Is the Negative More Relevant than the Positive? Cognitive Responses to TV Programs and Newspaper Articles on Genetic Engineering

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Abstract

That media reporting on technologies has a strong impact on the corresponding beliefs and attitudes of the audience is an often expressed but hardly proven assumption. A number of hypotheses have been proposed and empirically tested. Due to methodological difficulties the results were often inconclusive. The work described here uses an approach different from those used in previous studies. It is based on the “cognitive response approach“ as the methodological and analytical framework. The main hypothesis is that the same media messages may evoke very different cognitive responses in the recipients and, hence, may have different impacts on e.g. attitudes.

Two empirical studies were conducted. In the first study 338 test recipients read three short newspaper articles on genetic engineering. After finishing each article they were asked to remember and verbalize the thoughts they had had when reading the text. In the second study 51 test recipients watched three short TV films on genetic engineering. They were asked to “think aloud“ and to verbalize their thoughts while watching the films. In both studies questionnaires were administered before and after the reception of the stimuli, measuring (among other variables) pre- and post-attitudes, knowledge level and psychological features of the test recipients.

In total, more than 4,500 “cognitive responses“ were documented and analyzed. All in all, both studies yielded consistent results. About 60 percent of the thoughts were evaluative responses to different aspects of the films or articles. The recipients reacted far more often with criticism and negative evaluations than with approval and positive evaluations. Furthermore, there were more than four times as many thoughts critical of than favorable to genetic engineering. No consistent relationship between the slant of the stimuli (pro or contra genetic engineering) and the ratio of critical and affirmative thoughts during their reception was found. The only strong predictor of the ratio of responses positive or negative to genetic engineering is the recipients’ attitudes. Consistent with the cognitive response approach, attitude change effects could be attributed to the number of positive and negative responses evoked during reception.

Introduction

The impact of mass media coverage about science-based innovative technologies on public attitudes toward these technologies concerns many people in government, industry and science who favor a public that readily accepts technological innovation. Frequently, mass media are reproached for biased reporting focusing on risks and ignoring the benefits of technologies thus constructing a biased media reality that is useless or even misleading in dealing rationally with technological innovation (e.g. Kepplinger 1989). The media criticism usually comes as a double argument. First it is claimed that media in one way or another distort reality when reporting on controversial technologies. This is often empirically supported by content analyses. Secondly, the argumentation is completed by elaborating a hypothesis about the impact of biased reporting on the audience's opinions and attitudes.[1]

Whether a media bias in the reporting on innovative technologies exists or not is not the subject of this paper. The study reported here deals with the second part of the media-critical argumentation. It focuses on the reception of quite typical examples of mass media coverage on genetic engineering and its effects on attitudes.

A number of competing hypotheses concerning the impact on public attitudes of reporting on controversial technologies were proposed, three of which will be briefly sketched.

First, there is the assumption that the evaluations of a technology in the media coverage are transformed directly into the audience's attitudes. The more critical a coverage is with respect to technologies the more negative will the attitudes of the audience become and vice versa (Kepplinger 1989). The crucial factor of media coverage according to this hypothesis is the amount and direction of evaluations of the technology included in the coverage (i.e. the media slant).

A second hypothesis which modifies the first one is proposed by the "quantity of coverage theory" of Allan Mazur (1990). Mazur claims that the public image of a controversial technology becomes increasingly negative as the quantity of coverage on that technology increases – even if the coverage is balanced. Implicitly, he assumes an asymmetric perception and/or processing of negative and positive information. He supposes that negative aspects of a mixed message will have a larger impact on the image than positive aspects, particularly if the reception is casual.

The third hypothesis to be mentioned here is put forward by Stanley Rothman (1990). He argues that lay people are guided by experts whose opinions they learn from the mass media. According to this thesis lay people will tend to adopt the expert opinions as long as there appears to be a consensus among the experts. The relative frequency of experts with different opinions cited by the media is therefore, for Rothman, a crucial factor in the impact of media coverage on public attitudes toward controversial technologies.

All of these hypotheses focus on the relationship of media stimuli and attitude change and ignore the cognitive processes taking place during the reception of media products. Empirical studies of the above-mentioned hypotheses mostly relied on analyses on the aggregate level comparing changes of coverage with

[1] For a detailed discussion of the criticism of mass media reporting on technological and environmental risks see Dunwoody & Peters (1992) and Peters (1995).

changes of public opinion (Kepplinger 1989, Mazur 1990), comparing the use of expert sources in the coverage with perceptions of the distribution of opinions in expert communities (Rothman 1990) or comparing risk perception of readerships of different newspapers reporting differently on the risk sources (Wiegman et al. 1989).

Rather than trying to test one of the above media impact hypotheses directly the study described in this paper focuses on the reception process. What is going on in the minds of people reading a newspaper article or watching a TV film? These processes have too long been treated as a "black box". This study therefore uses a completely different methodological approach from those mentioned above and is oriented to the "cognitive response approach" (CRA) (e.g. Perloff & Brock 1980; Breckler & Wiggins 1991; Miller & Colman 1981).

In contradiction to the classical message learning theory (e.g. Hovland, Janis & Kelley 1953) this theory assumes that it is not the message that recipients learn but rather the self-generated thoughts, i.e. the cognitive responses (CR), evoked by the message. The cognitive responses are then thought to influence attitudes. Not positive or negative evaluations in the message but CR in favor of or critical to a technology evoked by the message influence the recipients' attitudes according to this theory. The CRA does not rule out the possibility of effects as predicted by message learning theory but it cautions against expecting them under all circumstances.

