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ATTITUDES TO GENE TECHNOLOGY:
The Significance of Trust in Institutions

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ABSTRACT: This is a study of the relationship between trust in institutions and attitudes to gene technology in general, and GM food and stem cell research in particular. The role of so-called active

trust is emphasised, meaning that trust is neither conceived as a trait nor a one-dimensional concept. The study uses data from a Eurobarometer survey of gene technology in Europe, conducted in 2002. People's attitudes in five European counties, France, Germany, Italy, Sweden and United Kingdom are compared, and the significance of trust in institutions in these countries is investigated. The results show that trust in institutions has an impact on attitudes to gene technology. Trust in experts, stakeholders and official bodies are associated with positive attitudes to GM food and stem cell research, whereas trust in Non Governmental Organisations is associated with negative perceptions of these technologies. This confirms the significant role of active trust.

Key Words: institutional trust; active trust; attitudes to gene technology; Eurobarometer; European public.

1 Introduction

It is now more than thirty years since the invention of gene technology. Nevertheless, this is a field that is still rather unknown to the general public, and it is only now that we start to see products on the market. The technology is complex and we as lay people know little about it; we have to trust our own judgment and the information we get through various expert systems and institutions. Gene technology is just one example out of many reminding us how expert dependent we in the West are today: From the moment we open our eyes in the morning until we fall asleep at night we are surrounded by technology, not only when we use, for example, the coffee machine or the car, but also in less direct forms such as heath care and products such as toothpaste and clothes. Confronted with new or unknown technology we can sometimes try it out, as when we buy a new mobile phone, and then form an attitude. Often, however, new technologies, such as new digital communication networks, are too abstract or complex to be experienced directly. If we are not able to try the new technology ourselves we become dependent on indirect experience, i.e. other people's experience and judgement, as well as information and statements from public actors. Moreover in cases of direct experience we often listen to advice and evaluations from others before making up our own minds, and in this process trust in others becomes an important aspect. This means that institutions such as the government, NGOs (Non Governmental Organisations) and different kinds of experts influence public opinion about modern complex technologies, such as gene technology (cp. Beck, 1992, 2000).

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In this article we argue that attitudes to complex technologies such as gene technology are influenced by trust in institutions.[1] Trust as an aid in decision making is functional when knowledge and personal experience is limited, and the possibility to foresee future consequences is also limited. We argue that trust in institutions has a significant impact on attitudes to GM food and stem cell research,[2] and that the attitude can differ depending on the object of trust (cp. active trust below).

The aim of this paper is therefore to investigate the relationship between trust in institutions and attitudes to gene technology, and more specifically to GM food and stem cell research, two controversial applications of gene technology[3]. Our assumption is that the correlations are similar across European countries although the level of positive or negative attitudes to GM food and stem cell research might differ. Five counties, France, Germany, Italy, Sweden and the UK are examined in this study. These countries were chosen because their populations differ in attitudes to gene technology in general (see Figure 1), and they also differ regarding gene technology policy and public debate (Gaskell & Bauer, 2001, Torgersen et al., 2002). Needless to say, these countries have different religions, and political and welfare systems and if it is possible to show significant relationships between trust and attitudes to gene technology in such a diverse sample of countries this will strengthen our argument.

2 Theories of trust

The concept 'trust'[4] has been studied in different disciplines, not least in psychology and political science, but in this paper the emphasis is on sociological theory and what is often labelled institutional trust (e.g. Sztompka, 1999).[5] At the beginning of the 1980s developed as

[1] We define institutions in line with Sztompka's (1999, p. 43-44) definition. He writes: *'…the trust directed at institutions and organizations (understood as specific structural arrangements within which actions and interactions take place). The school, the university, the army, the church, the courts, the police, the banks, the stock exchange, the government, the parliament, the industrial enterprise, and so forth, are typical objects for this type of trust.'*. This is comparable to the definition given in the Oxford Advanced Learner's Dictionary: '*[an institution is] an organization established for social, educational, religious, etc. purposes',* i.e. influential societal organisations such as the government, mass media, universities, and industry.

[2] For a survey of the nature of attitudes and public opinion, see e.g. Oskamp (1991), Ajzen & Fishbein, (1980), Heijs and Midden (1997).

[3] The choice of applications is based on earlier research which shows that people perceive 'green', i.e. agricultural, and 'red' i.e. medical, gene technology, differently (see Bauer & Gaskell, 2001; Durant, Bauer & Gaskell, 1998; Hampel et al. 2000).

[4] In the literature trust is separated from confidence, where the former is associated with risk and vulnerability, and the latter with familiarity and earlier experiences (Siegrist, Gutscher & Earle, 2005 p 147).

[5] Psychologists working from personality theory often view trust as a trait that individuals develop in varying degrees, and the focus is on individual and group differences across time. The most frequent method is psychometric scaling, and many

a subject of sociological theorising by the work of Niklas Luhmann (1999) and Bernard Barber (1983). Today there is an extensive literature on trust in sociology although there are relatively few empirical studies on the relationship between trust and attitudes (for an overview see Misztal, 1996).[6] A number of studies indicate a relationship between trust and attitudes to issues such as new technology, food safety and risk management (Berg, et al., 2005; Farquharson & Critchley, 2004; Siegrist, Earle & Gutscher, 2003; Siegrist, Gutscher & Earle, 2005). There are also examples of studies on the relationship between trust and attitudes to gene technology (e.g. Siegrist, 2000). There are, however, a number of limitations associated with these earlier studies of the relationship between trust and attitudes. Most of the refereed studies focus on only the relationship between trust and perceived risks while other important aspects of attitudes to technology are ignored (cp. Sjöberg, 2001). These studies are often made on small or otherwise limited samples and seldom include data from more than one country (e.g. Farquharson & Critchley, 2004; Siegrist, Earle & Gutscher, 2003; Siegrist, Gutscher & Earle, 2005). Empirical studies of risk perceptions in general have shown that these perceptions are influenced by a number of socio-economic variables, values and knowledge. These aspects are seldom included in the analysis of trust and attitudes, and when they are, only one or two aspects are analysed. We will return to these studies in connection to the presentation of our results.

