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Can Chinese Consumers Be Persuaded? The Case of Genetically Modified Vegetable Oil

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This paper investigates consumers' purchase intentions of vegetable oil that is made from genetically modified oilseeds (referred to as GM vegetable oil) in Beijing, China. It is found that consumers' purchase intentions of GM vegetable oil are low, indicating a considerable skepticism toward GM products. A potential reason for this skepticism is that Chinese consumers are not well informed about GM technology. Three types of information presented in the survey are found to have positive but differential impacts on consumers' purchase intentions. This signals that different information strategies may be implemented to influence Chinese consumers' purchase intentions of GM products.

Key words: genetically modified (GM), information, multinominal logit model, vegetable oil

Background

There has been considerable enthusiasm among scientists and industry about the possibilities of biotechnology—especially genetically modified (GM) organisms—in food production. At the same time, there has been substantial skepticism among consumers, much public policy debate, and a cautious approach from retailers (Rigby, 2004). A potential industry strategy to improve consumers' acceptance of GM food is to communicate biotechnology information to the consumers. However, there is mixed evidence regarding the effectiveness of this strategy in the United States, Canada and Europe (Hu, Veeman, & Adamowicz, in press; Huffman, Shogren, Rousu & Tegene, 2002, 2003; Lusk et al., in press; Nunn, 2000). Unlike in many developed countries, public debates on GM technology and foods have been limited so far in China. According to some studies, Chinese consumers are supporters of agricultural biotechnology and even GM food compared with other countries (Gale, Lin, Lohmar, & Tuan, 2002; Li, Curtis, McCluskey, & Wahl, 2002); others noticed the concerns raised by the publics (Jia, 2003). Despite their increasing awareness, however, Chinese consumers have little accurate knowledge of GM food (Sheng, 2001; Zhong, Marchant, Ding & Lu, 2002). Using vegetable oil as a case, this study aims to measure the effects of favorable information on the Chinese consumers' purchase intentions towards genetically modified foods.

Vegetable oil was chosen for this case, because the vegetable oil market has been increasingly driven by the biotech conventions around the world. The new Chinese regulations, which come into effect March 20, 2002, require that all GM crop traits be approved by China's Ministry of Agriculture and that every export shipment to China containing a genetically modified crop be issued a safety certificate. China's Ministry of Health has also recently announced its own labeling requirements for biotech food products. The new regulation requires that all GM foods are to be labeled positively as containing such ingredients, although the tolerance level has not been specifically identified (Hu, Veeman, & Adamowicz, 2003). The generic label reads: "This product is made from genetically modified ___." For products made from GM crops but containing no GM ingredients, the label reads: "This product is made from GM... while no longer containing GM ingredients." The latter label applies to GM vegetable oil.

China's new restrictive regulations on GM crops and foods are expected to affect the world oilseed trade. During 1999–2000, China imported 10 million metric tons of soybeans and close to 4 million metric tons of rapeseed, accounting for about 20% of the total world soybean imports and 35% of the total world rapeseed imports (Foreign Agricultural Service, 2002). The magnitude of this trade impact will likely be contingent on (a) how Chinese consumers react to the labeling of GM and non-GM vegetable oils and (b) how inspection, testing, and approval are administered and operated. An improved understanding of consumers' acceptance of GM vegetable oil in China will be useful to identify how prosperous the Chinese market for GM oilseeds and oils will be in the future. Understanding consumers will also affect the future direction of the private and public investments in the development, promotion, and use of GM technology around the world.

This paper attempts to answer four specific questions: (a) How do Chinese consumers' attitudes towards GM applications affect their purchase intentions for GM vegetable oil? (b) Will consumers' purchase intentions of GM oil be changed by favorable information on the GM technology? (c) Do different types of favourable information affect consumers' purchase intentions differently? (d) Do consumers' objective and subjective knowledge on GM oil affect their purchase intentions differently?

Survey Design and Data Collection

The development of the survey for this study was based on the previous literature of consumer preferences for GM food in various countries and regions (Bredahl, 2001; European Commission, 1997; International Food Information Council, 1999). China's capital city, Beijing, was chosen as the target city for the survey. To ensure the clarity and consistency of the survey questions, two rounds of extensive pretests were conducted before the field interviews were formally initiated. The survey instrument was written in Chinese, and all survey interviews were conducted in Chinese. Trained enumerators interviewed consumers at wet markets,[1] supermarkets, or the vicinity of the markets around the city of Beijing. A total of 671 respondents successfully completed the survey in winter 2002 and spring 2003; key demographic statistics of the sample are comparable to those reported in the 2001 Beijing Statistical Yearbook.

