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Genetic engineering: risks and hazards as perceived by the German public

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ABSTRACT *What do people associate with 'genetic engineering', and what are the resources they mobilize for gaining orientation and the ability to assess this new technology? These are the central questions discussed in this paper. The theses are based on 48 'Leitfadeninterviews', made between 1995 and 1997 and complemented by a representative survey carried out in Germany in 1997, which contains 1501 cases. Most findings of the qualitative study have been verified by the survey data, the latter, however, are not presented in this paper. Though the public is not well informed about genetic engineering, strong value judgements about genetic engineering are often pronounced. Attitudes and judgements are based on subjective heuristics of risk and embedded in arguments specific to their 'Lebenswelt'. As the terms relating to hazards have a value rational or aesthetic touch, they are not quantifiable and therefore are very difficult to be incorporated into a rational discourse on risk. The public's view of genetic engineering is shaped predominantly by two fields of application: 'genfood' and human genetics including prenatal, medical and pharmaceutical applications. In most cases, a rational weighing up of benefits and risks lacks knowledge. In the main, the attitudes are not technology related—they are embedded in a wider semantic space: the doubts of an abuse of genetic engineering processes within human genetics—keywords: cloning, eugenic—play an important role in the minds of the German public, as has been experienced historically. Furthermore, fear of an untenable manipulation of consumers by gradually introduced genetically engineered food, by uncontrolled leakage of pathogens during accidents in laboratories and experiments of deliberate release or the aversion of a society's subjugation to economic and technocratic imperatives are identified as serious hazards.*

Introduction

'Which resources do people mobilize for gaining orientation and judgement ability if they are confronted with a new and not yet well known phenomenon as, for example, genetic engineering?' This is a central question of a sub-project within this concerted action programme. Amongst the German public, most people feel unfamiliar with genetic engineering, although public discussion seems to have intensified during recent months. On the one hand, the process of cloning animals, the controversy about the release of genetically designed

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plants on approval, or the rising public demand for labelling genetically modified food might have affected peoples' opinions. On the other hand, one can imagine that genetic engineering can be perceived as a *symbol* and be embedded in a wider semantic context, too: a key technology that stands for modernization, for the business world, economic, ecological and risk globalization, even for a technocratic remodelling of the world, might induce feelings of presumption, uncertainty of risks and detriments, and could arouse associations to the history of nuclear power or events during the infamous Third Reich.

In fact, we can only speculate about the pictures people sketch out concerning genetic engineering, and we do so with regard to the mechanisms of gaining orientation and value judgement.

Thus, the sub-project pursues two main objectives: first, to clarify the semantic space of that technology in public opinion based on qualitative data and, second, to develop hypotheses and instruments to answer the question of how and why people judge genetic engineering as they do. In particular we discuss what concepts of risk are available, and to what extent the assumptions of risks and hazards are used in constructing value judgements.

Material and methods

The interpretations are based on 48 qualitative interviews. Twenty-four of them were carried out in 1995, 24 in the winter 1996/97. Due to the attempt to construct a 'grounded theory' (Glaser & Strauss, 1979; Strauss & Corbin, 1990) of what people think about genetic engineering, an interview guidance plan was developed designed to match the appropriate thematic frame. On the one hand, the interviews were focused on orientations towards technologies; on the other hand, the open questionnaire offered a wide frame for respondents to depict and narrate experiences they had made with technologies during their lifetime. The questions on how orientations towards technologies emerge focused on the perception of parents' occupational or private experiences with technologies, on the interview partners' playing behaviour during childhood, on the experiences gained in school, on vocational training, on experiences within their own profession, on leisure-time activities, and on the most recent impressions on contemporary issues. All these responses provided important information answering our key question: 'What are the resources people mobilize in gaining orientation and judgement ability when a new and not yet well known phenomenon as, for example, genetic engineering appears?'