In the following section we consider the meaning of institutional trust, its role in late modernity and relation to attitudes. Based on these considerations we present the rationale of our study.

2.1 Institutional trust in late modernity

The concept of trust is often related to the modernisation process and tendencies such as new kinds of risks, increased societal complexity and individualisation (cp. Beck, 1992; Farquharson & Critchley, 2004; Giddens, 1990; 1994a; Luhmann, 1999). Late modern

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other scholars have used scales developed by psychologists also to measure generalized trust (cp. Slovic, 1999). Another common conceptualisation of trust is operationalised by game theory known as the 'prisoner's dilemma' which has been used by behavioural psychologists, political scientists and economists.

[6] The relationship between trust and attitudes has been empirically investigated by psychologists (for an overview see Viklund, 2003). Trust is however most often defined as interpersonal trust and trust as a trait. Sociological studies of trust have primarily focused on cooperation in social and political settings, trust as a collective attribute and trust as social capital (Misztal, 1996, Putnam, 1993). More recently trust has also been studied in surveys with the aim of finding a relationship between trust and stable democracies (Inglehart, 1999), and trust in institutions has been in focus in studies of welfare development and food safety (e.g. Berg et al., 2005; Svallfors, 2002). For a thorough survey and testing of the origins of individual trust, see Delhey & Newton (2003).

societies are characterised by a complexity which can be reduced by trust (Giddens, 1990; 1991), and the concept of trust is linked to risk, since trust is only needed when there is something at stake – if there is no risk there is no need to trust (Sztompka, 1999, cp. Farquharson & Critchley, 2004). The complexity in modern Western societies implies both opportunities; a high level of welfare and alternative life chances, as well as limitations; increased dependence on other people and on autonomous expert systems, the latter having their own organisation, professions, specialist language and logic (Giddens, 1991). Consequently, due to lack of knowledge and insufficient other resources, such as time and money, a person is not able to control the effectiveness of, and actors in, these systems on her/his own. Trust is a strategy to reduce complexity,[7] cope with risk and the dependence of strangers and systems (Luhmann, 1999; Earle & Cvetkovich, 1995; Giddens, 1990; Sztompka, 1999).

The modernisation process, including an increased number of social relationships, indicates a change from interpersonal trust, to institutional trust (Lewis & Weigert, 1985; Luhmann, 1999). With Giddens' (1991) words, we face a transformation from a traditional society to modern and late modern society, where ontological security (related to interpersonal trust) has been disembedded by abstract expert systems (related to institutional trust). The differentiation of knowledge means that, in many contexts of late modernity, we are laymen and depend on expert knowledge (Giddens, 1991). Even in the field of our own expertise, no one knows everything, and trust has become an eminent mechanism in social life (Kohring, 2004). Trust in a multiplicity of abstract systems is a necessary part of everyday life, and the disembedded characteristics of abstract systems imply constant interaction with 'absent others' – people we never meet but whose actions directly affect our lives (Giddens, 1991). In the case of gene technology, the public have no direct experience of, for instance, GM food and hence have to trust in institutions in order to receive information about advantages and disadvantages, e.g. economic gain or health risks. In other words, we are not only dependent on expert systems such as scientists and experts, but also on institutions such as the Ministry of Agriculture and mass media for regulation and information.

Empirical studies of the relation between trust and attitudes often lack theoretical considerations (Siegrist, Gutscher & Earle, 2005). We take our theoretical departure in Lewis

[7] It is important to point out that distrust, such as suspicion, monitoring and activation of institutional safeguards, is also a way of reducing complexity.

and Weigert (1985) definition of trust as consisting of a cognitive, emotional and behavioural dimension. The behaviour dimension can also be seen as a consequence of emotional and/or cognitive trust rather than a separate dimension.[8] The emotional dimension is most profound in interpersonal relationships, while the preponderance of cognitive trust is found in trust in systems or institutions, although both dimensions are present in all kinds of trust. The cognitive base of trust lies in the 'trust in trust'; i.e. we trust the assumption that others trust (cp. Luhmann, 1999). Institutional trust can therefore be said to have elements of 'presentation' (Luhmann, 1999), appearance or reputation.[9] It is activated by the notion that 'everything seems in proper order' and is indispensable for the effective functioning of symbolic media, such as money and political power (Luhmann, 1999; Lewis & Weigert, 1985, cp. Giddens, 1990; 1994a). We trust in the fire brigade not necessarily because of personal experience but because everyone else also trusts it. Hence, the cognitive dimension of trust is collective and not only a matter of individual difference (Lewis & Weigert, 1985). Institutional trust can imply trust in abstract systems or organizations (cp. Giddens, 1990), but principally it refers to trust in actors constituting an institution and their trustworthiness (Sztompka, 1999). Thereby, institutional trust incorporates the process of discriminating between persons and institutions that are either trustworthy or not.

