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Objective and Subjective Knowledge: Impacts on Consumer Demand for Genetically Modified Foods in the United States and the European Union

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In the growing body of literature concerning consumer acceptance of genetically modified (GM) foods, there are significant differences in conclusions about the impact of knowledge on such acceptance. One potential explanation for these differences is the manner in which knowledge is measured. This paper first provides a review of the literature on objective and subjective knowledge, and reviews previous studies investigating the relationship between knowledge and acceptance of GM foods. Next, the goal of this study is to differentiate and examine the impact of both subjective and objective knowledge related to acceptance of genetically modified foods. Data from surveys collected in the United States, England, and France is used. Our findings suggest that knowledge should not be viewed as a unidimensional construct, and the way in which knowledge is measured significantly impacts the relationship with consumers' willingness to accept GM foods.

Key words: consumer acceptance, genetically modified foods, objective knowledge, subjective knowledge.

It is often argued that consumer education will improve acceptance of biotechnology (e.g., Hoban & Katic, 1998). This viewpoint is evident in the mission of the Council for Biotechnology Information (CBI), an organization backed by several biotechnology companies. The CBI's mission is to "improve understanding and acceptance of biotechnology by collecting balanced, credible and science-based information, then communicating this information through a variety of channels" (CBI, 2002). However, consumers in the United States are generally unfamiliar with issues associated with genetically modified (GM) foods. For example, a large-scale poll of US consumers in 2001 found that over half the sample had heard "nothing" or "not much" about GM foods or biotechnology (Pew Initiative on Food and Biotechnology, 2001). Pew concluded that US public opinion about genetically modified foods is "up for grabs."

The impact of knowledge on consumer acceptance of GM foods has been measured in a number of studies with contradictory results. One potential explanation for the existing differences is the manner in which knowledge is measured. The goal of this study is to differentiate and examine the impact of both subjective (self-rated, also known as perceived) and objective (tested) knowledge related to acceptance of genetically modified foods. Understanding the relationship of these variables, as well as factors that impact knowledge, may lead to a better understanding of how education could impact acceptance of biotechnology.

Objective Versus Subjective Knowledge

"Consumers are overconfident—they think they know more than they actually do" (Alba & Hutchinson, 2000, p. 123). The impact of knowledge on decision making, and the measurement of this variable, has long been a subject in marketing literature. Park and Lessig (1981) identified two major approaches for measuring product familiarity: one measuring how much a person knows about the product and the other measuring how much a person thinks they know about a product. Similarly, Brucks (1985) described three categories of consumer product class knowledge used in consumer behavior research: (a) subjective knowledge, the individual's perception of how much s/he knows; (b) objective knowledge, a measure what an individual actually knows; and (c) prior experience, the amount of purchasing or usage experience the consumer has with the product. However, according to Brucks, experience-based measures of knowledge are less directly linked to behavior.

Differences in objective and subjective knowledge occur when people do not accurately perceive how much or how little they actually know. Jacoby (1974) noted it is "not what is provided by the source, but how this information is perceived and affects the receiver (or class of receivers) which should be the preliminary and major focus of the entire public policy issue" (p. 101). Ruddell (1979) echoed that sentiment, noting that it is not the nature of the information, but rather its effects on the consumer, that impact consumer choices. Perceived (subjective) knowledge was found to be negatively associated with the amount of information acquired by consumers making food purchase decisions, and measured knowledge (score on quiz) was unrelated to information acquisition. This would impact consumer decisions, as those with higher self-rated knowledge are less likely to seek out information about a product (e.g., impacts of GM foods) before coming to a decision about this product. Ruddell's conclusion was that nutrition education that expands consumers' stored knowledge may reduce their reliance on information while increasing the number of thoughts involved in decision making.

Similarly, Brucks (1985) pointed out that consumers with high levels of subjective knowledge might be quick to rule out alternatives they believe to be inferior. Brucks further hypothesized that subjective knowledge is less strongly related to the number of attributes examined and the amount of inappropriate search than to objective knowledge. Bruck's subjective scale had a 0.54 ($p < 0.01$) correlation with the objective knowledge scale. Overall results indicated that subjective knowledge was not significantly related to the number of attributes examined, which Brucks noted was consistent with the theory that the number of attributes examined is determined primarily by actual memory content (objective knowledge).

