Journal of Agribusiness 18,3 (Fall 2000):249–260

The Role of Socioeconomic Factors and Lifestyle Variables in Attitude and the Demand for Genetically Modified Foods

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Consumer resistance is a key barrier to the diffusion of genetically modified foods (GMFs). Several studies have shown that consumers in general have a negative attitude toward GMFs. Through analysis of a survey conducted in Israel, we find consumer attitudes toward GMFs to be context specific, differing based on the available alternatives. Consumers responded positively to genetically modified meats when given the alternative choice of meats produced with hormones or dyes. We also address the importance of gender, education, and being religious on the consumer's attitude toward GMFs. Both education and being religious have significant effects on attitude, while gender does not.

Key Words: biotechnology, consumer attitudes, diffusion, genetically modified foods

Diffusion of some genetically modified (GM) food varieties has been rapid. In 1998, more than 63% of soybean acreage in Argentina, as well as 36% of U.S. soybean acreage, was planted with GM varieties (Traxler, Falck-Zepeda, and Sain, 1999). Similarly, more than 50% of U.S. cotton acreage and more than 20% of U.S. corn acreage were planted with GM varieties. However, the future of genetically modified food (GMF) is clouded by signs of consumer resistance. Individual fear, and resulting political restriction and legislation, impedes the development and use of genetic technology and may be the most considerable threat to its future use.

Consumers in the United States and in Europe responded differently to both the idea of genetic manipulation and to the consumption of foods based on genetically modified crops, animals, and other output. Gaskell et al. (1999) first used a cross-cultural survey to support the difference between the United States and Europe, and then analyzed the effect of intense media coverage, trust in regulatory procedures, and the difference between individual knowledge and consumer perception of genetics and biotechnology.

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The media directly affects public attitude and is the main source of consumer information regarding this subject. Gaskell et al. (1999) and Beachy (1999) hypothesize that intense media coverage will lead to a higher level of risk perception by the consumer. In addition, Gaskell et al. report that higher trust in regulatory mechanisms leads to lower resistance to genetic and biotechnology products. Both of these hypotheses were supported by empirical analysis.

No support was found in the above studies, however, for the hypothesis that more knowledge explains a more positive attitude. This finding is surprising; more knowledge is widely thought to decrease the negative predisposition toward a new technology (Gaskell et al., 1999; Saba, Moles, and Frewer, 1998). Less-educated individuals use less information in their product evaluation process and may be less competent in processing the information. The less educated use fewer quality cues, and as a result tend to rely on word-of-mouth information rather then on product information (Steenkamp, 1990). Zepeda, Dourhill, and You (1999) argue that perceived risk moderates willingness to accept biotechnological, agricultural products. In their respective conclusions, both Gaskell et al. and Zepeda, Dourhill, and You suggest that differences in cultural sensitivities are probably the best explanation for the differing levels of resistance to biotechnology. In particular, this might explain much of the gap between reception of GMF in the United States and Europe.

The purpose of this study is to investigate the impact of cultural variables on attitudes toward genetically modified food. Our questions were designed to find support for GMF when respondents are forced to choose between GMF and other available substitute products. Thus, the participants face a more realistic—*contextual*—framework in making their decisions. We used the results of a survey conducted in Israel to illustrate that religious status, education, and income have a role in determining attitude toward GMF, while gender does not.

Research Hypotheses

Gaskell et al. (1999) showed that there are differences among societies with respect to their attitude toward biotechnology and new science-based technology. Differences in education, religious status, and income can explain this difference in attitude. Level of education influences both accessibility to information and the ability to process new information; thus, individuals with a higher level of education often better understand the nature of new technology and its risks. In general, individuals with a higher education are more open to new ideas, including those with higher uncertainty. Therefore, we hypothesize that higher education decreases resistance toward genetic manipulation.