The research was based on the following assumption: breaking ambient and not well-known phenomena, people use to activate proved and habitualized 'lifeworld' resources (Schütz & Luckmann, 1973) treating ambient phenomena. Therefore, all the interview partners were asked about their views of nature, of human beings and the concept of the world, analogies to similar technologies, optimism or pessimism for the future, their understanding of progress, where loyalties or opposition to modernization were expressed, about their emotions, aesthetic preferences, their conception of quality of life, their private or occu-

pational objectives, and about the political responsibility and performance according to the future of the society. When they were asked 'what do you think about genetic engineering?', they were given the possibility of mentioning any other thoughts, feelings or reasons concerning this subject such as, for example, religious, political, or risk-specific ideas. Furthermore, the question deliberately did not focus on a special field of application. It was up to the respondents to refer to any aspect of genetic engineering in their responses. The interviews took from 40 to 150 minutes with an average of 1 hour.

In the sense of a constructivist procedure, no definition of genetic engineering was prescribed. According to the so-called 'Thomas theorem'[1] (Helle, 1977; Thomas, 1931), genetic engineering is what people believe genetic engineering to be.

The empirical results are based on an intensive evaluation of 48 narrative open interviews with lay people and 'professionals' in the field of genetic engineering. Between 'lay people' and 'professionals' a grey area exists of people who do not belong to either of these two categories. They are called 'semi-professionals'. 'Semi-professionals' constitute that category of people planning or carrying out large-scale technological projects. They are also people who are dealing with technical or economic risks within their profession but who are *not* biologists, however,. As special attention was directed to *public* orientations and value judgements, two-thirds of the interview partners were sampled from lay people, and one-third from professionals and semi-professionals.

The interview partners were selected using the method of 'theoretical sampling' (Strauss, 1987). To gain a highly valid impression about the semantic space of genetic engineering in the public, it was necessary to interview people 'as heterogeneous as possible'. With regard to some questions, it seemed to be advisable to distinguish between 'professionals' and 'lay people'. In contrast to 'professionals', lay people neither have professional knowledge nor are they working as experts in the field of genetic engineering. Because of this, this article focuses on the material obtained from lay people.

A theoretical sample was drawn from people with as many different attributes as possible. First, we chose people with different socio-demographic characteristics such as age, sex, occupation, level of education, marital status, and so on. Second, following Bourdieu's analytical scheme, we ensured the selection of people with a diverse composition of economic, social and cultural resources (Bourdieu, 1983, 1987). This procedure guarantees a high variation of the empirical data. The process of identifying respondents was continued until we achieved saturation with respect to aspects, arguments, and value judgements towards genetic engineering. Even then, some more interviews were conducted, first to gain more certainty concerning variance, secondly to improve the empirical opportunity to typify characteristic patterns of orientation towards genetic engineering.

The analysis of the data was rather complicated and time consuming. After transcription, an appropriate analytical scheme was constructed to interpret

T06: Mrs. H., 63 y. married, 1 child, basic education, housewife					
Field of Application	Aspects	Criteria	Evaluation	Argument	Quality of Evaluation
1. Genfood	Food in general	naturalness trust control	negative	not natural (labelling required)	emotional (distrust) value rational
2. Prenatal-human genetics	in-vitro-fertilization	naturalness presumptions	negative	not natural presumption: humankind against nature	value rational (nature as standard)
Summary: Mrs. H. feels not very well informed about genetic engineering. Her negative evaluation of this technology extends to two fields of application - genfood and i.v.-fertilization, and is mainly based on value-rational reasoning. Hereby, nature and naturalness play the role of a rather universal criterion.					

FIGURE 1. Characterization sheet relating to genetic engineering

'topic by topic'. During the empirical work, I developed 'characterization sheets' for analysing and typologizing data, one for each topic and each case according to the scheme shown in Fig. 1.

Complete transcript concerning genetic engineering; interview No. 6

T06.1.418 'What do you think about genetic engineering?'

T06.1.418 'Oh these genetic manipulations? I'm against it! I think, this is not only concerning food. This is too unnatural to me. I don't have any trust in such food. If they were labelled, I wouldn't buy them.'

T06.1.429 'Should they be labelled?'

T06.1.429 'Yes, absolutely.'

T06.1.429 'What other fields of application do you think of?'

T06.1.430 'So, for instance test-tube babies—I am really against it, too! I think, one should not work against nature in such a way.' [Pause]

T06.1.433 'Something else, that you remember about genetic engineering?'