Consumers' purchase intentions were elicited in two stages. First, respondents were asked whether they might continue to purchase an oil product if they were informed by a label that the product was made from GM oilseeds (while everything else remained the same, including the price of the product). Consumers who would continue to purchase a GM oil product were directed to the next section of the survey. Those respondents who answered "no" to this question were directed to the second stage. In the second stage, given the same product and price, three pieces of different favorable information about the GM technology were subsequently given; each respondent was asked to express again his or her purchase decision after each piece of new information. They were requested to select one of three purchase options: "Yes, I want to buy;" "No, I do not want to buy;" or "I don't know" (DK). The statements in the second stage incorporating the three pieces of favorable information were: (a) no traces of GM ingredients can be scientifically detected from the final oil made from GM oilseeds; (b) oil made from GM oilseeds is more nutritious; and (c) oil made from GM oilseeds may reduce pesticide usage and can help protect the environment. The order of these questions was randomized to avoid ordering effects.[2]

Consumers' attitudinal information on various factors was also collected. Consumer concern regarding the human health risks (variable *RISK*) was assessed by a Likert scale from 1 to 5, with 1 representing *not at all risky* and 5 representing *very risky.* Trustworthiness of government food safety management system (*TRUST*) was represented with 1 (*not at all trustworthy*) to 5 (*very trustworthy*). Consumers' subjective knowledge (*SKNOW*) was measured by allowing respondents to choose one value from 1 (lowest) to 5 (highest) that best described their own knowledge about agricultural genetic modification. Previous studies have pointed out the potential differential impacts that subjective and objective knowledge may play in forming consumers' perceptions and behaviors (Bredahl, 2001; Vannoppen, Verbeke, & Van Huylenbroeck, 2001). This differential impact has yet to be tested empirically. To measure consumers' objective knowledge, five true/false questions related to GM technology knowledge were proposed, including whether GM techniques can change the nutritional value of vegetable oil, whether GM techniques can reduce the content of saturated fat in vegetable oil, whether GM techniques can reduce the amount of pesticide applied for growing oilseed, whether GM techniques can increase yields of oil crops, and whether GM ingredients can be detected scientifically in oil made from GM oilseeds. Following Schibeci, Barns, Kennealy, and Davision (1997) and Nayga (2000), the total number of questions answered correctly by each con-

1. *A wet market in China is similar to a farmers' market in North America. It refers to a designated area (either open air or indoors) where individual sellers and buyers gather and make transactions.*

2. *Given the time and budget constraint, the within-subject design was used. An alternative approach is a between-subject design; however, such a design requires a much larger sample size to achieve the same level of statistical power as the current design. Another concern pertaining to the design of the survey (regardless of whether it is a within- or between-subject design) is that only favorable information was given to consumers—this approach may create some bias, if consumers interpret the information as additive to each other. However, during the interviews we told interviewees that the information statements should be treated individually. We therefore expect that the bias of misinterpretation is low in this study.*

sumer was used as a measure of their objective knowledge level.

Consumers' concerns regarding the environmental impact of the GM technology (*ENV*) were captured in a binary question. Individuals that had environmental concerns were assigned a value of one, and those that had no environmental concerns were assigned a value of zero. In the focus group discussion of the survey, some consumers raised their concern that because they believed that GM oil was already on the market and not distinguishable from the non-GM products, they did not have strong preferences for either oil. This effect has also been reported in the study of Hallman and Metcalfe (1993). A zero/one variable describing whether consumers believed that GM oil products were already available on the market (*MARKET*) was included. Finally, four socioeconomic and demographic variables were incorporated into the analysis as well: income level (*INCOME*), gender (*MALE*), age (*AGE*), and education level (*EDU*).

