sides of the political system.
   a. Political regulation of genomics: This aspect refers to whether human genome research requires regulation in the political and judicial systems and also to the assessment of existing legalities.
   b. Society's participation in regulation: This sub-frame refers to the possibility of participation in decisions about human genome research, both in terms of whether participation exists and whether it is considered as a good idea.
4. *Socio-ethical frame:* The fourth group consists of ethical and social patterns of interpretation. This frame is very similar in content to the so-called "ELSIs" (Ethical, Legal and Social Implications).
   a. Concept of man: Here, the focus is on the concept of man as conveyed by human genome research, especially the extent to which humans and their behavior is determined by genetic or environmental factors.
   b. Discrimination: Discussions about the potential of genomics in accounting for genetically based discrimination by insurance companies, employers, etc. fall under this sub-frame.
   c. Property rights and patenting: This category consists of property and usage rights connected to genetic information. One such issue is the question of whether genetic information should be regarded as ownable and, if so, who should own it?
   d. General ethical and moral questions are also part of the socio-ethical frame.

A clear trend emerges when looking at the quantitative distribution of these frames in German and US mass media debates, namely that both debates are strongly dominated by scientific and medical interpretations (Table 3). In Germany this frame represents more than half of all reporting, and in the USA over two-thirds of all interpretations. The medical frame that includes new possibilities for diagnosis, possible therapies and long-term effects is the most highly represented frame (cf. Tambor et al., 2002: 35). Another important frame interprets human genome research as significant scientific progress, sometimes calling it a "breakthrough", a "milestone" or an "important event in the history of the human race".

The socio-ethical frame, in which genomics is interpreted according to ethical and social criteria, comes in at a far second to scientific and medical interpretations. The economic and the political frames are used least in both countries.

Differences in Framing between the two countries can partially be traced back to differences in the Standing structure (Gerhards and Schäfer, 2006: 232). Scientific and medical as well as economic sub-frames are more strongly represented in the US discourse than in the German. Political interpretations are stressed more strongly in Germany. This refers not only to questions of political regulation of human genome research, but also to interpretations that emphasize the participation of society as a whole. Ethical and moral interpretations are more often used in Germany than in the USA.

4. Discussion and outlook

Theories dealing with the public sphere are often normative, whether they be about the societal public sphere in general, or specifically about the question of how science should be discussed in the public sphere. Seeing how these normative models for a scientific public sphere are scattered across the existing literature, we have systematized them into two ideal-type

Table 3. Framing in human genome research (in %)

	Germany	USA	Total
Scientific-medical frame	**57.1**	**68.5**	**61.2**
Scientific progress	15.0	19.0	16.4
Medical progress	31.7	34.8	32.8
Freedom of research	2.3	1.9	2.2
Accessibility of scientific knowledge	4.0	9.3	5.9
Research funding	3.2	3.0	3.1
Self-regulation of science	1.3	0.5	1.0
Economic frame	**6.9**	**10.5**	**8.2**
Business management effects	4.6	8.2	5.9
Economic effects	1.7	2.2	1.8
Political frame	**9.8**	**4.6**	**7.9**
Political regulation of genomics	4.6	3.5	4.2
Participation of society in regulation	5.2	1.2	3.8
Socio-ethical frame	**26.2**	**16.4**	**22.7**
Concept of man	8.1	5.7	7.3
Discrimination	4.7	4.3	4.6
Property rights and patenting	7.4	4.7	6.5
General ethical and moral questions	6.1	1.6	4.5
N	*1681*	*928*	*2609*

models, proposed a way to empirically operationalize them, and have illustrated the possible benefits of such an approach by adding an empirical case analysis of the German and US mass media debates surrounding human genome sequencing.

We have thus distinguished the following two normative models of the scientific public sphere, although admittedly simplified: a science-dominated model and a contextualized model. These models differ from one another in a variety of ways. The science-dominated model is based on the view that science in the public sphere should be dealt with, portrayed and evaluated according to scientific criteria. The contextualized model, on the other hand, is based on the view that science is only one actor among many and that scientific discoveries are not superior by definition. According to this model, debates in the public sphere should not be limited to only scientific actors, but should include other content as well.

Differences emerge regarding the mass media based on the premises of the normative models. We systematized these differences using the dimensions of Standing, Positioning and Framing. According to the science-dominated model scientific actors should first and foremost be given their say in order to discuss scientific aspects in the stricter sense. The contextualized model advocates a pluralistic debate with a variety of actors, critical assessments of scientific aspects and a variety of different interpretations.

