Framing of science issues in opinion-leading news: international comparison of biotechnology issue coverage

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This paper tests how the biotechnology issue, as an example of a major contemporary scientific debate, was framed and reframed by opinion-leading newspapers in Germany, Britain and the United States during the years 2000–2. The research design suggests a theoretical foundation of structure frame categories on the article level, combined with frames on the argument level. Argument framing is analyzed in actors’ statements and journalists’ own comments. Article framing is analyzed as structures and interpretative patterns in the whole news item. Comparative and cluster analysis of structure frames on the article level, argument frames, and single attributes of the text, shows that certain reframing takes place when media attention increases, in the form of a stronger ethical discourse in Germany and a more prominent public discourse in Britain. In the US opinion-leading press, the scientific-economic discourse is consequent.

1. Biotechnology in public opinion and in the media

Public attention as well as news media attention to an issue is limited to a short period of time: the attention increases, “peaks,” and then decreases again (Luhmann, 1970; Downs, [1972] 1991). This study tests how biotechnology issue coverage changes over time with the dynamics of media attention in the United States, Britain, and Germany.

It is questionable if one can speak of a single “biotechnology issue,” since there is such a rich variety of biotechnology applications. Modern applications of genetic engineering and reproduction are the main reason for contemporary public discussion about biotechnology and thus prime public definitions of the term. Owing to its complexity, biotechnology like most science issues, is unobtrusive to the general public most of the time. When the public perceives information about the science issue, it is mainly in the form of news media content (Kepplinger et al., 1991; Gaskell et al., 2001a, 2001b; Nisbet and Lewenstein, 2002). In all countries, biotechnology found more media attention when some of its specific applications caused key events, especially politically overt debate (Kepplinger et al., 1991; Gaskell et al., 2001a, 2001b; Nisbet et al., 2003). When the issue gets increased attention in news media, readers are likely to pay more attention to it, which makes peaking coverage especially important for public forming of opinion about the issue. This study develops a research design that analyzes coverage changes on a monthly basis to grasp these short but highly relevant phases of increased media attention.
Earlier research has established that certain changes occur to the coverage when the issue gets more media attention and becomes more politically overt:

First, a comparison of media attention and tendency on a yearly basis showed that when the former increased, the latter turned more negative (Gaskell et al., 2003). Key events and especially politically overt themes changed the tendency of the whole coverage in a more negative way, whereas less controversial themes regarding basic research and medical applications remained positive (Nisbet and Lewenstein, 2002; Gutteling et al., 2002).

Second, peaking issues were found to “move” within the newspaper, from the scientific and economic newsbeats to the political newsbeat. Thus, media attention increased because political journalists had picked it up (Keplinger et al., 1991; Nisbet and Huge, 2006).

Third, actors from political, economic, and scientific institutions were found to dominate the debate about the biotechnology issue in the public news media arena in Germany (Keplinger et al., 1991; Kohring et al., 1999; Merten, 1999), Britain (Gaskell et al., 2001a; Anderson, 2002), and the United States (Nisbet and Lewenstein, 2002; Nisbet et al., 2003; Nisbet and Huge, 2006). Comparative research also found a similar dominance of such institutional actors in all three countries (Kohring et al., 1999). However, media attention peaks were found to bring more attention to arguments from alternative actors, such as non-governmental and religious organizations, or reactions from public protests or critical experts (Gaskell et al., 2001a; Kohring and Matthes, 2002; Nisbet et al., 2003).

Fourth, a predominant share of the coverage frames the technology according to its usability. This was shown in Germany (Hampel et al., 2001; Kohring and Matthes, 2002), Britain (Kitzinger and Reilly, 1997; Gaskell et al., 2001a), and the United States (Ten Eyck et al., 2001; Nisbet and Lewenstein, 2002), indicating that science and economy journalists normally let scientific, business, or political actors describe the use of the technology in “routine coverage.” However, increased media attention also resulted in a reframing of the coverage, meaning that more room was given to frames other than usability (Gaskell et al., 2001b; Kohring and Matthes, 2002; Nisbet et al., 2003). So far, these changes were analyzed mainly on a yearly basis, measured as the contrast between coverage before and after a key event. This study investigates such changes on a monthly basis and compares them between countries.