Consumers' Concern and Knowledge About GM Foods and Technology

The survey results indicate that more than 67% of the respondents were concerned with GM foods, and about 20% of them believed that GM food was harmful for their health. The respondents' knowledge and awareness about GM technology was limited. Approximately 40% of respondents did not know what *GM* stands for, and 60% of the respondents were unsure of the fact that vegetable oil made from GM oilseed was already on the market. On the 1–5 scale measuring consumers' subjective knowledge, the average score was 2.21, indicating that most respondents did not consider themselves well informed about agricultural biotechnology. About 63% of the respondents did not know that GM technology can increase nutrients in food, and 82% of the respondents did not know that GM technology can reduce saturated fats in vegetable oil and other foods. Also, 72% of the respondents did not know that GM technology can decrease pesticide application in oilseed production, and 87% of the respondents did not know that oil made from GM oilseed cannot be distinguished from non-GM oil. On average, the respondents answered 1.57 out of five true/false questions correctly. Approximately 26% of the respondents did not answer one knowledge question correctly. Close to 60% of the respondents considered GM technology a complex scientific matter and would leave it for experts to make the judgment regarding its safety.

Empirical Model

In this paper, within each information scenario, consumers faced three options regarding GM oil: *purchase*, *do not purchase*, and *don't know*. Consumers who chose to buy GM oil in the first stage (before given any new favorable information), or those who changed their idea from "do not purchase" to "purchase" after receiving a piece of favorable information, were regarded as *final buyers* for GM oil. A consumer was categorized as either a *no-buyer* or a *doubter* if he or she chose the "do not purchase" or "don't know" option, respectively, after viewing new favorable information. The multinomial logit model (MNL), developed by Nerlove and Press (1973) on the basis of random utility theory, is appropriate to identify consumers' preferences towards GM oil in this application.

A number of variables can be used to explain consumers' behaviour. First, a dummy variable, *INFOR*, indicates whether a consumer had viewed a piece of new information. Second, consumers' attitudinal and knowledge variables were added, including *ENV*, *RISK*, *TRUST*, *MARKET*, *SKNOW*, and *OKNOW*. Third, variables representing consumers' demographic characteristics were included, such as *INCOME*, *MALE*, *AGE*, and *EDU*. We call the above three types of variables *original variables*; their specific definitions and statistics are given in Table 1. Finally, to determine whether the three types of new information had a differential impact on consumers' purchase intentions, consumers' responses after each new piece of favorable information were pooled together as one data set. A series of dummy variables, *INF1*, *INF2*, and *INF3*, were created to represent favorable information types I, II, and III, respectively (e.g., *INF1* equals one if the consumer was given the first type of favorable information, otherwise zero; *INF2* and *INF3* were defined similarly for the second and third types of favorable information). As new pieces of information were given as a context, these variables were interacted with other factors, and the interacted variables were then included into vector x. For identification reasons, only dummy variables representing the first and second type of favorable information were used.

In a MNL model, direct interpretation of parameters of the random utility function on the probabilities is not very meaningful due to the nonlinearity of the probability function. The appropriate way is to interpret each variable's marginal contribution to choice probabilities. The marginal effects do not necessarily bear either the same value or sign as the parameters themselves (Train,

Table 1. Descriptive statistics of the original independent variables.

	Definition	Mean	SD
INFOR	1if an individual viewed new information, otherwise 0.	0.5191	0.4998
ENV	1if an individual has environmental concerns on GM foods, otherwise 0.	0.0658	0.2470
RISK	1–5 scale variable capturing how much an individual is concerned about human health, with 1 representing *not at all risky* and 5 representing *very risky*.	3.0219	0.9144
TRUST	1–5 scale variable capturing how much an individual trusts the government food safety regulating system, with 1 representing *not at all trustworthy* and 5 representing *very trustworthy*.	2.7135	1.1565
MARKET	1if an individual believes that GM oil is already on the market, otherwise 0.	0.3838	0.4864
SKNOW	0–5 discrete variable capturing an individual's subjective knowledge level, with 1 representing *very little* and 5 representing *very much*.	2.2145	0.9225
OKNOW	0–5 discrete variable capturing an individual's objective knowledge level, with 0 representing the lowest and 5 representing the highest knowledge level.	1.5653	1.2825
INCOME	1–9 scale variable for the respondent's monthly household income level, with 1 to 9 representing below $200, $200–399, $400–599, $600–799, $800–999, $1,000–1,199, $1,200–1,399, $1,400–1,599, and above $1,600, respectively.	3.3272	2.1276
MALE	1 if the respondent is a male.	0.4984	0.5001
AGE	1–6 scale variable for the respondent's age, with 1 to 6 representing below 30, 30–39, 40–49, 50–59, 60–69, and above 70, respectively.	2.2991	1.1571
EDU	1–5 scale variable for the respondent's education level with 1 to 5 representing junior high, high school, college, university, and graduate degree, respectively.	3.2480	1.2202