This distinction between learning the message and learning message-induced cognitive responses seems rather over-subtle without the further assumption that there is no straightforward relationship between the content of the message and the thoughts evoked by it. Counterarguments are a priori as plausible a response to a message as thoughts congruent with it. The kind of responses evoked may vary strongly from one recipient to the other. Pre-knowledge, pre-attitudes, cognitive competence and personality of the recipients, for example, are thought not only to modify the effects of a message to some degree (as also message learning theory would grant) but are considered crucial for the generation of cognitive responses to that message.

The CRA thus leads us to expect the possibility of attitude change counter to the slant of the message as well as a great variance of responses and attitude change effects dependent on recipients' characteristics. Using the cognitive response approach as a methodological framework implies looking at the cognitive responses evoked by messages and their dependence on the recipients' characteristics.

Genetic engineering (GE) as a complex innovative technology with mixed public acceptance in Germany (Hampel & Renn 1998) and a media coverage that according to content analyses seems to be quite balanced on the whole (Kepplinger, Ehmig & Ahlheim 1991; Ruhrmann, Kohring & Görke 1997; Giegler & Merten 1997) provided the context of this study.[2] It is an exploratory study focusing on a number of research questions but not trying to test specific hypotheses. Four research questions are addressed in this paper:

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[2] This study was part of the compound project "Chancen und Risiken der Gentechnik aus der Sicht der Öffentlichkeit" ("Chances and Risks of Genetic Engineering as Seen by the Public") coordinated by the Akademie für Technikfolgenabschätzung in Baden-Württemberg, Stuttgart, and funded by the German Federal Ministry of Education, Science, Research and Technology.

(1) What kind of thoughts are induced by mass media coverage of genetic engineering in ordinary audiences? Which evaluations are included in these thoughts? In particular, we wanted to check the psychological assumption of differential processing of negative and positive information in Mazur's quantity of coverage theory.

(2) How are evaluations of genetic engineering in the CR linked with the slant of the articles and TV films used as stimuli?

(3) Which recipient characteristics influence the nature of the CR evoked? In particular we were interested in the impact of pre-attitudes, cognitive resources and motivation to process messages. An influence of pre-attitudes on cognitive information processing is assumed by a number of theories, e.g. cognitive dissonance theory (Festinger 1957) and congruency theory (Osgood & Tannenbaum 1955). "Cognitive resources" and "motivation" are crucial variables in the elaboration likelihood model (Petty & Cacioppo 1986) and are thought to influence the decision between a central and a peripheral route of message processing.

(4) Is there a relationship between evaluations in the CR and attitude change? Based on the CRA we hypothesize that the direction and amount of attitude change is influenced by the number and valence of evaluations in the CR. We expect that the number of CR favorable to GE evoked during the reception process is correlated positively with attitude change (i.e. attitude change towards the positive) and that the number of evaluations critical of GE is correlated negatively with attitude change.

Method

Study design

Two studies with a similar methodology were conducted involving test recipients selected randomly from the telephone directory in two regions of Germany (Münster and Stuttgart). In the first study (print study) three short newspaper articles on genetic engineering were presented to 338 test readers in the context of face-to-face interviews. Articles A and B were read by all test subjects, articles C and D were presented alternately.[3] The articles dealt with different applications of GE and were neutral to positive toward genetic engineering. Before and after the presentation of the articles the test subjects answered a number of questions from which several scales were derived (see Table 1).[4]

After reading each article the recipients were asked to recall and verbalize their thoughts while reading the text according to a modified "thought list technique" (Huber & Mandl 1994). The given thoughts were written down by the interviewers and later categorized by means of content analysis.

[3] The purpose of the alternate presentation of article C and D was to introduce an experimental design which is not discussed in this paper.

[4] Due to limited space the full methodological details of the survey questions and the scale construction are not given here. Further methodological information may be requested from the author.

In a second study (TV study) three TV films on genetic engineering of about eight minutes each were presented in separate sessions to 51 test viewers in a laboratory setting. The films dealt with different aspects of genetic engineering and were partly critical of and partly favorable to GE. The subjects of this study also answered a number of questions before and after the video presentation. Because of the smaller number of test recipients and the resulting limitations for multivariate statistical analyses only an abbreviated version of the questionnaire used in the print study was administered.

The test viewers were asked to verbalize the thoughts they had while viewing the films according to the "thinking aloud" technique (Weidle & Wagner 1994). If they wanted to make a longer comment they could stop the video. The comments were recorded on one track of a magnetic stereo cassette while the film sound was recorded on the other track. This technique allows the passage of the film to which a comment refers to be identified. That proved to be important for the later content analysis because it made it easier to reconstruct the meaning of comments which were often very short and fragmentary.

Besides the test recipients' pre-attitudes and post-attitudes which were determined using two different methods in each of the studies (Likert scale and semantic differential), four other variables were measured in the print study (see Table 1). "Knowledge level" and "education" are used as indicators of the recipients' cognitive resources in dealing with the coverage; "interest in genetic engineering" and "need for cognition" are used as indicators of the recipients' motivation to carefully watch and process the media stimuli.

Table 1
Overview of variables describing characteristics of test recipients

Variable	**Scale construction**	**Print study**	**TV study**
Pre-attitude I	Likert scale consisting of 8 items expressing possible risks and benefits of GE	x	x
Post-attitude I	Same as pre-attitude I (different items)	x	x
Pre-attitude II	Summary index calculated from a semantic differential with 8 adjective pairs loading on the evaluative dimension	x	x
Post-attitude II	Same as pre-attitude II (different adjective pairs)	x	x
Knowledge level	Knowledge test based on 12 statements about genetic engineering the truth of which had to be rated	x	
Education	Standard survey question for highest school examination (six possible levels)	x	
Interest in genetic engineering	Survey question (four possible responses)	x	
Need for cognition	Likert scale consisting of 8 items (modified and abbreviated version of a scale published by Bless et al. 1994)	x	

A total of 4,526 cognitive responses were recorded in the two studies: 3,199 CR in the print study and 1,327 CR in the TV study. In the print study each test recipient gave on average 3.2 responses to each article; in the TV study 8.7 responses were recorded on average for every test recipient and every film – approximately only one thought per minute of film and subject. When interpreting the results it should be considered that the responses verbalized by the recipients are most likely only a – perhaps biased – sample of a larger set of thoughts evoked by the media stimuli.

