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Understanding Attitudes Towards Genetically Modified Food: The Role of Values and Attitude Strength

ABSTRACT. This study was aimed at gaining a better understanding of the nature of negative attitudes towards genetically modified (GM) food. A sample of 250 students at the University of Tromsø responded to a questionnaire measuring attitudes towards GM food, attitude strength, intention to buy such food, and their personal values. Values and attitude strength proved to be important constructs when explaining the attitudes. A structural model was estimated, confirming that the negative attitudes towards GM food were embedded in universalism and hedonism values, and also predicted behavioural intention to buy such food. Attitude centrality was found to moderate the value-attitude relationship. Central attitudes mediated the relation between values and behavioural intention, while for the less central attitudes there was no relation between values and attitudes. Rather, both were independent predictors of intention. The study showed that some individuals hold weak attitudes and therefore may be more likely to change their attitude than those whose attitude is embedded in values.

Genetic modification seems to arouse strong opinions. Several studies have indicated that most people in Europe have quite negative attitudes toward genetic engineering and genetically modified (GM) food (Bredahl, 1999, 2001; Frewer, Howard, & Shepherd, 1996, 1997; Frewer, Scholderer, Downs, & Bredahl, 2000; Grunert et al., 2001; Hoban, Woodrum, & Czaja, 1992; Kuznesof & Ritson, 1996; Miles & Frewer, 2001). A Eurobarometer survey (European Commission, 2000) showed citizens of EU countries to be sceptical: Genetic engineering was regarded as unnatural, threatening the order of things, and as something that could cause a global disaster.

Quite a few studies provide evaluations of risks and benefits of genetic modification from a biotechnological or biological point of view, most of them concluding that genetic modification is a natural extension of breeding methods, and perhaps even safer than the traditional methods. For example, Harlander (1991) suggests that biotechnology is the key to enhanced food productivity, improved quality, nutrition, and a safe food supply. Another category of studies



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argues against genetic modification of organisms and animals on the basis of concern for animal welfare (Fox, 1988; Thompson, 1997). In the social science domain, a range of studies focus on consumers' risk perception and trust in information sources (Frewer et al., 1996, 1997, 2000; Hoban et al., 1992; Miles & Frewer, 2001). Some studies in the attitude domain are concerned with attitudes towards GM food and other variables as predictors of behavioral intentions to buy GM food (Bredahl, 2001; Cook, Kerr, & Moore, 2002; Sparks, Shepherd, & Frewer, 1995). Others have carried out more qualitative studies of attitudes, perceptions, and values associated with genetic modification (Bredahl, 1999; Grunert et al., 2001; Kuznesof & Ritson, 1996).

Attitude, defined as the disposition to evaluate an attitude object with some degree of favour or disfavour (Eagly & Chaiken, 1993), is generally found to be the strongest predictor of behavioural intention, while in some studies perceived control over behaviour and subjective norm are additional significant predictors of the intention to buy GM food. Environmental self-identity was found to be a significant predictor of intention in studies by Sparks et al. (1995) and Cook et al. (2002). Moral and ethical considerations have also been shown to have an influence on attitudes towards GM food (Sparks et al., 1995). Also, some studies have found that the object of genetic modification is important: Many respondents are less negative towards genetic modification of plants and micro-organisms, and may even find some arguments supporting the technology (see, for example, Frewer et al., 1997). Genetic engineering of animals is not generally accepted.

Some of the studies mention values as antecedents to attitudes. Bredahl (2001) argues that though consumers' experience of GM is very limited, they still perceive such food as very risky. She states that the specific attitudes towards GM food are therefore likely to be based on more general attitudes, which again are embedded in values. This was not tested explicitly in Bredahl's study.

