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Valuing Information on GM Foods in the presence of Country-of-Origin Labels

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ABSTRACT

Information on production methods (genetic modification (GM) or organic production) and locations (country of origin) are commonly found on food package labels. Both pieces of information may be used as a proxy for food safety and (perceived) quality by consumers. Our study investigates the interactive effects between information on production method and country-of-origin labeling (COOL) by conducting choice experiments in the European Union, United States and Japan. This study also investigates the effect of information about potential benefits of biotechnology on consumer acceptance of GM foods. Results indicate that consumers preferred GM foods produced domestically to GM foods imported from foreign countries, and individuals with information on consumer benefits, producer benefits, and environmental benefits were willing to pay more than individuals without information in some cases, but the effect of information varied by type of information, location, and the country of origin of the products

Keywords: Genetically modified food, biotechnology, country of origin, consumer attitudes

1 Introduction

The debate over the relative advantages and disadvantages of use/consumption of genetically modified (GM) foods has continued over decades. The dispute involves consumers, government regulators, non-government organizations, biotechnology companies, scientists, and social economists. Many social science researchers, especially agricultural economists have studied consumers' knowledge, acceptance, and preferences of GM foods, and they found that consumers' preferences vary by locations, their prior knowledge of GM technology, and the information provided in public (Hoban, 1997; Hoban and Katic, 1998; Gaskell et al., 1999; Baker and Burnham, 2001; Lusk *et al*., 2004; House *et al*., 2004). For example, Lusk *et al*. (2004) find that information on health and environmental benefits of biotechnology significantly reduces the amount of monetary compensation that consumers require to purchase GM foods. They also find that the effect of information varies with the type of information and the location of where the information is released.

Often research on consumer perception of GM foods focuses on the technology used but does not include information on country of origin. However, in the market consumers are faced with considering multiple attributes at the same time. For example, in the European Union (EU), regulations call for labeling food products containing authorized GM ingredients as well as country-of-origin labeling (COOL) for certain foods (such as fresh fruits and vegetables). Since both the GM label and location attribute can be used as a proxy for food safety and quality by consumers, the availability of COOL in the market may change consumers' attitudes towards GM foods, both with respect to their willingness to pay (WTP) for GM foods and to their response to the positive information on why producers use biotechnology. Thus, when investigating the value the information on GM foods, adding COOL to the study may lead to a more

realistic understanding of consumer acceptance of GM foods.

It is reasonable to believe that there are interactive effects between COOL and GM attributes. One reason is public trust in biotechnology from foreign countries. Consumers, particularly those in Europe, have shown health and food safety concerns about GM foods in general (Bredahl, 1999; Esnauer, 2001; Burton *et. al.*, 2001; Sylvie, 2003). When it comes to GM foods from foreign countries, these concerns may increase if consumers have greater trust in their own country's technology and regulations than in those countries that the GM foods are imported from. Thus trust in this information may vary depending on the source country. In addition, consumers' patriotism and willingness to promote their own country or local economy (Shimp and Sharma, 1987) could also restrain their purchase of imported GM foods.

The goal of this paper is to investigate the interactive effect between information on COOL and production methods (GM, traditional and organic). In addition, we use different information treatments to determine if the consumers' reaction to positive information on reasons for the use of biotechnology varies with country of origin

2 Literature Review

Many researchers have examined consumers' acceptance of GM foods and they reach a general conclusion that consumers are willing to pay premiums for GM-free over GM foods when there is no benefit information provided for GM foods (Baker and Burnham, 2001; Burton et al., 2001; Lusk et al., 2001). More recently, several studies have found that information and knowledge on biotechnology could change consumers' acceptance of GM products (Lusk *et al*., 2002; Rousu *et al*., 2002; Lusk *et al*., 2004; House *et al*., 2004).

Rousu *et al*. (2002) studied both negative and positive information effects on consumers' WTP for GM foods and found that consumers who received positive information about GM foods placed higher value on some GM foods than non-GM labeled foods, consumers who received negative information about GM foods discounted the GM foods, and consumers who received both sides of information placed a lower value for GM foods than non-GM foods. Lusk *et al*. (2004) pointed out that Rousu et al. (2002) gave little insight into which specific type of information has the largest influence on consumer acceptance. Lusk *et al*. (2004) contributed to the literature by studying the effects of information about environmental benefits, health benefits and benefits to the third world of biotechnology on consumers' WTP for GM foods. By conducting auctions in the United States, UK, and France, they concluded that though positive information significantly decreased the amount of money consumers demanded to consume a GM cookie versus a cookie with no GM ingredients (except for French consumers), the same information did not have the same effect in all locations.

