Explaining Consumer Attitudes to Genetic Modification in Food Production[1]

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Abstract

Consumers have not had many possibilities yet for seeking out, buying and consuming genetically modified food products. However, for various reasons consumer attitude formation with regard to these products is likely to be complex and closely related to personal values. The paper presents a model for explaining consumer attitudes to genetic modification in food production which builds on modern cognitive psychology and multi-attribute attitude theory. In addition, the paper introduces the empirical research which is undertaken at present to validate and estimate the parameters of the model by means of surveys in Denmark, Germany, the United Kingdom and Italy (total n=2000).

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Introduction

Genetic modification is increasingly used in the development of new foods and ingredients for food production, and the benefits of these applications are widely appraised by food producers and food technologists, who generally tend to dismiss the occurrence of serious risks arising from applications of gene technology in food production (e.g. Scholderer, Balderjahn & Will, 1998). Research has, however, shown consumers to be far less supportive of genetic modification, and considerably less so of applications in the food domain than of applications in the medical field (e.g. European Commission, 1997; Heijs & Midden, 1995).

In itself, gene technology offers entirely new and seemingly infinite possibilities for combining genetic material from different species and even for combining human genetic material with animals or plants. Up till now, consumers have, however, only had little opportunity to actually seek out, buy and consume foods produced by means of genetic modification, and their experience with this type of products is therefore limited. Taken together, this makes genetic modification a highly involving process characteristic among consumers, and these aspects generally give reason to expect consumer attitude formation with regard to using genetic modification in food production to be complex and closely related to personal values.

Research conducted so far points to some shortcomings of existing consumer behaviour theory in explaining consumer attitudes to genetic modification in food production (reviewed in Bredahl, Grunert & Frewer, 1998). Moreover, most research undertaken so far is so diverse in focus and

research methodology that it is difficult to derive more general conclusions about the constituents of these attitudes. Together with the potential complexity of consumer attitudes to applying genetic modification in food production, this calls for the development of a new theoretical basis.

A model for explaining consumer attitudes to genetic modification in food production

The model which we suggest for explaining consumer attitudes to genetic modification in food production adopts a cognitive approach and takes into account previous research into consumer attitudes to general and specific applications of genetic modification, alternatively modern biotechnology. The model specifically builds on Fishbein's multi-attribute attitude model, which states that a person's attitude to an object is determined by the sum of beliefs that the person has about the consequences or attributes of the object weighted by their evaluations (Fishbein, 1963). This model has been widely applied in consumer research, but some revision is required in the this context.

For example, it has been shown that consumer attitudes to genetic modification in food production are not only based on the consequences that the technology is perceived to have for the person him- or herself, as claimed by Fishbein, but also on considerations of consequences for other groups in society, such as one's family, future generations and the environment (Bredahl, 1998; Frewer, Howard & Shepherd, 1996). The beliefs about the consequences of applying gene technology in food production may even vary in strength depending on which outcome group the person has in mind. Thus, in empirical research in this domain, the beliefs

underlying attitudes should be explicitly related to key outcome groups so that the influences of each group on overall attitudes can be assessed.

Likewise, it has been shown that beliefs about the risks and benefits of genetic modification are important determinants of attitudes (e.g. Hamstra, 1991, 1995). Generally, perceived risks can be considered to influence attitudes negatively, while perceived benefits can be assumed to influence attitudes in a positive direction, thereby allowing a certain amount of risk to be compensated for by perceived greater benefits in the minds of the consumers. To allow the weights of these two kinds of beliefs to be empirically assessed, we suggest that an explicit distinction be made between perceived risks and perceived benefits of applying gene technology in food production.

Furthermore, it seems reasonable to expect consumer attitudes to genetic modification in food production to be determined both by beliefs concerning the production process and by beliefs that relate specifically to the perceived quality of the resulting product, as has also been suggested by Frewer, Howard, Hedderley and Shepherd (1997). In fact, it may even be that a person's attitude to genetic modification in food production is determined both by beliefs about process and beliefs about product regardless of whether the production technology is directly traceable in the final product (e.g. yoghurt produced with a genetically modified starter culture) or not (e.g. beer brewed by means of genetically modified yeast). Again, to allow the weights of the two kinds of beliefs to be determined empirically, we suggest an explicit distinction between process and product beliefs.

More general attitudes and knowledge domains can also be expected to significantly influence attitudes. Previous research has indicated at least five general attitude and knowledge domains as antecedents of attitudes to genetic modification in food production. These are perceived knowledge about genetic modification (Bredahl, 1998; Frewer, Howard & Shepherd, 1997), attitude to environment and nature (Frewer, Hedderley, Howard & Shepherd, 1997; Hamstra, 1995), attitude to science and technology (Borre, 1990; Hamstra, 1991; Sparks, Shepherd & Frewer, 1994), food neophobia (Bredahl, 1998), and trust in regulators (Frewer, Howard, Hedderley & Shepherd, 1996). In addition, it seems likely that consumers' perceived personal control over buying and eating foods produced with gene technology will significantly influence attitudes, and that these attitudes will also be influenced by the consumers' level of knowledge about food production.