The present article seeks to investigate, in depth, the nature of attitudes towards GM food. As noted above, a range of studies have shown that these attitudes are mostly negative. Consumers' acceptance or rejection of GM food is an issue that may have political, economic, and social implications, not only in Europe, but worldwide. One important goal of this paper is therefore to understand the bases of negative attitudes towards GM food. It seems that there are two variables that further the understanding of these attitudes: *attitude strength* and *values*. If attitudes towards eating GM food are indeed

based on values, then these attitudes will be strong and resistant to change, even if the technology proves to be harmless. There may however also be individuals whose negative attitudes are rather weak. In other words: Two people may give the same score on some attitude scale, but the strength can be different, meaning that there might be differences in the underlying evaluations, with differing consequences. We will, in our analysis, distinguish between attitude valence, which we define as favourable or unfavourable thoughts and feelings about GM food, and attitude centrality, which refers to attitude importance, relation to values, or centrality to self (Judd & Krosnick, 1982). In this paper, we will first discuss the constructs mentioned above, and then present the results of an empirical study.

ON THE RELATIONSHIPS BETWEEN VALUES, ATTITUDE STRENGTH, ATTITUDES, AND BEHAVIOUR

Rokeach (1973) defined values in the following way:

> A value is enduring belief that a specific mode of conduct or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct or end-state of existence along a continuum of relative importance.

Many studies have used the Schwartz Value Survey (Schwartz, 1992) to measure values. The instrument covers 56 values, which pertain to 10 motivational value types (e.g., hedonism, tradition, or benevolence). Earlier studies have shown that hedonism values are related to food in general (Feather, Norman, & Worsley, 1998), while universalism values, security, and self-direction values are related to GM food attitudes and behaviour (Grunert et al., 2001). Genetic modification also often seems to be related to ethical issues, like animal welfare (Thompson, 1997) – this is closely related to universalism values in the Schwartz Value Survey. Several studies indicate that consumers associate genetic modification (in food) with tampering with nature; it is also considered unnatural, implying high risk (the underlying dimension being the threat to nature) (e.g., Alvesleben, 2001). It was therefore deemed appropriate to use the two value dimensions that are most often mentioned in connection with food choice in general (hedonism values) and genetically modified food (universalism values with an emphasis on nature/environment values) in our study.

Values are important because they may have a central position in individuals' self-conception. Values may also guide our behaviour (Burgess, 1992; Schwartz, 1992). Many studies have found only a weak relationship between values and behavior (e.g., Feather, 1990). In order to explain this, other constructs have been introduced as *mediators* or *moderators*, such as attitudes (Homer & Kahle, 1988; Stern, Dietz, Kalof, & Guagnano, 1995; Vaske & Donnelly, 1999), reasons (Maio, Olson, Allen, & Bernard, 2001), attitude strength (Holland, Verplanken, Smeets, & Van Knippenberg, 2001; Kraus, 1995; Krosnick & Abelson, 1992), attitude function (Maio & Olson, 1995), and the degree to which values are central to the self (Verplanken & Holland, 2002).

Researchers have found a significant relationship between values, attitudes, and behavior. For example, Homer & Kahle (1988) tested the causal relationship between values, attitudes, and behaviour with a structural equation model in the context of natural food shopping. They found support for the hypotheses that values influence attitudes and that attitudes mediate the value-behaviour relationship. Vaske & Donnelly (1999) conducted a study of the value orientation–attitude–behaviour relationship in the context of wildlife preservation. This study too found that attitudes mediated the relationship between values and intention. There is also some evidence that attitudes only partially mediate the relationship between values and behaviour or intentions. This could occur when subjects do not have well-formed attitudes towards the attitude object (Manfredo, Fulton, & Pierce, 1997; Vaske & Donnelly, 1999).