2003, pp. 61-64). For a continuous or a scale discrete explanatory variable x_i, the marginal effect of x_i on the probability of $Y = j(P_j = \text{Prob}(Y = j))$ can be expressed as the derivative[3]

$$\frac{\partial P_j}{\partial x_i} = P_j \beta_i^j - P_j \sum_{k=1}^{K} P_k \beta_i^k , \quad (1)$$

where β_i^j is the coefficient of x_i in the j^{th} choice. The marginal effect of a dummy variable on the probability of $Y = j$ is

$$\overline{P}_j \big| x_k = P_j(x_k = 1) - P_j(x_k = 0) . \quad (2)$$

Given the presence of interaction effects, the overall marginal effect of variable x_i can be derived. Supposing β_i^j, β_{i1}^j, and β_{i2}^j represent the coefficients associated with the original variable x_i and the first and second type of information interaction variables respectively, then the overall marginal effect for a continuous variable is

$$\frac{\partial P_j}{\partial P_i^{all}} = P_j(\beta_i^j + \beta_{i1}^j + \beta_{i2}^j) - P_j \sum_{k=1}^{K} P_k(\beta_i^k + \beta_{i1}^k + \beta_{i2}^k) . \quad (3)$$

For a dummy variable x_k, the formula to calculate this marginal effect is the same as Equation 2.

Estimation and Empirical Results

The MNL model was estimated for the pooled data with the "don't know" option as the base alternative.[4] The model has the freedom-adjusted pseudo-R^2 statistic of 0.288, indicating a reasonably well-fitted model for this type of cross-sectional data (Louviere, Hensher, &

3. *For scale variables, marginal effects calculated by derivatives are only approximates. A more precise approach would be to calculate over an arc of scale variables. This more complicated approach was not taken in this study, as the derivatives approximate arc marginal effects fairly well, especially when there are many scales in a variable (such as AGE and EDU).*

4. *We recognize that those respondents who expressed their willingness to purchase GM oil were not presented with new information. This creates an unbalanced panel data, which indicates that a model with a selection mechanism may be more consistent. However, in this paper, we observe the exact behavior of those who did not see new information; therefore, the issue of selection is not expected to be large.*

Swait, 2000, p. 54). The MNL estimates of the model are summarized in Table 2. The results reveal that many estimated coefficients were not significant. Although a joint exclusion test may be performed to determine which variable may be dropped from the study, after some preliminary analysis we decided not to drop the insignificant variables, due to the belief that even they are not statistically significant; rather, they are economically significant, and we can still show these variables as not being important in consumers' purchasing decisions. Table 3 reports overall marginal effects for variables that were significantly different from zero in the MNL model.[5] Without additional clarification, the marginal effects were calculated at the median level of each significant discrete dependent variable.

Marginal Effects

The marginal effect of *INFOR* (a dummy variable equaling one if an individual viewed new information) indicated that exposing consumers to new types of favorable information increased their likelihood of purchasing GM oil by roughly 12% and decreased the likelihood of not purchasing or being uncertain by 6%. This suggested that providing Chinese consumers with favorable information on GM oil could increase their GM oil purchasing intentions. Note that the discussion here is targeted at new favorable information in general when compared with no such information. We do not intend to interpret the effect of a particular type of information or the differences between the three types of information. (We will discuss this in the next section.) Table 3 also shows that consumers who had more trust (one scale unit higher in the trust measurement question than the sample average) in the government food safety management system (*TRUST*) had a 3.7% higher probability of purchasing GM oil, and the possibility of them having an unclear decision (don't know) was 1.6% less. If consumers were aware that GM oil products were already available on the market (*MARKET*), they would be less likely to reject GM oil by 2.3%. Overall, as represented by variables *TRUST* and *MARKET*, consumers' attitudes may play an important role in their GM vegetable oil purchasing decisions. Government agents or vegetable oil marketers who wish to promote GM oil should focus on improving consumers' trust in the government food safety management system and reinforcing consumers' belief that GM oil has already been available on the market.

