実践論文

日本におけるユーグレナ食品に関する選択実験
- 学生調査を事例として -
Choice Experiment on Food Containing Euglena in Japan
- Evidence from Undergraduate Survey Data -

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ユーグレナを含む仮想的なガムに対する学生調査において，選択モデリングの一種である選択実験（choice experiment: CE）を採用し，選好構造を分析した．CE の属性として，上から順に，ガムに含有される成分（カルシウム・ビタミン・ユーグレナ），ガムの推薦者（インターネット・友人・トクホ），成分の含有量，14 ケ入り価格を設定した．さらに，潜在的な市場セグメントを分析するために，潜在クラスモデル（latent class model）を採用した．分析の結果，価格属性とそれ以外の属性のトレードオフ関係を示すクラスと，含有成分・情報源のみに着目するヒューリスティクスを用いているクラスの 2 つが同定され，ユーグレナ食品を普及させるには，インターネットニュースやブログでの情報公開ではなく，個人的なコミュニケーションを重視すべきことが示唆された．

We conducted a choice experiment (CE) survey on a hypothetical chewing gum that includes Euglena using undergraduate students, in which respondents choose their most preferred option from a choice set. Our CE questions relate to the type of nutritional-content attributes of the chewing gum: calcium, vitamins, Euglena; recommendations about the chewing gum from the Internet, from friends, from 'tokuho' labels certified by Japanese authorities; the amount of nutritional content; and the price of the gum, vertically placed in this order into the choice set. Then, to identify the latent market segment, we utilized a latent class model. As a result, there were two latent segments: one cluster indicated a trade-off structure between price and nonprice attributes, while another cluster indicated a certain heuristic feature focusing solely on the type of nutritional content and information source, which were placed at the first and second position of alternatives from the top of our choice sets. This suggests that when diffusing brand-new food products such as Euglena foods, we should pay more attention to personal communication, rather than announcements via Internet news sites or blogs.

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1. Introduction

Nowadays, microalgae such as Euglena are receiving increasing attention with regard to human consumption. While Mata et al. (2009) reviewed the development and generation of biofuels from microalgae, new food product development containing Euglena is being increasingly investigated in Japan (Redmond 2015). Euglena contains many nutritional compounds, such as paramylon, vitamins, calcium, and so on[1]. As functional food labeling has been permitted since April 2015 in Japan, there is substantial potential to diffuse or deploy Euglena foods, especially in Japanese markets[2]. Therefore, we decided to conduct marketing research to elicit consumer preferences for Euglena foods in order to identify latent market structures following the release of brand-new functional foods that contain substantial health benefits.

Choice modeling (CM) techniques have been utilized frequently to elicit preferences for foods. CM describes hypothetical behavior, meaning that it is extremely flexible, overcomes the problem of limited data availability due to the lack of an existing market, and can cope with multicollinearity using certain experimental design procedures. In particular, a choice experiment (CE) technique, in which respondents choose their most preferred type from alternatives, has been frequently employed in many contexts related to food choice. In the context of new food product development, Krystallis et al. (2010) suggested the usefulness of hypothetical CE to predict the latent market structure or consumer preferences for brand-new food products. To illustrate, they utilized three kinds of functional children's snacks in Greece: savory puffs, chips, and croissants. Larue et al. (2004) also conducted a CE survey on food with functional health benefits along with genetically modified food production, suggesting that organic functional food would be profitable in Canada. Due to the scarcity of behavioral data on new food products, CE techniques are increasingly being used and are a promising method of conducting marketing research.

In order to examine whether the brand-new Euglena foods could be accepted by Japanese food consumers, we used CE techniques to elicit consumer preferences given certain labeling or recommendation information. As a pilot study, we designed our survey for undergraduate students. In order to ensure that the undergraduate respondents could relate to our CE scenario, we employed a hypothetical functional chewing gum. In addition, we decided to include information of recommendations as an attribute of the food choice set in order to capture the reputation or recommendation effect.

This article proceeds as follows. In Section 2, we summarize the literature on CE food surveys, and then in Section 3 we describe our survey design and econometric methods. In Section 4 we present and discuss the estimation results, and in Section 5 we provide concluding remarks and topics for future research.