The relationship between values and the attitudes themselves has not received much attention. In some studies, the relationship has been found to be weak (e.g., Kristiansen & Hotte, 1996). This might be due to the abstract and general nature of values, which are shared by many people and thus are unlikely to explain much of the variability in attitudes and behaviour, which are more specific constructs (Vaske & Donnelly, 1999). There are few published studies of other variables which might moderate the value–attitude relationship and which could explain the weak relation that is often found between these constructs. Exceptions include several studies that have found a stronger value–attitude relationship when attitudes explicitly serve a value-expressive function than when they exist to serve more materialistic needs (Maio & Olson, 1994, 1995, 2000). We suggest that attitude strength, and *attitude centrality* in particular, could moderate

the relationship between values and attitudes. For strong attitudes, we would expect values to guide attitudes, which again predict behavioural intention. For weak attitudes on the other hand, the relationship between values and attitudes should be weaker and may not even be significant. We could, however, expect values to influence intentions directly in this case (Manfredo et al. 1997; Vaske & Donnelly, 1999).

The concept of attitude strength was introduced by Krosnick, Boninger, Chuang, Berent, and Garnot (1993) to summarize many of the characteristics given to attitude features other than valence: extremity, degree of personal involvement with the issue, level of confidence in the attitude, emotional content, and accessibility in memory. According to Krosnick & Petty (1995), strong attitudes are durable (i.e., temporarily stable, difficult to influence) and have an impact on behaviour and information processing.

Recently, there has been a debate on the dimensionality of attitude strength, addressing in particular the commonly accepted dimensions of *embeddedness* (centrality) and *commitment*, which both cover a number of strength features (Holland, Verplanken, & Van Knippenberg, 2003; Pomerantz, Chaiken, & Tordesillas, 1995). Embeddedness is concerned with the relation of the attitude to other constructs such as other attitudes and values (Budd & Spencer, 1984; Judd & Krosnick, 1982; Katz, 1960), and refers to attitude importance, relation to values, and centrality to the self. Commitment often refers to attitude certainty, likelihood of change, and extremity (Lavine, Huff, Wagner, & Sweeney, 1998; Pomerantz et al., 1995) and as such, concerns the degree to which an attitude is clear and stands out (e.g., accessibility, certainty), and the confidence with which the attitude is held. This definition should not be confused with Kiesler's (1971) definition of commitment as "the pledging or binding of the individual with behavioural acts." Since we were mainly concerned with the value–attitude relationship, we focused on attitude centrality (i.e., embeddedness) in our study.

The present paper aims to examine the role of values and attitude strength (in the form of attitude centrality) in the context of GM food. Our contribution to the growing literature on consumers' perceptions of genetically modified food is the study of possible antecedents to attitudes towards GM food. Another aim is the study of the moderating role of attitude strength on the value–attitude relationship. Based on the preceding discussion we propose:

PROPOSITION 1. Attitudes towards GM food have a significant impact on the intention to buy GM food: The more positive (or less negative) attitudes students have, the stronger is the intention to purchase GM food.

PROPOSITION 2. Universalism (environmental) and hedonism values influence intention to buy GM food with the attitude towards eating such food as a mediator.

PROPOSITION 3a. Attitude strength, especially attitude centrality, moderates the relationship between values and attitudes towards GM food. We expect that participants with central attitudes possess values that are related to their attitudes, which in turn are related to their intentions. Participants with less central attitudes are not expected to exhibit a significant relationship between values and attitudes.

PROPOSITION 3b. Attitude centrality moderates the relationship between attitudes and intention to buy GM food. This would be manifested by a more consistent relationship between attitudes and intention for the group with central attitudes as compared to the group with less central attitudes.

METHOD

Sample and Procedure

A questionnaire was administered to 250 students from different faculties at the University of Tromsø. An assistant approached the students, presented the questionnaire, and whenever necessary, assisted the respondents. After the participants had completed the questionnaire, they were thanked and dismissed. The average age of the students was 25 years; 147 were female, while 102 were male. One participant did not disclose her or his gender.

Measures

The questionnaire had four parts: Attitude measures, attitude strength measures, intention to buy measures, and value measures.

Attitude towards eating GM food was measured by a 3-item, 7-point (1–7) semantic differential scale. The items were chosen from previous attitude towards the act scales (Bruner & Hensel, 1998). The

items used were: ''foolish–wise,'' ''reasonable–unreasonable,'' ''negative–positive.''