Park, Mothersbaugh, and Feick (1994) modeled self-assessed knowledge, including predeterminants, and compared the differential determinants of objective and subjective knowledge. Using a structural model, Park et al. found 33% of the subjects' response (self-rating of knowledge) was based on product-class information stored in memory, and 59% were based on product experience. Additionally, Park et al. found that a general level of self-confidence was not related to self-assessed knowledge. Comparing objective to subjective knowledge, stored product class information was more strongly related to objective knowledge, and product experience was more strongly related to self-assessed knowledge.

Ellen (1994) also examined the relationship between objective and subjective knowledge related to making sound precycling and recycling-based shopping decisions. Among other findings, levels of objective and subjective knowledge varied significantly by age—older participants indicated lower levels of both measures of knowledge, as did persons with lower incomes and education. No significant relationship was found between perceived and objective knowledge. Significant relationships were found between subjective knowledge and three recycling behaviors (convenience recycling, committed recycling, and source reduction behaviors), but objective behavior was an important indicator only for committed recycling. Ellen noted that further investigation into the reason for the different levels of objective and subjective knowledge were still needed.

Alba and Hutchinson (2000) summarized the literature comparing objective and subjective knowledge by indicating that correspondence between the two types of knowledge is not high, and operationalization of the relevant constructs occurs at an abstract level. Although considerable literature does exist defining the differences between the constructs of knowledge, Flynn and Goldsmith (1999) noted the three constructs of knowledge identified by Brucks (1985) are often used interchangeably in the literature.

Previous Research on Knowledge and Genetically Modified Foods

There appears to be significant disagreement on the impact of knowledge on consumer acceptance of biotechnology. However, much of this disagreement can be explained when considering the type of knowledge used in each study.

Hamstra investigated consumer acceptance of genetically modified foods in three studies (1991, 1993, and 1995) by interviewing and conducting focus groups with Dutch consumers and using means-end chain theory (Hamstra, 1993) and an empirical model (Hamstra, 1995) to test the relationships between the characteristics and acceptance. In Hamstra's model, consumer characteristics (including knowledge) were found to have little to no effect on acceptance of biotechnology.

Gaskell, Bauer, Duran, and Allum (1999), Hoban (1998), and Chern, Rickertsen, Tsuboi, and Fu (2003) measured objective knowledge. Gaskell et al. (1999) found that textbook knowledge (as measured by a score on true/false "textbook" items on general knowledge about foods and genes, enzymes, etc.) was significantly higher in Europe than in the United States. Gaskell et al. concluded from this that levels of knowledge did not explain the more positive attitudes in the United States towards genetically modified foods. In contrast, however, Hoban (1998) found that US consumers were better able to accurately answer true/false questions than European consumers. Chern et al. (2003) tested knowledge with two true/false questions. Although the authors questioned differences in these ratings by country (comparing the United States, Norway, Japan, and Taiwan) in levels of objective knowledge, they appear to have combined measures of subjective and objective knowledge into one variable in their final estimation of willingness to accept—making it hard to understand the conclusions.

A few studies have found significant positive relationships between subjective knowledge and willingness to accept genetically modified foods. Boccaletti and Moro (2000) measured subjective knowledge in Italy using a four-point self-rated scale. Using an econometric model, Boccaletti and Moro found that knowledge played "an important role in purchasing decisions regarding products exhibiting a lower use of pesticides and organoleptic properties." However, they concluded from this, and the positive relationship between the knowledge variable and willingness to accept that "[proper] information makes individuals more confident regarding GM foods, thereby increasing their WTP" (willingness to pay). This final statement may be incorrect, as the authors measured subjective knowledge, which should not be interpreted as the amount of correct knowledge (objective knowledge) a person has. Li, Curtis, McCluskey, and Wahl (2002) also found subjective knowledge significantly related to acceptance. In this study, Li et al. used a two-point self-rated scale to measure subjective knowledge in a study of Chinese acceptance of GM soybean oil. Many other studies have examined willingness to pay for GM foods; however, these were not included in this review, as they either did not include knowledge as a variable or did not provide enough information to determine the type of knowledge measured. Lusk et al. (2004) found subjective knowledge significantly affected respondents' bid levels in an experimental auction when information about the benefits of genetic modification were introduced to auction participants. Their results suggested that participants with higher initial levels of subjective knowledge were likely to change their bids less as a result of the new information they were provided with, implying they relied more heavily on their subjective knowledge.