With this perspective of institutional trust, we run the risk of reducing the individual to the system,[10] ignoring the possibility of individual evaluations in relation to personal knowledge and experience (Misztal, 1996). We therefore broaden our perspective by adding aspects of trust from modernization theory: The individualization assumption implies the need of a definition of trust including an active subject (Misztal, 1996; cp. Beck, 1992). One who has tried to combine a structure and actor perspective of trust is Giddens (1994b). He argues that the complexity of late modernity includes a new kind of reflexivity, where not only society in self-confrontation becomes reflexive, but where institutions and expert systems are as well questioned (Giddens, 1990, 1994b, 2002, cp. Beck, 1992). As a consequence, trust understood in terms of responsibility and legitimacy, based in fate and tradition, diminishes

[8] The behavioural dimension is the action which the trust in a person or institutions results in, and as Lewis and Weigart (1985), we will not discuss this dimension any further.
[9] In this study we do not differentiate between trust in the institution per se, or in the reputation of the institution.
[10] Luhmann (1999) does not see trust as an individual trait or rationale at the individual level; trust is rational and functional for maintaining the system, i.e. he discards the rational choice perspective. Rational choice theory views trust as a purposive behaviour aiming at maximization of utility under risk, see e.g. Coleman (1990). For a critical evaluation of the use of rational choice theory and trust see Sato (2002).

and a kind of 'active trust' develops (cp. 'critical trust' by Walls et al., 2004; Misztal, 1996).[11] Hence, trust is still a function of reducing system complexity, but the notion of active trust emphasises the transformative aspect of trust, i.e. trust in different institutions will have different effects depending on e.g. the situation and/or issue.

2.2 Rationale of the present study

Theoretically we argue that institutional trust is mainly based on cognitive processes, used in relation to attitude objects of high complexity and about which the individual has limited knowledge. Institutional trust is not seen as trait; on the contrary, the individual can trust some institutions and organisations but not trust others, so-called to 'active' trust. Furthermore, we argue that trust in an institution by definition does not decrease e.g. fear or perceptions of risk; on the contrary, active institutional trust is dependent on the object of trust: Trust in one type of object, e.g. an organisation, can increase people's sense of risk, while trust in another organisation decreases this perception. Last, the strength of the relationship between institutional trust and attitudes depends on the attitude object, i.e. the more complex object and the less knowledge the individual has about it, the more important will institutional trust be. This also indicates the importance of knowledge in the analysis of institutional trust.

Compared to earlier empirical studies we include and investigate active trust and not only institutional trust in general, and we also include a number of socio-economic variables and knowledge as control variables. The study is based on random sample data from five European countries and we used additive scales to measure trust to avoid overestimating the impact of trust (cp. Sjöberg, 2001).

[11] Wynne (1996) criticises Giddens' conceptualisation of trust, which according to Wynne develops from an automatic (or abstract) trust during early modernity to a reflexive (or active) trust during late modernity. Wynne argues that non-reflexive trust has never prevailed among the public, and that the active trust concept is based on a rational choice assumption, where the individual chooses who to trust in a specific situation. Wynne discards this idea for a more hermeneutic assumption, where the public responses to, for example, scientific expertise are based on an awareness of and accommodation to social dependence on expert institutions (Wynne, 1996). The concept of active trust in relation to interpersonal relationships has also been criticised (see e.g. Adams, 2004; Mestrovic, 1998). The main argument against active trust in personal relationships is that that it *per se* cannot replace e.g. faith, because it would mean constant questioning, for instance a partner's faithfulness and honesty, indicating the opposite of trust.

3 Material and methods

To monitor the public perception of gene technology in Germany, Italy, France, the UK and Sweden, data from the Eurobarometer on Biotechnology, 2002 (58.0), were used. The survey consists of 16,000 interviews, representing the population in the EU over the age of 15, made at the end of 2002. In each country, 1,000 people were interviewed and the sampling principle applied was a multi-stage, random (probability) one.[12] Moreover in each country, a number of sampling points were drawn with probability proportional to population size (to cover the entire country) and population density. All interviews were carried out face-to-face in the respondent's home and in the appropriate national language.

The Eurobarometer questionnaire was developed within the project 'Biotechnology and the European Public'. The survey is based on the questionnaire employed in four previous Eurobarometer surveys on biotechnology (1991, 1993, 1996 and 1999). General questions about gene technology and questions about specific applications were asked, as well as questions about attitudes, trust and regulation.

The explanatory variables used in this paper are considered to be exogenous and can be described as traditional socio-demographic variables, gender, age, education, knowledge[13], a variable that measures how often the respondents talked about gene technology, or 'familiarity' and trust in different institutions. Trust was measured both directly and indirectly: In the direct question respondents were asked to state which institutions they trust to tell the truth about modern biotechnology, and in the indirect question we asked if the respondents thought that different societal institutions such as industry, the government and newspapers are "doing a good job for society when regard to gene technology.". The selection of explanatory variables is based on results from earlier studies of attitudes to new technology and environmental issues (e.g. Bennulf, 1994; Ester, P, Halman & de Moor, 1994; Farquharson & Critchley, 2004; Heijs & Midden, 1997, Siegrist, Gutscher & Earle, 2005). The dependent variables are attitudes to gene technology, more particularly attitudes to GM food and stem cell research. In the analyses of trust, an order logit regression model was used

[12] Germany was divided in two parts, East and West, each with a sample of 1000 people.

[13] The knowledge variable is not an absolute measurement of knowledge but an indicator of people's knowledge (if they know genes exist in all living things etc.), a way of discriminating between people and groups concerning their understanding of gene technology. It might not be the best indicator of knowledge, since there is a range of ways of defining and measuring knowledge, but we still find it useful. It is important to stress that there is nothing to indicate that the relation between knowledge and attitudes is self-evident. Hisschemoller and Midden (1999) argue that the relationship depends on the evaluation of attributes connected to, in this case, a particular technology. Then, knowledge may influence the attributes that are part of forming the attitude, which in turn gives an indirect effect on the attitude-forming process.

because of the qualitative character of the variables (all variables except gender are ordinal). Non-observed heterogeneity between countries, i.e. characteristics not observable in this data, was taken into account by controlling the different error terms of the individual countries. This means that differences between countries does not influence the results.

The next sections present the results, beginning with a general description of attitudes to gene technology in Europe, followed by more specific attitudes to GM food and stem cell research. The third and main part of the result section presents the analyses of possible relations between trust and specific attitudes.