Content analysis of cognitive responses

There are two types of evaluations in the CR which are analyzed in this paper: evaluations of specific reference objects (i.e. evaluations of all kinds of facts, events, decisions, opinions, people or organizations mentioned in the articles and films), and the slant of CR favorable to or critical of genetic engineering. The slant of cognitive responses is usually based on specific evaluations but there are also evaluations that have no semantic reference to GE, e.g. evaluations dealing with the presentation form of the article or film.

Evaluations of specific reference objects are straightforward evaluations, i.e. statements disclosing a critical/negative or an affirmative/positive view on a reference object. Reference objects were classified into five groups:[5]

1. facts (scientific information, observations, events, decisions and actions)
2. actors (i.e. people, organizations, political bodies and their opinions) further distinguished into
    (a) source opinions (i.e. opinions ascribed to a source cited or reported in the article or TV film)
    (b) actors as such (i.e. cited or reported sources; people, organizations and political bodies otherwise mentioned in the article or TV film; people; organizations and political bodies not mentioned in the article or TV film but nevertheless referred to in the CR)
3. medium (i.e. newspaper/TV program, article/film or journalist) further distinguished into
    (c) author opinions (i.e. opinions ascribed to the author of the article or film)
    (d) medium itself (i.e. the specific article or film, the specific journalist or the newspaper or TV program in general)

There can be more than one evaluation of a specific reference object in a single CR. The code book used for the content analysis allowed up to five references; only a maximum of four were used, however. Depending on the reference object the evaluative connotation of references was coded with different category systems which were made comparable on an aggregate level by means of recoding. The recoded category systems used to classify evaluations consists of three categories: “positive“, “negative“ and “neither positive nor negative“.[6]

Slant is defined as the aggregate bias of a response favorable to or critical of genetic engineering. Manifestation of slant can take a variety of semantic forms. A positive slant toward GE, for example, is coded if the CR contains an explicit positive basic evaluation of genetic engineering, points out a positive consequence of GE, agrees with a statement in the article or film positive to GE, praises a protago-

[5] The cognitive responses also included other semantic references, e.g. references to oneself, to other technologies, to past experiences or to information from other sources. These aspects of the CR are not discussed in this paper.

[6] The meaning of the latter residual category differs somewhat depending on the reference object. With respect to facts, source opinions and author opinions the third category comprises ambivalent (i.e. partly positive, partly negative) evaluations and evaluations the meaning of which was unclear (e.g. if it could not be decided whether some comment was meant literally or ironically). In the coding of references to actors as such the third category was used to code non-evaluative responses. If the medium itself is the reference object the third category includes non-evaluative, ambivalent and unclear responses.

nist of GE, criticizes a negative evaluation of GE, criticizes an opponent of GE or plays down a negative consequence of GE. It is thus possible that a positive slant to GE is based on negative evaluations of specific reference objects and vice versa. Our code book for the content analysis allows slant to be classified in one of four categories: positive, negative, missing/unclear and ambivalent (i.e. partly positive, partly negative). Since ambivalent CR hardly occurred the categories missing/unclear and ambivalent were summarized leading to the same threefold classification system for slant as used for the specific evaluations consisting of the categories “positive“, “negative“ and “neither positive nor negative“.

Results

Evaluations of facts, actors and medium in cognitive responses

Frequency and direction of evaluations

The 4,526 CR collected in the two studies contain 3,108 coded references to the above-mentioned reference objects. Tables 2-4 show that most of these references show a clear – either positive or negative – evaluation. This is partly true because of the selection of references and hence a consequence of the methodology applied. For references to facts, source opinions and author opinions (see Table 2) the coders were instructed to code only evaluative references. A similar preponderance of evaluative references over non-evaluative, unclear or ambivalent references, however, also exists with respect to references to actors and the medium (see Tables 3-4) where the coders had to code all references. 61.7 percent of the CR contain at least one clearly positive or negative basic evaluation. On the whole that indicates that the test recipients reacted particularly often to cues in the messages which provoke evaluative responses.

Still more remarkable is that the evaluative references are predominantly negative. If the test recipients react evaluatively to “facts” presented in the coverage they are mostly critical. If they comment on actors then most often on those they dislike. Their comments about the article or film, about the journalist or about the newspaper or TV program are more often critical then affirmative. And, finally, if they respond to opinions of either sources cited in the coverage or to opinions the journalists themselves let slip in, the test recipients more often contradict than support these opinions. (The latter, however, is only true for the print study. In the TV study, the proportion of positive and negative references to source opinions and actor opinions is approximately balanced). The preponderance of negative over positive evaluations hence is true for both studies and most categories of reference objects (see Tables 2-4). Altogether there are 3.6 times more negative than positive evaluations.