As Frewer *et al*. (1998) pointed out, the credibility of the information sources and prior attitudes towards the technology significantly influenced individuals' reactions to biotechnology information. One should not overlook the effect of COOL on the credibility of information related with GM products. When consumers have certain prior attitudes or purchasing experiences on products from one country, the information provided by that country could also affect consumers' trust of the positive biotechnology information provided by the suppliers.

A large body of research has studied country-of-origin effects. Schooler (1965) was the first study to use empirical tests to show the influence of COOL on consumers' acceptance of products. Since then, a growing body of literature has studied consumers' preferences for COOL. Most research confirms that consumers prefer foods produced in their own country or region (Verlegh and Steenkamp, 1999; Loureiro and Umberger, 2003; Loureiro and Umberger, 2005; Chambers et al., 2007). For example, Loureiro and Umberger (2003) showed that U.S. consumers are willing to pay $1.53 and $0.70 per pound more for steak and hamburger produced in the United States. In their subsequent article (Loureiro and Umberger, 2005), results from a nationwide survey show that consumers are willing to pay a (relatively small) price premium for U.S. produced meat due to their concerns about food safety issues associated imported products.

Researchers have found different reasons why COOL information affects consumers' purchasing decisions. Some of them showed that country of origin is a cognitive cue; that is, consumers use COOL to infer the quality of a product (e.g., Bilkey and Nes, 1982; Steenkamp, 1990; Loureiro and Umberger, 2007). Moreover, many studies have shown that country of origin is not merely a cognitive cue, but also has symbolic and emotional meaning (e.g., Verlegh and Steenkamp, 1999; Agrawal and Kamakura, 1999; Ehmke, Lusk, and Tyner, 2008). They showed that COOL affects consumer behavior through country

image, along with consumers' animosities,[*] ethnocentrism,[†] and trust in certificate authorities. For example, using a meta-analysis, Verlegh and Steenkamp (1999) found that differences in economic development are important factors underlying the country-of-origin effect. Ehmke, Lusk, and Tyner (2008) conducted a conjoint experiment in four countries at different levels of economic development and found that consumers prefer food from their own location indicating ethnocentric tendencies play a role in COOL preferences.

It has been over ten years since Lusk *et al.* (2004) conducted auctions with information treatments on consumers' preferences on GM foods in European countries and the United States in 2001. Our study conducted in six countries across Europe, Asia, and North America would reveal more information about consumers' acceptance and preference on GM products and illustrate whether attitudes have changed in the past ten years. In addition, our article contributes to the body of literature by studying the interactive effects between GM labels and COOL.

3 Survey Design

3.1 Choice Experiment

Participants were randomly recruited adult primary grocery shoppers from six countries (the United States, Japan, Belgium, France, Germany, and Spain). A choice experiment in which the respondent was presented with four alternatives for purchasing fresh apples—GM, traditional, organic apples, and "I would not choose any product" was presented. For each type of apple, price and country of origin were provided. There were five different price levels within one location, and the median price was designed to be consistent with the prevailing retail market price in that location. We assigned the first three lowest price levels to GM apples, the middle three price levels to traditionally grown apples, and the highest three price levels to organic apples. Details of the price attribute are reported in Table 1. Country of origin had three levels: China, New Zealand, and the home country. These three levels were selected represent a developing country (China), a developed country (New Zealand), and the home country. All six locations[‡] produce apples, making "produced domestically" a realistic choice for consumers to consider. By allowing for calculation of the interactions, the D-efficiency criterion was used to identify the best combination of choice sets, resulting in a choice experiment with 18 choice sets. Studying different countries will help us understand whether the interactive effect is common in these countries.

[*] *Animosity* is defined as anger related to previous or ongoing political, economic, or diplomatic events.

[†] *Ethnocentrism* is defined as a belief that it is inappropriate, or even immoral, to purchase foreign products because to do so is damaging to the domestic economy, costs domestic jobs, and is unpatriotic.

[‡] In order to clarify the notation of the six countries where we conducted the survey (Belgium, France, Germany, Spain, Japan, and the United States) and the country of origin on the product labels (domestic, China, and New Zealand), in this paper "location" refers to the six countries where we conducted the survey, and "country" in COOL refers the country of origin that on the product in the choice experiment.