T06.1.433 'Nothing, at the moment.'

T06.1.434 'Where and how have you informed yourself about genetic engineering?'

T06.1.435 'Oh, only through TV and magazines.'

T06.1.437 'Would you say that you feel well informed?'

T06.1.437 'No, not so good. One is not informed as long as food is not labelled. I can only feel being informed, if I know "yes, this is genetically modified and that one is not". Then I'll really choose a natural one, which is grown like in earlier days. Such food I can trust.'

For the purpose of demonstration, Fig. 1 contains an example which is not very complex but is—as we will see—somehow significant for public orientations towards genetic engineering. However, in some cases these 'characterization sheets' extend to over one and a half pages.

The first column contains the name of the subject area—for instance 'genfood'. Since most people are not used to arguing in a very abstract format, the second column contains the example on which the subject area has been expressed—'tomatoes', for example. The third column describes the specific standards that are constructed by the interview partners to handle and judge a topic, for example 'nature'. The fourth column represents direction and intensity of the value judgement on a scale between 'very good', 'sceptical or ambivalent' to 'very negative'. The arguments used by the respondents are listed in the fifth column, for instance 'unnatural'. Last, but not least, the 'logical status' of the value judgement assigned to the sixth column, for example 'value rational', 'emotional', 'instrumental-rational', 'ethical', 'categorical' or 'aesthetic'. All information on each 'prototype' was transferred to a large data base providing an interface to a statistical package as a means of gaining easy access to analyse the data, compare different cases, identify specific patterns, and explore the data for appropriate typologies. However, statistical data analysis must be used with caution since it is not allowed to draw any quantitative generalizations from the qualitative data. This kind of qualitative material can claim to offer a very comprehensive perspective of orientations towards genetic engineering. It provides a highly valid understanding of what the semantic space around biotechnology is, and what the most crucial resources are that people mobilize in order to gain orientation and judgement.

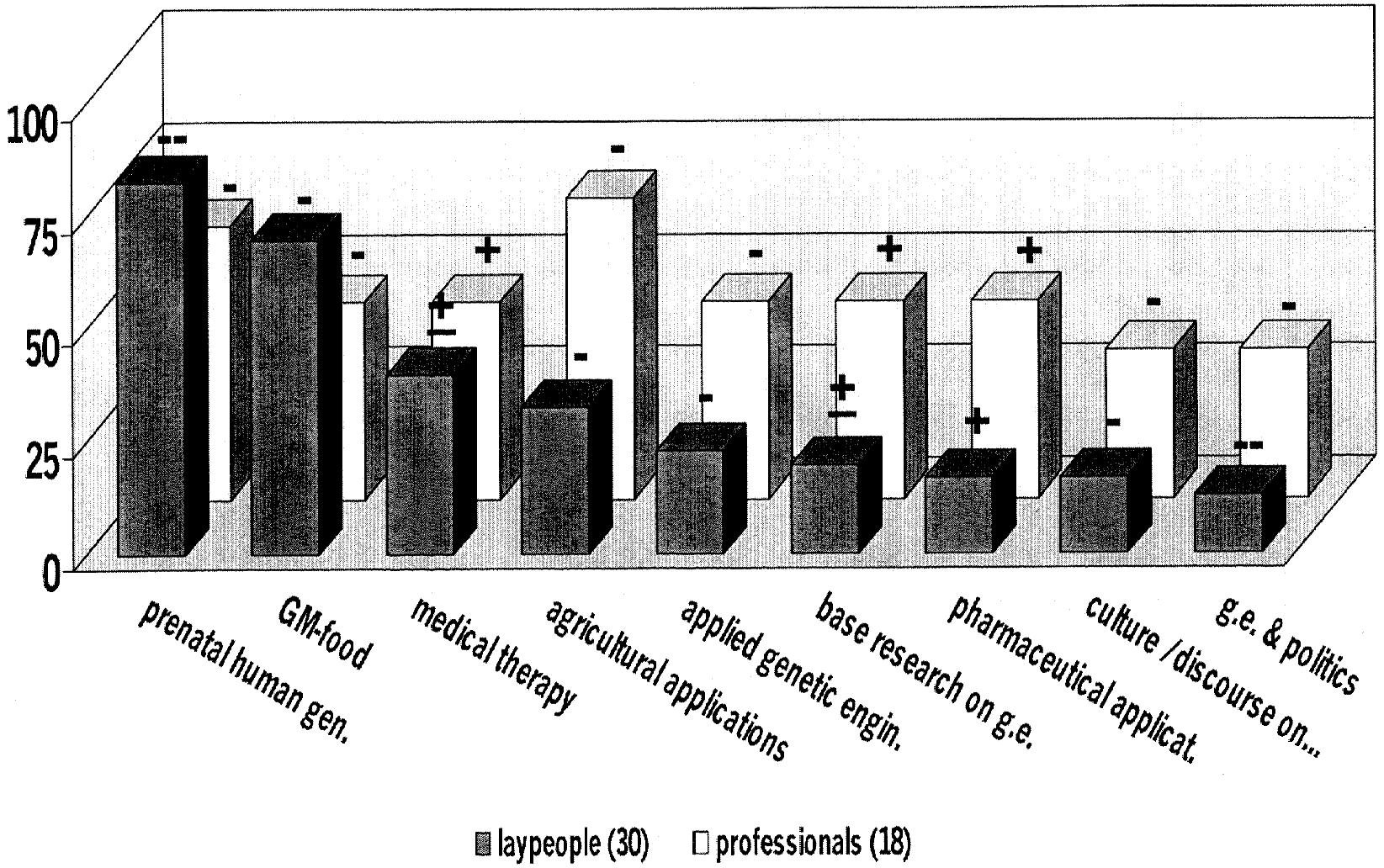
General orientations towards genetic engineering within the German public