Gaskell et al. (1999) found that moral issues count much more than risk perception in framing a negative attitude toward genetic technology usage, calling to mind that among the strongest opponents of genetic manipulation are religious leaders who feel that it is immoral to change God's creations using genetic manipulation. This leads us to hypothesize that religion is an important factor in determining the individual's attitude toward and support of GMF.

In their study of consumer acceptance of agricultural biotechnology, Zepeda, Dourhill, and You (1999) hypothesized that income affects the level of support in biotechnology. Their findings were mixed, and they could not prove that being poor indicated a low support level. However, income is correlated with education, risk aversion, and the ability to purchase information. Therefore, we hypothesize that higher income will lead the consumer to be more receptive to GMF.

Gaskell et al. (1999) illustrated the differences in acceptance levels of biotechnology among nations. Israel is a nation that has quickly adopted many new technologies.[1] Representative of this is Israel's high level of investment in R&D, high number of businesses in communications, and the strong presence of the Internet (see "Internet Conundrum," *Crossborder Monitor*, 1999). Consequently, we expect that the proportion of individuals who support GMF will be higher in Israel than in Europe and the United States. Our emphasis in this investigation is to explain differences in attitudes toward genetic modification within a society.

Research Design and the Questionnaire

In Gaskell et al. (1999), individuals were asked whether or not they support genetic modification in food and medicine and whether they think it is risky, morally acceptable, and useful. Level of support, moral acceptability, and risk perception were measured according to answers on a five-point scale to questions of the following format: "To what extent do you agree or disagree that this application is useful (risky, morally acceptable, to be encouraged) for society?" However, since an ideal choice rarely exists, this is an unsuitable set of alternatives. In many cases, biotechnology has been developed to replace chemical treatment of foods. Many of the new developments in biotechnology are providing substitutes to chemical treatment. Consumers are essentially faced with a choice between two "evils"—chemical or biotechnological. Therefore, we argue it is more appropriate to ask respondents to indicate their choice between these two alternatives (chemical vs. biotechnological) rather than to indicate the level of support for genetic manipulation in general.

In our survey, respondents were asked to choose between two alternatives: (1) traditionally treated meat (chicken and beef), or (2) the GM substitute for these meats. The precise questions are shown in the box below.

1. Which do you prefer? (circle only one)
   [a] Buying a chicken which has been treated with antibiotics to prevent poultry illness.
   [b] Buying a genetically modified chicken whose genes have been modified in order to prevent poultry diseases.
2. Which do you prefer? (circle only one)
   [a] Buying a pretreated beef meat (color is added to the meat in order to gain more aesthetic appearance).
   [b] Buying a genetically modified meat (genes are altered to gain more aesthetic appearance).

[1] For example, four years after the launching of the cellular phone technology in Israel, the percentage of households owning cellular phones was one of the highest in the world (see "Internet Conundrum," *Crossborder Monitor*, 1999).

We selected chicken and beef since they account for more than 70% of meat consumption in Israel. Pre-tests and in-depth interviews with experts indicated that chickens are treated with hormones and antibiotics to increase the rate of their survival, and that most consumers recognize this as a negative attribute.

Beef consumers did not like the idea of color injection, which is often used to make the product look more appetizing (red and juicy). Following these findings, we first asked the respondents to indicate whether they prefer consuming chicken that during its growth was treated with antibiotics and hormones, or consuming chicken that was genetically manipulated, eliminating the need for hormone and antibiotic treatment. We then asked the consumers to indicate whether they prefer to buy beef with color additive, or beef whose red coloring was due to gene manipulation.

The Survey

The survey was conducted in Israel in May 1998. We interviewed 370 respondents from the metropolitan area of Tel-Aviv in the meat department of a supermarket chain. Of the 370 respondents, 333 were female and 27 male; 160 had lower-than-average income, 133 reported average income, and 77 above-average income. With regard to education, 157 of those surveyed had high school or lower education, and 213 had college or higher education. Finally, regarding religious status, 237 respondents indicated they were secular (not religious), 111 conservative, and 22 religious (Orthodox Jews).