Table 2
Evaluation of facts, source opinions and author opinions in cognitive responses

	Print study			TV study		
	Facts [%]	Source opinions [%]	Author opinions [%]	Facts [%]	Source opinions [%]	Author opinions [%]
Positive/affirmative	17.7	26.0	33.3	17.8	45.8	49.3
Negative/critical	77.8	72.4	66.7	74.5	47.7	46.3
Unclear/ambivalent	4.5	1.7	0.0	7.8	6.5	4.5
	100.0 (n=1,544)	100.0 (n=181)	100.0 (n=9)	100.1 (n=552)	100.0 (n=107)	100.1 (n=67)

Table 3
Evaluations of actors as such in cognitive responses

	Print [%]	TV [%]
Praise, appreciation, sympathy	16.2	10.8
Criticism, contempt, antipathy	73.7	81.7
Non-evaluative	10.1	7.5
	100.0 (n=99)	100.0 (n=93)

Table 4
Evaluations of the medium as such in cognitive responses

	Print [%]	TV [%]
Positive/affirmative	20.6	32.5
Negative/critical	62.3	48.1
Non-evaluative or ambivalent	17.2	19.5
	100.1 (n=379)	100.1 (n=77)

Substantiation of evaluations by arguments

Besides the unbalanced frequency of positive and negative evaluations another form of asymmetry was found in the data: negative evaluations are more often substantiated by arguments than positive evaluations. Evaluative references to facts, source opinions and author opinions were classified with respect to the presence of an argument or explanation for the evaluation.[7] We were interested in whether the test recipients tried to substantiate their judgments or not. No attempt was made to determine the quality of the argument given; only the presence of an argument was coded.

[7] The presence of an argument was coded if a reason or explanation was given for an evaluation. This was assumed if it was possible to rephrase the core message of the response in the form: "x is positive/negative because ...".

Tables 5-6 show that the test recipients supported a larger proportion of negative than of positive evaluations by arguments. This effect is somewhat stronger in the data of the TV study than in that of the print study. There are two possible explanations for the greater proportion of substantiated responses among the negative evaluations. If one assumes that more thinking about a cue results in more arguments recalled or generated ad hoc, the observed asymmetry in the relative frequency of given arguments indicates that on the average more cognitive effort is used to process negative than positive information probably because the latter is considered more relevant. Another possible explanation, however, would be to assume a social communication norm requiring stronger justification of criticism/disapproval than of praise/affirmation. If the latter hypothesis is true, the preponderance of substantiation among the negative evaluations might be considered a methodological artifact produced by the way (i.e. communication between test recipient and interviewer/experimenter) the cognitive responses were gathered. Indirectly, however, this effect also should result in more intensive processing of cues evoking negative responses. The anticipation of the need to justify critical evaluations more strongly than affirmative evaluations in communication with others will probably intensify cognitive efforts in order to develop arguments useful for the persuasive justification of one's opinion. In both cases, giving arguments for opinions indicates particularly intensive cognitive efforts.

Table 5
Substantiation of positive and negative evaluations of facts, source opinions and author opinions in the cognitive responses by means of arguments (print study)

	Facts		Source opinions		Author opinions	
	Positive [%]	Negative [%]	Positive [%]	Negative [%]	Positive [%]	Negative [%]
Substantiated (argument given)	52.4	58.7	31.9	42.7	0.0	50.0
Unsubstantiated (no argument given)	47.6	41.3	68.1	57.3	100.0	50.0
	100.0 (n=273)	100.0 (n=1,201)	100.0 (n=47)	100.0 (n=131)	100.0 (n=3)	100.0 (n=6)

Table 6
Substantiation of positive and negative evaluations of facts, source opinions and author opinions in the cognitive responses by means of arguments (TV study)

	Facts		Source opinions		Author opinions	
	Positive [%]	Negative [%]	Positive [%]	Negative [%]	Positive [%]	Negative [%]
Substantiated (argument given)	46.9	71.5	22.4	82.4	24.2	77.4
Unsubstantiated (no argument given)	53.1	28.5	77.6	17.6	75.8	22.6
	100.0 (n=98)	100.0 (n=411)	100.0 (n=49)	100.0 (n=51)	100.0 (n=33)	100.0 (n=31)

Reference level of evaluations of sources and medium

A third asymmetry found in CR containing positive or negative evaluations was that negative evaluations of sources or of the medium are more often generalized to the source or author than are positive evaluations. With respect to sources and authors

who express opinions test recipients can direct their evaluations to different reference levels. They can attack or support the specific opinion uttered (e.g. "I don't believe that opinion x is true" or "opinion x is correct") or they can praise or criticize the person who presented that opinion (e.g. "person x is a liar", "person x is a competent expert"). As Tables 7-8 show recipients are more likely to generalize negative than positive evaluations to the personal level.[8]

Table 7
Reference level of positive and negative evaluations of sources in cognitive responses

	Print study		TV study	
	Positive [%]	Negative [%]	Positive [%]	Negative [%]
Specific evaluation (reference to source opinions)	93.2	77.8	94.2	56.3
General evaluation (reference to actors[1] as such)	6.8	22.2	5.8	43.7
	100.0 (n=44)	100.0 (n=108)	100.0 (n=52)	100.0 (n=87)

[1] Only references to those actors who are cited with opinions in the article or film are included in the data of this table

Table 8
Reference level of positive and negative evaluations in the cognitive responses of the medium

	Print study		TV study	
	Positive [%]	Negative [%]	Positive [%]	Negative [%]
Specific evaluation (reference to author opinions)	3.7	2.5	56.9	45.6
General evaluation (reference to medium as such)	96.3	97.5	43.1	54.4
	100.0 (n=81)	100.0 (n=242)	100.0 (n=58)	100.0 (n=68)

Slant of cognitive responses favorable to or critical of genetic engineering

Frequency and direction of slant

Since the newspaper articles and TV films presented to the test recipients deal with genetic engineering it is hardly surprising that many, if not most, of the specific evaluations also directly or indirectly imply an evaluation of genetic engineering. 64.3 percent of the CR in the print study and 47.6 percent of the CR in the TV study carry a slant favorable to or critical of genetic engineering.

[8] An interesting question is whether this pattern of asymmetric use of reference levels in evaluation is typical of the distribution of praise and criticism in general. Do, for example, teachers more often generalize evaluations of pupils' achievements to the personal level when they criticize their pupils' work rather than when they praise it?