The marginal effects of the objective knowledge variable (*OKNOW*) were significant for two options, with a positive sign on the choice of agreeing to purchase and a negative sign on the choice of being uncertain. These effects show that if consumers' objective knowledge levels were one scale unit higher than the sample average, they would be 2.4% more likely to purchase a GM oil product and 1.3% less likely of being uncertain. The marginal effects of consumers' subjective knowledge (*SKNOW*) were highly significant for all three options and had the same directions of impact as the three choice options for *OKNOW*. It is interesting to note, however, that the magnitudes of the marginal effects of *SKNOW* were considerably larger than those of *OKNOW*. This reinforces our previous expectation that it is what consumers *think* they know that matters more to their decision making than what they actually know. From another perspective, this states the importance of consumers' attitude and perceptions in their purchasing decisions.

The model also predicts that Chinese consumers with older age and higher education would be more likely to purchase GM oil. Although our finding is consistent with previous studies that individuals with a higher education are more likely to value new technology, the majority of previous studies have also found that older individuals are generally less prone to accept new technologies. This is an interesting outcome. We propose two potential explanations for this result: First, respondents' age may be representing other (demographic) factors that were, for one reason or another, not incorporated into the study (such as whether a household has any children); therefore, the effect of age might become mingled by the other unobserved factors. Second, this result may simply be (GM) product- and/or culture-specific. Future studies in this area should pay closer attention to verify or test the effect of consumers' age found here.

Marginal Effects of Information

There are several different approaches to examine the marginal effects of different types of information. One method to do this is to calculate the marginal effects of the information interaction terms in the MNL model (such as the level of consumers' concern on human

5. *For dummy variables, standard error estimates for marginal effects derived from changes of probabilities are not available. We therefore interpret the marginal effects as significant (either at the 10% or 5% significance level) if the corresponding coefficient is significant (either at the 10% or 5% significance level).*

Table 2. Estimates of the multinomial logit model (*N* = 671).

	Yes option		No option		Don't know option	
Variable	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**
INFOR1	0.4720	0.8668	-0.414	0.8152	-0.472	0.8668
ENV1	0.4406	0.7773	-0.9822	0.9834	-0.4406	0.7773
RISK1	0.4852**	0.2356	-0.4515**	0.2203	-0.4852**	0.2356
TRUST1	-0.1200	0.1642	-0.1813	0.1608	0.12	0.1642
MARKET1	-0.3711	0.4866	-1.0665**	0.4644	0.3711	0.4866
OKNOW1	0.0257	0.1981	0.0549	0.1867	-0.0257	0.1981
SKNOW1	-0.8252**	0.3678	0.7973**	0.3757	0.8252**	0.3678
INCOME1	0.1506	0.1075	-0.0072	0.1028	-0.1506	0.1075
MALE1	0.1999	0.4199	-0.4057	0.4113	-0.1999	0.4199
AGE1	0.0846	0.1709	0.14	0.1689	-0.0846	0.1709
EDU1	-0.1263	0.1950	0.0433	0.1949	0.1263	0.1950
INFOR2	0.0932	0.8792	0.0633	0.7051	-0.0932	0.8792
ENV2	0.1726	0.8214	0.4775	0.7749	-0.1726	0.8214
RISK2	0.1851	0.2463	0.0708	0.2023	-0.1851	0.2463
TRUST2	-0.0095	0.1703	-0.2513*	0.1517	0.0095	0.1703
MARKET2	-0.3900	0.5092	-0.5184	0.4284	0.39	0.5092
OKNOW2	0.0162	0.2068	0.1129	0.1741	-0.0162	0.2068
SKNOW2	0.0430	0.3833	-0.447	0.3689	-0.043	0.3833
INCOME2	-0.0741	0.1092	0.0853	0.0991	0.0741	0.1092
MALE2	-0.3756	0.4334	0.0141	0.3900	0.3756	0.4334
AGE2	-0.0273	0.1732	0.2346	0.1541	0.0273	0.1732
EDU2	0.0455	0.2020	0.0641	0.1877	-0.0455	0.2020
INFOR	4.3675**	0.6109	-4.063**	0.4946	-4.3675**	0.6109
ENV	-0.1669	0.5468	-0.4781	0.5653	0.1669	0.5468
RISK	0.2206	0.1688	0.0368	0.1424	-0.2206	0.1688
TRUST	0.3215**	0.1201	-0.0695	0.1063	-0.3215**	0.1201
MARKET	0.3969	0.3641	0.5759*	0.3013	-0.3969	0.3641
OKNOW	0.4346**	0.1434	-0.2948**	0.1235	-0.4346**	0.1434
SKNOW	0.9471**	0.2677	-1.4496**	0.2520	-0.9471**	0.2677
INCOME	-0.1040	0.0759	0.0876	0.0704	0.104	0.0759
MALE	0.3758	0.3033	0.0378	0.2756	-0.3758	0.3033
AGE	0.2162*	0.1218	-0.4574**	0.1113	-0.2162*	0.1218
EDU	0.3175**	0.1415	-0.3959**	0.1320	-0.3175**	0.1415
LL	-2312.34					
pseudo R^2	0.288					