4 Trust and attitudes to gene technology

Earlier studies show that people in Europe are more concerned about gene technology compared to people in for instance the US (Bauer & Gaskell, 2001). However, in the late 1990s this started to change, and today the US is closing in on Europe regarding scepticism towards the technology (Horning Priest, 2000). The European population on the other hand is not homogeneous; there are large variations between the European countries. There is also research showing that there are differences between attitudes to specific applications of gene technology and the general attitude towards gene technology. People express more positive attitudes to gene technology in general (Bauer & Gaskell, 2001; Durant, Bauer & Gaskell, 1998).

If we look at the data from the 2002 Eurobarometer survey, the variation between the European countries persists regarding the overall attitudes to gene technology. The percentage of people in the different countries believing that biotechnology will improve our way of life within the next twenty years varies between 35% in Greece and 71% in Sweden (see Figure 1).

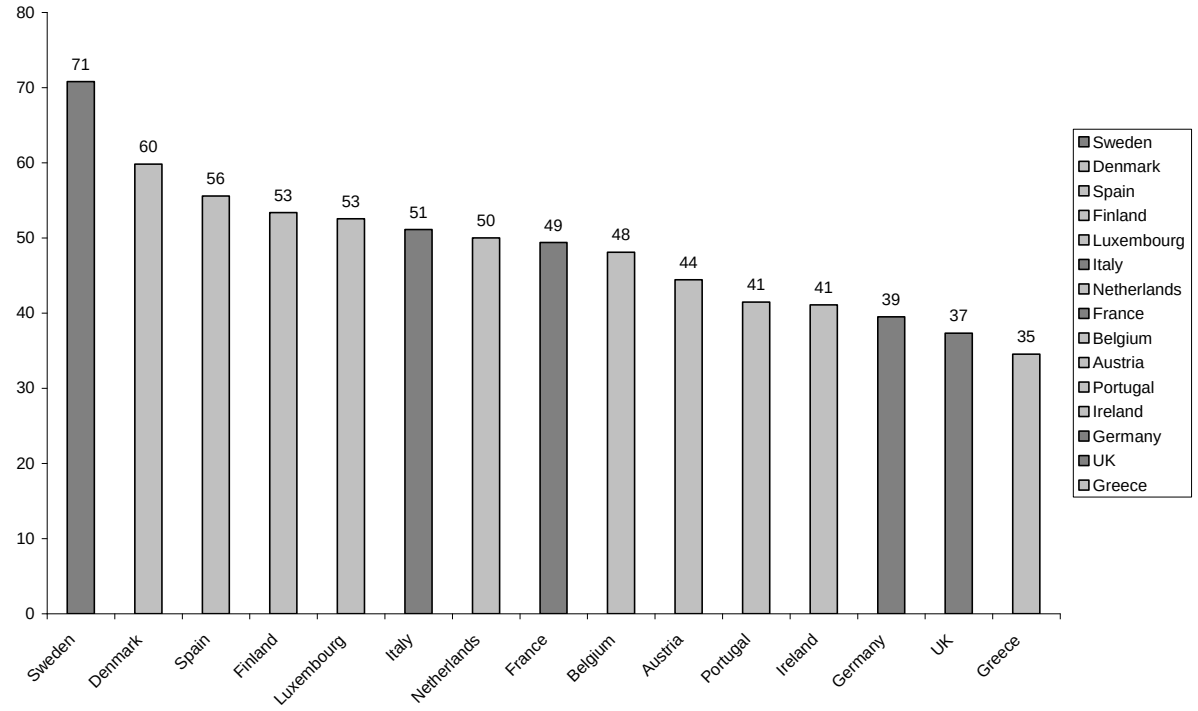

Figure 1. Attitudes to biotechnology in the EU in 2002. Percentage of people agreeing that biotechnology will improve our way of life within the next twenty years.

Compared to earlier studies the Swedish population seems to have become more positive to biotechnology but this result might also be due to the broad formulation of the question. Since it is not possible to study all countries in detail five countries are selected for further analysis: Sweden, Italy, France, Germany and the UK. As mentioned, Swedes are the most positive to gene technology in Europe. In Italy and France, among many other countries, about half of the population is positive to biotechnology. The German and British populations are less positive and together the selected countries represent different attitudinal clusters within Europe. These countries also differ regarding gene technology policy and public debate as well as religion, politics and culture (Bauer & Gaskell, 2001; Durant, Bauer & Gaskell, 1998).

4.1 Attitudes to GM food and stem cell research

Earlier studies of public perception of gene technology show a rather sceptical attitude towards food applications of gene technology on the part of the European public. So-called 'green' (agricultural applications of) gene technology has so far received more scepticism

than 'red' gene technology, i.e. medical applications (Bauer & Gaskell, 2001; Bauer & Gaskell, 2002; Durant, Bauer & Gaskell, 1998; Hampel et al. 2000; Olofsson, Rashid & Öhman, 2003; Öhman, 2002). Earlier studies show that the evaluation of green gene technology differs between different kinds of use. Transgenic animals and food are, for example, less accepted than plants and micro-organisms (Bauer & Gaskell, 2001; Durant, Bauer & Gaskell, 1998; Hamstra, 1998; Hampel et al., 2000; Urban & Pfenning, 2000). People, so far, do not see many consumer advantages of GM food products; rather the benefits of GM food are believed to remain solely in industry (Alvensleben, 2001; Hviid Nielsen, Jelsoe & Öhman, 2002). Stem cells, or therapeutic cloning, has been subject to controversial public debate and policy-making in many European countries (Ideland, 2002; Nippert, 2002) though few studies have looked at public perceptions. The current state of legislation and policy in Europe can be described as deeply heterogeneous (Nippert, 2002 cp. Paul, Li & Brundin, 2002). This section will present our findings about attitudes to GM food and stem cell research in four attitude perspectives: whether the applications are perceived as risky, beneficial, morally acceptable or if they should be encouraged or not.