Table 1.
Price levels in the Choice Experiment

Location	GM	Organic	Traditional
Belgium (€/kg)	0.94	1.40	1.87
	1.40	1.87	2.34
	1.87	2.34	2.81
France (€/kg)	1.24	1.85	2.47
	1.85	2.47	3.09
	2.47	3.09	3.71
Germany (€/kg)	0.94	1.40	1.87
	1.40	1.87	2.34
	1.87	2.34	2.81
Spain (€/kg)	0.94	1.40	1.87
	1.40	1.87	2.34
	1.87	2.34	2.81
Japan (yen/kg)	249	369	492
	369	492	615
	492	615	738
The United States ($/lb)	0.99	1.49	1.99
	1.49	1.99	2.49
	1.99	2.49	2.99

3.2 Information Treatment

Each participant in the survey was randomly assigned to receive one "information treatment" or receive no information before choice experiment. Each information treatment provided one of three types of information on the reason for the use of biotechnology: consumer benefits; producer benefits; and environmental benefits as follows:

1) Consumer benefits: *In the case of biotechnology, the apple has a special protein, which increases the shelf life of the apple. Because of this method, the apple will stay fresher longer and it is less likely to have bruises (soft brown spots).*

2) Producer benefits: *There is currently an insect that transmits a disease in apples. This disease causes the apple tree to produce less, or in extreme cases, die. As a result, apple production could decrease, and the average cost of apples would start increasing. In the case of biotechnology, the apple has a special protein, which makes it resistant to this insect. This will allow apple farmers to stay in business, and keep apple prices from increasing over time.*

***3)* Environmental benefits:** *In the case of biotechnology, the apple has a special protein, which makes it resistant to certain insects. This allows the farmer to use less pesticide when producing the apple. Reducing the use of pesticides is good for the environment. A lot of research shows that the usage of pesticides damages the environment and threatens the survival of many creatures in wild.*

4) No information: *No information was given, participants went directly to the choice experiment*.

To ensure participants read the information treatment before making choice decisions, we added validation questions after the information treatment to check if they read the information. For example, after the consumers benefits information, we asked the following question: "In this example, biotechnology is used to increase shelf life of the apple. A. True B. False." Those who didn't correctly answer this question were removed from the study.

Furthermore, even if participants have received the information, they may suspect the correctness of the GM benefits, especially when the GM apples are imported from foreign countries. To capture this information trust issue, we directly asked a question about if they trust the biotechnology and benefits claimed for the apples from China and New Zealand. Both the validation question and the follow up trust question about the information could help us have more information about consumers' attitudes towards the information treatments.

4 Multinomial Logit Model

Consumer choice decision process is modeled within a random utility framework (Bockstael, Hanemann, and Kling, 1987; Bockstael, McConnell, and Strand, 1989; Kaoru, Smith, and Liu, 1995). The utility level of the i^{th} product for the n^{th} respondent at a given choice occasion *t* can be written as:

(1) $$U_{nit} = V_{nit} + \varepsilon_{nit}, \quad n = 1, \ldots, N, i = 1, \ldots, I, t = 1, \ldots, T$$

where V_{nit} is the deterministic component and ε_{nit} is the random component. ε_{nit} is assumed to have an *iid* extreme value distribution.

In this article we assume the usual linear-in-parameter utility functional form that consumer n in selecting alternative i from a finite set of J alternatives at choice occasion *t* is defined as:

$$U_{nit} = \beta_p p_{it} + \beta_1 O_{it} + \beta_2 COOL_{it} + \beta_3^i O_{it} \times COOL_{it} + \beta_4 O_{it} \times Income_n + \varepsilon_{nit}$$

where p represents the price of product i, vector $COOL$ represents the dummy vector of the country of origin, and O represents the dummy vector of the operating methods of the foods (traditional, organic, and GM).

Under the assumption that ε_{nit}'s are *iid* with an extreme value distribution, the probability of consumer n choosing alternative i at a given choice occasion t is given by the multinomial logit (MNL) model:

(2) $$\text{Prob}(y_{nit}|\beta) = \frac{\exp(\beta_p p_{it} + \beta_1 O_{it} + \beta_2 COOL_{it} + \beta_3^i O_{it} \times COOL_{it} + \beta_4 O_{it} \times Income_n)}{\sum_{j=1}^{J} \exp(\beta_p p_{jt} + \beta_1 O_{jt} + \beta_2 COOL_{jt} + \beta_3^i O_{jt} \times COOL_{jt} + \beta_4 O_{jt} \times Income_n)}$$

The utility parameters are not directly informative for considering consumer behavior implications. Instead, previous research usually converts them into monetary values (i.e., WTP). WTP estimates are derived by determining the value difference between two products with different attribute levels. In our analysis, we use choice option "none of these products" as the base in the regression. The WTP value for a certain level of attribute m compared to consuming nothing is the negative value of the ratio of the coefficient of this attribute to the price coefficient: $-\beta_m / \beta_p$.