2. Literature Review

In the context of CEs on food, multiple labeling has been researched extensively. For example, nutritional facts or health claims has been employed in many previous studies

[1] Euglena Co., Ltd.: http://www.Euglena.jp/en/ [retrieved on Sep 30th 2015].
[2] Consumer Affairs Agency, Government of Japan: http://www.caa.go.jp/foods/pdf/150810_1.pdf [Japanese only, retrieved on Sep 30th 2015].

(Barreiro-Hurle et al. 2010; Drescher et al. 2014; Gao and Schroeder 2009; Lacanilao et al. 2011; Lowe et al. 2013; Lusk and Parker 2009; Hu et al. 2012; Mørkbak et al. 2011). Genetically modified product labeling has also been employed (Burton and Pearse 2002; Kontoleon and Yabe 2006; Rigby and Burton 2005; Carlsson et al. 2007; Tonsor et al. 2005; Volinsky et al. 2009). Many previous studies have used organic labels or sustainability labels (Aizaki et al. 2013; Fonner and Sylvia 2015; Hu et al. 2012; Mauracher et al. 2013; Onozaka and McFadden 2011; Rigby and Burton 2005; Scarpa et al. 2007; Van Loo et al. 2014). Labels related to health risk or safety have also been studied (Aizaki et al. 2013; Imami et al. 2011; Kontoleon and Yabe 2006; Mørkbak et al. 2011; Ortega et al. 2011). When researching the possibility of diffusing Euglena food products, we should take certain types of labeling into consideration.

Although some food labels provide reputational information (Scarpa et al. 2007; Bonaiuto et al. 2012) that helps consumers to choose with confidence, because there are often large amounts of information on food labels as mentioned above, we also care about alleviating 'information overload' (Malhortra 1982). Traffic light systems, such as red, yellow, and green, have been employed as nutritional claim labels in Lowe et al. (2013). However, there is no existing food policy in Japan relates to the use of traffic light systems in CEs. Therefore, we should identify another strategy that helps make choices and alleviates information overload.

Previous research on consumer choice focused on the effect of certain information sources that recommend buying brand-new products. Hoefkens et al. (2012) focused on a point-of-purchase promotion of nutritional information and found a positive effect on the choice of healthier products for university undergraduates. Aljukhadar et al. (2012) employed an Internet-based product recommendation agent using an adult consumer panel, and found a positive effect on alleviating information overload. Zhao and Xie (2011) researched that the online peer reviewers are more effective in changing the choice of a digital camera within the subsequent days, and distance others' one that was as the forum consists the other university undergraduates are more effective in two months later. Therefore, it seems certain that the positive effects on, at least, peers of undergraduates helps to alleviate information overload.

3. Materials and Methods

We administered our survey at Dokkyo University from April 4th to 28th, 2015. Before implementation, we conducted preliminary discussions with six undergraduates at a Taro Ohdoko Seminar at Dokkyo University to help in the design of the questionnaire and to select attributes for the CE questions, and we conducted a pretest session to improve the quality of the questionnaire with the help of 14 undergraduates at the Taro Ohdoko Seminar[3]. We decided to conduct an in-person self-administered CE survey to elicit the preferences for the attributes of chewing gum, including type of nutritional content, recommendations from certain information sources, amount of nutritional content and the price of the gum, which we assumed are important to undergraduates in selecting chewing gum.

[3] Twenty undergraduates participated in the Taro Ohdoko Seminar. Fourteen of them completed the pretest session, while the other six were involved in the preliminary discussion.

Then, we selected the levels of the attributes, as shown in Table 1. As to type of nutritional content, we selected calcium, vitamins, and Euglena. The levels of the former two were assumed to be familiar to Japanese undergraduates. As for the recommendations from certain information sources, we selected three types to mimic the sources available to undergraduates: information on the Web such as Internet news and blogs, information from friends, and information from 'tokuho' labels certified by the Ministry of Health, Labour, and Welfare in Japan[4]. Regarding type of nutritional content and price, we selected levels similar to those found in Japan. It is clear that CE performance depends on the respondents interpreting the questionnaire correctly. Thus, we simplified our questionnaire as much as possible.

We organized our questionnaire as follows. First, we collected demographic information: gender, age, faculty, and department. Second, we provided information on Euglena: definition; nutrition content, and health benefits. Then, we ask respondents whether they had heard our description of Euglena before participating in our survey, and whether they understood this description. Third, we provided a hypothetical scenario (see the Appendix) and eight CE questions along with sample answers. Finally, we collected respondents' attitudes on whether they are prone to buy brand-new commodities and their 'food-style' scale (Satomi et al. 2006) as their lifestyle covariates with regard to food.