Finally, Bredahl (1998) noted that low familiarity with the product and technology was often linked to low trustworthiness of the product. This may be related to Brucks' (1985) suggestion that a third component of knowledge is product experience. Bredahl (1998) concluded that knowledge would help demystify the technique and increase consumer acceptance. However, Bredahl also acknowledged that many consumers opposed GM foods for ethical reasons that were unlikely to be affected by increased knowledge.

Tied closely to the subject of knowledge is the consumer's perception of the risks and benefits of genetically modified foods. In theory, a consumer would determine their rating of the risks and benefits based on their subjective and objective knowledge of the product or process. Extensive research to identify the factors that influence consumers' perception of risks in food (e.g., Frewer, Howard, & Shepherd, 1995; Raats & Shepherd, 1996) has confirmed that consumers' concerns about food safety are not so much determined by the hazard itself but by the social and psychological characteristics of the food hazard. Technological hazards, such as genetic modification in food production, are attributed a moderate "dread" score, due to their involuntary nature, but are often scored very high on the "unknown" factor, due to the perceived high level of uncertainty (Frewer et al., 1995; Yeung & Morris, 2001).

In the case of GM foods, consumers' concerns and potential benefits extend beyond traditional food safety. Among the supposed advantages of GM foods are improved food safety, functional benefits to food (better taste, nutritional quality), and environmental benefits (e.g., less pesticides; Caulder, 1998; Grunert et al., 2001). Equally, it is claimed by some protagonists that GM-based productivity advances are necessary to satisfy growing world food demand and that any country failing to embrace GM methods risks becoming technologically backward and suffering falling international competitiveness (Food Standards Agency [FSA], 2003a, 2003b). Consumers may feel that in supporting GM they are supporting their own farmers and food manufacturers. But for each potential benefit, there is a potential risk—safety may be lowered, quality reduced, the environment damaged, developing countries disadvantaged,

Table 1. Summary of demographic characteristics of sample.

Variable	% of sample
Highest level of education completed	
Less than high school degree	14.9
High school degree or equivalent	33.0
University undergraduate degree or more	42.4
Other	9.7
Household income before taxes	
<$20,000	12.3
$20,000–$39,999	25.9
$40,000–$59,999	32.7
$60,000–$79,999	19.7
>$80,000	9.4
Location	
Grenoble, France	26.2
Reading, England	26.5
Lubbock, Texas	23.9
Long Beach, California	14.2
Jacksonville, Florida	9.1
Age	
25–34	25.6
35–44	30.7
45–54	25.2
55–65	18.5

and farmers and food manufacturers rendered subservient to multinational life science companies (Bredahl, Grunert, & Frewer, 1998; Morris & Adley, 2000; Perdikis, Kerr, & Hobbs, 2001). Consumers have also expressed concern about the abuse of living things for commercial benefit and the existence of unpredictable and possibly harmful long-term effects of genetic modification (FSA, 2003a, 2003b). Frewer and Shepherd (1995) point out that risk perceptions and ethical concerns in relation to genetic modification were not completely independent. Kuznesof and Ritson (1996) explored UK and Irish consumers' attitudes to GM using focus groups and found that the main reasons for rejecting the technology were moral and religious objections, concerns about the safety and control of the technology, and lack of trust in the institutions. The relationship between perceptions of risks and benefits and objective and subjective knowledge has yet to be directly studied.