Attitude centrality was measured by a 3-item, 7-point (1–7) semantic differential scale. It was measured by the following items: ''How important is the issue of genetic modification to you?'' (totally unimportant–very important), ''How central is your attitude towards GM food to your self-image?'' (not central at all–very central), and ''How well does your attitude towards GM food represent your values'' (very poorly–very well). These items have been used in several earlier attitude strength studies (Holland et al., 2003; Pomerantz et al., 1995).

Intention to buy GM food was measured by a 3-item, 7-point scale (1–7) (certainly not-certainly). The items were: ''Are you going to buy GM food?'', ''Are you going to buy GM food if the quality is better compared to traditional food?'', and ''Are you going to buy GM food if it is cheaper than traditional food?''. The second and third items were included because Kuznesof & Ritson (1996) showed that price and quality in comparison to traditional food were important in determining whether people were willing to try GM food or not.

Values were measured with Schwartz Value Survey (Schwartz, 1992), translated into Norwegian. The items were measured by a 9-point importance scale, from -1 = ''opposed to my values'' to 7 = ''of supreme importance'' (Schwartz, 1992). The *hedonism* dimension consisted of two items: ''pleasure'' and ''enjoying life.'' The *universalism* dimension had eight items: ''equality,'' ''unity with nature,'' ''wisdom,'' ''a world of beauty,'' ''social justice,'' ''broad-mindedness,'' ''protecting the environment,'' and ''a world at peace.''

Data Analysis

A descriptive analysis was conducted first, analysing the means, standard deviations, and correlations for the variables. Analysis of the distributional assumptions associated with structural equation modelling followed, with a focus on kurtosis and skewness of the data. The data seemed to be quite suitable for structural equation modelling. The kurtosis and skewness values were within the limits suggested in Bollen (1989), and the data can thus be considered to be normally distributed.

A confirmatory factor analysis was run for the whole sample to check discriminant validity and construct reliability. LISREL 8.50 (Jöreskog & Sörbom, 2001) was used with the maximum likelihood

estimator, and the covariance matrix as input. The scales were tested using Chi square, Root Mean Square Error of Approximation (RMSEA), and Goodness of Fit Index (GFI) as fit measures. We also evaluated the items for reliability by checking whether the factor scores were larger than 0.4, and by calculating the composite reliability for the constructs (Hair, Anderson, Tatham, & Black, 1995).

In order to demonstrate mediation, there are four relationships to test. First the mediator should be correlated with the dependent variable (attitude and intention in our case). Second, the independent variable should be significantly correlated with the dependent variable (hedonism & universalism values and intention). Third, the relationship between the independent variable and the mediator should be significant (values and attitude). Finally, the relationship between the independent variable and the dependent variable should be non-significant after controlling for the mediator. Partial mediation may occur when the mediator variable has a significant role, but does not eliminate the effects of other predictors. A significant reduction in the path between the predictor and the dependent variable, when a mediator variable is introduced, indicates that the (partial) mediator is strong (Baron & Kenny, 1986). We tested three structural models to see if the model confirmed our hypotheses. To evaluate the model fit, we used Chi square, RMSEA, NFI, and CFI as fit indices.

Next, a multiple group structural equation model (LISREL 8.5) was run to test whether attitude centrality moderated the relationship between values and attitudes and between attitudes and intentions. The sample was split into two groups at the median of attitude centrality in order to test for moderation effects of attitude centrality on values–attitude and attitude–intention relations. The central attitudes group had 119 subjects, while the non-central group had 108 subjects. The covariance matrix was used as input. In a multiple group analysis, the goodness of fit was tested across the subgroups. First, the parameters of interest were constrained to be equal for the subgroups (unmoderated model). Next, all parameter estimates were set free, that is, the model was unconstrained (moderated model). Then the difference in chi square was analysed. If it is significant, then moderation is indicated. The chi square of the constrained model should be larger (giving worse fit) than the chi square of the unconstrained model. Finally, separate models were estimated for the two groups with different degrees of attitude centrality.