Results

In this section, we discuss our survey results and, in particular, their support of our research hypotheses. To review, we previously hypothesized the following:

- HYPOTHESIS 1. Those with higher levels of education have a decreased resistance to GMF.
- HYPOTHESIS 2. More religious individuals are more resistant toward GMF.
- HYPOTHESIS 3. Those with higher income levels have a decreased resistance to GMF.
- HYPOTHESIS 4. Resistance to GMF is context specific and must be considered in relation to available alternatives.

Of those who responded to our survey, 54 people said “no” to genetic manipulation in chicken, thus preferring antibiotics and hormones. Only 12 individuals chose beef with color additive over GM beef. The fact that support of GM beef is 4.5 times higher than support of chicken proves that there is no general support of biotechnology or genetics, and that support must be considered in the context of the available alternatives (Hypothesis 4).

Table 1. The Effect of Education on Preference for Genetically Modified Chicken (N = 370 respondents)

	Education Level			
Description	Elementary	High School	College	University
% Favoring antibiotics/hormones	36.8	24.6	9.5	4.7
% Favoring GM chicken	63.2	75.4	90.5	95.3
No. of respondents	19	138	63	150
$\chi^2 = 31.87$	DF = 3	Prob. = 0.000		

Note: The χ^2 statistics test for significant differences in percentage of respondents preferring GM chicken.

Table 2. The Effect of Religion on Preference for Genetically Modified Chicken (N = 370 respondents)

	Religious Status		
Description	Orthodox	Conservative	Secular
% Favoring antibiotics/hormones	36.4	21.6	9.3
% Favoring GM chicken	63.6	78.4	90.7
No. of respondents	22	111	237
$\chi^2 = 18.12$	DF = 2	Prob. = 0.000	

Respondents' Support of GM Chicken

We now offer an analysis of respondents' support of GM chicken. Due to the small variation in support of GM beef, univariate analysis is uninteresting. However, we include analysis of support for GM beef in the multivariate estimation at the end of this "Results" section. Of those who responded, women had a higher resistance toward GM chicken than men (14.4% vs. 8.3% against), but this difference is statistically insignificant.

Table 1 supports Hypothesis 1, showing that more educated individuals tend to be more favorable toward GM chicken. We found that higher educated groups, i.e., college and university graduates, have a significantly higher support ratio for biotechnology than lower educated individuals, i.e., elementary and high school graduates (93.9% vs. 75.8%). This supports the notion that public education campaigns may lead to higher acceptance levels of GMF in general.

Table 2 supports Hypothesis 2 that acceptability of genetic modification increases with secularity and decreases with the level of religious intensity. We found that the Orthodox group is the most strongly opposed to genetics (36.4% preferred chicken

Table 3. The Effect of Income on Preference for Genetically Modified Chicken (N = 370 respondents)

	Income Level		
Description	Low	Average	High
% Favoring antibiotics/hormones	27.3	17.3	6.3
% Favoring GM chicken	72.7	82.7	93.7
No. of respondents	77	133	160
$\chi^2 = 1.96$ DF = 2 Prob. = 0.050			

Note: The χ^2 statistics test for significant differences in percentage of respondents preferring GM chicken.

treated with antibiotics and hormones), followed by conservatives (21.6%). Conversely, our survey suggests that an overwhelming majority of those who consider themselves secular are in favor of the new technology (90.7% favored GM chicken).

Table 3 shows evidence supporting Hypothesis 3. Lower income individuals appear to be more suspicious than higher income individuals toward the new genetic technology. Only 6.3% of high-income individuals favored traditionally treated chicken versus 27.3% of low-income individuals. Again, it appears that those in the higher income group are overwhelmingly in favor of GM chicken.