The number of CR critical of GE by far exceeds the number of thoughts favorable to GE. Taking both studies together there are 4.0 times as many CR with a negative slant toward genetic engineering than CR with a positive slant. The media stimuli used for the studies on the whole evoked primarily negative and neutral but hardly positive evaluations of genetic engineering (see Table 9).

Table 9
Slant of cognitive responses with respect to genetic engineering

	Print [%]	TV [%]
Positive / affirmative evaluation of GE	15.1	3.9
Negative / critical evaluation of GE	49.2	43.7
No, unclear or ambivalent evaluation of GE	35.6	52.4
	99.9 (n=3,199)	100.0 (n=1,327)

Impact of article slant on slant of cognitive responses

Interestingly enough, with one exception, a preponderance of CR with a slant critical of genetic engineering is found in the responses to every article and film regardless of its slant.[9] The exception is Article C which deals with the destruction of an outdoor genetic engineering experiment by radical opponents of genetic engineering. The act of destruction, the radical opponents who did it and a politician showing some sympathy for them were evaluated quite critically by most test recipients. Since criticism of opponents of genetic engineering was coded as an implicitly positive evaluation of genetic engineering the relative majority of responses to this article is in the category of positive evaluation of GE.

While this seems doubtful from a logical point of view – the opponents were hardly criticized because of their opinion but rather because of the method (i.e. destruction) used to express it – this classification seems to be justified from a psychological point of view. As demonstrated by congruency theory (Osgood & Tannenbaum 1955) with respect to the persuasive impact there is a kind of equivalence between statements which are positive toward an attitude object and statements negative to sources critical of that attitude object. The reason behind this is a tendency for "congruent" evaluations in the cognitive systems of people. Put simply: people want to hold the same opinions as those they like and they want to contradict the opinions of those they dislike. If they see that people they dislike have an attitude similar to their own they may begin to like these people or to change their attitude. Hence, if test recipients confirm in a cognitive response that they dislike these radical opponents this may well imply a persuasive push towards a more positive evaluation of genetic engineering.

Remarkably, the stimulus with the most positive slant toward genetic engineering (Article B) evoked the largest proportion of CR critical to genetic engineering (see

[9] The slant of the newspaper articles and TV films was determined by three methods: expert assessment, systematic content analysis with a codebook used to analyze reporting on genetic engineering in another study of the compound project (Giegler & Merten 1997) and rating of slant by the test recipients themselves. All three methods led to more or less consistent results. Based on these instruments, the slant toward genetic engineering of the seven stimuli was rated on a five-step scale (very positive, positive, neutral, negative, very negative).

Table 10). This article was so uncritical toward the possible risks of GE that most test recipients questioned its objectivity. The thoughts evoked by this article deal to a large degree with the credibility of the scientific experts cited, with the credibility of the newspaper publishing that article and with counterarguments against the conclusions presented in the article.

Table 10
Evaluation of genetic engineering in the cognitive responses to the seven media stimuli

		Article A [%]	Article B [%]	Article C [%]	Article D [%]	Film A [%]	Film B [%]	Film C [%]
Slant of media stimulus toward genetic engineering:		*neutral*	*very positive*	*positive*	*neutral*	*negative*	*positive*	*negative*
Slant of CR toward genetic engineering	Positive / affirmative evaluation of GE	7.6	3.9	44.0	23.6	3.0	6.9	1.7
	Negative / critical evaluation of GE	50.8	69.5	16.5	39.0	48.7	40.9	42.3
	No, unclear or ambivalent evaluation of GE	41.6	26.6	39.5	37.4	48.2	52.3	56.0
		100.0 (n=1,084)	100.0 (n=1,045)	100.0 (n=532)	100.0 (n=538)	100.0 (n=396)	100.0 (n=465)	100.0 (n=466)

Impact of recipients' pre-attitudes, cognitive resources and motivation on slant of cognitive responses

The analysis described in this chapter is based only on the print study because the number of test recipients in the TV study is too small to allow for detailed bivariate statistical analyses. In order to determine the influence of recipients' pre-attitudes, cognitive resources and motivations to process the media content on the slant of CR, two indices summarizing the evaluative content of responses were calculated for each subject. The index "valence" provides information about the preponderance of positive or negative evaluations in the CR of each subject. It is calculated according to the formula:

$$Valence = \frac{n_+ - n_-}{n_+ + n_- + n_0},$$

with n_+ as the number of CR favorable to genetic engineering, n_- as the number of CR critical of genetic engineering and n_0 as the number of CR neutral to genetic engineering. The index has a value range from -1 (only CR critical of GE) to +1 (only CR favorable to GE). If there is an equal number of favorable and critical CR its value is 0.

A second index "evaluation" provides information about the proportion of evaluative CR (regardless of whether positive or negative) of the total number of responses:

$$Evaluation = \frac{n_+ + n_-}{n_+ + n_- + n_0},$$

n_+, n_- and n_0 have the same meaning as in the formula for "valence". The value range of "evaluation" is from 0 to +1; "0" if there is no evaluative response at all and "+1" if all CR carry a slant favorable to or critical of GE.

Correlations were calculated between these two indices and pre-attitudes toward genetic engineering (indicators: 8-item Likert scale and a semantic differential), cognitive resources (indicators: education and level of knowledge about genetic engineering measured by a 12-item knowledge test) and motivation to process information (indicators: personality variable "need for cognition" measured by a 8-item Likert scale and interest in GE). The correlations are shown in Table 11.