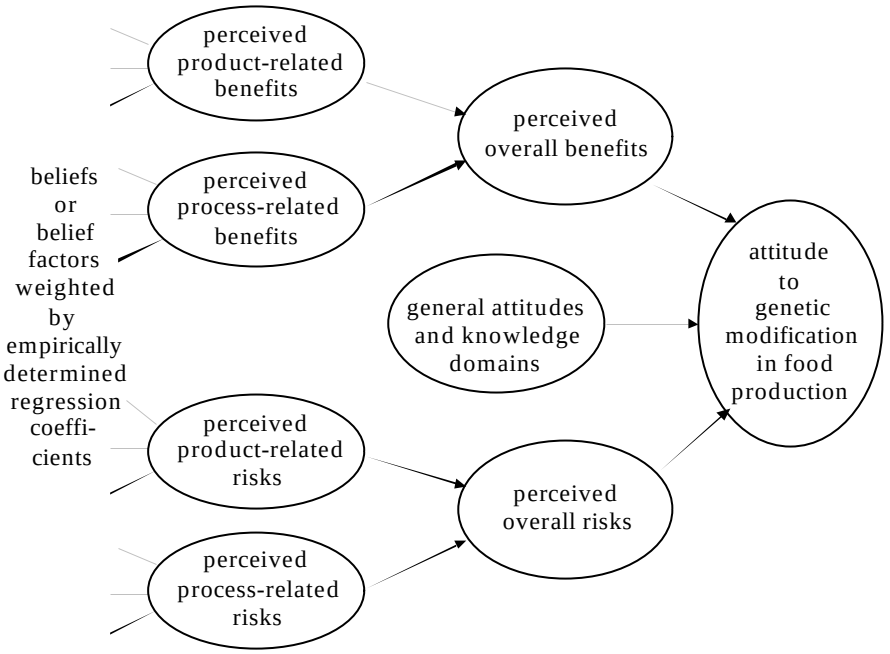
Finally, the proposed model takes into account the general critique of the multiplication principle in Fishbein's model that has been put forward by Schmidt (1973) and Evans (1991) among others. They point to the fact that the covariances of the multiplicative composites based on belief strengths and evaluations are heavily dependent on the scales used to measure the underlying items; this causes problems in interpreting correlation and regression coefficients. To avoid this statistical problem, we suggest that belief strengths are measured directly and that the direct assessment of outcome evaluations is replaced by standardized regression coefficients resulting from a regression of beliefs on the global measures of attitude. Since the beliefs will be interrelated, and in order to allow an estimation of the model by structural equation analysis using latent constructs, single beliefs may be replaced by belief factors, identified by means of principal components analysis.

To summarize, our model for explaining consumer attitudes to genetic modification in food production deviates from Fishbein's model in five ways: outcome beliefs are specified for different outcome groups, an explicit distinction between perceived benefits and risks is included, a distinction between beliefs about product and process is made, more general attitudes and knowledge domains are included as determinants of attitudes, and the belief-based measures of attitudes are weighed by standardized regression coefficients rather than direct evaluation measures.

A graphical presentation of the model can be seen in figure 1. More formally, the postulated relationships can be listed as follows:

Figure 1

Determinants of attitude to genetic modification in food production



$$A = w_1 B + w_2 R + \sum_i u_i GA_i$$

$$B = \sum_j \sum_k \beta_{jk} pb_{jk} + \sum_l \sum_k \beta_{mk} cb_{mk}$$

$$R = \sum_j \sum_k \beta_{jk} pr_{jk} + \sum_l \sum_k \beta_{mk} cr_{mk}$$

where

A = attitude to genetic modification in food production

B = perceived overall benefits

R = perceived overall risks

GA_i = general attitude or knowledge domain *i*

w, u, β = empirically determined weights (standardized regression coefficients)

pb_{jk} = strength of belief about product-related benefit *j* related to outcome group *k*

pr_{jk} = strength of belief about product-related risk *j* related to outcome group *k*

cb_{mk} = strength of belief about process-related benefit *m* related to outcome group *k*

cr_{mk} = strength of belief about process-related risk *m* related to outcome group *k*

Research objectives

The aim of the empirical research is to validate the proposed attitude model across different cultural environments and to estimate the relative impacts of the various parameters in explaining consumer attitudes to genetic modification in food production.

Methodologically, the aim is also to investigate the applicability of omitting the evaluation terms of Fishbein's framework in order to avoid the statistical bias that arises from the traditional multiplicative composites.

Method

Respondents

2000 consumers were interviewed in Denmark, Germany, the United Kingdom and Italy, with 500 interviews in each country, using a standardized, self-administered questionnaire. Denmark, Germany and the United Kingdom have previously been shown to differ in food-related lifestyles (Brunsø, Grunert & Bredahl, 1996) and the four countries have been shown to differ in attitudes towards modern biotechnology as well (European Commission, 1997). The countries are

therefore regarded apt candidates for investigating cross-national similarities and differences in the constituents of consumer attitudes to genetic modification in food production.