How do people perceive genetic engineering? With respect to the double character of genetic engineering—application to concrete fields and its symbolic meaning—the investigation of the opinions that the public associates with this technology is not trivial. If we discuss technological risks, the prevalent views on technology and its predominantly perceived applications will probably influence the result.

The first row of Fig. 2 shows the most important fields of application as reported by lay people. The second row shows the proportion of applications as reported by professionals. Above each bar, the direction of the value judgement is symbolized, where the range extends from triple plus, meaning 'very positive' to triple minus, standing for 'very negative'.

Most interview partners were not used to discussing genetic engineering in an abstract, theoretical way. Even in the case of sweeping statements, these

Figure 2: Perception and Valuation of Genetic Engineering and its Fields of Application



Biotech Project 1997: 48 guidebook interviews; range: --- very bad ... +++ very positively

judgements were exemplified by referring to concrete applications. Amongst the group of lay people, the view of genetic engineering seemed to be dominated by two applications: 25 of the 30 lay people mentioned 'prenatal human genetics': this topic covers prenatal diagnostics, manipulations of the germline, cloning of human beings, and *in vitro* fertilization. It aroused the most negative judgements among all interview partners. The second application that seems to affect lay public opinion, is 'genfood'. Slightly more than two-thirds of the lay people and a smaller portion of semi-professionals and professionals listed this application, associated with moderate negative connotations.

The most important field of application mentioned by semi-professionals and professionals was agricultural applications, including topics like nutrition of the world or manipulating domestic animals or plants. Value judgements were rather negative, partly because of the risks of proliferation of genetically modified organisms, or because of the perception of a somehow 'wrong logic': many interview partners, speaking on this topic—lay people as well as professionals—insisted that hunger in developing countries has been a consequence of political and economic malfunction, and there is no need to solve these problems through technological means.

In contrast, the production of drugs by genetic technology, which is more or less approved by both groups, was mentioned only by one-sixth of lay people and a little more than half of the semi-professionals and professionals. The same pattern seems to hold for the application of genetic engineering in medicine, particularly for cancer therapy.

In all of our sub-populations, instrumentally based conclusions were quite positive, whereas categorical, ideological or system-critical evaluations were particularly negative.

The data analysis so far justifies a first conclusion: there seems to be only a small difference between professionals and the lay public in perceiving genetic engineering: most lay people have come to a slightly negative view, and the proponents of the other group to a sceptical or an ambivalent overall judgement. Among professionals, the perception of genetic engineering extends to a larger range of applications, whereas the view of the lay public is rather clearly shaped by only two fields of application—prenatal human genetics and genfood. Both are evaluated predominantly negatively.