Multivariate Estimation of Survey Results

We now turn to multivariate analysis of the survey results. Logit estimation was used to determine the relative influence of these variables in the support of GMF. We define *GMCHICKEN* to be a dummy variable that takes the value of 1 if a respondent preferred GM chicken to the alternative, and 0 if the respondent did not. We use logit estimation to find the relative influence of income, education, and religious status on the support of GMF. The probabilities of falling into either group are then written as:

$$(1) \qquad \Pr(GMCHICKEN = 0) = \frac{e^{\varepsilon' \gamma^{\in}}}{e^{\varepsilon' \gamma^{\in}} + e^{\varepsilon' \gamma^{\cap}}} + \varepsilon^{\eta}$$

and

$$(2) \qquad \Pr(GMCHICKEN = 1) = \frac{e^{\varepsilon' \gamma^{\cap}}}{e^{\varepsilon' \gamma^{\in}} + e^{\varepsilon' \gamma^{\cap}}} + \varepsilon^{\Theta},$$

where

$$X\gamma^{\varkappa} = \gamma_{\Theta}^{\varkappa} + \gamma_{\theta}^{\varkappa} CONSERVATIVE + \gamma_{I}^{\varkappa} SECULAR + \gamma_{\iota}^{\varkappa} AVGINCOME + \gamma_{K}^{\varkappa} HIGHINCOME + \gamma_{\kappa}^{\varkappa} EDUCATION.$$

Here, all independent variables are dummies: *CONSERVATIVE* takes on a value of 1 if the individual is conservative, *SECULAR* takes on the value of 1 if the individual is not religious, *AVGINCOME* takes on the value of 1 if the respondent has an average income level, *HIGHINCOME* takes on the value of 1 if the individual has above-average income, and *EDUCATION* takes on the value of 1 if the individual has more than a high school education. Our base case is therefore low-income Orthodox Jews who have not been college educated.

The logit model assumes that the ε's are independently and identically distributed with mean zero. As is customary, we set $\gamma_{\Theta}^{\eta} = \gamma_{\theta}^{\eta} = \gamma_{I}^{\eta} = \gamma_{\iota}^{\eta} = \gamma_{K}^{\eta} = \gamma_{\kappa}^{\eta} = 0$, and use maximum likelihood to estimate the remaining parameters. Thus the reported coefficients are the effect of the independent variables on the probability of preferring GM chicken to the alternative. This same procedure is followed for beef, defining the dummy variable *GMBEEF* to be equal to 1 for respondents who preferred GM beef to the alternative. The results of our estimation are presented in tables 4 (chicken) and 5 (beef).

Table 4 suggests that support of GM chicken decreases with religious intensity. The secular group supported GM more than did the conservative group (coefficients of 1.386 vs. 1.186, but not significant), and both showed higher support than the Orthodox group (significant at the .05 level). A higher level of education contributed to support for GM chicken (statistically significant at any level). Finally, income has a weak influence on GM preference (high income individuals are significantly more inclined to prefer genetic technology, at the .05 level). Based on these findings, although education, income, and religious status are correlated, they appear to make different contributions in the support of GM foods.

The lower number of individuals who resisted GM beef in favor of beef with color added (table 5) does not provide the minimal critical mass needed to find a statistically significant relationship between support of GM beef and the socio-demographic variables. However, it is interesting to see the correlation between support in GM chicken and beef.

Analysis of General Support for GMF

Here, we attempt to analyze general support for GMF using joint support for GM chicken and GM beef. Previous studies have not considered support for GMF to be context specific. Understanding which individuals (by category) completely resisted genetic manipulation ("no" to GM chicken and beef, $CAT = 0$), those who resisted GM only in one product (either beef or chicken, $CAT = 1$), or those who supported GM in both products ($CAT = 2$), may allow us to separate the role of the socio-demographic characteristic on an individual's attitude from the context variable (the effect of the stimuli). Table 6 reports the classification of respondents according to their multi-support, as well as the respective values of the category variable (*CAT*).