RESULTS

Descriptive Results

After preliminary screening of the data and removal of inappropriate cases, 227 cases were left for analysis. Missing values were taken care of by the listwise deletion method. Table I shows descriptive statistics for the constructs used in our study. The correlations indicate discriminant validity for the constructs; that is, all correlations are less than 1.00 by an amount twice their standard error (Anderson & Gerbing, 1988). The table shows that attitudes were quite negative (mean value = 3.15). In fact, 70.5% of the sample had negative attitudes (score < 4) towards GM food, while 17.3% had positive attitudes. Looking at the extreme cases, only 1% had the most extreme positive score, while 10% had the most extreme negative score.

Measurement Model Results

We began the analysis by conducting separate confirmatory factor analyses for all constructs to test their reliability. Table II shows the loadings, *t*-values and composite reliability (should be > 0.7) for the indicators and constructs. Convergent validity was determined by studying the individual item loadings on the constructs. Reliability was assessed by computing the composite reliability coefficients for the constructs (Hair et al., 1995).

As Table II shows, the factor loadings for the three *attitude* items are quite high, as is the composite reliability; *t*-values are significant at

TABLE I
Correlations and Mean Values for the Constructs

	Intention	Attitude centrality	Hedonism values	Universalism values	Attitude	Mean	SD
Intention	1					4.14	1.71
Attitude centrality	−0.361***	1				3.29	1.23
Hedonism values	0.091	−0.068	1			4.76	1.14
Universalism values	−0.291***	0.327**	0.307***	1		3.54	1.24
Attitude	0.720***	−0.263***	0.082	−0.212**	1	3.15	1.41

** $p < 0.01$; *** $p < 0.001$.

TABLE II
Measurement Model Results (Individual Construct Loadings)

Constructs and indicators	Standard loading	*t*-values*	Composite reliability [1]
Attitude			
Foolish–wise	0.89	16.48	0.91
Unreasonable–reasonable	0.92	17.32	
Negative–positive	0.84	15.20	
Centrality			0.63
Personal importance	0.65	7.07	
Centrality	0.67	7.27	
Represent values	0.49	6.05	
Intention			0.90
Will buy	0.80	13.98	
Will buy if better quality	0.90	16.63	
Will buy if cheaper	0.88	16.12	
Hedonism values			0.67
Pleasure	0.60	6.94	
Enjoy life	0.81	6.78	
Universalism values			0.72
Unity with nature	0.82	10.81	
World of beauty	0.62	8.56	
Protecting the environment	0.57	7.91	

* all p's < 0.001, indicating significant parameter estimates.
[1] $(\Sigma \text{ std. loading})^2/((\Sigma \text{ std. loading})^2 + \Sigma\epsilon)$.

the 0.001 level. The factor loadings for the *attitude centrality* items are acceptable. The composite reliability is somewhat below the recommended 0.7 (0.63), but the difference is so small that for theoretical reasons we decided to retain the construct in the analysis. For *intention* to buy GM food, the factor loadings and composite reliability are high and the scale gives a perfect fit to the data. The fit measures for the two-dimensional *value* construct are excellent ($\chi^2 = 05.60$ ($df = 4$), RMSEA $= 0.042$, GFI $= 0.99$). The factor loadings for hedonism values are acceptable, while the composite reliability is somewhat below the recommended 0.7. We chose to keep the hedonism value in the model since it has been shown to have an influence on food choice in earlier studies as mentioned. Also, hedonism was measured as in Schwartz Value Survey (1992), which has proved to be a valid measure in many studies. The universalism value scale originally consisted of eight items, but the scale fit was poor for our data with low factor scores on several items. These were excluded, and the best model was achieved using the three items mentioned in Table II. This was anticipated since it is reasonable to expect that environmental values

will be related to perceptions of genetic modification (Grunert et al., 2001). Factor loadings are above the recommended 0.4, and the composite reliability is also acceptable. Finally, the total measurement model fit is good according to several fit measures ($\chi^2 = 63.9$, $df = 67$, $p = 0.5842$; RMSEA = 0.000; GFI = 0.96).