2. Framing of the biotechnology issue

The framing concept allows media content to be studied in a direct approach, however the definition of what a frame is tends to vary depending on research interest. According to Pan and Kosicki (1993: 55), frames in the news media text must be operationalized through analysis of syntactic structures and script structures, but also through their theme and rhetoric. However, it is important to distinguish between the script structure on the article level, which is interpretative, and the attributes on the argument level, which are quantifiable and describe a certain salience. Furthermore, interpretative frames on the article level are based on theory and are pre-defined, constructed before the content analysis (Gamson and Modigliani, 1989), whereas the salience of attributes on the argument level opens beneficial opportunities for post-defined frame constructs, i.e., to construct the frames from combinations of attributes that proved to be salient in the analysis (Kohring and Matthes, 2002: 145).

This important distinction enables a methodologically beneficial triangulation of three kinds of measurable variables: 1) single argument attributes, 2) the combination of salient attributes in argument frames, and 3) theory-based structure frames on the article level. The triangulation of article level and argument level results enables a detailed understanding of how the biotechnology issue was framed and reframed during changing media attention.
Argument attributes can be understood as the “aspects” in Entman’s definition of framing as to “select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation and/or treatment recommendation” (Entman, 1993: 52). In this study, the measured attributes are the actor stating the argument, the specific theme that is argued about, the focus\(^3\) and dimension\(^2\) of the argument, and the valence regarding biotechnology. Similar attributes have been operationalized in the second-level agenda-setting approach (e.g., McCombs et al., 2000) as well as in priming research (e.g., Iyengar and Simon, 1993).

Argument frames are operationalized in line with Kohring and Matthes, who argued that framing is a “certain pattern in a given text that is composed of several different text elements” (Kohring and Matthes, 2002: 145). The combination of attributes in an argument creates a specific pattern in the text, i.e. the argument frame. The methodological benefit of this operationalization is that argument frames are not pre-defined but created as a result of the analysis, based on how frequent different attribute combinations are.\(^3\) The framing of the issue in each argument is captured by its specific combination of dimension and focus. This approach opens many opportunities, for example to study how specific actors framed their arguments and evaluated the issue.

Structure frames are defined as “a central organizing idea or story line that provides meaning to an unfolding strip of events” (Gamson and Modigliani, 1989). These frames on the article level must be pre-defined and based on theory, earlier research, and pre-analyses of the media text. The structure frames in this study were developed with the aim to create a set of pre-defined structure frames which could be valid for all kinds of science issues, enabling comparisons beyond the specific biotechnology issue.

Culture theory (Thompson et al., 1990) was used as reference for developing frame categories based on criteria that were often applied in earlier research but rarely motivated theoretically. When based on two alternative relations between Man and Nature—on the one hand, the view on Nature as controllable by Man or not; on the other hand, the relationship between Man and Nature as separated or integrated—the key is found to a matrix that allows an empirical analysis of four structure frame categories: Utility, Risk, Control, and Fate. An additional fifth frame is the Morality frame, focused on ethical aspects of the biotechnology issue. These five structure frames form different patterns, through which the public definition of science issues in general and the biotechnology issue in particular can be debated and positively or negatively evaluated. None of the structure frames are by definition connected to a certain evaluation of the issue.