Judgements vary also with respect to the basis of evaluation: in essence, judgements based on instrumental-rational reasoning lead to a more positive view on genetic engineering than all other kinds of judgements. Instrumental-rational reasoning, however, plays a notable role only among semi-professionals and professionals. On the part of lay people, only a quarter of the judgements are based on instrumental-rational thinking; however, a clear majority of judgements are 'lifeworld-based', which includes value-rational, ethical, religious, aesthetic or emotional reasoning.

The rather small differences between the views of professionals and the lay public may be surprising. However, the group of professionals has been defined extensively. It consists of biologists who have professional knowledge of this

technology. If we had selected only those people who actually work in genetic engineering, especially in highly responsible positions, we would have found much more enthusiasm, extending at least to the field of application in which these people do active work. In these cases, approval is marked not only by material interests but also by their professional ability to form their environment in a relevant and desirable way. To all intents and purposes, all these people can be characterized as pure or at least moderate technocrats: appropriate strategies for solving problems are predominantly considered to be technical ones. For instance, interview No. 7 shows considerable euphoria. Mr H. is 44 years old. He is the head of the public relations department of a large German car company: 'Due to my modest knowledge, ... like the renewable energies, I understand genetic engineering as a great chance to save the whole world ...'.

Risks and hazards: the reasons for scepticism

With regard to the semi-professionals and professionals, risk seems to be the key variable in dealing with genetic engineering. As Table 1 shows, every professional, three-quarters of the semi-professionals but only every second lay person mentioned one or more risks in connection with genetic engineering. On average, lay people mentioned 1.6, semi-professionals 2 and professionals 3 different kinds of risk.

More important than the number of risks is the question: 'What understanding of risk governs the thinking of each of the three groups?' One distinction is whether risks are reported as technical risks or social hazards. Two-thirds of the interviewed lay people, every second professional, but only a quarter of semi-professionals referred to social hazards. An assessment of quantitative risks was absent among the German public: none of our lay people, and only a small portion of semi-professionals and professionals tried to estimate risks in a quantifiable manner. Only a quarter of lay people and semi-professionals, but four out of six professionals mentioned that they tried to balance risks and benefits.

Owing to the lack of quantitative parameters and appropriate knowledge, such balances are rather more qualitative than quantitative. This is true even for the most professional of our theoretical sample. A typical answer is found in interview No. 55, Mrs S., a 39-year-old female doctor of biology, director of a molecular biology company: '... Genetic engineering contains an incredible number of chances and opportunities, but there are also risks included, which one should reflect upon. And where you have to ask yourself over and over: "Is this o.k., what I am doing?" ... If these are great risks or not, this is up to each individual. It is hard to assess, if these are big risks or not. I think, the opportunities genetic engineering contains, are much more important. But the risks should not be neglected.'

The next question is how risk-related judgements are justified: amongst the lay people, judgements are based mainly on value-rational, ethical, or emotional reasoning. This is true also for semi-professionals and professionals, but in these

FIGURE 3. Genetic engineering: selected attributes of risk assessment by groups of interview partners

	Lay people	Semi-professionals	Professionals	Total
Total cases	30	12	6	48
Risks reported? Yes	15	8	6	29
Proportion	50%	75%	100%	60%
No. of risks reported	24	16	18	58
Mean	1.6	2.0	3.0	2.0
Valid cases	15	8	6	29
Type of reported risk				
Social hazards	10	2	3	15
Risks and benefits balanced	4	2	4	10
Quantifiable risks reported	0	2	1	3
Quality of judgement (mult. responses)				
—instrumental-rational	3	5	6	14
—value-rational, ethical, religious	12	4	6	22
—aesthetic, emotional	4	4	3	11
—categorical	0	0	2	2
—ideological, cultural-/ system-critical	0	2	2	4
—sceptical, ambivalent	4	2	3	9
—historical	2	1	0	3
No. of judgements (*N*)	25	18	23	66
Valid cases	15	8	6	29

two groups instrumental-rational judgements play a comparably relevant role. Thus, semi-professionals and professionals exhibit a more complex orientation towards risks.