Test of Mediation Effects

Table III presents the results of our mediation tests. Model 1 supports our Proposition 1, i.e., that attitude towards eating GM food predicts intention to buy GM food (the first prerequisite for mediation).

The model fit is excellent (χ^2 (38) = 44.34, RMSEA = 0.027). There is a strong relationship between attitude towards eating GM food and intention to buy ($\beta = 0.72$, $p < 0.0001$). The relationship between universalism and hedonism values and attitudes is also significant. Model 2 examines the relationship between values and intention, thus testing the second condition for mediation. It proves to be significant

TABLE III
Mediation Analysis

Structural path	Proposition	Model 1 Full model[1]	Model 2 Values → intention[1]	Model 3 Values → attitude[1]
Attitude → intention	P1	0.72*** (10.21)		
Hedonism values → intention	P2	0.12 (−1.63)	0.33** (3.09)	
Universalism values → intention	P2	−0.23* (−2.11)	−0.51*** (−4.62)	
Hedonism values → attitude	P2	0.27* (2.69)		0.26** (2.60)
Universalism values → attitude	P2	−0.38*** (−3.82)		−0.37*** (−3.60)
R^2 for intention (Models 1 & 2)		0.67	0.22	
R^2 for attitude (Model 3)				0.12
χ^2		44.34	16.77	16.26
df		38	17	17
CFI		1.00	1.00	1.00
NFI		0.98	0.98	0.98
RMSEA		0.027	0.000	0.000

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

for both hedonism ($\beta = 0.33$, $p < 0.01$) and universalism values ($\beta = -0.51$, $p < 0.001$), suggesting that the more important the universalism (environmental) values are, the less likely is purchase of GM food. For hedonism values the relationship is the opposite. Testing the third mediation condition, we then examined the relationship between values and attitudes (Model 3). Also these relationships are significant ($\beta = 0.26$, $p < 0.01$ and $\beta = -0.37$, $p < 0.001$ for hedonism and universalism values, respectively), indicating that hedonism values have a positive influence on attitudes, while universalism values give rise to more negative attitudes. For the final test of mediation, we turned to Model 1 anew. In order to indicate mediation, the relationship between values and intention should be non-significant in the full model. Our results confirm this only partly. The relationship between hedonism values and intention is non-significant, while universalism values still influence intention directly even when attitudes are introduced. The analysis shows, however, that the strength of the relationship between values and intentions is lower in the full model than in Model 2. This implies the existence of a partial mediation mechanism in our sample, meaning that attitude has mediated the effect of universalism values on intention but only partially, and that the values also have had a direct effect on intention.

Test of Moderator Effects

The next step in our analysis was to test the model (the full model) for moderator effects of attitude centrality on the values–attitude relationship and the attitude–intention relationship, (Propositions 3a and 3b). A multiple group analysis was conducted for groups with central and non-central attitudes. The results from the group analysis are shown in Table IV.

There is a significant difference in the model fit between the unmoderated Model 1 and the moderated Model 2. Furthermore, to find out which relations were moderated, we gradually eased the restrictions in the constrained model. The causal path between values and attitudes (Model 3) gives a significant chi square difference, indicating that the value-attitude relation has been moderated by attitude centrality. The non-significant chi square difference between the unconstrained model and the model where the attitude–intention path was freed (Models 1 and 4), indicates that attitude centrality has not been a moderator between attitude and intentions. We can therefore conclude that the

TABLE IV
Multi-Group Analysis: Moderation Results

Model	χ^2	*df*	p	GFI	CFI	RMSEA
1. Unmoderated model	127.4	98	0.03	0.90	0.98	0.05
2. Moderated model	113.9	94	0.08	0.91	0.99	0.04
3. Values–attitude free	114.8	96	0.09	0.91	0.99	0.04
4. Attitude–intention free	125.32	97	0.03	0.90	0.98	0.05
Differences in chi-square	$\Delta\chi^2$	*df*	p			
$\Delta\chi^2$ Model 1–2	13.25	4	0.010			
$\Delta\chi^2$ Model 1–3	12.34	2	0.002			
$\Delta\chi^2$ Model 1–4	1.82	1	0.177			

relationship between universalism/ environmental values and attitudes is moderated by attitude centrality, confirming Proposition 3a. Proposition 3b, on the other hand, is not supported by our data.