Questionnaire

At the beginning of the questionnaire a short definition of gene technology and genetically modified food products was given. The definition was kept in as neutral terms as possible to avoid undesirable attitudinal effects, and went as follows:

> All living organisms (plants, animals and human beings) are made up of cells. The cells contain, among other things, hereditary characteristics (genes) that determine what each organism will look like, for instance whether a child will get blue eyes or whether a plant will be able to resist a certain pesticide.
>
> The hereditary characteristics of all living organisms are changed from one generation to another, either naturally or through traditional breeding techniques. By gene technology the hereditary characteristics are altered in a new way. Gene technology can be used to modify the hereditary characteristics of an organism, to move hereditary characteristics from one organism to another, or to take away a specific hereditary characteristic from an organism.
>
> When we use the term 'genetically modified food products' in this study, we mean foods where gene technology has been applied at some stage in the production process.

The questionnaire listed the relevant items in a randomized order. Unless otherwise noted, the items mentioned below were measured on 7-point Likert scales.

The global constructs A, B and R were each measured by three items. Attitude was measured by 'Applying gene technology in food production is *extremely bad – extremely good*', 'Applying gene technology in food production is *extremely foolish – extremely wise'*, and 'I am *strongly against – strongly for* applying gene technology in food production'. Perceived overall benefits

were measured by 'Overall, applying gene technology to produce food products will prove beneficial to the environment, myself and other people that are important to me', alternatively '.. will offer great benefits..' and '.. will prove advantageous..', and perceived overall risks were measured by 'Overall, applying gene technology to produce food products involves considerable risk to the environment, myself and other people that are important to me', alternatively '.. will prove harmful..' and '.. will prove disadvantageous..'. The items were all assessed on *strongly disagree – strongly agree* scales.

Specific risks and benefits were elicited from an introductory qualitative study conducted in the four countries using means-end chain theory and the laddering technique (Bredahl, 1998). The elicited risks and beliefs were covered by one item each in the questionnaire and were also rated on *strongly disagree – strongly agree* scales.

As far as possible measurement of the general attitude and knowledge domains GA was based on already established measurement instruments found in the literature. Attitude to nature was measured by six items. The items constituted a subset of Dunlap and Van Liere's 'New Environmental Paradigm' scale (1978), which was used by Steger, Pierce, Steel and Lovrich (1989) with results similar to those obtained by using the complete scale. Attitude to technology was measured by five items which have previously been used with success by Hamstra (1991). The items are a modified subset of items of a scale which was originally developed to measure technocratic attitudes among scientists. Food neophobia was measured using five items of the ten-item scale developed by Pliner and Hobden (1992). The five items were selected on a subjective basis. Allison (1978) developed a 35-item scale for measuring consumer alienation

from the marketplace, and the dimensionality and validity of the scale was further investigated by Bearden, Lichtenstein and Teel (1983), who identified a three-factor structure. Here, we have used a subset of five items from the identified 'business ethics' factor, which originally consisted of eleven items. Again the items were selected on a subjective basis, excluding items which were not considered appropriate in relation to food issues. All items were rated on *strongly disagree-strongly agree* scales.

Perceived knowledge of the use of gene technology in food production was attributed both to self, the average person, government and industry, each measured by one item, while perceived personal control was measured by two items inspired by previous measurements of the 'perceived behavioural control' measure of Ajzen's Theory of Planned Behavior (1985). Again, all items were assessed on *strongly disagree-strongly agree* scales. Actual knowledge of food production was measured by eight items which were rated on dichotomous *true-false* scales.

The questionnaire was developed in English and was translated into Danish, German and Italian by bilingual researchers. The translated versions were then cross-checked by another group of bilingual researchers and the questionnaire was pretested in each country (n=30) to allow final adjustments before the full-scale applications.

Data collection

Data were collected by means of personal in-home interviews as this was thought to be the most neutral and least stressing interview setting for respondents of all countries. All respondents

completed the questionnaire themselves in the presence of an interviewer who could be consulted with questions relating to the usage of response scales and other technical matters.

Analysis

In the analysis of the data, special emphasis will be put on the cross-cultural validity of the results, and the general construct validity of the results will also be analyzed.

First, principal components analysis will be used to explore the unidimensionality of the items used as measures of each the general attitude and knowledge domains. Likewise, principal components analysis will be used with the belief items to detect possible underlying belief factors. The belief items are expected to group into process and product beliefs, each covering one or more factors.

The applicability in a cross-cultural setting of the detected factors and of each of the three-item measures of the global constructs A, B and R will then be analyzed using multi-sample confirmatory factor analysis. Here, the framework proposed by Grunert, Grunert and Kristensen (1994) which distinguishes among several levels of cross-cultural comparability will be applied and the cross-cultural validity of the data will be analyzed both on an item and scale basis. In addition, the reliabilities of the individual scales will be analyzed by means of Cronbach's alpha.

Depending on the cross-cultural validity of the data, the proposed attitude model will then be estimated on the pooled data and separately for each country. Possible modifications of the model will be considered as well by inspection of modification indices.

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