5 Results

5.1 Samples and data

We designed the survey to compare consumers' attitude toward GM foods in the U.S., Japan and the EU. Regional or cultural diversities in Europe may cause different GM acceptances. Based on the study by Gaskell *et al.* (2006), we separated the EU into GM tolerant and GM sensitive regions. We selected samples from the two regions independently: consumers from France and Germany who were shown to be sensitive to biotechnology in Gaskell et al.'s work, and consumers from Belgium and Spain, who were relatively tolerant of biotechnology in food. Our sample size was determined based on a 95% confidence level and 5% confidence interval. However, if the European countries are treated individually and not grouped, we maintain a 95% confidence level and a 7.5% confidence interval. The final number of observations was 1,446, with 738 from Europe, 331 from Japan, and 377 from the United States. In each region, participants were randomly assigned one of the information treatments including no information (baseline). Summary statistics of selected variables are shown in Table 2.

Table 2.
Summary Demographic Statistics

Variable	Definition	Locations					
		Belgium	France	Germany	Spain	Japan	USA
Age	age<=24 years old	28.41%	25.38%	29.94%	26.06%	21.75%	27.85%
	age 25~54	66.48%	68.02%	68.93%	72.87%	76.74%	60.21%
	age over 55	5.11%	6.60%	1.13%	1.06%	1.51%	11.94%
Edu.	Undergraduate degree or higher	68.18%	64.47%	33.90%	75.00%	64.05%	54.64%
	Other wise	31.82%	35.53%	66.10%	25.00%	35.95%	45.36%
Income[a] (in 1000s)	Median level Household Income	38~46 (€)	31~38 (€)	46~57 (€)	31~38 (€)	6000~7900 (¥)	60~75 ($)
Employ.	Full time job	66.48%	68.02%	76.27%	71.28%	64.65%	53.58%
	Otherwise	33.52%	31.98%	23.73%	28.72%	35.35%	46.42%
Family Size	Mean	2.74	2.98	2.77	3.11	3.28	2.75
	(Std. Dev.)	(1.19)	(1.42)	(1.32)	(1.12)	(1.30)	(1.39)
Children[b]	Mean	0.73	0.92	0.76	0.84	0.83	0.69
	(Std. Dev.)	(0.97)	(1.14)	(1.00)	(0.87)	(0.96)	(1.11)
Obser.	Number of observations	176	197	177	188	331	377

Note: [a] Numbers of money are in thousands, and are written in each country's own currency.
[b] Number of children less than 18 years old in the family

In the survey we asked respondents' self-rated knowledge about biotechnology, acceptance and satisfaction of domestic and imported GM foods, and whether consumers trust the benefit information claim if the GM food is imported. These questions could help us understand consumers' preferences regarding the COOL and GM labels.

Participant self-rated knowledge of facts and issues concerning genetic modification was collected on a scale of one (not at all knowledgeable) to nine (extremely knowledgeable) and is shown in Table 3. The average scores suggest that participants considered themselves relatively unknowledgeable of facts and issues concerning genetic modification, and among all the countries, respondents from Germany considered themselves relatively more knowledgeable than respondents from other countries did.

Table 3.
Self-rated knowledge about biotechnology
1=not at all knowledgeable; 9=extremely knowledgeable

	Location					
	Belgium	France	Germany	Spain	Japan	USA
Mean score	3.852	4.045	5.215	4.606	4.668	4.140
Std. Dev.	(1.980)	(2.026)	(2.158)	(2.012)	(1.751)	(2.185)

The perception of the importance of COOL is summarized in Table 4. Respondents from all six countries consistently considered COOL as an important piece of information with average scores above 3.5 on a scale ranging from one (not at all important) to five (extremely important). Moreover, when it comes to the safety concerns over fresh fruits produced domestically, in New Zealand, and in China, the average scores of satisfaction had the same pattern in all six locations: respondents were satisfied with domestic produced fresh fruits the most, followed by fruits from New Zealand, then fruit from China (Table 5).