Again, if we consider falling into any of these three categories as a probabilistic event, then we can use the corresponding multinomial logit model:

Table 4. Logit Estimation of Preference for Genetically Modified Chicken versus Chicken Treated with Antibiotics and Hormones

	Estimation Results		
Variable	Coefficient	Std. Error	Significance [a]
Constant	−0.431	0.541	0.426
CONSERVATIVE	1.186	0.555	0.033
SECULAR	1.386	0.544	0.011
AVGINCOME	0.283	0.366	0.440
HIGHINCOME	1.060	0.451	0.019
EDUCATION	1.322	0.374	0.000

[a] Reports significance for the two-tailed test.

Table 5. Logit Estimation of Preference for Genetically Modified Beef versus Beef Treated with Dyes

	Estimation Results		
Variable	Coefficient	Std. Error	Significance [a]
Constant	2.474	1.091	0.023
CONSERVATIVE	0.279	1.142	0.807
SECULAR	0.075	1.139	0.948
AVGINCOME	−0.179	0.655	0.784
HIGHINCOME	1.762	1.162	0.130
EDUCATION	1.132	0.726	0.119

[a] Reports significance for the two-tailed test.

$$(3) \qquad \Pr(CAT = 0) = \frac{e^{\varepsilon\beta^{\in}}}{e^{\varepsilon\beta^{\in}} + e^{\varepsilon\beta^{\cap}} + e^{\varepsilon\beta^{\parallel}}} + \varepsilon^{\eta},$$

$$(4) \qquad \Pr(CAT = 1) = \frac{e^{\varepsilon\beta^{\cap}}}{e^{\varepsilon\beta^{\in}} + e^{\varepsilon\beta^{\cap}} + e^{\varepsilon\beta^{\parallel}}} + \varepsilon^{\Theta},$$

$$(5) \qquad \Pr(CAT = 2) = \frac{e^{\varepsilon\beta^{\parallel}}}{e^{\varepsilon\beta^{\in}} + e^{\varepsilon\beta^{\cap}} + e^{\varepsilon\beta^{\parallel}}} + \varepsilon^{\theta},$$

where

$$X\beta^{\varkappa} = \beta_{\Theta}^{\varkappa} + \beta_{\theta}^{\varkappa} CONSERVATIVE + \beta_{\mathrm{I}}^{\varkappa} SECULAR + \beta_{\iota}^{\varkappa} AVGINCOME + \beta_{\mathrm{K}}^{\varkappa} HIGHINCOME + \beta_{\kappa}^{\varkappa} EDUCATION,$$

Table 6. Classification of Respondents According to General Support for Genetically Modified Food

	Interpretation of Category (*CAT*) Variable		
Value of *CAT* Variable	Prefers Genetically Engineered Beef	Prefers Genetically Engineered Chicken	No. of Observations
CAT = 0	No	No	11
CAT = 1	No	Yes	2
	Yes	No	43
CAT = 2	Yes	Yes	314

and where all independent variables are as previously defined. Again for all i, ε^i is assumed to be independently and identically distributed with mean zero in the logit model.

To find a well-specified result, we set $\beta_{\Theta}^{\theta} = \beta_{\theta}^{\theta} = \beta_{I}^{\theta} = \beta_{\iota}^{\theta} = \beta_{K}^{\theta} = \beta_{\kappa}^{\theta} = 0$. Hence, those who responded "yes" to both questions are designated the comparison group. Here again we used maximum likelihood to obtain the estimates. The results are presented in table 7.

The estimated coefficients have the signs suggested by Hypotheses 1–3. Consumers who are Orthodox, have lower income, and who are less educated are more likely to be against genetic manipulation of food than other individuals. High income is statistically significant, and being conservative versus being Orthodox explains resistance in one case relative to support in both cases.