We then looked at the central and non-central attitude groups separately, and found considerable differences in the patterns of interrelationships in the two groups.

Table V shows that while the relationship between attitude and intention is relatively similar and strong for both groups, the relationship between values and attitude is quite different: The relation between universalism values and attitudes is quite strong and negative (−0.50) for participants with central attitudes, while for participants with non-central attitudes the same relationship is non-significant.

TABLE V
Standardised Path Coefficients and Model Fit for the Subgroups

Paths	Central attitudes[1]	Non-central attitudes[1]
Hedonism values – attitude	0.22 (1.45)	0.28 (1.89)
Universalism values – attitude	−0.50** (−3.13)	0.04 (0.24)
Attitude – intention	0.81*** (6.01)	0.70*** (6.01)
Universalism values – intention	−0.12 (−1.52)	−0.20* (−2.03)
χ^2 (39) for the model (*p*)	45.02 (0.2345)	44.03 (0.2671)
RMSEA	0.036	0.035
GFI	0.94	0.93
CFI	0.99	0.99
R^2 Attitude	0.18	0.09
R^2 Intention	0.75	0.49

[1] *t*–values in parenthesis; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

This implies that, for the latter group, other constructs than measured values have influenced the attitudes towards GM food. The relationship between hedonism value and attitudes is non-significant for both groups. It is interesting to observe that the relation between universalism values and intention is not significant for the group with central attitudes, while it constitutes the only significant relation for the non-central attitude group (besides the attitude–intention relationship). Even with this relationship, the explained variance in intentions is significantly higher for the central attitudes group (0.75) than for the other group (0.49).

Furthermore, the means of the value, attitude, and intention scales show quite clear differences between the two groups. Table VI shows that attitude towards eating GM food is significantly less favourable for the high centrality group than for the low centrality group, and the intention to buy such food is higher for the low centrality group. The high centrality group also appears to have deemed environmental values to be more important. This means that for students with central attitudes, universalism values have guided their attitudes, which again have guided their intention to buy GM food. Students with non-central attitudes have been directly guided by their universalism values and their attitudes.

Together, the results indicate that strong negative attitudes towards GM food are based on environmental or universalism values, while weak attitudes seem to be based on other beliefs.

DISCUSSION

The results of this study provide support for our propositions, with the exception of the proposition suggesting that attitude centrality moderates the attitude–intention relationship. As predicted, the attitude

TABLE VI
Construct Mean Values for the Subgroups

	Central attitudes	Non-central attitudes	*p*
Attitude	2.87	3.46	< 0.001
Intention	3.63	4.70	< 0.001
Hedonism values	4.67	4.88	ns
Universalism values	3.83	3.21	< 0.001

towards GM food was a strong predictor of intention to buy GM food. Universalism and hedonism values influenced the intention to buy GM food with attitude as mediator. Attitude centrality proved to be a moderator of the relationship between universalism values and attitudes towards GM food, as expected. For people with central attitudes, the universalism values gave rise to attitudes which were mainly negative – the more important the universalism values, the more negative the attitudes. For the non-central attitude group, the relationship between universalism values and attitude was not significant, indicating that in this group other beliefs probably influence the attitude towards GM food. Universalism values, however, had a direct influence on intentions for this group. Even though Judd and Krosnick (1982) predicted that central attitudes are more closely linked to values, they did not obtain evidence for such a relationship. Our results, on the other hand, confirm their expectations. This might indicate that identifying the most relevant values is an important prerequisite for finding this kind of relationship.