Table 4.
Importance of country-of-origin labels
1= not at all important; 5=extremely important

	Location					
	Belgium	France	Germany	Spain	Japan	USA
Mean score	3.727	3.893	3.665	3.636	3.903	3.610
Std. Dev.	(0.959)	(0.963)	(1.114)	(0.937)	(0.854)	(1.020)

Table 5.
Satisfaction with the safety of fresh fruits from different countries
1=very dissatisfied; 5=very satisfied

	Location					
	Belgium	France	Germany	Spain	Japan	USA
Domestic country	4.204	4.178	3.910	4.401	4.021	4.090
(Std. Dev.)	(0.728)	(0.829)	(0.881)	(0.895)	(0.907)	(0.827)
New Zealand	3.657	3.429	3.411	3.457	3.549	3.344
(Std. Dev.)	(0.786)	(0.939)	(0.866)	(0.819)	(0.764)	(0.765)
China	2.602	2.327	2.659	2.690	1.612	2.681
(Std. Dev.)	(0.926)	(1.021)	(0.924)	(0.892)	(0.826)	(0.946)

Respondents' trust in label claims provided by a certain country is important to measure the interactive effect between COOL and GM labels. If respondents perceive claims about the benefits of biotechnology differently depending on where the food was produced (and technology applied), country of origin will influence their preference toward GM or non-GM food differently depending on where it is produced. Respondents were asked if they trust the benefit claim if the products are imported from New Zealand or China. The results of the Person's independent test (Chi-square test, shown in the last column of Table 6) indicate that respondent trust in the claims for apples produced in China or New Zealand are significantly associated with locations. That is, consumers in Spain have stronger trust in the claims of China and New Zealand compared to other countries. In addition, the results of the paired t-test indicate that respondents in all six countries have significantly stronger trust in the benefit claims from New Zealand over China.

Table 6.
Do you trust the biotechnology and benefits claimed for the apples from the following countries?
(1=don't trust at all; 5=trust strongly)

	Location						Chi-square test
	Belgium	France	Germany	Spain	Japan	USA	
Produced in China	1.568	1.484	1.719	2.082	1.405	1.840	97.05**
(Std. Dev.)	(0.822)	(0.859)	(1.023)	(1.140)	(0.641)	(1.123)	
Produced in New Zealand	2.768	2.574	2.742	3.126	3.094	3.050	171.50**
(Std. Dev.)	(1.318)	(1.348)	(1.447)	(1.110)	(0.882)	(1.310)	
Paired t-test	-13.29**	-12.71**	-10.22**	-12.53**	-28.81**	-16.97**	

** indicates $p<0.05$.

5.2 WTP for GM apples results

To illustrate the information treatment effect on different types of product across six locations, WTP values were estimated from multinomial logit models. In all six locations, respondents were willing to pay a premium for apples grown traditionally or organically compared to GM apples. Respondents' WTP for GM apples produced domestically, imported from China, and imported from New Zealand are reported in Table 8. Values for WTP for traditional or organic apples are not presented as the focus is GM apples.

In all six locations, the order of WTP from the highest to the lowest is domestic GM apples, GM apples imported from New Zealand, and GM apples imported from China. Among all the locations, only consumers from Spain and the United States had significant positive WTP value for GM apples imported from China under some circumstances, and respondents from all the other locations had either insignificantly different from zero or significantly negative WTP values for GM apples imported from China. This implies that consumers from most European countries (except Spain) and Japan would prefer consuming no apples to consuming GM apples from China even if they were give positive information about biotechnology. The WTP for GM apples from New Zealand are significantly positive in most cases, indicating that consumers from all six locations prefer to consume some GM apples from New Zealand over not consuming apples. GM apples from New Zealand had a modest price premium compared to GM apples from China, but still in all cases, consumers would willing to pay more for domestically produced GM apples.

