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Ecological Concerns about Genetically Modified (GM) Food Consumption using the Theory of Planned Behavior (TPB)

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Abstract

The commercial use of genetic modification (GM) technology in the food industry has been a common issue in the public. Decision-makers and scholars have indicated the benefits of the application of GM technology to the agriculture and food industries, such as lower production costs and product development with regard to sensory-related factors, health, and convenience that increase farming productivity, food supplies, and efficiency and reduce prices. However, previous studies have indicated that there is limited understanding of the potential ecological effects of the application of GM technology and/or of ethical considerations. Thus, the purpose of this study is to identify the structural relationships among ecological concerns and the Theory of Planned Behavior's (TPB) constructs (attitude, subjective norm, perceived behavioral control, and behavioral intention) in the genetically modified (GM) food context. The main survey was fielded in a metropolitan area in South Korea from October 11–27, 2013, and a survey of 387 qualified respondents was used using a structural equation modeling (SEM) approach. All measures were assessed for unidimensionality, reliability, and construct validity, and then two models (TPB and TPB+EC) were independently tested and compared using SEM. The TPB with ecological concerns included, adopted as the predictive model to measure intention to purchase GM foods, is compared with the explanatory power of both models (the TPB vs. the TPB+EC). The implications of this study are discussed for future research.

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1. Introduction

Previous studies have indicated that there is limited understanding of the potential ecological effects of the application of ethical considerations (Deblonde et al., 2007; Dowd & Burke, 2013). Ecological problems have been connected to negative societal responses, even though attitudes toward the benefits of genetically modified (GM) foods may offset attitudes about its environmental risks (Dowd & Burke, 2013). Therefore, consumption trends indicate that many consumers are willing to pay for ethically-produced goods. From this point of views, this study is to identify the structural relationships among ecological concerns and the Theory of Planned Behavior's (TPB) constructs (attitude, subjective norm, perceived behavioral control, and behavioral GM food context).

2. Literature review

2.1 Ecological concerns

Consumers have become increasingly interested in the environment and conservation issues and have begun to engage in ethical consumerism. For example, Honkanen et al. (2006) pointed out that concerns about the environment, ecological concerns, and a desire for harmony with nature are among the reasons for choosing organic foods and other organic products. Deblonde et al. (2007) also noted that environmental concerns in food choice have increased with the issues related to the debate about genetically modified (GM) food, including food safety, social acceptability, the responsibility and accountability of the food producers with regard to animal welfare, and the growing lack of food security. Chen (2007) discussed consumers' worries about the use of GM technology in food production, such as environmental pollution, unintentional gene transfer to wild plants, and the threat to crops' genetic diversity. Dowd and Burke (2013) suggested that ethical values affect consumers' perceptions of ecological issues and/or their level of concern about environmental ethics and add that these ecological concerns are important predictors of ecologically conscious consumers' behaviors in food choice.

2.2 Ecological concerns and Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (TPB) is one of the most commonly applied theoretical frameworks for predicting and understanding human behavior (Ajzen, 1991). The TPB argues that human action is guided by three kinds of beliefs: behavioral beliefs, normative beliefs, and control beliefs. A behavioral belief, an individual's belief about the results of a particular behavior, creates the individual's attitude toward the behavior. Normative belief, which refers to an individual's perception of how a particular behavior will be judged by significant others, produces a subjective norm. Control belief refers to an individual's perceptions of the control he or she has over the behavior, which is connected to perceived behavioral control (Ajzen, 1991).

In Arvola et al. (2008)'s work, they defined moral norms as "doing the right thing". In this context, ecological concern in the current study, which refers to concern about doing the right thing for animal welfare, environment and ecosystem can be regarded as moral norms. Although it was not related to food, in their research to examine the relationship between environmental concern and each of three variables in the TPB, Arvola et al. (2008) found that it is significantly related to those three variables, and people who are more conscious about environmental issues are more likely to exhibit environmentally friendly behavior.