**Significant at the 10% significance level. **Significant at the 5% significance level.*

health interacted with different types of information: *RISK1*, *RISK2*, etc.) in a way similar to what was reported in Table 3. This approach is helpful when used to investigate each interaction term separately but will not be very informative when used to see the combined effects of several different variables (such as *RISK1* and *TRUST1*). Moreover, the calculation of these marginal effects is not as straightforward as it may appear. As Ai and Norton (2003) reported, almost all published economic works in which marginal effects of interaction terms were used in discrete choice models calculated or interpreted the effects incorrectly. The correct marginal effects involve second-order derivatives of the distribution function specified in terms of all the variables in the

Table 3. Marginal effects of probability changes with respect to attitude, demographic, and information interacted variables.

Variable	To buy[a]	Not to buy[a]	Don't know[a]
INFOR[b]	0.124**	-0.061**	-0.063**
TRUST	0.037**	-0.021	-0.016**
	(0.0012)	(0.0169)	(0.0079)
MARKET[b]	—	-0.023*	—
OKNOW	0.024**	-0.011	-0.013*
	(0.0115)	(0.0078)	(0.0071)
SKNOW	0.045**	-0.041**	-0.036**
	(0.0221)	(0.0096)	(0.0017)
AGE	0.032**	-0.024**	-0.008
	(0.0102)	(0.0074)	(0.0059)
EDU	0.047**	-0.030**	-0.017**
	(0.0122)	(0.0084)	(0.0068)

**Significant at 10% significance level.*

***Significant at 5% significance level.*

[a]Standard errors are reported in parentheses.

[b]Marginal effects are calculated by taking the probability differences. Otherwise, marginal effects are evaluated at the median.

model with respect to the variable in interest. Given the difficulties associated with the more conventional approach, we directly calculated the overall marginal impact of information using a sensitivity analysis through various explanatory variables included in the model.

The marginal effects of information type I (no detectable trace of GM residue could be found in GM oil) and type II (oil made from GM oilseeds is more nutritious) on consumers' purchase intentions were examined relatively to information type III (an application of GM oilseeds can reduce pesticide usage). This comparison involves the evaluation of all the variables created by interacting the original variables with information contexts. To better reflect the impact of heterogeneity in consumers' profiles towards their responses to new information, representative consumers were grouped into hypothetical profiles. Four consumer profiles (*I* to *IV*) were created to capture the variation among the effects of information type I on different consumers. For example, the first type of consumers is defined with a high risk perception (takes a value of 5 for the *RISK* variable), a low subjective knowledge (takes a value of 1 for the *SKNOW* variable), and lack of awareness that GM oil is already on the market (takes a value of 0 for the *MARKET* variable). Consumers in other profiles are defined accordingly.

In a similar manner, given that there is only one *INF2* (the dummy variable equaling one if consumers were given the second type of information) interacted variable that had a significant marginal effect, two consumer profiles (*A* and *B*), were created to compare the effects of the second and third type of information. The first profile is based on consumers with a high trust in the government food safety management system (takes a value of 5 for the *TRUST* variable); the second is based on consumers with a low trust level (takes a value of 1 for the *TRUST* variable). The simulation results are reported in Table 4.

These results indicate that as consumers differ in their attitudes and risk perceptions, their responses towards various types of new information are quite different as well. Between the first and third types of information, for all four consumer profiles (I to IV), the first type of information increased consumers' probability of purchasing GM oil and decreased their probability of not purchasing when compared with the third type of information. Recall that the first type of information reveals that no trace of GM ingredients can be detected, whereas the third type of information is that GM oilseeds may help protect the environment. The results show that Chinese consumers were more likely to be persuaded by information with more direct consumer effects than one that reveals the environmental effect, which may not directly benefit consumers. The heterogeneous impact of information on different consumers can also be clearly seen: The difference between the first and third type of information seemed to matter tremendously for the second type of consumers (high risk, low subjective knowledge, and aware that GM oil is in the market)—the first type of information was 33.7% more likely to persuade consumers to purchase GM oil then the third type. However, for the fourth type of consumers, (low risk, high subjective knowledge, and not aware GM oil is on the market), the first type of information was only 5.7% more likely to induce purchasing then the third type of information.