Table 11
Correlations between "valence" and "evaluation" of test recipients' responses and their pre-attitudes, cognitive resources and motivation (print study)

	Pre-attitudes		Cognitive resources		Motivation	
	Likert scale	Semantic differential	Education	Knowledge	Need for cognition	Interest in genetic engineering
Valence	0.53**	0.47**	0.10	0.02	0.07	0.16**
Evaluation	-0.09	-0.07	-0.13*	-0.14**	-0.02	-0.02

* $p \leq 0.05$, ** $p \leq 0.01$

The inspection of the correlation matrix reveals three kinds of significant relationships. First, there is quite a strong relationship between both measures of pre-attitudes and the "valence" of the CR evoked by the articles. A strong predictor of the proportion of thoughts critical of or favorable to GE are therefore the test recipients' pre-attitudes toward GE. Recipients with positive and negative attitudes toward GE respond very differently to the same media content. The responses tend to be consistent with the pre-attitudes held: recipients with positive attitudes generate more favorable and less critical CR than recipients with negative attitudes toward GE.

Secondly, there are weak but significant correlations between both indicators of cognitive resources – education and knowledge – and the index "evaluation" (i.e. the proportion of CR carrying an evaluation of genetic engineering). Recipients with a high level of cognitive resources tend to be somewhat more guarded with respect to evaluating genetic engineering as clearly favorable or critical than those with a low level of cognitive resources.

Thirdly, there is a weak but significant correlation between the recipients' expressed interest in genetic engineering (one of the indicators of motivation) and "valence". Recipients expressing greater interest in GE on the average generate significantly more CR with a favorable and fewer with a critical slant to GE. If one controls for pre-attitude the partial correlation between "valence" and interest in GE remains significant; additionally the correlations of "valence" with "need for cognition" and "education" become significant. There is hence a weak tendency for recipients with high motivation and high education to generate more positive and less negative responses than recipients with less motivation and education.

Effects of cognitive responses on attitude change

Before and after presenting the media stimuli the attitudes of the test recipients toward GE were measured with different versions of the two attitude scales (i.e. Likert scale and semantic differential). Based on a pretest the pre- and post-versions of each scale were composed of items, or adjective pairs, from a larger pool having approximately the same mean and standard deviation. From the re-

sults of the pre- and post-measurement of recipients' attitudes the degree and direction of attitude change was calculated. While on the aggregate level there was hardly a change of attitudes, such an attitude change did occur on the individual level.

Part of the calculated attitude change on the individual level is due to measurement error. Multiple linear regression models were used to analyze whether the slant of cognitive responses evoked by the stimuli is related to attitude change as the cognitive response approach assumes. The models aim to explain post-attitudes by the number and direction of thoughts evoked in the reception process controlling for pre-attitudes. Pre-attitudes, number of responses favorable to GE and number of responses critical of GE were hence introduced into the model as independent variables to explain post-attitudes. If there is a systematic change of attitudes on the individual level attributable to the slant of the cognitive responses the regression parameters related to the number of favorable and critical CR should be significantly unequal to 0.[10]

Separate models were calculated for both attitude indicators: the first using Likert scales to measure pre- and post-attitudes; the second using semantic-differential-based attitude indicators as measures of pre- and post-attitude. Tables 12-13 show the results of regression analyses for both studies and both attitude scales. Because of the smaller number of test recipients in the TV study (n=51) as compared to the print study (n=338) most parameters of the regression models in the TV study are statistically not significant. The structure of the models, however, is almost the same in both studies.

[10] It might seem that a more direct approach to determine the influence of CR on attitude change would be to compute regression models using attitude change as the dependent variable. There are two reasons why this approach (though actually leading to comparable results) is statistically problematic. First, such a model would require pre- and post-attitudes to be measured with scales of identical scaling properties (neutral point and variance) for the difference to be meaningful. While we succeeded in constructing two versions of each attitude scale with almost identical properties, it is impossible to obtain completely identical scales. Secondly, since attitude change is calculated as difference of post- and pre-attitudes a regression model using attitude change as the dependent variable and pre-attitudes as an independent variable would have the measurement error term of pre-attitudes as a component in the values of the dependent as well as of an independent variable. This would systematically affect the regression parameters related to pre-attitudes and would also inflate the proportion of variance explained by the models. The statistical approach actually used avoids both problems. It neither requires identical scaling properties of pre- and post-attitude measures nor does it produce statistical artifacts by a linear relationship of dependent and independent variables.

Table 12
Multiple regression analysis to determine effects of cognitive responses and pre-attitudes on post-attitudes (print study)

		Dependent variable: post-attitudes			
		Model 1 (Likert scale)		Model 2 (Semantic differential)	
		B	β	B	β
Regression constant		9.85**		9.24**	
Independent variables	Pre-attitudes	0.55**	0.56**	0.70**	0.64**
	No. of responses favorable to GE	0.48**	0.16**	1.28**	0.22**
	No. of responses critical of GE	-0.34**	-0.21**	-0.61**	-0.19**
Multiple r^2 (adjusted)		0.56		0.69	

** $p \leq 0.01$

Table 13
Multiple regression analysis to determine effects of cognitive responses and pre-attitudes on post-attitudes (TV study)

		Dependent variable: post-attitudes			
		Model 1 (Likert scale)		Model 2 (Semantic differential)	
		B	β	B	β
Regression constant		9.91**		11.18**	
Independent variables	Pre-attitudes	0.51**	0.53**	0.67**	0.66**
	No. of responses favorable to GE	0.70	0.22	0.72	0.11
	No. of responses critical of GE	-0.09	-0.15	-0.24*	-0.21*
Multiple r^2 (adjusted)		0.55		0.62	

* $p \leq 0.05$, ** $p \leq 0.01$

In both models the most important predictor of post-attitudes is pre-attitudes toward GE. It is of little surprise that test recipients didn't completely change their attitudes under the influence of the media stimuli; rather, post-attitudes are systematically related to pre-attitudes. In addition to this rather trivial effect there is the hypothesized systematic relationship of post-attitudes to the slant of the CR evoked by the media stimuli. The regression coefficients related to the number of favorable and critical responses are all highly significant in the models of the print study and partly significant in the TV study. The explained variance of the regression models including "number of responses favorable to GE" and "number of responses critical of GE" as independent variables increases by 6.1 percent (model 1) and 7.8 percent (model 2) in the print study and by 2.9 percent (model 1) and 3.6 percent (model 2) in the TV study compared to the corresponding basic models including only pre-attitudes as an independent variable. The regression analysis therefore proves an impact of the cognitive responses generated during the media reception on attitude change. Responses favorable toward GE make the recipients' attitudes more positive; critical responses lead to attitude changes toward the negative end of the scale.