In creating choice sets, we eliminated any possible correlation in the attributes in the experimental design methodology, primarily by using the main effects of a fractional factorial design along with the attributes and levels given in Table 1 in order to reduce the number of combinations below the maximum factorial 3^4=81 (Lorenzen and Anderson 1993). We created 16 profiles, and randomly selected two of these to create our choice sets. For simplicity, we set a fixed attribute ordering: type of nutritional content, recommendations, amount of nutritional content, and price, in that order, in the vertical direction. We included an opt-out option that made it possible to mimic real-world situations (Ryan and Skåtun 2004). Thus, we provided two alternatives and one opt-out option for each of the CE questions, which represented eight choices per respondent in accordance with incorporating the 'too close to call option' in Fenichel et al. (2009)[5].

We sampled as many undergraduates as possible at Dokkyo University using convenience sampling and campus street intercepts. We distributed our 8-item survey questionnaires to 200 students and obtained 168 responses incorporating 1343 individual answers[6]. Figure 1 shows an example of the items that were included in the questionnaire. The demographics of our sample are detailed in Table 2, while the students' attitudes are presented in Tables 3 and 4[7].

We started our examination of the CE data with a principal component analysis on attitudes toward brand-new products and a food-style scale, respectively, in order to summarize the attitudinal

[4] http://www.mhlw.go.jp/topics/bukyoku/iyaku/syoku-anzen/hokenkinou/hyouziseido-1.html [Japanese only, retrieved on Sep 30th 2015].

[5] It is too difficult to translate 'too close to call' in Japanese. Instead, we utilized the expression as 'I cannot choose between the two alternatives.'

[6] We designed our survey instrument to enable us to examine the checkbox positioning above and below the CE questions by creating subsamples (Ohdoko and Tamamiya, forthcoming). In this article, we pooled all of our samples so as to treat the subsample as a counter-balanced design with regard to the checkbox positioning effect of the CE.

[7] In order to utilize every covariate of the respondents, we used only the fully answered responses. We could not identify which respondents were sampled by convenience sampling and which by campus street intercept.

	M	N	L
Type of nutritional content	Euglena	Vitamins	I cannot choose between the two alternatives.
Recommended by	Web	Friends	
Amount of nutritional content	300 mg	200 mg	
Price (JPY/pack)	JPY 110	JPY 130	
	□	☑	□

Fig. 1: Example of Answers

Table 1: Attributes and Levels of CE

Attribute (unit)	Levels
Type of nutritional content	Calcium, vitamins, Euglena
Recommended by	Web, friends, tokuho
Amount of nutritional content (mg)	100, 200, 300
Price (JPY/pack)	90, 110, 130

covariates. For this analysis, we used the procedure 'princomp3', which is a modification of the 'princomp' procedure in R, to conduct a 'varimax' rotation and produce principal component loadings directly (Aoki 2009)[8]. When choosing components, we checked eigenvalues in excess of 1.000. As a result, we obtained one principal component on attitudes toward brand-new products and four on the food-style scale. Then, we decided to interpret principal components with absolute values of component loadings in excess of 0.400. As to attitudes toward brand-new products in Table 3, we interpreted the first principal component (PC 1 in Table 3) as indicating a preference for brand-new products. As for the food-style scale in Table 4, we interpreted the first principal component (PC 1 in Table 4) as indicating a negative attitude to having meal with many other people, disciplined meal, and food and meal safety; the second (PC 2) as indicating a positive attitude to having meal with many other people, but negative for disciplined meal and safety; the third (PC 3) as indicating a positive attitude to relieving stress using food or meals; and the fourth (PC 4) as indicating a positive attitude to disciplined meal, but negative to having meal with many other people and safety. We decided to introduce these component scores into our membership function (see, e.g., Boxall and Adamowicz 2002; Kontoleon and Yabe 2006).