The difference in impacts between the second and the third type of information does not have a generally consistent pattern across the two types of consumers identified. Compared with the third type of information, the second type of information only decreased the probability of not purchasing (by 2.1%) for consumers with a very high trust in the government food safety management system (profile A) and increased the probability of purchasing and being uncertain. However, for consumers who did not trust the government at all (profile B), the second type of information would lower their purchasing intention by 1.8% compared with the third type of information. In other words, the persuasive power of

Table 4. Marginal effects with respect to different types of information under various consumer profiles.

Purchase intentions	Marginal effect of type I information (compared with type III)				Marginal effect of type II information (compared with type III)	
	Consumer profile I[a]	Consumer profile II[b]	Consumer profile III[c]	Consumer profile IV[d]	Consumer profile A[e]	Consumer profile B[f]
Yes	0.214	0.337	0.18	0.057	0.003	-0.018
No	-0.139	-0.319	-0.231	-0.051	-0.021	0.003
DK	-0.075	-0.018	0.052	-0.005	0.017	0.015

[a]Consumer profile I: high risk perception, low subjective knowledge, not aware that GM oil is on the market.
[b]Consumer profile II: high risk perception, low subjective knowledge, aware that GM oil is on the market.
[c]Consumer profile III: low risk perception, high subjective knowledge, aware that GM oil is on the market.
[d]Consumer profile IV: low risk perception, high subjective knowledge, not aware that GM oil is on the market.
[e]Consumer profile A: high trust in the government food safety management system.
[f]Consumer profile B: low trust in the government food safety management system.

information that reveals nutrition features of GM oil varied across consumers with different perceptions. GM oil promoters, if successful, should notice the opposite effect of this particular type of information to various consumers compared with the information that identifies the environmental benefit of GM oil.

Conclusions

This paper investigated consumers' purchase intentions of vegetable oil that was made from genetically modified oilseeds in Beijing, China. Consumers' purchase intentions of GM vegetable oil were found to be rather low, indicating a considerable skepticism towards GM vegetable oil among Beijing residents. A multinomial logit analysis indicated that the more consumers trusted the government food safety management system, the more likely they would like to purchase GM oil. If consumers believed that GM oil was already on the market, they would be less likely to refuse to purchase GM oil. Similarly, the more knowledgeable (regardless of whether consumers felt they were knowledgeable or truly knowledgeable), older, and better-educated consumers were more likely to purchase GM oil. The presence of favorable information was found to have a significantly positive impact on the consumers' intentions to purchase GM vegetable oil. This implies that Chinese consumers were likely to change their negative attitudes towards GM oil after being exposed to some positive information related to GM technology. On average, when a piece of favorable information was presented to consumers, they would be up to 12% more likely to purchase GM oil than when the information was not revealed.

Different types of favorable information were also found to have impacts on consumers' purchasing intentions for GM vegetable oil. The magnitude and direction of impacts, however, depended largely on what state of perceptions or attitudes consumers were in. On average, the information stating that no trace of GM ingredients can be detected in the final product was more effective, in terms of persuading consumers to purchase GM oil, than the information stating the potential benefit that GM oilseeds may have on the environment; the former was found to be 6% to 21% more effective then the latter, depending on various consumers. Compared again with the information linking to GM oilseeds' environmental benefit, the information that affirms the nutritional benefit of GM oil can be slightly more effective for some consumers (0.3% better) or be slightly worse for the others (1.8% worse). Another important finding of this paper is that the heterogeneity among consumers' perceptions and attitude is crucial for understanding the effectiveness of various types of information. Government policy makers or GM oil makers should recognize these differences and realize that the best strategy to improve the acceptance of GM oil in China would be to target specifically different types of consumers while maintaining the consideration for cost implications.

Finally, in this study we considered only the impacts of *favorable* information about GM oil on consumers' purchasing intentions. In practice, negative information about GM oil or GM technology (such as "this product may contain GM ingredients, whose impacts on human health have not been finally confirmed by science") may be provided to consumers as well. Negative information may most likely occur due to the requirements of mandatory government policies. This constitutes another important research topic, where the approach outlined in this study may also be applied.

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