The unstandardized regression coefficients (B) of the models related to the number of favorable and critical responses have a clear meaning. They stand for the statis-

tically calculated attitude change (in units of the attitude scale used) related to one single positive or negative CR. All four models show that a favorable response on the average produces a larger attitude change toward the positive than a critical response does toward the negative. The specific impact of positive responses on attitudes is hence stronger than the specific impact of negative responses. The greater number of negative responses is compensated, at least partially, by a greater specific impact of positive responses.

Discussion

Mass media caused attitude change

This reception study has shown that in contrast to simple stimulus-response hypotheses of mass media effects, the slant of media products is not easily transformed into opinions and attitudes held by the audience.

First, there is no obvious relationship between the slant of media publications on genetic engineering and the average slant of cognitive responses evoked by them. In particular, it is not true that the more favorable the coverage is towards genetic engineering, the more favorable are the recipients' responses.[11] There is always a chance that arguments pro or contra genetic engineering presented in mass media coverage stimulate thoughts of denial, counterarguments and doubts about the credibility of either a source presented in the coverage or of the medium itself rather than thoughts of approval. A variety of thoughts may be evoked in different recipients by a single cue in the coverage, the distribution of which is difficult to anticipate. That the effects of coverage are diverse and hard to anticipate makes it difficult for communicators to manipulate the public.

Secondly, pre-attitudes strongly influence the cognitive responses of the recipients. It is not true that people selectively notice only such cues in media content which are congruent with their existing attitudes, as one might assume following the cognitive dissonance hypothesis (Festinger 1957). On the contrary, recipients seem to react particularly to those cues which provoke critical responses. Not ignoring but depreciating information contradicting one's opinions and finding counterarguments are the main instruments of media recipients to maintain cognitive congruence. The CR evoked have the effect of defending the recipients' attitudes against persuasion. While this dependence of thoughts on pre-attitudes limits the manipulation potential of mass media it also limits the utility of mass media coverage for individual opinion-formation. It questions the ability of media recipients to change their attitudes according to the new information available to them.

Allan Mazur's hypothesis that even balanced reporting about controversial technologies leads to a negative impression of that technology (Mazur 1990) is confirmed by our data. There is also some evidence to support his speculation that this effect might be a consequence of superficial reception. Interest in genetic engi-

[11] This is not to say that the content of articles or films does not affect the thoughts of recipients. However, there is not a clear monotonous statistical relationship between the slant of the media stimuli and the preponderance of thoughts positive or negative toward GE. The number of articles and films used in these studies is too small for a full statistical analysis of this relationship. As explained in the introduction, the analysis of the dependence of media effects on media stimuli is not the main focus of the present study.

neering, as well as the need for cognition and education if one controls for pre-attitudes, which most likely go along with a high-attention reception style, somewhat increase the likelihood of positive responses. However, our study does not provide evidence that a negative impression of GE (measured as the relation of favorable and critical CR) necessarily results in a shift toward more negative attitudes because of a greater specific impact of positive thoughts on attitude change.

This may lead to some speculation about the conditions required for mass media to cause attitude change. Perhaps the media have an influence primarily in the early phases of the issue career when recipients are confronted with an issue for the first time and have no firm pre-attitudes or when critical events (in the private or public sphere) give rise to a new orientation. Furthermore, it seems possible that the media only have an effect in combination with social information processing in interpersonal networks. According to advanced variants of the well-known "two-step flow model", media coverage directs attention by the agenda setting effect and provides a shared information base. Interpretation of this information and transformation into attitudes, however, is thought to take place by means of interpersonal communication (cf. Merten 1988; Schenk 1989).

As postulated by the cognitive response approach (Perloff & Brock 1980), the number of responses favorable to and critical of GE were a predictor of attitude change. There are effects of the reception of mass media coverage on attitudes but these are mediated by the nature of the cognitive processes evoked. The same coverage can have different effects on different recipients. To conclude, the media have the potential to stimulate cognitive processes leading to attitude change but they cannot easily determine the direction and result of these processes.

Asymmetry in the processing of positive and negative aspects

Altogether the analysis of the evaluations in the CR indicate that the test recipients in our study scanned the content of the films and newspaper articles during the reception of the media messages presented to them particularly for cues evoking evaluative responses. They process these cues differently depending on the evaluations evoked. Negative aspects more likely trigger cognitive responses than positive aspects, negative evaluations are more often substantiated by arguments than positive evaluations and negative evaluations are more often generalized from opinions to the holders of these opinions than are positive evaluations.

Although there is no a priori relationship between evaluations of facts, actors and the medium and the slant of the responses, most CR showed a slant and that slant was much more often critical of than favorable to genetic engineering. Thus the thoughts of the respondents during the reception of the media stimuli seem to have focused mostly on negative aspects of GE even if the article or film was neutral or carried a positive slant with respect to GE.