- **Utility**: Nature is a human resource to be used as long as it is beneficial for human life. Man can use natural resources in a “trial and error” approach, because Nature is expected to survive and cope with human intervention.
- **Risk**: Nature is seen as too powerful to control. Complex technology is a risk because it has impacts on Nature which cannot be managed by Man. Even the smallest change in Nature may have disastrous consequences, and Nature must thus be treated with great care.
- **Control**: since each alteration has an impact on all of humankind, the changes on Nature inflicted by Man must be under strict control, carefully regulated through political authority. Nature can be used to certain limits, which must be regulated and are not to be trespassed.
- **Fate**: the fatalist approach. Since Man is an integrated part of the changing Nature, it is out of human hands to control any changes (Beck, 1986: 45). The scientific process is a part of the natural way of development. Man cannot control the changes in Nature but only try to cope with the consequences.
- **Morality**: the issue was also covered in terms of its moral implications. The moral frame was identified when ethics and morality were explicit interests of the coverage.

This framing approach was applied in a comparative analysis of opinion-leading news media biotechnology coverage in Germany, Britain and the United States to study if there are differences between the countries and how the dynamic biotechnology coverage changes over time.

**Hypotheses**

Based on earlier research elaborated above, the following hypotheses were tested:

(H1) In all countries, increased media attention can be explained by politically overt key events and leads to a “move” of the biotechnology issue to the political section of the newspapers.

(H2) The news press in all countries selects institutional actors rather than alternative actors as argument sources in the coverage, but when media attention to the issue increases, alternative actors are more frequently selected.

(H3) In all countries, argument frames regarding the scientific, economical, or political dimensions (institutional frames) are more frequent in the coverage than argument frames about societal, ethical, risk, or environmental effects (alternative frames), but the share of alternative frames increases with increasing media attention.

(H4) The utility frame is the most dominant structure frame in all countries, but when media attention peaks the coverage is reframed by increasing shares of alternative structure frames (*control, morality, risk, fate*).

(H5) In each country, the relationship between argument and article framing creates a nationally unique discourse, which grows stronger when media attention increases.

3. **Methodology**

The content analysis was conducted on a representative sample of coverage about biotechnology in two opinion-leading newspapers in Germany (*Sueddeutsche Zeitung, Frankfurter Allgemeine Zeitung*), Britain (*The Guardian, The Times*), and the United States (*New York Times, Washington Post*). This newspaper selection enables a reasonable comparison between countries, taking into account public reach, targeted readers, political impact, political position, and editorial style. The sample contained c.7 percent (2,544 news items) of the estimated total coverage in each newspaper during the time period 2000–2 and was drawn from the LexisNexis database with a search string based on earlier research and pre-analysis of news content in the three countries. The news content was coded by three scholars, who, after coder practice, reached an average inter-coder reliability of 0.91 for the variables on the article level, e.g., structure frames and general tendency, and an average of 0.68 for the more complex variables on the argument level, e.g., the actor, theme, dimension, focus, and valence of the argument. The main reason for the lower reliability on the argument level was the difficult identification of arguments in the text: if an identical argument was repeated in the same text it was to be coded only once, but if any attribute in the argument changed, the argument was to be coded again. Considering the additional complexity of multilingual analyses, the reliability was acceptable.
All variables were measured in terms of 1) salience in the coverage, and 2) share of coverage over time. Salience was measured as the quantity of news items or arguments that contained the variable for the whole time period 2000–2 and is presented below as the share of total coverage in each country. The dynamic analysis unit for the three-year time period was the frequency measured as share of total coverage per month, resulting in 36 cases for each calculation of a correlation: the news value of a variable means the strength of the correlation between the share of coverage where the variable is found and the media attention frequency per month. The polarization of a variable is the strength of the correlation between the variable’s valence balance and the total media attention per month.

4. Results

The general tendency of the coverage was more often positive than negative in all countries. The positive share of news items measured 53 percent in Germany and Britain, and 67 percent in the United States. Although not significant at this general level, increasing media attention led to a slightly more negative tendency in German (−.071) and British (−.286) news, whereas the US coverage tendency (.311) changed to the positive.