Method

The data collected in this study was from a survey conducted with experimental auction participants in three cities in the United States, one in England, and one in France. Marketing research firms were contacted in Long Beach, California, Jacksonville, Florida, and Lubbock, Texas in the United States, Reading, England, and Grenoble, France to recruit subjects randomly from the general population of the selected cities, with the stipulation that the participants be females between the ages of 25 and 65 with household incomes above $25,000. In 2001, women were the primary grocery shoppers in almost 70% of US households (Progressive Grocer, 2002). The age range was limited to 25–65 due to concerns that a disproportionate number of students or retirees might agree to participate due to their relatively low opportunity cost of time. The gender, age, and income restrictions were also imposed in an attempt to create more homogeneous samples across the geographic locations, which would allow for a stronger test of the location effect. Participants were given a survey that included questions about their knowledge and opinions of genetic modification in food production and food in general. The survey also collected basic sociodemographic information. A summary of demographic characteristics of the sample (n = 309) are provided in Table 1.[1]

Measures were developed for both subjective and objective knowledge of genetic modification in food production. Subjective knowledge was measured using a single self-report item. The objective measure of knowledge was designed as series of four true/false questions (Table 2). Additionally, based on the literature on consumer perception of risks and benefits and a review of the various empirical applications mentioned above, we developed a series of questions to measure risk and benefit perception. These were grouped into categories: agricultural and food business risk; agricultural and food business benefit; risk to you and your family; benefit to you and your family; risk to the developing world; benefit to the developing world; environmental risk; environmental benefit; and moral/ethical concerns. Three additional categories did not have potentially symmetrical risks and benefits: long-term health risk; long-term production benefit; and long-term food quality improvement. Data were collected on responses to nine-point Likert scales anchored by

1. *Differences in data across location matched expectations. For example, participants in California reported larger incomes than participants in Texas and Florida, which is consistent with reports from the US Census Bureau (2004). World Bank data also confirms differences found in per-capita gross national income between the three countries.*

Table 2. Survey measures.

	Subjective knowledge	Objective knowledge
Question(s)	How knowledgeable would you say you are about the facts and issues concerning genetic modification in food production?	Ordinary fruit does not contain genes, but genetically modified fruit does. (49.8% correct) By eating genetically modified fruit, a person's genes could also be changed. (66.3% correct) Genetically modified animals are always larger than ordinary animals. (53.4% correct) It is impossible to transfer animal genes to plants. (25.2% correct)
Answer type	Likert scale: 1 (*not at all knowledgeable*) to 9 (*extremely knowledgeable*)	True/false
Descriptive statistics	Mean = 3.56; SD = 1.65; range = 1–8	Cronbach's alpha = 0.54