4.1.1 Risk, usefulness, moral acceptability and encouragement

Perceived risks and benefits might have an impact on acceptance of GM food and stem cells research (Siegrist, 2000). Studies show that giving the respondents information only about benefits results in more favourable attitudes to GM food (Frewer et al., 1996; Frewer, et al., 1997; Hamstra, 1998; Hoban, 1998). However, benefits perceived as only favouring producers have a negative impact on acceptance, and products associated with risks, especially for the environment and physical illness, are not accepted to the same degree. Moral values and beliefs about nature are also important in the evaluation of GM food. When GM food is perceived as un-natural or immoral, acceptance is low (Frewer, et al., 1996; Hamstra, 1998; Hoban, 1998). In addition, if risks and benefits are weighed against moral acceptability it has been shown that perceived risk has low or no impact on encouragement, whereas moral acceptability has an impact (Fjæstad et al., 1998; Durant, Bauer & Gaskell, 1998). The results from the Eurobarometer study in 2002 are presented in Table 1.

Table 1. Perceived usefulness, riskiness, moral acceptability and encouragement of GM food and stem cell research in France, Germany, Italy, Sweden and the UK. Percentages of respondents agreeing with the statement.

	Germany	Italy	France	UK	Sweden
GM food is useful	43.2	29.9	24.2	50.2	42.9
GM food is risky	58.8	56.7	51.1	52.1	57.2
GM food is morally acceptable	41.0	30.3	21.7	43.7	43.1
GM food should be encouraged	32.7	26.3	19.5	37.1	33.5
Stem cell research is useful	61.2	70.5	69.7	72.9	72.6
Stem cell research is risky	55.1	47.5	59.1	56.1	52.6
Stem cell research is morally acceptable	48.0	56.6	52.4	55.1	62.4
Stem cell research should be encouraged	50.3	59.2	58.4	57.1	63.6

A majority of the respondents in all five countries consider GM food risky, ranging from 58.8% in Germany to 51.1% in France. The number of respondents who perceive GM food to be useful differs more between the countries, from 29.% in Italy to 50.2% in the UK. Concerning moral acceptability, slightly more than 40% of the people in three of the countries, the UK, Sweden and Germany, perceive GM food acceptable. In France, on the other hand, only 21.7% find it morally acceptable. Turning to overall encouragement of GM food we find a similar pattern: The support of GM food is lowest in France and highest in the UK.

In Table 1 we also find the corresponding results for stem cell research. As expected, considering the differences in attitudes between GM food and stem cell research found in earlier studies, the respondents are more positive to stem cells than GM food. There are differences between the countries but not as large as for GM food. People in Sweden are the most positive to stem cell research; they have the highest percentages agreeing that stem cell research is useful (together with the UK), morally acceptable and should be encouraged. Germans on the other hand are the least optimistic on these dimensions and Italy, France and the UK constitutes a group in between. Compared to the other four countries, people in France perceive stem cell research as risky, 59.1%. Stem cell research is perceived as least risky by the Italian public, 47.5%, followed by Swedes, 52.6%.

These results confirm earlier findings of the difference between red and green gene technology also in the case of stem cell research, a still relatively controversial application.

There are rather large variations between the countries in perceptions of different aspects of both applications. Compared to the other countries Swedes seem to be more positive to stem cell research and Germans are slightly more negative and the lowest support for GM food is found in France and Italy. The next section analyses the relationship between trust and attitudes to GM food and stem cell research.

4.2 Trust in institutions and attitudes to GM food and stem cell research

The relationship between trust and attitudes has been investigated in a number of empirical studies with varying results. Theoretically trust is associated with risk and knowledge, and most of the empirical studies focus on risk perceptions or attitude objects of which people in general have limited knowledge, e.g. new technologies or environmental hazards. General trust, based on trust as a trait, has shown stable but limited impact on risk perceptions (Siegrist, Gutscher & Earle 2005; Viklund, 2002). The same is true for institutional trust as a predictor for both risk perceptions and perceptions of benefits associated with technologies (Berg et al., 2005; Farquharson & Critchley, 2004; Siegrist, 2000; Siegrist & Cvetkovic, 2000; Siegrist, Cvetkovic & Roth, 2000; Sjöberg, 2002). Critics have argued that the explanatory power of generalised trust is limited and that the way of measuring trust and risk, with the same kind of likert scales, influences the results in a positive way (Sjöberg, 2001). One of our arguments for the relationship between trust and attitudes is lack of knowledge, an argument found in many theories of trust. Empirical studies have also shown that trust is an important dimension in attitudes when the level of knowledge is low (Sjöberg, 2001; 2002; Siegrist & Cvetkovich, 2000).

The measurement of trust is not unproblematic, especially concerning trust in institutions using a survey. There is considerable criticism against using psychometric scales, originally designed to measure trust as a trait, as an indication of generalised trust (e.g. Lewis & Weigert, 1985; Sjöberg, 2001; Yamagishi, 1998). It has also been shown that asking directly about trust in institutions might give a biased picture, since people tend to express the opinion that they trust hardly any societal institutions, although their actions in everyday life display trust (cp. Kohring, 2004).

To avoid this problem, and at the same time avoid using a subjective psychometric scale, we used both a direct and an indirect measurement of trust initially. On the one hand we asked which institutions the respondent trusts to tell the truth about modern biotechnology,

and on the other hand we asked whether different societal institutions such as industry, the government and stakeholders are doing a good job for society regarding gene technology. The latter can be seen as an indirect indicator of trust.

Table 2. The order of how much people trust the different institutions in Europe.