Several studies on ethical consumerism have attempted to identify consumers' decision-making related to ethically-produced goods using the Theory of Planned Behavior (TPB) to explain customers' behavioral intentions to purchase ethically-produced goods. Shaw and Shui (2002) used the TPB framework to identify a significant effect of internal ethics on the formation of ethical purchasing intentions. Vermeir and Verbeke (2008) used the TPB model to find that individual characteristic like personal values play a key role in sustainable food consumption. Accordingly, another objective of this study is to examine the relationships among constructs that can predict and explain consumers' intention to buy GM foods by proposing an extended model of the TPB that incorporates ecological concerns.

3. Methods

The proposed model consists of five dimensions: ecological concerns, attitude, subjective norm, perceived behavioral control, and behavioral intention. Academic experts in the field of business reviewed the appropriateness of the measurement items, and thirteen items were chosen to capture the latent constructs. A pilot study was carried out with a convenience sample of 75 university students to test and further refine the research instrument. The main survey was fielded in a metropolitan area in South Korea from October 11–27, 2013, with three well-trained students administering the survey to a convenience sample of people on the streets and around shopping malls and restaurants. A total of 440 questionnaires were distributed, out of which 387 (88.0%) were usable. The proportion of females (n=209, 54.0%) was higher than that of males (n=178, 46.0%). More than a third of the respondents (n=148, 38.2%) were 25-34 years old, while 30.2 percent were 35-44 years old (n=148), 18.1 percent were 45-54 years old (n=70), and 11.1 percent were less than 25 years old (n=43). A large proportion of the sample had completed their undergraduate education (n=155, 40.1%), while 26.9 percent of the respondents held a two-year college degree (n=104), around 21 percent had completed high school (n=80), and 11.6 percent had done postgraduate work (n=45).

4. Findings

The constructs' Cronbach's alphas ranged from 0.708 to 0.889, higher than the minimum cut-off score of 0.7. The Confirmatory Factor Analysis (CFA) using maximum likelihood estimation with 387 respondents was performed to assess the underlying structure of the variables in the model. All measures were assessed for unidimensionality, reliability, and construct validity (Anderson & Gerbing, 1988). The results revealed a satisfactory fit to the data.

Table 1. Results of confirmatory factor analysis for the measurement model

Factors and items	Std. loadings	Critical Ratio	Cronbach's coefficient	AVE*
Ecological concerns (EC)			.889	.615
Mankind is severely abusing the environment	.961	fixed		
Humans must live in harmony with nature in order to survive	.879	26.01		
I am worried about the state of the world's environment and what it will mean for my future	.754	18.45		
Attitude (AT)			.834	.507
Applying gene technology in food production is extremely good	.852	fixed		
Applying gene technology in food production is extremely wise	.841	14.35		
I am strongly for applying gene technology in food production	.695	14.26		
Subjective norm (SN)			.744	.541
The people in your life whose opinions you value would not mind if you eat GM food?	.991	fixed		
What do you think the attitude of persons for you important would be toward you eating GM food in the future?	.695	14.36		
Perceived behavioral control (PBC)			.708	.511
How confident are you that it is possible to avoid eating GM food?	.861	fixed		
Do you consider yourself able to monitor your diet and avoid GM food?	.743	3.36		
Behavioral intention (BI)			.765	.521
I will buy GM food if it was of better quality than ordinary food	.811	fixed		
I intend to consume GM food in the future	.741	13.70		
I will buy GM food if it was cheaper than ordinary food	.625	11.62		
Chi-square value(df)=89.743(56); $\chi^2/d.f=1.60$, CFI=.985; GFI=.967; AGFI=.946; NFI=.962; RMSEA=.040				

Note: All items were measured on a 7-point Likert scale, * AVE: average variance extracted

Construct validity was examined by assessing convergent validity and discriminant validity (Fornell & Larcker, 1981; Ping, 2004). As Table 2 shows, all indicators loaded on the proposed constructs were significant at $p < .001$. Average Variance Extracted (AVE) for the measures ranged from 0.511 to 0.615, exceeding the recommended value of 0.50 and confirming convergent validity (Anderson & Gerbing, 1988). To ensure the discriminant validity, the squared correlation coefficients between any pairs of constructs should be lower than the AVE for each construct (Anderson & Gerbing, 1988). The AVE value for each construct was greater than the squared correlation between constructs, indicating that discriminant validity was achieved.