Issues

Partly confirming the first hypothesis, primarily politically overt themes created the peaks in the media attention of all three countries (Figure 1) but only in Germany the issue moved significantly to the political section (Table 1). In Germany, the stem cell controversy about whether or not to allow the use and import of embryonic stem cells for research purposes caused attention peaks in June and November 2001. The issue was at these times discussed in the German parliament. The news values indicate that pre-implantation diagnostics also found more attention in Germany, as if the controversial stem cell issue also opened up these news media for a broader debate about biotechnology and birth. In Britain, the genetically modified (GM) crops issue coincides with the strongest coverage peaks: in May 2000, the Prince of Wales publicly condemned GM food, and Scottish farmers discovered that they had mistakenly sowed GM rogue seeds. In May 2002, environmental activists destroyed a GM crop trial field and Prime Minister Blair condemned this action in a public speech supporting GM trials. However, GM foods and plants did not show significant news values, indicating that they were not controversial themes comparable to the stem cell issue in Germany and the United States. Gene therapy and DNA sequencing showed significant news values, but received limited coverage. In the United States, the coverage peaked in July and August 2001, when the newly elected President Bush had to decide, whether or not to support research on stem cells from human embryos with governmental funding. No other biotechnology themes found increased media attention, indicating that the stem cell issue was more strongly associated with the new presidency than with biotechnology.

Actors

The second hypothesis could only be partly confirmed. Indeed, the actors making statements in the coverage frequently represented politics (Germany 23 percent, Britain 16 percent, US 18 percent), science (17 percent, 13 percent, 14 percent), and business institutions (8 percent, 11 percent, 16 percent). However, they were frequently accompanied by journalists’ comments (18 percent, 19 percent, 17 percent) and public voices of some kind (8 percent, 15 percent,
Alternative actors, such as non-governmental or religious organizations found very little attention for their arguments, only 3 percent in the United States and 5 percent shares in Germany and Britain. When media attention increased, several actors increased their statements and they were increasingly polarized: in Germany and Britain, science actors (Germany .646**, Britain .653**) argued more positively and religious actors (−.631**, −.748**) and journalists (−.429**, −.645**) argued more negatively. In the United States,

Table 1. Theme argument shares and news value for themes and sections

<table>
<thead>
<tr>
<th>Argument share</th>
<th>Germany %</th>
<th>Britain %</th>
<th>United States %</th>
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<tbody>
<tr>
<td>Theme selection</td>
<td></td>
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<tr>
<td>Stem cells</td>
<td>27</td>
<td>GM crops/food 21</td>
<td>Genetic information 25</td>
</tr>
<tr>
<td>Research</td>
<td>25</td>
<td>Economy 21</td>
<td>Economy 17</td>
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<tr>
<td>Economy</td>
<td>21</td>
<td>Genetic information 15</td>
<td>Stem cells 15</td>
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<tr>
<td>Sequecing</td>
<td>11</td>
<td>Biomedicine 12</td>
<td>Research 14</td>
</tr>
<tr>
<td>Genetic information</td>
<td>11</td>
<td>Research 12</td>
<td>Biomedicine 13</td>
</tr>
<tr>
<td>Biotechnology in general</td>
<td>11</td>
<td>Stem cells 10</td>
<td>GM crops/food 11</td>
</tr>
<tr>
<td>Pre-implant diagnostics</td>
<td>.572**</td>
<td>Gene therapy .458**</td>
<td>Stem cells .590**</td>
</tr>
<tr>
<td>Sections</td>
<td>Political .395*</td>
<td>Economy −.349*</td>
<td></td>
</tr>
</tbody>
</table>

*Measured as shares of news items where the theme was mentioned. N = 905 (Germany), 769 (Britain), and 869 (US) news items. Only themes with shares 10% included.
** Correlation is significant at the 0.01 level. * Correlation is significant at the 0.05 level.
religious actors (−.476**) alone were negatively polarized against more positive science actors (.497**), business actors (.524**), and journalists (.429**).10