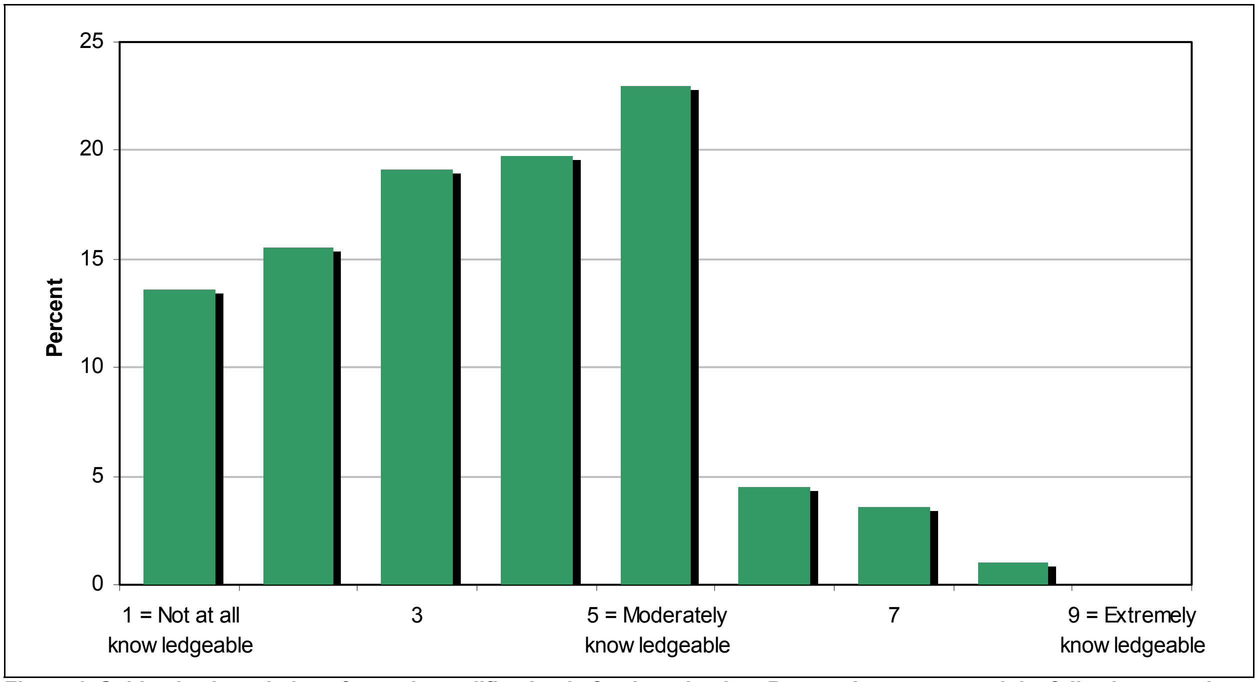

Figure 1. Subjective knowledge of genetic modification in food production. Respondents answered the following question: "How knowledgeable would you say you are about the facts and issues concerning genetic modification in food production?" Respondents answered by circling a number on a 1–9 scale.

strongly disagree and *strongly agree*. Other information collected included consumer attitudes towards food, technology, the environment, and information sources.

Results

Descriptive statistics and coefficient alphas for the subjective and objective knowledge variables are shown in Table 2. Less than 9% of the respondents identified themselves as more than moderately knowledgeable (a 5 on a 9-point scale) about genetic modification in food production (Figure 1). A total score for objective knowledge was created by summing the number of correct answers to the four true/false questions. The average number of correct answers was 1.95 on a four-point scale, indicating that, on average, respondents got less than half of the questions correct. Cronbach's alpha (a measure of unidimensionality) estimates the reliability of the objective knowledge scale (SAS, 1999). Of the sample, only 10% of the respondents answered all four true/false questions correctly, whereas 18% answered all four incorrectly.

The measure of objective knowledge correlates (r = 0.36, $p < 0.01$) with the measure of subjective knowledge. Table 3 shows differences along demographic lines in objective and subjective knowledge. Responses to this question differed significantly between some of

Table 3. Differences in objective and subjective knowledge on demographic characteristics.

Variable		Objective knowledge χ^2	Objective knowledge Means	Perceived knowledge χ^2	Perceived knowledge Means
Age	25–34	12.18	2.08	12.40	3.75
	35–44		1.91		3.43
	45–54		2.04		3.46
	55–65		1.72		3.63
Income	<$20K	18.98	1.69	29.54	3.64
	$20K–$40K		1.91		3.32
	$40K–$60K		1.90		3.79
	$60K–$80K		2.16		3.44
	>$80K		2.10		3.48
Education	<High school	37.66*	1.24	34.91*	3.17
	High school		1.73		3.00
	College		2.29		4.02
Religion	Christian	16.30	1.88	40.77*	3.20
	Catholic		2.12		4.15
	Other		1.90		3.70
	None		2.17		4.00
Location	France	18.80	2.14	77.52*	4.70
	England		1.85		3.16
	Lubbock		2.12		3.16
	Long Beach		1.68		3.10
	Jacksonville		1.64		3.18