Is the large amount of evaluative responses an indicator of high competence of the recipients? Does it show that people are able to generate their own opinion using the media? That recipients with more cognitive resources (education and knowledge of genetic engineering) had a somewhat lower proportion of evaluative responses suggests that evaluations are often not the result of careful reasoning. Many evaluative responses of the test recipients seem to be quite unreflected "repulse reflexes" to cues evoking cognitive dissonance.

There is obviously a bias in the processing of media content with recipients directing more cognitive effort to the processing of cues evoking negative evaluations. There are other fields and studies where such an asymmetry in the processing of negative and positive information has also been found. From person perception research it is known that negative information about a person is perceived particularly attentively and influences the assessment more strongly than positive information (Fiske 1980). Femers (1993, p. 96) found a "risk bias" in an analysis of information preferences people have when forming an opinion about a controversial technology. Finally, negativism is also known as news value (Bell 1991, p. 156; Schulz 1976, p. 34) or news selection predictor (Bohle 1986), i.e. journalists tend to find negative stories more newsworthy than positive stories.

With respect to attitude change, however, regression analysis demonstrated a reverse asymmetry in the strength of the specific impact of positive and negative CR. The attitude shift toward the positive caused by a single favorable response is larger than the attitude shift toward the negative caused by a single critical response. The bias found in the elaboration of positive and negative aspects seems to be compensated for by a reverse bias in the specific impact of positive and negative responses. The cognitive system elaborates negative aspects more intensively than the positive aspects but seems to compensate this bias in the final integration of the different aspects into the attitude.

The initial question put forward in the title of this paper "Is the negative more relevant than the positive?" therefore gets a mixed answer.

On one hand, there are several indications that recipients are particularly attentive to cues evoking critical responses. Furthermore, they seem to process these cues more intensively and generalize more readily from opinions to personal characteristics of sources if they disagree with the opinions expressed. On the other hand, the specific impact of CR favorable to GE on recipients' attitudes seems to be stronger than the specific impact of CR critical of GE. Obviously recipients implicitly weigh positive thoughts more strongly than negative thoughts when updating an attitude.

With respect to attention the negative seems to be more relevant than the positive; with respect to attitude change, however, positive and negative aspects are approximately equally relevant.

The questions now is: Are there good reasons why recipients deal with negative information about new technologies such as genetic engineering more intensively than with positive information? I would like to offer three speculative explanations in an attempt to find some rationality behind that pattern:

(1) *Asymmetrical error preference hypothesis*: More immediate attention for negative than for positive information may be a universal feature of the human cognitive system acquired during biological and/or cultural evolution.[12] If one assumes asymmetry in the severity of consequences of failures to recognize something positive as against failures to recognize something negative (e.g. identifying someone as friend or foe), evolution should have favored attention patterns directing more immediate attention to cues revealing something

[12] Asymmetric error preferences are quite common. Examples are the design of alarm systems where usually the possibility of a false alarm is preferred over failures to recognize a real danger or in inference statistics where erroneous acceptance of a false hypothesis is considered worse than erroneous non-acceptance of a true hypothesis.

threatening than to those hinting at something beneficial. A typical characteristic of the time when that preference developed might have been that an error in the recognition of something positive could later be corrected while an error in the detection of something negative could not because one was dead.[13]

(2) *Informativeness hypothesis*: The value of information is dependent on the existing expectations. A message is the more informative the more it produces surprise. As every journalist well knows the headline "man bites dog" will gain more attention than the headline "dog bites man". A preference for negative information may hence be seen as a consequence of living in a relatively safe social and physical environment where, on the whole, the positive (i.e. absence of danger) is the expected and the negative is the unexpected.

(3) *Differential trust hypothesis*: Recipients may believe that those responsible for the management of technological innovation in a functionally differentiated society (i.e. government, industry and science) are committed to the promotion of innovative technologies such as genetic engineering. They may further assume that these groups and institutions are oriented towards the possible benefits and not sensitive enough to the risks. Hence, the public may trust the responsible institutions and routine procedures with respect to the handling of chances and benefits and may therefore be prepared to delegate responsibility for these aspects. With respect to the management of risks, however, members of the general public may have less trust in institutions and routines and hence they may feel that they themselves need to keep a critical eye on the risk aspects. According to the differential trust hypothesis the public concerns itself with the negative aspects of genetic engineering above all because it perceives a political deficit in the management of risks but not in the management of benefits.[14]

It is not possible to decide from this study which of the above-mentioned hypotheses is true. They give, however, some plausible reasons to assume that the reception pattern focusing on the negative is not just an expression of irrationality of the media audience. It is unclear whether the focus on negative information is a general characteristic of the media reception process or whether it is limited to certain cultures or issue contexts as the third hypothesis suggests. Further studies dealing with a broader range of topics and with a cross-cultural design are needed to reveal the cultural conditions and issue characteristics leading to such a reception pattern. Surprisingly though our study indicated that more intensive processing of negative information during the reception of mass media coverage does not necessarily imply ignoring the positive aspects in attitude formation.

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[13] Interestingly enough, there is much rhetoric by politicians and industry trying to persuade the public that there is also no way of correcting a wrong perception when one has missed the chance offered by technological innovation. This often refers to the competition of national economies using the argument that only the first on the global market is going to profit economically from an innovation. If the argument is true then it becomes a matter of great political and economic relevance whether there are intercultural differences in the asymmetry in dealing with information on chances and risks. This matter is discussed in Germany as well as in a number of other countries as the "public acceptance problem".

[14] The assumption of differential trust corresponds to an understanding of public communication that sees an important political function in its ability to deal with those matters that cannot be delegated safely to responsible social institutions and routines. This may be the case because the problems are new and responsible institutions do not yet exist or because there are indications of a dysfunction (e.g. bias, incompetence or corruption) of the responsible institutions.

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