Our proposition that attitude centrality moderates the attitude–intention relationship was not confirmed by the results. This was unexpected and deserves a comment. It should be noted that we only obtained a measure of the intention to buy GM food, not of actual behaviour. We should perhaps not expect the relationship between attitude and intention to be different for the central and non-central attitudes, especially when the two constructs are measured in the same questionnaire. It would be interesting to study the influence of attitude centrality on the *attitude–behaviour* relationship.

Overall, our results may have implications for the understanding of people's attitude change processes. It was not our goal to find out how to persuade people to accept GM food. It is, however, important to learn how negative attitudes are formed and what might influence them. Our results show that there is variation in the strength of negative attitudes toward GM food. In other words, negative attitudes toward GM food are not of the same quality for all individuals who have such attitudes. For some individuals, the negative attitudes are strong. By strong attitudes we mean, in this case, attitudes that are closely linked to important values, in particular values that can be labelled as universalism. It may be that other constructs are also part of such a network, for instance political beliefs and attitudes. Embedded attitudes are stable and resistant to change (Petty & Krosnick, 1995). Johnson and Eagly (1989) labelled these attitudes high in

value-relevant involvement. According to their meta-analysis of persuasion and attitude change effects, involvement of this type typically inhibits attitude change. This suggests that this segment of the population will not be easily convinced of the benefits and safety of GM food, no matter what information becomes available.

At the other end of the attitude strength spectrum are individuals who hold a negative but weak (non-central) attitude. There may be various reasons why a negative attitude is weak. For instance, weak negative attitudes may originate from lack of information, the presence of contradictory beliefs (ambivalence), or a total lack of involvement. Except perhaps for the latter category, these individuals may be very sensitive to new information. After all, relatively little is known as yet about GM food among the general public. It can thus be expected that these individuals may either shift towards a positive attitude or towards strengthening their negative attitude, according to the information that becomes available. In the case of GM food, however, the scepticism towards the technology and its products might be so deeply rooted in values that this influences their intention not to buy GM food. The significant negative relationship between universalism value and intention is an indication hereof.

The attitudes towards GM food were predominantly negative in the whole sample. These attitudes may be both stronger and more negative in a sample consisting of students only, as in our case. Norwegian students are often perceived as more radical than the rest of the population, and as more concerned about environmental issues. Students might have different foundations for their attitude strength than the rest of the population. The study should therefore be repeated with a representative sample in order to test if there are differences in attitude strength between students and the general population.

Our results show that universal values are important antecedents of attitudes towards GM food, thus confirming several earlier studies which have shown that consumer scepticism to GM food is related to environmental concern (The European Commission, 2000; Grunert et al., 2001). Overall, the study shows that it is important to take values and attitude strength into consideration when studying attitudes towards GM food. The results of the study could have implications for persuasion strategies formed by practitioners on either side of the debate. Proponents of GM food may experience difficulties in trying to convince those with strong negative attitudes to change their attitudes. These attitudes are deeply embedded in personal values, and

are resistant to change because they are linked to other cognitions. These would have to change as well, if the attitude changes (Eagly & Chaiken, 1993). Also, when an attitude is linked to an important value, it creates resistance to counter-attitudinal message (Ostrom & Brock, 1968). Persons with strong, central attitudes may just disregard any information opposite to their attitudes. To change weak negative attitudes to more positive ones should be easier. This group may be approached by providing information about the environmental (and other) benefits of GM food.

Opponents of GM food have an easier task than proponents, because people start out with predominantly negative attitudes towards the issue. Obviously, strong negative attitudes do not need to be influenced. Those with weak attitudes may also easily be persuaded to become more negative. The persuasive message could be targeted on creating a link between *universalism* values and attitude, emphasizing the negative effects of GM on nature and environment. Focusing on *hedonic* values will have no effect for either proponents or opponents in trying to change people's attitudes.

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