** Significantly different at the 95% confidence level.*

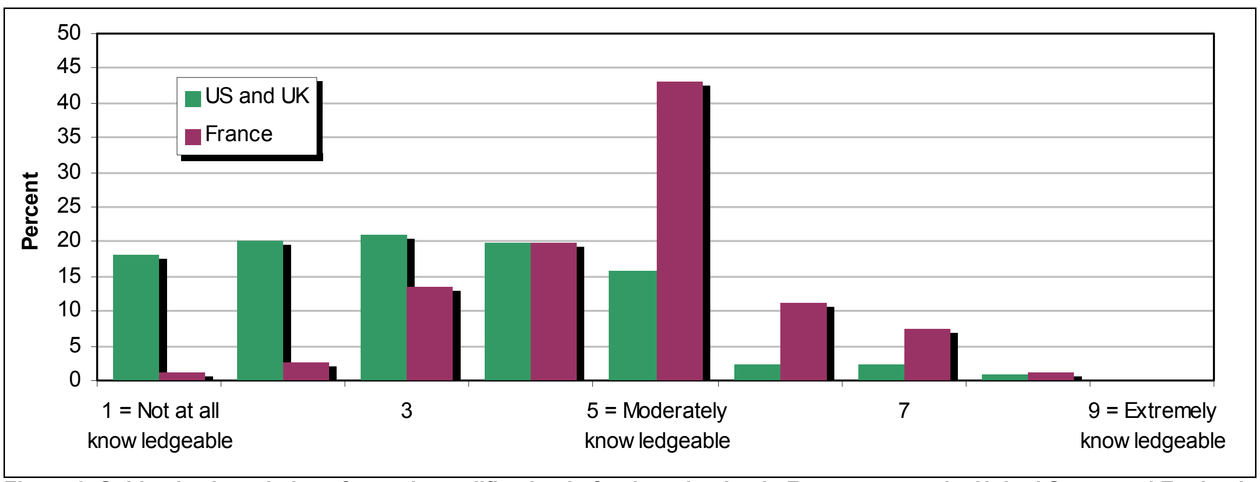

Figure 2. Subjective knowledge of genetic modification in food production in France versus the United States and England.

the locations. There was no significant difference between the US locations and England; however, there was a significant difference between the Grenoble, France respondents and the rest of the sample. French respondents were significantly more likely to indicate they were more knowledgeable (subjective knowledge) about genetic modification in food production (Figure 2). There were no statistical differences between the three locations for the objective knowledge scale.

Respondents with a college education had significantly higher objective and subjective knowledge. Interestingly, education was the only demographic variable

Table 4. Summary statistics and definitions of attitudinal variables.

Variable	Definition	Mean (SD)
WTA (dependent variable)	I am willing to eat genetically modified food products. (1 = *strongly disagree*; 9 = *strongly agree*)	4.92 (2.37)
Trust in information about genetic modification in food production		
Government	Level of trust in information about genetic modification in food production from government agencies such as the USDA and FDA (1 = *strongly distrust*; 9 = *strongly trust*)	5.26 (2.23)
Activists	Level of trust in information about genetic modification in food production from activist groups such as Greenpeace (1 = *strongly distrust*; 9 = *strongly trust*)	4.74 (2.18)
Perception of risks and benefits of genetic modification in food production		
Perceived risk	Sum of risk scales items shown in Table 5	40.45 (3.78)
Views about the environment		
Environment 1	When humans interfere with nature, it often produces disastrous consequences. (1 = *strongly disagree*; 9 = *strongly agree*)	6.09 (2.25)
Environment 2	Mankind is severely abusing the environment. (1 = *strongly disagree*; 9 = *strongly agree*)	7.03 (2.14)
Views about food		
New food	I don't trust new foods. (1 = *strongly disagree*; 9 = *strongly agree*)	3.25 (2.02)
Food quality	Quality is decisive for me in purchasing foods. (1 = *strongly disagree*; 9 = *strongly agree*)	7.34 (1.60)
Natural food	I usually aim to eat natural food. (1 = *strongly disagree*; 9 = *strongly agree*)	6.33 (2.06)
Views about technology		
Technology 1	The degree of civilization of a people can be measured from the degree of its technological development. (1 = *strongly disagree*; 9 = *strongly agree*)	5.27 (2.28)
Technology 2	In this country we are probably better off than ever, thanks to the tremendous progress in technology. (1 = *strongly disagree*; 9 = *strongly agree*)	6.68 (1.82)

that significantly differed relating to objective knowledge. Respondents that identified themselves as Christian had significantly lower subjective knowledge than other respondents.