Table 7.
WTP for GM apples under different information treatments

	WTP				ΔWTP		
	Consumer benefits	Producer benefits	Environ. Benefits	No explanation	Diff_1[a]	Diff_2[b]	Diff_3[c]
Belgium (€)							
Domestic	3.54***[d]	2.01***	2.83***	1.47***	2.26***	0.60	1.44***
	(0.90)[e]	(0.54)	(0.42)	(0.21)	(0.93)	(0.58)	(0.48)
China	0.17	-2.01	-0.99	-0.97*	1.75***	-0.51	0.98***
	(0.68)	(1.78)	(0.70)	(0.57)	(0.55)	(1.01)	(0.42)
NZ	1.85***	0.20	1.13***	0.17	1.09	-1.34	-0.07
	(0.44)	(0.95)	(0.27)	(0.33)	(0.88)	(1.87)	(0.91)
France (€)							
Domestic	1.27***	1.89***	1.65***	2.03***	-0.77***	-0.15	-0.39
	(0.14)	(0.20)	(0.16)	(0.18)	(0.23)	(0.27)	(0.24)
China	0.18	-0.87*	-0.80*	0.16	-0.49	-0.64*	-0.69**
	(0.24)	(0.53)	(0.45)	(0.34)	(0.28)	(0.37)	(0.32)
NZ	0.71***	0.58*	0.50**	1.20***	0.02	-1.08*	-0.98*
	(0.18)	(0.31)	(0.25)	(0.21)	(0.41)	(0.64)	(0.56)
Germany (€)							
Domestic	-0.74	1.48***	1.68***	0.17	-1.10	1.40***	1.59***
	(2.29)	(0.21)	(0.20)	(0.42)	(2.34)	(0.47)	(0.47)
China	-2.41	-0.42	-0.17	-1.20*	-1.74	0.78	1.32**
	(3.36)	(0.46)	(0.39)	(0.73)	(2.78)	(0.66)	(0.64)
NZ	-1.81	0.33	0.85***	-0.38	-1.54	0.86	1.11
	(2.70)	(0.32)	(0.23)	(0.58)	(3.45)	(0.87)	(0.83)
Spain (€)							
Domestic	2.77***	2.06***	2.36***	2.18***	0.61	-0.13	0.17
	(0.43)	(0.16)	(0.17)	(0.21)	(0.48)	(0.27)	(0.27)
China	0.71**	0.35	1.42***	0.57**	0.20	-0.10	0.38
	(0.32)	(0.23)	(0.14)	(0.27)	(0.31)	(0.25)	(0.24)
NZ	1.42***	1.13***	1.60***	1.22***	0.15	-0.22	0.88***
	(0.24)	(0.15)	(0.14)	(0.20)	(0.41)	(0.35)	(0.31)

Japan(¥)							
Domestic	484.47***	557.20***	487.88***	435.85***	47.38	121.79***	50.62
	(35.73)	(31.98)	(33.23)	(23.55)	(41.67)	(39.98)	(41.06)
China	-180.97**	-88.62	-150.50**	-83.43	79.71*	197.76***	128.46***
	(91.00)	(68.05)	(76.29)	(56.03)	(47.44)	(37.98)	(43.35)
NZ	292.33***	408.66***	340.73***	212.77***	-106.81	-6.46	-72.47
	(37.94)	(26.40)	(32.43)	(28.60)	(107.16)	(90.12)	(96.10)
US ($)							
Domestic	1.86***	2.50***	2.83***	1.63***	0.24	0.88***	1.21***
	(0.11)	(0.12)	(0.15)	(0.11)	(0.16)	(0.16)	(0.19)
China	0.73***	1.22***	1.16***	0.42**	0.39**	1.10***	1.48***
	(0.14)	(0.12)	(0.14)	(0.17)	(0.18)	(0.17)	(0.19)
NZ	1.20***	1.92***	2.29***	0.83***	0.31	0.80***	0.74***
	(0.11)	(0.10)	(0.13)	(0.14)	(0.23)	(0.20)	(0.22)

[a]Diff_1 is the difference between Group 1(consumer benefits) and 4 (no explanation), the mean difference and the standard deviation were obtained by 1000 times bootstrap of the contingent logit model.

[b]Diff_2 is the difference between Group 2 (producer benefits) and 4,), the mean difference and the standard deviation were obtained by 1000 times bootstrap of the contingent logit model.

[c]Diff_3 is the difference between Group 3 (environmental benefits) and 4,), the mean difference and the standard deviation were obtained by 1000 times bootstrap of the contingent logit model.

[d] * p<0.1; ** p<0.05; *** p<0.01.

[e] Numbers in parentheses are standard deviations.

WTP differences between groups with and without information are presented in last three columns in Table 7. The differences between the WTP values were generated by bootstrap methods with 1000 replications for each product in each group. Differences between these values are used to obtain the WTP difference and its standard deviation. The first difference, Diff_1, shows the WTP mean difference between respondents with "consumers benefit information" and consumers with no information. Diff_2 represents the mean difference between respondents with "producer benefit information" and respondents with no information. Diff_3 represents the mean difference between the last information treatment group, "environmental benefit," and respondents with no information. These differences illustrate how different types of positive information could affect respondents' WTP for GM apples in each location.

All three information treatments significantly increased consumers' WTP for GM products only in the United States. All other countries had scenarios where the WTP values from information treatment groups were not significantly higher than respondents without information. In some cases French consumers' WTP for GM apples significantly lowered compared to the group without information. The results are consistent with Lusk *et al.* (2004), where they found that positive information had significantly positive effects on respondents in the United States while it had the opposite effects on respondents in France. The consistency of these results, even over time, indicates that the respondents' reaction to positive information on biotechnology has changed little in France and the United States: consumers in the United States were more likely to be influenced by information provided to them, and change their WTP accordingly, but consumers in France behaved oppositely when they were given positive information about biotechnology, that they were originally in doubt with, and were willing to pay even less.