After all, the most interesting question is: 'what subjects do people associate with risks?' Each interview partner had the opportunity to relate risks to different fields of application and to develop—if desired—multiple aspects and arguments.

Let us first consider the lay public group: 12 out of 15 lay people who mentioned risks, related risks to prenatal human genetics, and 11 to agricultural and food applications. These three fields of application attracted nearly 80% of all risk arguments. One single argument was dominant: 12 out of 15 lay people fear an *abuse* of genetic engineering by criminals, by politicians, irresponsible entrepreneurs or in general by humankind. This fear is related to genfood, but on an even higher scale to prenatal human genetics. The German public rejects cloning or manipulating human beings. People are concerned about social selection and its consequences, due to imperatives of the political or economic system, for example loss of tolerance for disabled people. In particular, some of

the older interview partners explicitly mentioned the 'Third Reich' as a horrifying example of the abuse of human genetics. A considerable number of people expressed a general mistrust of humankind. Let me cite a well pointed but not untypical answer, given in interview No. 7 with Mr A. He is 71 years old and retired. In earlier days he was a public official. 'Surely, genetic engineering is a progress in medicine, but, as I noticed already: Humans tend to abuse everything, everything, everything. Every invention, every progress. And the abuses of genetic engineering, surely, cannot be assessed until now. Basically, one will be able to ascertain now, that benefits and detriments are to be interpreted more to detriment ... You can breed a certain kind of human beings and there, I see a great danger. We already had a regime, which tried to breed human beings ... I can even imagine, that one day, people are produced only by lack of spare parts. These criminal elements rob people—not money but people—, they will exploit them and sell their parts for money. And thus, I like to say, due to such considerations, my horror is big.' All lay people who reflected hazards in combination with human genetics came to an extremely negative judgement. The second most frequently used argument refers to uncertain and unknown potentials of benefits and detriments. But only half of those discussing abuse mentioned benefits and detriments. When they did, the judgements of risks were ambivalent, if not sceptical.

Amongst the group of semi-professionals and professionals, considerations of risks were much more widely spread. Most of them think about 'applied genetic engineering'. This includes particular aspects such as genetic engineering as a tool, as well as applied tests and deliberations concerning manipulated organisms. The usual attributes of risk, such as reversibility, probability and the assumed extent of detriment, are important for them. In the same way, regulation and control play an important role in judging the balance between risks and benefits. In general, the judgements are sceptical or ambivalent. The second and third positions refer to prenatal human genetics and the shift of interpretation of our world by genetic engineering. In both respects, the value judgements are clearly negative, based on various arguments. The risks of agricultural applications take fourth position. It also triggers clear negative evaluations. The most important argument is the objection against natural sciences for providing only missing, bad or paradoxical expertise and information strategies to influence public policy.

Our findings show that there is a considerable difference in discussing risks between lay people and professionals. Lay people particularly associate social hazards with genetic engineering; professionals prefer technical emphasis and procedural aspects of risks. Because suspicion of abuse is widespread among the lay public, there seems to be no institution trustworthy enough to regulate and control its problematic applications: in contrast, entrepreneurs, politicians or administrative institutions are guarding against abuse. Their perception is closely related to technical risks, they exhibit a much smaller fear of abuse, and they have more confidence in the German economic and political system. Overall, they are less radical in their judgements.

In addition, our data show that lay people in particular link the hazard of genetic engineering with social abuse, particularly in the fields of human genetics and genfood. There is considerable social mistrust of almost everyone: politicians, entrepreneurs, humankind. The risk-based objections against genetic engineering are less related to the impacts of the technology than to the assessment of the social and political situation in Germany. Obviously, this reflects not only German history but also the present situation, which is characterized by pessimism, mistrust, alienation, and retreat into privacy. With regard to genfood, politicians are largely made responsible for this condition by some respondents: a government trying to camouflage the application of new technologies will lose trust.