Direct question	Indirect question	
1. Medical profession	1.	Medical doctors
2. Consumer organisations	2.	Patient organisations
3. Environmental organisations	3.	Consumer organisations
4. Universities	4.	University scientists
5. Animal welfare organisations	5.	Environmental organisations
6. TV/newspapers	6.	Scientists working in industry
7. International institutions (not companies)	7.	Newspapers
8. National governmental bodies	8.	Farmers
9. Farmers' organisations	9.	Shops
10. Religious organisations	10.	European commission
11. Particular industry	11.	Government
12. Political parties	12.	Industry

The results confirm that a direct question leads to a lower response rate compared to an indirect question; nevertheless, the order of precedence is more or less the same (see Table 2). Unfortunately the questions were not identical concerning the alternative institutions and the way the response alternatives were structured, which may explain the small differences in the results. Considering the resemblance between the two questions and the disadvantage of using a direct question and the advantage of predefining trust in the indirect question, we chose the indirect measurement in our analysis.

As mentioned earlier, the aim of this study is to investigate the relationship between trust in institutions and attitudes to GM food and stem cell research. First we made an index of the twelve trust questions, giving us a rough measurement of institutional trust, which we then analysed against attitudes to different aspects of GM food and stem cell research. Of the four aspects use, risk, moral acceptability and encouragement, described in the previous section, only two were chosen for further analysis, since earlier research shows that respondents employ the four aspects as a two-dimensional structure: Risk is one factor, and use, encouragement and moral acceptability comprise another (Durant, Bauer & Gaskell, 1998; Midden et al., 2002). This result was confirmed in our data by a factor analysis, applied across the range of biotechnology applications, including GM food and stem cell research. As

a result we can reduce the number of attitude indicators to two: one of risk and the other of use, moral acceptability or encouragement. This makes it possible to choose two aspects of GM food and stem cell research as dependent variables: whether the application is risky, and whether the respondents think it should be encouraged or not. The results from the bivariate regression analysis of trust and attitudes to GM food and stem cell research, in the five selected countries are presented in Table 3.

Table 3. Bivariate order logit model estimating the relationship between trust and attitudes to GM food and stem cell research in France, Germany, Italy, Sweden and the UK.

		Risky GM food	Risky stem cells	Encourage GM food	Encourage stem cells
France		**-0.092***	**-0.099***	**0.103***	**0.107***
		(-2.73)	(-2.94)	(3.28)	(3.25)
	Pseudo R^2	*0.009*	*0.010*	*0.012*	*0.012*
	N-obs	*316*	*388*	*316*	*390*
Germany		**-0.084***	**-0.066***	**0.200***	**0.184***
		(-3.86)[1]	(-3.29)	(8.98)	(9.30)
	Pseudo R^2	*0.008*	*0.005*	*0.041*	*0.036*
	N-obs	*829*	*853*	*808*	*841*
Italy		**-0.108***	**-0.063***	0.043	**0.090***
		(-3.44)	(-2.09)	(1.34)	(2.91)
	Pseudo R^2	*0.013*	*0.004*	*0.002*	*0.009*
	N-obs	*348*	*348*	*351*	*366*
Sweden		**-0.070***	**-0.066***	**0.121***	**0.078***
		(-2.19)	(-2.08)	(4.09)	(2.56)
	Pseudo R^2	*0.005*	*0.004*	*0.014*	*0.006*
	N-obs	*414*	*410*	*402*	*406*
UK		0.006	**-0.069***	**0.078***	**0.113***
		(0.21)	(-2.45)	(2.81)	(3.82)
	Pseudo R^2	*0.000*	*0.006*	*0.008*	*0.015*
	N-obs	*397*	*411*	*392*	*398*

* significant at least at 0.05 level

^ significant at least at 0.1 level

[1] z-value

Pseudo R^2 = goodness of fit

The relationships are rather weak but significant in 18 out of 20 cases, which indicates that trust in institutions influences attitudes to GM food and stem cell research. The results also show that the more people trust institutions; the less risky they perceive the applications to be, the more they think the applications should be encouraged. In other words, the more institutional trust people have, the more positive are their attitudes. However, measuring trust this way makes it impossible to draw conclusions regarding active trust, since different kinds of institutions are grouped into one measurement. This kind of analysis can conceal the fact that the direction of the relation between trust in a specific institution and attitudes can differ between institutions. The results might also reflect individual trust dispositions rather than

institutional trust. The analyses do not consider any other factors, and to adjust for these limitations, further analyses are needed.

The trust measure was therefore recoded into four types of institutions:[14] 1) 'experts' (medical doctors and university scientists); 2) 'stakeholders' (industry; shops; farmers; scientists working in industry); 3) 'NGOs' (consumer, patient and environmental organisations) and 4) 'official bodies' (the government and the European commission). Media was not included since it is to be considered as a channel more than a source in the case of institutional trust.

Before we turn to the multivariate analyses of active trust, possible differences in trust between the five countries are examined. Figure 2 shows the differences in trust between Germany, Italy, France, the UK and Sweden in the four groups of institutions described above.[15] The Swedish public trusts official bodies and experts more than people in the other countries do. The UK public on the other hand trusts stakeholders more than the average for the other countries and the French public trusts NGOs and experts more than average. Besides these differences the countries are quite similar.

[14] The variables were measured using the number of respondents reporting that they trust a specific institution doing a good job for society. This means that the number of variable values differs between the four groups of institutions depending on the number of specific actors included; experts range from 0 to 2, stakeholders from 0 to 4, NGOs from 0 to 3 and official bodies range from 0 to 2.

[15] All differences between countries are significant on the 5% level in a one-way ANOVA.