For the remainder of the countries (Belgium, Germany, Spain, and Japan), information showed positive effects on respondents in some cases, but were not always significant. The magnitudes of the effects were different as well.

In Belgium, information on consumer benefits had positive effects for domestic GM apples and GM apples from China: groups with this benefit information were willing to pay 2.3 euros more for domestically grown GM apples than the group without this information, and this information premium was 1.8 for GM apples from China. Similar effect for the environmental benefit information for Belgium consumers: those who had this information treatment were willing to pay more for domestic GM apples or GM apples from China than those who had no information treatment. However, for those respondents in Belgium who read information on the producer benefit, their WTP for imported GM apples was not significantly different from those who had no information at all.

For respondents in Germany, the story is totally different: there was no significant effect from information on consumer benefits, but there was a significant WTP discrepancy between individuals who read about environmental benefits and those who did not have any information for domestic GM apples and GM apples imported from China. For GM apples from New Zealand, no information treatment had significant effects.

For consumers from Spain, only environmental benefit information had significantly positive effect for GM apples from New Zealand, and all other information had no impact. However, for consumers from Japan, all three positive information scenarios had significantly positive effects for domestic GM apples and GM apples from China, but not for GM apples from New Zealand.

In summary, the impact of positive information differed on respondents in different locations, and different types of information had different influences as well.

5.3 Tests for information effect differences

To further study the information effects across locations and country of origin, a sequence of ANOVA (analysis of variance) tests to test the equality of WTP changes was conducted. This allows for a test of whether the information treatment affects respondents differently across location or country of origin, and if different information treatments affect equivalently. Details of all the tests results can be found in the Appendix A. Three types of tests, country effect test, information effect test, and location of production effect test were conducted.

For country effect test, we tested if information had the same effect across all countries[§] for each type of product in each information treatment. Since the currencies are different among these countries, we converted all WTP changes into euros in order to test the equality of the absolute value of WTP change across locations within one currency. For example, we tested that the WTP for domestic GM apples, whether the WTP differences between respondents with "consumer benefit information" and respondents with no information are consistent across six locations:

$$\Delta WTP_{diff\_1}^{Belgium} = \Delta WTP_{diff\_1}^{France} = \Delta WTP_{diff\_1}^{Germany} = \Delta WTP_{diff\_1}^{Spain} = \Delta WTP_{diff\_1}^{Japan} = \Delta WTP_{diff\_1}^{USA}$$

All of the country effect tests confirmed that the equality of WTP differences were rejected, indicating that information had different impacts in all six countries.

Information effect tests were also conducted to test if different information treatments had the same impact, holding location of production constant. One example would be testing wither different information treatments had the same impact on domestic GM apples in Belgium:

$$\Delta WTP_{diff\_1}^{domestic\ GM} = \Delta WTP_{diff\_2}^{domestic\ GM} = \Delta WTP_{diff\_3}^{domestic\ GM}$$

In total, there were three tests for each location, resulting in 18 total subtests. The hypothesis was rejected in all 18 cases, implying that different information had different impacts within the same location.

We also tested the location of the production difference: whether WTP differed given the same information treatment, comparing only the location of production. One example would be testing whether "consumer benefit" information had the same impact on domestic GM apples, GM apples from China, and GM apples from New Zealand in Belgium:

$$\Delta WTP_{diff\_1}^{domestic\ GM} = \Delta WTP_{diff\_1}^{GM\ China} = \Delta WTP_{diff\_1}^{GM\ New\ Zealand}$$

Again, all the tests were rejected, indicating that information treatment had different impacts on GM apples produced in different locations.

All of these tests confirm that information treatment effects are not the same on different types of

[§] Since the currencies are different among these countries, we converted all the WTP changes into euros in order to test the equality of the absolute value of WTP change across locations within one currency.

product across countries. Therefore when providing information to consumers, we need to analyze the value of this information case by case, and there is no clear pattern of it.

6 Conclusion

Our paper studies the interactive effect between the GM label and COOL, and the effects of positive information on biotechnology on consumers' WTP for GM foods in six locations (Belgium, France, Germany, Spain, Japan, and the United States).