An Index Measure of Intensity of Support for GM

An alternative approach to separating the effect of sociodemographic variables and the stimuli effect is to build a support index. This method also allows for easier interpretation of multivariate effects than those obtained from the logit estimation. Let *CAT* be an index of the intensity of support for genetic modification, where *CAT* = 0 when the individual resists GM in both cases, *CAT* = 1 when the individual supports GM only in one case, and *CAT* = 2 if he or she supports GM in both cases. By treating *CAT* as an ordinal measure, we can then use a regression to measure the effects of religion, income, and education on support for GM. We estimated the effect of the sociodemographic variables using an OLS regression of *CAT* on a constant, and on *CONSERVATIVE*, *SECULAR*, *AVGINCOME*, *HIGHINCOME*, and *EDUCATION*. We emphasize that we conducted this regression in the interest of interpretation, rather than estimating a predictive model. For this reason, and for the sake of simplicity, we present the OLS results in table 8.

These results show that being secular has a more significant influence on support for GM than does having a college education. Having a higher-than-average income also seems to influence the degree of support for GM. Again, these

Table 7. Multinomial Logit Estimation Results

	Estimation Results		
Variable	Coefficient	Std. Error	Significance [a]
***CAT* = 0:**			
Constant	−1.654	1.127	0.142
CONSERVATIVE	−0.648	1.165	0.578
SECULAR	−0.753	1.166	0.519
AVGINCOME	−0.111 [b]	0.678	0.870
HIGHINCOME	−1.932	1.163	0.097
EDUCATION	−1.107	0.741	0.135
***CAT* = 1:**			
Constant	0.404	0.566	0.044
CONSERVATIVE	−1.175	0.583	0.013
SECULAR	−1.143	0.575	0.260
AVGINCOME	−0.443	0.392	0.028
HIGHINCOME	−1.041	0.473	0.000
EDUCATION	−1.472	0.413	0.475

Notes: CAT = 0 denotes that respondent preferred neither genetically modified product; *CAT* = 1 indicates that respondent preferred only one of the GM products. The comparison group consists of those respondents who preferred both GM products.

[a] Reports significance for the two-tailed test.

[b] This coefficient does not always have the same sign effect on the corresponding probability.

Table 8. Intensity of Support for Genetically Modified Food: OLS Estimation Results

	Estimation Results		
Variable	Coefficient	Std. Error	Significance [a]
Constant	1.4099	0.1019	0.000
CONSERVATIVE	0.1918	0.1024	0.062
SECULAR	0.2203	0.0979	0.025
AVGINCOME	0.0721	0.0629	0.252
HIGHINCOME	0.1741	0.0643	0.007
EDUCATION	0.1894	0.0515	0.000
Regression R^2 = 0.11			

[a] Reports significance for the two-tailed test.

results support Hypotheses 1–3, i.e., income, education, and being secular have positive effects on the support for GMF.

Summary

In this study, we have shown that lifestyle and sociodemographic variables substantially explain support of genetically modified food (GMF). Higher levels of education, income, and secularity contribute to the support of genetic technology. In addition, we have demonstrated that the level of resistance is context dependent, i.e., people who resist GMF in one case may change their minds in another context (for instance, where a traditional alternative has lower benefits). The only individuals who are consistent in their resistance are those with moral concerns and intense religious beliefs, supporting the hypothesis that religious status is a good predictor.

To increase support of biotechnology, policy makers should concentrate on educating and explaining the nature of this technology and, in particular, the tradeoff between this "evil" and other, worse alternatives. A dialog with religious leaders regarding this topic may prove valuable. The positive response to biotechnology found in our survey may also reflect the direct choice that consumers were asked to make between biotechnology and other alternatives. Consumers may support biotechnology when it is recognized to be "the lesser of two evils." Public education about biotechnology should emphasize the context-specific nature of alternatives associated with its introduction.

The analysis was conducted in Israel, a country whose citizens display an overall positive attitude toward new technologies, including biotechnology. Additionally, Israel is a society blessed with a unique mixture of religions and cultures, limiting confidence in the general nature of the survey's findings. The positive predisposition of Israel's society changes the overall significance of the results, but not the innate differences between individuals and the various sources of these differences. Thus, these considerations can serve as a guideline for future research conducted both in Europe and the United States.

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