Argument frames
The third hypothesis cannot be fully confirmed, because although arguments framed by science, politics, or economy are frequent, the most frequently argued frame is about societal effects (Germany 12 percent, Britain 16 percent, US 14 percent), focusing on technology impacts on society or health. Its popularity indicates that both proponents and critics claim the right to define the technology in terms of its societal effects. It must however be remembered that since organized protest movements are rarely included in the coverage, it is more frequently journalists themselves, selected voices from the general public, or institutional actors who do it. Other frequent argument frames are ethical effects in Germany (9 percent) and risk effects in Britain (12 percent) and the United States (10 percent). In all countries, ethical frames have the highest news values: in Germany, ethical importance (.542**) and effects (.539**) are emphasized along with the political positioning frame (.543**); in Britain the ethical importance frame (.369*) increased the most, whereas in the United States the ethical impact (.392*) and ethical importance (.495**) frames are accompanied by the argument frame concerning political position changes (.465**) regarding the technology. This indicates a strong focus on ethics in Germany, on ethical and other public consequences in Britain, and on ethics and the new presidency in the US press.

Structure frames
That the utility frame (Germany 55 percent, Britain 65 percent, US 69 percent) would dominate the coverage was well established in earlier research and the fourth hypothesis was also confirmed by this study. The view of Nature as separated from Man, and Nature as a controllable resource at Man’s disposal, is deeply rooted in these three Western post-industrialized countries. Knowing that the utility frame was so dominant, was there ever a reframing of the coverage? Did more problematic structure frames ever become more frequent in the coverage than the utility frame? Comparing the frequency of the utility frame with the total frequency of the alternative structure frames for each month (Figure 2) shows that there were such occasions and that they were strongly correlated with the peaks of increased media attention. This reframing was most strongly indicated in the German newspapers, less so in Britain, and the least prominent in the United States. Such temporary breaks in the dominance of the utility frame would not have been visible if the study had measured frame frequencies on a yearly basis, thus showing the relevance of studying monthly, or even shorter, time units.

Different discourses
The results indicate that, next to the dominant utility frame in the routine coverage, the brief peaks of increased media attention caused some reframing, stronger in Germany and Britain, weaker in the United States. The reframing in Germany was focused on the stem cell issue and characterized by an ethical discourse that was led by frequently quoted ethical experts, often involving political, scientific and societal argument frames. In the British coverage a public discourse was observed that focused more on arguments from journalists and the public about ethical effects, as well as risks and environmental effects of GM crops and food. The US press, even during times of increased media attention to the stem cell issue, continued to cover the biotechnology issue mainly through a scientific-economic discourse. Even when attention to
the stem cell issue peaked, institutional actors and journalists dominated the coverage with positive arguments about societal effects and other alternative argument frames.

The relationship between article frames and argument frames was tested through a cluster analysis for each country (Table 2). In all countries, the results indicate dominant utility and control frames, but they connect to different argument frames and, thus, confirm unique national discourses. In Germany, the most prominent cluster included both the morality and the control frames. They were connected to arguments about societal and ethical effects of the technology, confirming the strong ethical discourse. In Britain, the utility frame was most prominent in combination with arguments on risk effects. This confirms a British discourse with emphasis on public risk. In the United States, typically institutional framing is found in the two most prominent clusters, confirming a strong scientific-economic discourse.

5. Discussion

News selections that decide the coverage content lie in the hands of news media journalists and editors. They decide which issues to include or emphasize and which to play down or ignore, based on their perception and interpretation of the issues at hand. They also decide which actors to include, which arguments to publish and how to frame and evaluate an issue. This study suggests that these news selections are largely similar in the three countries during routine coverage, however, when media attention increases, the selections made by opinion-leading news media indeed set nationally unique discourses, within which the biotechnology issue is reframed at times when it is most obtrusive to the public. Since public attention to this mostly unobtrusive issue is focused on those short periods of time when media attention increases and biotechnology turns into a public issue, the reframing of the issue is relevant to the understanding of how mass media coverage may influence public opinion.