Summary and conclusions

First, qualitative data provided evidence for the dual character of genetic engineering: people base their estimate of benefits and risks on the associations that they attribute to the different fields of application. Lifeworld-based arguments are prevalent within the German public. Orientations and value judgements are particularly relevant in the perception of prenatal human genetics and genfood. In both cases, doubts and fears dominate over a rational balance of risks and benefits and the great majority of lay people come to a clear negative judgement.

Second, in the case of prenatal human genetics and genfood, people tend to justify their judgements on values based on ethics, emotions or even system criticism. They consider social abuse and social consequences of genetic engineering as major risks. They expect abuse of human genetics by criminals, irresponsible politicians, entrepreneurs, or 'humankind' in general. The scenarios extend from declining tolerance against handicapped people, increase in abortion, eugenics, to cloning and designing human beings according to political and economic needs. Thus lay people serve as lobbyists for social values: values concerning nature, naturalness, the value of life, the right of free development of one's personality, and the right of autonomy for each consumer to choose between food—genetically manipulated or not. Most of these values are deeply internalized. They reflect a life-long anchoring in one's biographical experience and can hardly be manipulated by PR campaigns. Anyone who neglects them will offend not only deeply rooted social values but also the identity and lifeworld of the citizens. Furthermore, the politicians' plea for a renaissance of basic values will be futile if they ignore the threat to such salient values induced by modern technology.

Third, the data show that risk-specific orientations among the lay public are less associated with genetic engineering and its consequences, but are particularly related to the perceived shape of the present German society. A remarkable proportion of interview partners relate genetic engineering and its hazards symptomatically to the shape of society. They have obviously lost trust in the political and economic system, in humankind, and in some of society's basic

institutions. Is this lack of socio-cultural 'ligatures' symptomatic of postmodern, highly individualized societies?

Fourth, the concepts of risk preferred by politicians, scientists, and entrepreneurs do not match public understanding. The professionals and semi-professionals use conventional risk concepts that allow quantification of expected losses over time. The lifeworld-based concepts of hazards, however, pursue qualitative deliberation about risk: none of the interview partners mentioned parameters of risk—neither their probability nor their potential benefits or detriments. Instead, risks are assessed as being extremely high or extremely low. Most respondents had problems when they tried to balance potential benefits with moral hazards. The balancing of risks and benefits seems impossible for them because they lie on different dimensions. Thus the equation remains unresolvable. One should be sceptical, if one tries to expand classical risk concepts of balancing risks and benefits to this domain.

Fifth, the public discussion of genetic engineering affects the perception of natural sciences. Scientists dealing with genetic risks run the danger of losing prestige and trustworthiness among the public. Some of the interview partners reported that they perceive two kinds of scientists: one kind argues that biotechnological risks are extremely small; the other alleges risks as unpredictably high. People complain that nobody is willing or capable to show valid and unambiguous results. The so-called 'expert-dilemma' undermines the prestige of the natural sciences and its experts. It reinforces the impression that these scientists are not independent advisers but stakeholders either of supporting or of opposing groups. Independence, however, seems to be a key variable on which experts have been estimated as being trustworthy or not.

Sixth, in a social discourse on risks, a series of codes exerts persuasive power. Regularly such arguments develop the highest strategic effect in Western modernized industrial societies based on rational calculation. This is supported by empirical data. There is little chance to dispute conclusions based on moral or aesthetic reasoning or value-rational thinking since they are excluded from a conventional 'trade-off' analysis. Under these circumstances discourse on risk reflects two special strategies: first, terms of risk are frequently instrumentalized only to label an already existing, deeply rooted agreement or rejection of genetic engineering 'in the politically correct way'. They act as the 'Trojan Horse' for transporting deeper convictions. Second, one can assume that people with substantial interests in continuing research and industrial transfer of genetic processes will do what they can to turn the public discourse of genetic engineering from lifeworld concerns to economic necessities, and from moral hazards to 'rational risk management'. Then lay people will have only little opportunity to argue against elaborate, highly rational claims, even if the proponents' concept of risk does not touch upon the dimensions that matter to most people. One might assume that the powerful risk concepts will prevail in the end and lifeworld-based concerns will be dismissed as irrational or old-fashioned.

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Note

1. The so-called Thomas theorem—modified by R. Bendix—reads: 'As long as men live by what they believe to be so, their beliefs are real in their consequences.'

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