To demonstrate the different results that can be obtained by interchanging the type of knowledge measurement used, a model was developed to determine the impact of knowledge (both subjective and objective) on willingness to accept genetically modified foods. Two ordered probit equations were estimated with willingness to accept (WTA) genetically modified foods (on a scale of 1 to 9) as the dependent variable:

WTA = f (Age, Education, Income, Location, Government, Activists, Perceived risk, Environment 1, Environment 2, New food, Food quality, Natural food, Technology 1, Technology 2, Subjective knowledge), and

WTA = f (Age, Education, Income, Location, Government, Activists, Perceived risk, Environment 1, Environment 2, New food, Food quality, Natural food, Technology 1, Technology 2, Objective knowledge).

Independent variables include demographic variables and attitudinal variables; defintions are provided in Tables 4 and 5. In one equation, subjective knowledge was included as an independent variable; in the second equation objective knowledge was used. It is hypothesized that the two knowledge variables will influence willingness to accept differently, with subjective knowledge more likely to have a stronger effect.

Results are shown in Table 6. As expected, the models are very similar in which variables significantly influence willingness to accept, with the exception of the knowledge variables. Increased levels of subjective knowledge significantly increased willingness to accept, but objective knowledge was not significantly related to willingness to accept. Significant demographic variables included education (college educated respondents were more likely to have a higher acceptance level), income (respondents with income levels below $40,000 were more likely than those with incomes above $100,000 to have a higher acceptance level), and location (all loca-

Table 5. Measurement items for perceived risks and moral concerns.

Agricultural and food business risk	Agricultural and food businesses could be exposed to great risk from genetic modification in food production. Genetic modification in food production will pose risks for agricultural and food businesses. Agricultural and food businesses could receive great benefits from genetic modification in food production (reversed score). Genetic modification in food production will not provide benefits for agricultural and food businesses.
Risk to you and your family	Genetic modification in food production will not pose risks to my family and me (reversed score). My family and I could be exposed to great risks from genetic modification in food production. The use of genetic modification in food production will not be beneficial to my family and me. My family and I could benefit from genetic modification in food production (reversed score).
Developing world risk	The developing world could be exposed to great risk from genetic modification in food production. Genetic modification in food production will not pose risks for the developing world (reversed score). The developing world could receive great benefits from genetic modification in food production (reversed score). Genetic modification in food production will provide no benefits to the developing world.
Environment risk	Genetic modification in food production will not pose risks for the environment (reversed score). The environment could be exposed to great risks from genetic modification in food production. The environment will not benefit from genetic modification in food production. Genetic modification in food production could provide benefits for the environment (reversed score).
Long term health risk	I am concerned about the lack of knowledge of long-term effects of genetic modification in food production on human health. The side-effects from eating food produced using genetic modification are largely unknown. There is little danger that genetic modification in food production will result in new diseases for humans (reversed score).
Quality	Genetic modification is necessary to improve the quality of food products. Food obtained through genetic modification will be of low quality (reversed score). Genetic modification will improve the quality of food products.
Production	Thanks to genetic modification in food production enough food will be produced to feed the world's growing population. Genetically modifying food is the only way to increase global food production. The world's food supply will not be increased through the use of genetic modification (reversed score).
Moral concerns	Man has no right to "play God" with nature. Genetic modification in food production is morally wrong. Genetic modification in food production threatens the natural order of things.

tions were significantly more likely to have higher acceptance levels than Grenoble). Attitudinal variables that were significant included trust in information sources (those who trusted government sources were more accepting, and those who trusted activist sources were less accepting); risk perceptions (those who perceived genetic modification as riskier were less accepting); environmental views (those who believed human interference with nature could result in disastrous consequences were less accepting); views about food (those who didn't trust new foods and indicated they try to eat natural foods were less accepting); and views about technology (those who believed technology in general was beneficial were more accepting).