To analyze the CE data, we employ a random utility model where we define the utility of the respondent choosing alternative i as:

$$U_i = V_i + \varepsilon_i = \beta' x_i + \varepsilon_i, \qquad \text{(Eq. 1)}$$

McFadden (1974) showed that the choice probability of i among J alternatives becomes a conditional logit (CL) with random utility maximization given a Type I extreme value distribution for the error component, as follows[9]:

$$P_i = \exp(V_i)/\sum_j \exp(V_j). \qquad \text{(Eq. 2)}$$

Green and Hensher (2003) indicated that a latent class (LC)[10] or latent segment logit with the use of repeat data to estimate the choice probability with preference heterogeneities could relax the assumptions of CL, i.e., preference homogeneity and the independence of irrelevant alternatives (IIA), which was comparable to a

[8] Cf. Shigenobu Aoki website: http://aoki2.si.gunma-u.ac.jp/ [Japanese only, retrieved on Sep 30th 2015].

[9] This assumes a strictly increasing, continuous, and strictly quasi-concave utility function.

[10] See also Swait (1994). LC is also called a "finite mixture model."

Table 2: Demographics

Item	Subitem	
No. of samples		168
Gender	Male	80
	Female	88
Age	18	15
	19	68
	20	61
	21	18
	22	5
	23	1
	Mean	19.601
	SD	0.942
Faculty	Foreign Languages	63
	International Liberal Arts	15
	Economics	64
	Law	26
Euglena definition and nutritional content		
Heard about Euglena before participating in survey	Yes	20
	No	148
Understands our interpretation	Yes	151
	No	17
Normally purchases chewing gum	Yes	68
	No	100

Note: SD is standard deviation. P values are estimated by Fisher's exact test. The numbers in the third and fourth columns denote the relevant number of samples except for the rows labeled Mean and SD of age.

random parameter logit (RPL)[11]. The choice probability of respondent n ($n = 1, \cdots, N$) is given as follows:

$$\pi_{nit} = \sum_c H_s \prod_t P_{nit|s}, \text{ (Eq. 3)}$$

where t ($t = 1, \cdots, T$) denotes the number of times the respondent answers, $c(c = 1, \cdots, C)$ denotes the number of classes, $P_{nit|s}$ is the form of the CL and the choice probability of those who belong to class s, and g_{ns} is known as the 'membership function,' which consists of H_s, the probability that respondents belong to class s, and can be expressed in the familiar form of a multinomial logit model as follows:

$$H_s = \exp(g_{ns}) / \sum_c \exp(g_{nc}), \text{ (Eq. 4)}$$

where we specified our membership function in additively separable form including demographics and/or attitudinal covariates z_n, as $g_{ns} = \gamma_s' z_n$. For identification, the parameters in one class are arbitrarily set to zero.

In the food CM, some researchers have employed CL for simplicity (Aizaki et al. 2013; Burton and Pearse 2002; Hu et al. 2012; Lusk and Parker 2009; Mauracher et al. 2013; Mørkbak et al. 2011). Others have used an RPL to incorporate overall unobserved preference heterogeneity (Barreiro-Hurle et al. 2010; Carlsson et al. 2007; Caputo et al. 2013; Drescher et al. 2014; Fonner and Sylvia 2015; Gao and Schroeder 2009; Hu et al. 2012; Onozaka and McFadden 2011; Ortega et al. 2011; Rigby and Burton 2005; Sakagami et al.

[11] For any two alternatives i and k, the IIA property of CL in Eq. 2 is equivalent to the ratio of the probabilities not depending on any alternatives other than i and k ($P_i/P_k = \exp(V_i)/\exp(V_k)$; Train 2009). When it comes to LC, the ratio of the probabilities becomes:
$P_{nit}/P_{nkt} = \sum_c H_s \prod_t P_{nit|s} / \sum_c H_s \prod_t P_{nkt|s}$. Then, the ratio depends on all alternatives other than i and k, and IIA is totally relaxed (Shonkwiler and Shaw 2003).

Table 3: Attitudes toward Brand-New Products and Results of Principal Component Analysis

Item	Mean	SD	PC1
I am attracted by products labeled 'limited-time offer'	4.036	0.972	0.894
I am attracted by brand-new products	3.929	0.964	0.899
I am attracted by products containing brand-new nutrients	2.899	1.130	0.597
Eigenvalue			1.965
Contribution			0.655
Cumulative contribution			0.655

Note: SD is standard deviation. PC is principal component. We used the following coding: 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree.