Table 2. Construct validity of the measurement model

	F1: EC	F2: AT	F3: SN	F4: PBC	F5: BI
F1: EC	.615*				
F2: AT	-.494	.507*			
F3: SN	-.214	.246	.541*		
F4: PBC	.556	-.267	-.109	.511*	
F5: BI	-.549	.555	.317	-.310	.512*
Mean(SD)	5.36(1.23)	3.90(1.14)	3.78(1.52)	4.00(1.57)	3.06(1.16)

Note: *AVE, The scores range from 1 to 7.

Two models (TPB and TPB+EC) were independently tested and compared using SEM. The TPB model shows a satisfactory fit with a chi-square value (df) of 121.81(32), and $\chi^2/df=3.80$, CFI=.932, GFI=.940, NFI=.911, and RMSEA=.085. The TPB+EC model also provides an acceptable level of fit with a chi-square value (df) of 194.67(60), and $\chi^2/df=3.24$, CFI=.941, GFI=.928, NFI=.917, and RMSEA=.080. The TPB+EC model improved explanatory power from the TPB's .444 to .518, so this study shows that the proposed model (TPB+EC model) improves the model's ability to predict the intention to purchase GM foods.

Table 3. Goodness-of-fit indexes for models

Index	Recommended value*	Observed statistics	
		TPB model	TPB + EC model
Model χ^2 (d.f)	N/A	121.81 (32)	194.67 (60)
Explanatory power (R^2)	Attitude		.270
	Behavioral control	.444	.518
p-value	≥ 0.05	.000	.000
CFI	$0 \leq 1$, close to 1.0	.932	.941
GFI	$0 \leq 1$, close to 1.0	.940	.928
AGFI	$0 \leq 1$, close to 1.0	.897	.890
NFI	$0 \leq 1$, close to 1.0	.911	.917
RMSEA	$\leq .08$.085	.080

Table 4. Structural parameter estimates for the proposed model

Paths	Estimate	Critical Ratio	Result
Ecological concerns → Attitude	-.520	-8.79**	Accepted
Ecological concerns → Behavioral intention	-.321	-3.21**	Accepted
Attitude → Behavioral intention	.425	6.30**	Accepted
Subjective norm → Behavioral intention	.241	4.58**	Accepted
Perceived behavioral control → Behavioral intention	-.185	-2.76*	Accepted

Chi-square value(df)=194.67(60); $\chi^2/d.f=2.90$, CFI=.941; GFI=.928; AGFI=.890; NFI=.917; RMSEA=.076

Note: * $p < 0.05$, ** $p < 0.01$, All items were measured on a 7-point Likert scale

5. Discussion and conclusions

The purposes of the current study were to identify the structural relationships between ecological concerns and the TPB constructs (attitude, subjective norm, perceived behavioral control, and behavioral intention) in the GM food context. Consistent with other studies that have applied the TPB to the topic of food choice, the original TPB model was found to be robust, explaining 44.4 percent, which is higher than the 39 percent by Armitage and Conner's (2001) meta-analysis. Therefore, this result supports hypothesis 1. A comparison of the two models (the TPB vs. the TPB+EC) also shows that the negative effect of ecological concerns was found to be significant in attitudes toward GM foods and in predicting the intention to purchase GM foods, adding 7.4 percent to the explanatory power (51.8%). Thus, hypothesis 2 is supported. This result is similar to other applications of the TPB to food consumption: e.g., 50 percent of the variance in intention to eat fruit and vegetables (Murnaghan et al., 2010), 55 percent of the variance in intention to purchase organic apples, and 36 percent of the variance in intention to purchase organic pizza (Dean et al., 2008).

The study's findings in regard to the issue of ecological concerns and/or environmental ethics are in line with those of other studies (e.g., Dowd & Burke, 2013; Shaw & Shui, 2002), which identified a significant effect of ethical issues added to the TPB, and ethical values significantly predicted the intention to choose novel foods. The present study's results show that ecological concerns has a negative effect on attitudes toward GM foods and predicts the intention to purchase GM foods. This finding shows that people understand the environmental risks and ecological problems from using GM technology in the agriculture and food industries, and that this consideration has a negative effect on their intention to buy GM foods. Therefore, this study found that consumers' ecological concerns are related to negative societal responses to purchasing GM foods.

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