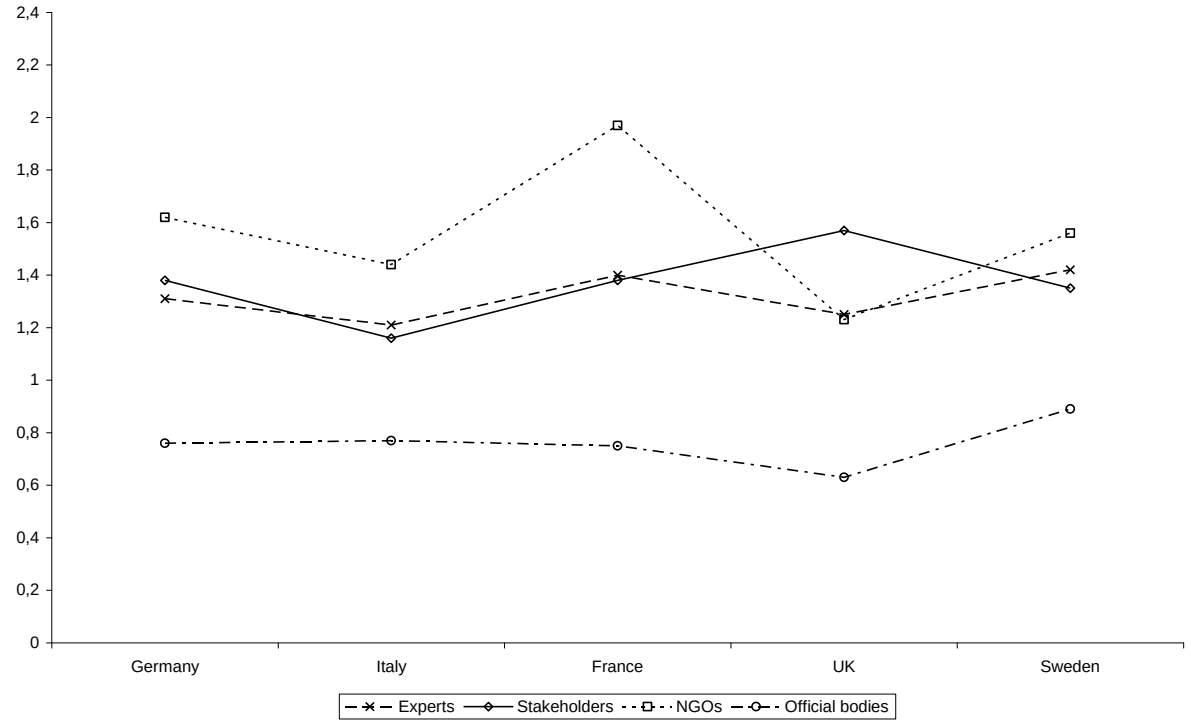

Figure 2. Trust in four groups of institutions: experts, stakeholders, NGOs and official bodies, divided by countries. The scale shows the mean number of actors trusted in each group of institutions (N.B. the different groups of institutions one cannot be compared to each other).

In the multivariate analyses of the relations between active trust and attitudes we also used traditional socio-demographic variables: gender, age[16], education[17], textbook knowledge[18], and the variable that measures how often the respondents talked about gene technology, or 'familiarity'[19]. Knowledge and familiarity were added because it is a common argument that a high level of knowledge and familiarity (together often described as awareness) make people more positive to new technologies, and this means that they see the technology as less risky.

Four order logit models were estimated, one for each dependent variable, and the results are shown in Table 4.[20]

[16] Age is categorised in four groups; 15-24, 25-39, 40-54, 55 and older.
[17] However, education had to be excluded because of multi-colinearity with knowledge.
[18] Index of 10 questions.
[19] The question was 'Before today have you ever talked about modern biotechnology with anyone?' and answered on a four-point scale from no never to yes frequently.
[20] In the Eurobarometer survey a so-called split ballot was used when asking about different applications such as GM food and stem cell research, which means that only half of the sample answered these questions. As a result the sample is decreased by 50% of the total Eurobarometer sample.

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Table 4. Order logit model estimating what makes the people in Germany, Italy, France, the UK and Sweden encourage an application or think that it is risky. Results based on the 2002 survey.

	GM food risky	Stem cells risky	GM food encouraged	Stem cells encouraged
Trust in experts	**-0.197***	**-0.242***	**0.192***	**0.323***
	(-3.92)[1]	(-4.75)	(3.74)	(6.44)
Trust in stakeholders	**-0.061***	**-0.061^**	**0.145***	**0.080***
	(-2.33)	(-2.15)	(5.37)	(3.08)
Trust in NGOs	**0.171***	**0.092***	**-0.144***	**-0.101***
	(5.48)	(2.91)	(-4.52)	(-3.21)
Trust in official bodies	**-0.142***	-0.084	**0.146***	**0.180***
	(-2.92)	(-1.76)	(2.93)	(3.74)
Gender	-0.074	0.084	**0.244***	0.087
	(-0.99)	(1.15)	(3.25)	(1.18)
Age	**0.069^**	0.007	-0.058	0.025
	(1.98)	(0.21)	(-1.65)	(0.69)
Familiarity	0.026	**0.052***	**-0.053***	0.010
	(1.12)	(2.89)	(-2.39)	(0.51)
Knowledge	0.012	0.008	**0.079***	**0.063***
	(0.60)	(0.46)	(4.08)	(3.37)
Countries (compared to Sweden)				
France	**0.517***	**1.173***	-0.263	-0.086
	(3.38)	(8.49	(-1.86)	(-0.60)
Germany	0.143	**0.355***	**0.363***	**-0.595***
	(1.33)	(3.23)	(3.17)	(-5.05)
Italy	**0.457***	0.250	-0.106	-0.004
	(3.27)	(1.90)	(-0.70)	(-0.03)
UK	0.085	**0.408***	**0.341^**	**-0.316***
	(0.63)	(3.20)	(2.47)	(-2.38)
Pseudo[2] R^2	0.015	0.023	0.030	0.032
N-obs	2392	2527	2354	2520

* significant at least at 0.01 level

^ significant at least at 0.05 level

[1] z-value

Pseudo R^2 goodness of fit

The results show that trust plays a significant role in the understanding of attitudes to GM food and stem cell research. We find that three of the institutions contribute significantly in all four analyses, experts, stakeholders and NGOs, and that trust in official bodies is significant in three cases. Trust in experts, stakeholders and official bodies is related to a lower risk perception and more positive attitudes to encourage the applications. Trust in NGOs has an opposite pattern; risk perception is high and more sceptical attitudes towards encouraging GM food and stem cell research. These results confirm the assumption of active trust since the direction of the relations between trust and attitudes varies between different institutions.