We found that in all six locations, consumers preferred organic or traditionally grown apples to GM apples, and among GM apples, consumers preferred domestically grown apples to imported apples from New Zealand or China. Four information treatments (consumer benefits, producer benefits, environmental benefits information, and no information) were conducted in the choice experiments. For respondents from the United States, individuals' WTP for GM apples with positive information were significantly higher than those without any information; but for respondents from France, some WTP for GM apples of those who had information treatment were significantly lower than those who had no information treatment. ANOVA tests rejected the equality hypotheses of the information treatment effects across location and across country of origin.

In sum, our paper studies the interactive effects between the GM label and COOL with information treatments. We find that consumer reaction to biotechnology is complex. Consumers who receive different benefit information about the reason for the use of biotechnology react differently, and consumers in different countries react differently than those in other countries. Importantly, there do appear to be interactive effects between COOL and biotechnology. Consumers tend to trust biotechnology from their own country more than other countries. We believe this will add to the body of literature and generate discussion about how WTP and reaction to information differs in the presence of COOL, as well as how this differs across cultures.

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Appendix A. Test for differences in information effect across information treatment, country, and country of origin

Hypothesis tested	F value	p value	Degrees of freedom
Tests for the equality of effect of a given information treatment across country			
1. Consumer benefit information had the same effect in all locations			
1) Domestic produced GM apples	1598.98	0.000	5
2) GM apples imported from China	448.13	0.000	5
3) GM apples imported from New Zealand	1220.00	0.000	5
2. Producer benefit information had the same effect in all locations			
1) Domestic produced GM apples	2620.58	0.000	5
2) GM apples imported from China	670.64	0.000	5
3) GM apples imported from New Zealand	2775.74	0.000	5
3. Environment benefit information had the same effect in all locations			
1) Domestic produced GM apples	4359.08	0.000	5
2) GM apples imported from China	1475.24	0.000	5
3) GM apples imported from New Zealand	3614.94	0.000	5
Tests for the equality of effect of information treatments within a given country			
1. All information treatments had the same effect in Belgium			
1) Domestic produced GM apples	552.38	0.000	2
2) GM apples imported from China	520.10	0.000	2
3) GM apples imported from New Zealand	1625.02	0.000	2
2. All information treatments had the same effect in France			
1) Domestic produced GM apples	1757.62	0.000	2
2) GM apples imported from China	1117.13	0.000	2
3) GM apples imported from New Zealand	65.16	0.000	2
3. All information treatments had the same effect in Germany			
1) Domestic produced GM apples	1469.91	0.000	2
2) GM apples imported from China	580.71	0.000	2
3) GM apples imported from New Zealand	1114.56	0.000	2
4. All information treatments had the same effect in Spain			
1) Domestic produced GM apples	1058.54	0.000	2
2) GM apples imported from China	2439.87	0.000	2
3) GM apples imported from New Zealand	841.94	0.000	2
5. All information treatments had the same effect in Japan			
1) Domestic produced GM apples	633.18	0.000	2
2) GM apples imported from China	186.78	0.000	2
3) GM apples imported from New Zealand	1431.83	0.000	2
6. All information treatments had the same effect in the United States			
1) Domestic produced GM apples	7782.66	0.000	2
2) GM apples imported from China	1376.04	0.000	2
3) GM apples imported from New Zealand	8344.62	0.000	2
Tests for the equality of effects of information treatments across COOL within a given country			
1. information treatment had the same effect across COOL in Belgium			
1) Consumer benefit information	535.30	0.000	2
2) Producer benefit information	649.86	0.000	2
3) Environment benefit information	1450.35	0.000	2
2. information treatment had the same effect across COOL in France			
1) Consumer benefit information	1605.53	0.000	2
2) Producer benefit information	956.32	0.000	2
3) Environment benefit information	557.89	0.000	2

3. information treatment had the same effect across COOL in Germany				
1)	Consumer benefit information	16.99	0.000	2
2)	Producer benefit information	226.93	0.000	2
3)	Environment benefit information	137.67	0.000	2
4. information treatment had the same effect across COOL in Spain				
1)	Consumer benefit information	1058.54	0.000	2
2)	Producer benefit information	2439.87	0.000	2
3)	Environment benefit information	841.94	0.000	2
5. information treatment had the same effect across COOL in Japan				
1)	Consumer benefit information	1909.37	0.000	2
2)	Producer benefit information	2832.95	0.000	2
3)	Environment benefit information	2365.03	0.000	2
6. information treatment had the same effect across COOL in the United States				
1)	Consumer benefit information	143.42	0.000	2
2)	Producer benefit information	784.47	0.000	2
3)	Environment benefit information	3731.52	0.000	2

Note: ANOVA tests of equality were conducted. The null hypotheses were rejected at 1% significance level for all tests.