By analyzing the mass media debate on human genome research in Germany and the USA, we have also paid attention to which of the two normative models the debate most closely corresponds. We found a general public hegemony of scientific actors, positive evaluations and scientific-medical interpretations across different media and different countries.[6] We have shown elsewhere that this dominance can be traced back to extensive public relations efforts by scientific actors and their political supporters. These actors were able to mobilize considerable resources and to make use of their news value as prominent actors. Competition between the Human Genome Project and Celera Genomics has been an additional factor that drove both actors to intensify their PR efforts (cf. Gerhards and Schäfer, 2006: especially 183ff.; cf. also Nerlich et al., 2002; Sulston and Ferry, 2002).

The debate on human genome research corresponds more closely with the science-dominated public sphere model. Supporters of the contextualized model of the scientific public sphere may not be pleased with this outcome, in that the debate was not pluralistic enough from their point of view; alternative perspectives that focus more on ethical, moral and social questions have not been sufficiently considered, and critical actors from civil society received only marginal Standing. Our results show a "public hegemony" consisting of the supporters of human genome research and a lack of pluralistic reporting in both countries for this specific example (Gerhards and Schäfer, 2006; cf. with similar results Costa, 2003; Rödder, 2005; Smart, 2003). This outcome does not correspond to the requirements for the contextualized model, which is currently more prominent in relevant literature.

In showing how the two normative models can serve as a benchmark for empirical cases, we hope that the conceptual framework presented here will serve as a useful point of reference for further studies. We can imagine this to happen in three ways:

- Literature on science in the public sphere and in the mass media has thus far often contained normative elements which have not been explicitly spelled out. The normative models presented above make these elements explicit and organize them in a coherent theoretical framework.
- Normative elements in the existing literature often remain abstract and cannot easily be translated into empirical indicators. Our framework, which consists of Standing, Positioning and Framing dimensions, may help to make rather abstract theoretical elements empirically accessible.
- Such empirical measurement enables social scientists as well as other observers to easily decide whether concrete debates on science in the public sphere or in the mass media match either of the normative models. If these observers adopt a particular model, which we have not done in this article, the model may serve to evaluate concrete debates in a systematic way or serve as a base for political action. Based on perceived shortcomings in particular debates as compared to the normative models, they might emphasize the need for stronger participation by certain groups (e.g. in consensus conferences) or emphasize the need to critically train science journalists in the ELSI aspects of the issue at stake.

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Notes

1 This quote has been translated into English for this publication, as have several other quotes from German books and articles.

2 Genome research generally refers to the analysis of complete genomes including the number and arrangement of genes as well as their sequence and function (Hucho and Köchy, 2003: 3). In this article, we restrict ourselves to human genome sequencing research. Media reports on "functional genomics" are not included. More information on the basic technology, methods and aims of genomics can be found in Cook-Deegan (1995).

3 The exact method of our content and frame analyses is quite complex and exceeds the scope of a short journal article. For a more detailed description, see Gerhards and Schäfer (2006: 67ff.).

4 Average 2000 circulation figures for the four newspapers are as follows: 440,000 copies for the *Süddeutsche Zeitung*, 390,000 for the *Frankfurter Allgemeine Zeitung*, 1,160,000 for the *New York Times*, and 810,000 for the *Washington Post* (Informationsgemeinschaft zur Verbreitung von Werbeträgern, 2000; ABC, 2000).

5 Data from a project on German press coverage on molecular medicine from 1995 to 2004 show that human genome research was one of the most prominent bio-scientific topics in German press reporting and considerably exceeded coverage on the cloned sheep Dolly, for example (Weingart et al., 2006).

6 We have also examined the validity of our results for Internet news coverage on human genome research. We found that communication is dominated by scientific actors, that the Positioning of these actors is mostly positive, and that interpretations are largely scientific-medical even in this new and allegedly egalitarian public sphere (Gerhards and Schäfer, 2007). Analyses of French, British and Austrian print media showed a similar picture (Gerhards and Schäfer, 2006: 169ff.). Irish (O'Mahony and Schäfer, 2005), Italian (Costa, 2003) and Spanish (Davo and Álvarez-Dardet, 2003) print media seem to follow the same pattern.

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