Conclusions

The impact of education on knowledge and acceptance of genetically modified foods is an important issue for policy makers, agribusinesses, and other parties interested in the acceptance (or rejection) of genetically modified foods. When investigating these subjects, it is important to be mindful of the differences between objective and subjective knowledge. Both measures may be important factors in willingness to accept new products; however, they may impact acceptance differently, as found in this study.

Our research differed from the previous research findings of both Gaskell et al. (1999) and Hoban (1998), who each found that objective knowledge[2] differed depending on location of the respondent. Gaskell et al. found EU respondents to have more objective knowledge than US respondents, whereas Hoban found the exact opposite. In our research, there was no significant

2. *Although neither Hoban nor Gaskell et al. made a distinction between objective and subjective knowledge, both based their conclusions about knowledge on a set of true/false questions that would be similar to a scale of objective knowledge. Neither used questions about the respondents' perception of their knowledge (subjective knowledge).*

Table 6. Result of ordered probit estimation.

	Subjective knowledge	Objective knowledge
Variable	**Coefficient (SE)**	
Age	0.007 (0.006)	0.009 (0.006)
< High school education	-0.334 (0.259)	-0.288 (0.271)
High school education	-0.409* (0.152)	-0.426* (0.155)
Income < $20,000	0.335 (0.321)	0.367 (0.324)
Income $20,000-$39,999	0.243 (0.284)	0.263 (0.283)
Income $40,000-$59,999	-0.135 (0.282)	-0.094 (0.280)
Income $60,000-$79,999	0.119 (0.301)	0.129 (0.299)
Trust in government	0.172* (0.033)	0.167* (0.033)
Trust in activists	-0.076** (0.031)	-0.068** (0.031)
Perceived risk	-0.014 (0.012)	-0.014 (0.012)
Environment 1	-0.123* (0.033)	-0.114* (0.033)
Environment 2	0.024 (0.033)	0.017 (0.032)
New food	-0.097* (0.036)	-0.102* (0.037)
Food quality	0.052 (0.045)	0.055 (0.045)
Natural food	-0.084** (0.038)	-0.081** (0.037)
Technology 1	0.057* (0.027)	0.056** (0.027)
Technology 2	0.157* (0.040)	0.157* (0.039)
Reading	1.307* (0.233)	1.149* (0.221)
Long Beach	1.100* (0.253)	1.007* (0.248)
Lubbock	1.327* (0.217)	1.191* (0.213)
Jacksonville	1.275* (0.249)	1.188* (0.249)
Subjective knowledge	0.219** (0.093)	
Objective knowledge		0.090 (0.057)
Log-likelihood function	-535.90	-539.59
Percent correct prediction (naïve prediction 19.4%)	33.3%	33.0%

, **, and * indicate significance at the 99%, 95%, and 90% confidence level, respectively.*

location effect on the responses to objective knowledge; however, there was a significant relationship between subjective knowledge and location.

It is frequently assumed that increased education will increase knowledge—specifically objective knowledge. In fact, in this case, the only demographic variable correlated to objective knowledge was education, with the expected relationship—as education level increased, objective knowledge increased. However, one must be cautious in concluding that increases in objective knowledge can increase acceptance of genetically modified food products. It is often argued that consumer education will cure the woes of the biotechnology industry. For example, Hoban and Katic wrote: “Educational programs that provide consumers with information needed to better understand food biotechnology need to be developed and implemented” (p. 20). Our results indicated that only those with a college education or higher were significantly more likely to be accepting of GM food products. Additionally, objective knowledge (partially a result of education) was not related to acceptance. However, subjective knowledge (also related to education) was a significant determinant of how willing consumers were to eat GM food products.

The implications of this finding are twofold. First, it indicates that researchers should use caution when investigating the impact of “knowledge” on acceptance of genetically modified foods (or other products). Knowledge should not be seen as a unidimensional construct that can be easily measured either by asking true/false questions or asking the respondents to rate their knowledge. Researchers should measure the type of knowledge appropriate to the study (which may include both subjective and objective knowledge measures). The second implication is that when investigating the impact of educational programs on acceptance of genetically modified foods, it is important to investigate the impact of those educational programs on both subjective and objective knowledge.

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