The results also show that, although both traditional socio-demographic variables, such as age and gender, as well as familiarity are included, trust in institutions have the most stable relationship with attitudes to GM food and stem cell research. Gender plays a significant role regarding encouragement of GM food, men being more positive towards GM food. Age has no, or marginal, explanatory power. Familiarity contributes weakly in two out of four analyses, the more people talked about stem cell research the more risky the think it is and the more they talked about GM food the less they want to encourage it. Knowledge contributes significantly to whether people think that GM food and stem cell research should be encouraged or not. The more knowledge people have the more they want to encourage the applications. Differences between countries show that country-specific components influence people's attitudes to GM food and stem cell research. For example people in France perceive GM food as more risky compared to Swedes, and Germans are less willing to encourage stem cell research.

We find that there are indications that trust in institutions influences the process of attitude formation and this confirms our assumption of active trust. These results will be further discussed in the concluding section that follows.

5 Concluding discussion

In this paper we explored the impact of institutional trust on attitudes to two applications of gene technology: GM food and stem cell research. From our results we conclude that the assumption, that trust in institutions influences attitudes, is confirmed. There is a stable, albeit weak,[21] relationship between trust and attitudes to GM food and stem cell research; the more people trust in different societal institutions, the more positive they are to the two gene technology applications. This is in itself interesting, since it indicates that trust in institutions increases acceptance of controversial technologies as part of the individual process of understanding complex issues (cp. Beck, 1992, Giddens, 1990, Luhmann, 1999) and it confirms earlier studies (e.g. Siegrist, 2000; Siegrist, Cvetkovic & Roth, 2000). Whether this is due to individual dispositions, or system trust is, however, not possible to decide in a bivariate analysis using a single measurement of institutional trust. Our results also give the

[21] The chosen method order logit regression, does not measure explained variance since the purpose of this study was to confirm the significance of institutional trust rather than to test the strength of the relationship. Compared to the control variables, which have shown stable correlations in earlier studies, trust is the most stable and influential variable indicating reliable results.

impression that trust always decreases perceptions of risks and increases acceptance: the question is whether this is really the case? This study therefore takes the concept of trust one step further and shows that trust in institutions is an active trust.

When we differentiate between various kinds of societal institutions, and control for potential influential factors, we find that there are still significant correlations between institutional trust and attitudes to gene technology. We have found relationships between trust in experts, stakeholders and official bodies and the perception that the application is not that risky and also should be encouraged, whereas trust in NGOs shows the opposite pattern. These differences in direction of the relation between trust in different institutions and attitudes to gene technology imply that the idea of active trust is supported (Giddens, 1994b). Stakeholders want to use the technology and place products on the market, and official bodies usually have the role of regulating these processes. The results indicate that if this dual process of market and regulation is trusted, then the risk is perceived as lower and the gene technological application in question is also encouraged. It is also interesting that trust in NGOs with their obvious role of opposing stakeholders as well as experts and official bodies, show an opposite pattern. This can have consequences on public debates about new technological applications; in cases where NGOs are given much space in the debate public attitudes might become more sceptical compared to when for instance official bodes or stakeholders are represented in the debate. We can therefore conclude that active, cognitive-based trust in institutions and its impact on attitudes becomes more important in late modern societies, where people are faced with a large number of complex and abstract issues on a regular basis (Luhmann, 1999; Earle & Cvetkovich, 1995; Sztompka, 1999).

The results that trust in experts also lead to a less sceptical opinion, or a perception that GM food and stem cell research are not so risky, have some interesting implications. Late modern societies with complex technological systems and increased individualisation amplify our dependence on abstract expert systems; in other words, no one knows everything, even in the field of their own experience (Kohring 2004, cp. Giddens 1994a). In this context, the rather solid relationship between trust in experts and positive attitudes to gene technology attracts attention, and it would be interesting to study it further in relation to other social issues. The overwhelming majority of experts has argued against any proclaimed risks in connection with both gene technology and GM food, even though there have been a few sceptical voices over the years (cp. Molder & Gutterling, 2003; Olofsson, 2002). At the same

time, it is also clear that the mass media's way of amplifying controversies by putting expert opinions against each other (Olofsson, 2002) does not make people who trust in experts less convinced of the advantages of the issue in question. This somewhat challenges the view that mass media's image of, for example, experts creates interpretative packages which people can use to make sense of the world (cp. Gamson & Modigliani, 1989).

The results also show that there is further difference between GM food and stem cell research in respect to trust: If we look at the level of trust, we find that it does not fluctuate much between the different groups of institutions concerning GM food, but for stem cell research, experts are relatively more trusted compared to other institutions. This difference might be because stem cell research is less known and seemingly more complex. GM food products were introduced as early as in the beginning of the 90s and people have perhaps even seen a can of modified tomatoes, at least in media. Stem cell research, on the other hand, is in an earlier stage of development and therefore the expert dependence is higher. Experts are often first involved in the creation and launch of new technological applications, while official bodies, stakeholders and NGOs come later in the process of technological diffusion. If people have personal experiences of a product, they are less dependent on expert advice compared to more unknown applications.

Would it be possible that the relationship between trust and attitudes is the opposite, that a certain attitude influences trust in specific institution? It is not possible to rule out this possibility with our design, but one can question whether it is reasonable to think that a positive attitude to e.g. stem cell research would make a person trust experts more. The answer to this question is that neither theory nor earlier studies support such an interpretation.

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