When asked: “Do you think [biotechnology] will improve our way of life in the next 20 years, it will have no effect or it will make things worse?” 69 percent of the US respondents believed in long-term improvement, whereas only 40 percent of the German respondents and 37 percent of the British respondents shared that belief. The share of negative respondents was c.10 percent in all countries, whereas a higher rate of respondents in the European countries did
The reframed coverage peaks in German and British press could partly explain why German and British respondents let ethics and risk aspects influence their support of the technology more strongly than US respondents do. However, no clear causality between media coverage and public opinion could be tested here, owing to the lack of comparable surveys able to register effects of these short media attention peaks. Moreover, it is likely that the national differences discussed here are embedded in national culture and reflected in public opinion as well as in opinion-leading press coverage. For example, comparable discrepancies exist between the national regulatory systems (Jasanoff, 2005).

This paper aimed to prove that the public biotechnology issue can be more thoroughly understood by a combined analysis of article and argument level, which should hold true for other public issues as well. The structure frames are theoretically valid and can be applied for any public issue that is connected to the use of natural resources. The dimensions and foci of the argument frames may be refined to fit other specific issues. Future research may benefit from extending the analysis of these frames to other science issues, other news media, or other public arenas.

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Notes

1 Use, Impact, and Management.
Salient combinations of Focus and Dimension form argument frames, for example the dimension “Science” and the focus “Impact” form the frame *Development*, and the dimension “Politics” and the focus “Management” form the frame *Regulation*. For a full list, see Listerman (2007).

The sample was representative in its relative share of coverage for each newspaper and, importantly, also representative over time, reflecting monthly changes in media attention for each newspaper.

German search string: Biotech! OR Geneti! OR Gentech! OR Klon! OR Embryo! OR Genoms OR Erbgut! OR Genen OR DNS OR Genforsch! OR Stammzell! OR DNA OR Venter OR Gentherap! OR Genman! OR Genseq! OR k*nstliche Befruchtung OR Genanaly! OR Gent! OR Genpat! OR Retortenbab! OR Pr* Implant!

British/US search string: biotech! or life science or genetic! or genome! or dna or clone! or cloning! or embryo! or stem cell! or gmo or gm food! or gm crop! or ivf or in-vitro fertilization or in-vitro fertilisation or venter or gene therapy or test tube bab! or xenotransplant or bioremediation.

More details on the research design are found in Listerman (2007).

In Listerman (2007), the news values were operationalized as the correlation of the variable frequency with the total coverage frequency per month. As noted by Professor Hans Peter Peters, this would allow also for randomly related variables to show significant correlations. Therefore, the news values were recalculated for this article, using the share of the total coverage where the variable is included, instead of its frequency.

Arguably, these events could be viewed as “after quakes” from the major media attention caused by the GM crops and foods issue in the later years of the 1990s (cf. Gaskell et al., 2001a; Frewer et al., 2002), where the reframing of the issue was shown to be evident. Although the years 2000–2 were not as dramatic in Britain as in Germany or the United States, the events that occurred did cause clear increases in media attention on a monthly basis and are therefore suitable for the purposes of this study.

Measured as shares of arguments stated by each actor. \(N = 5,015\) (Germany), \(3,482\) (Britain), and \(4,604\) (US) arguments.

** Correlation is significant at the 0.01 level.


Frequent surveys before, during and after media attention peaks seem to be required for media effects studies. Frewer et al. (2002) found effects when measuring public opinion before, during and after the media attention peaks in Britain in spring 1999, and so did Bonfadelli et al. (2002) in Switzerland. Analyses of less frequently polled surveys could not as convincingly confirm media effects hypotheses, e.g., Mazur’s hypothesis (Gutteling, 2005) or cultivation (Bauer, 2002, 2005).

References


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