Table 4: Food-style Scale of Satomi et al. (2006) and Results of Principal Component Analysis

Item	Mean	SD	PC 1	PC 2	PC 3	PC 4
It is enjoyable to have a meal with my friends	4.601	0.649	–0.602	0.440		
It is very important to have meals with other people in order to create relationships	4.560	0.690	–0.619			
I often enjoy a meal more when I am in a place with good atmosphere	4.470	0.854	–0.506			−0.417
I enjoy having a meal with many other people	3.988	1.050	–0.636			
I frequently have conversations during a meal	3.815	1.007	–0.652			
It is enjoyable having a meal with my family members	4.101	0.933	–0.676			
I have meals regularly	2.964	1.152	–0.514	–0.577		0.430
I take nutritional balance into consideration	2.911	1.110	–0.546	–0.556		
I frequently have meals with my family members	2.952	1.362		–0.484		0.444
I have meals to let off steam	3.298	1.226			0.791	
I usually look forward to my next meal	3.655	0.997			0.709	
I frequently eat until I am full	3.655	0.997			0.417	
I am particular about food safety	3.482	1.083	–0.423	–0.533		–0.409
I care about food's expiration date	3.631	1.092		–0.513		–0.582
I like to eat healthy food	3.232	1.061	–0.415	–0.467		
Eigenvalue			3.592	2.373	1.648	1.363
Contribution			0.239	0.158	0.110	0.091
Cumulative contribution			0.239	0.398	0.508	0.598

Note: SD is standard deviation. PC is principal component. We used the following coding: 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree.

2006; Scarpa et al. 2007; Tonsor et al. 2005; Van Loo et al. 2014). The other approach is a hierarchical Bayes model (Volinsky et al. 2009). While an RPL can measure individual marginal utility or willingness to pay using Bayes' theorem (Train 2009) and a hierarchical Bayes model fits for 'one-on-one marketing,' because it can estimate individual parameters (Frischknecht et al. 2014)[12], it fits certain concepts of marketing research used to identify latent market segments,

[12] See also Ansari et al. (2000), Abe (2009), Bradlow (2009), and Bodapati (2008).

Table 5: List of Variables

Variable	Content	Description
$Sample_B$	The dummy variable of sample B	Takes a value of 1 if the respondent belongs to sample B; 0 otherwise
ASC_M	Alternative specific constant of option M	Takes a value of 1 if the chosen alternative is the leftmost option M; 0 otherwise
ASC_N	Alternative specific constant of option N	Takes a value of 1 if the chosen alternative is the middle option N; 0 otherwise
Calcium	The type of nutritional content is calcium	Estimated value from other effect-coded variable estimates
Vitamins	The type of nutritional content is vitamins in general	Takes a value of 1 if the chosen alternative contains the level 'Vitamins'; –1 if it contains the level 'Calcium,' which is an omitted variable; 0 otherwise
Euglena	The type of nutritional content is Euglena	Takes a value of 1 if the chosen alternative contains the level 'Euglena'; –1 if it contains the level 'Calcium,' which is an omitted variable; 0 otherwise
Friends	The information source making the recommendation is friends of the respondent	Estimated value from other effect-coded variable estimates
Web	The information source making the recommendation is Internet news and/or blogs	Takes a value of 1 if the chosen alternative contains the level 'Web'; –1 if it contains the level 'Friends,' which is an omitted variable; 0 otherwise
Tokuho	The information source making the recommendation is 'tokuho' labeling	Takes a value of 1 if the chosen alternative contains the level 'Tokuho'; –1 if it contains the level 'Friends,' which is an omitted variable; 0 otherwise
Amount	The amount of nutritional content	Numerical value
Price	The price of a pack of chewing gum with 14 pieces	Numerical value
Male	The respondent's gender is male	Takes a value of 1 if the respondent is male; 0 otherwise
Age	Respondent's age	Numerical value
Known	Whether they have heard our Euglena description before participating in the survey	Takes value of 1 if the respondent has heard; 0 otherwise
Understood	Whether they have understood our Euglena description	Takes a value of 1 if the respondent has understood; 0 otherwise
Foreign	The respondent's faculty is Foreign Languages	Takes a value of 1 if the respondent belongs to Faculty of Foreign Languages; 0 otherwise

which can be implemented by LC[13]. Indeed, many studies have utilized LC (Caputo et al. 2013; Imami et al. 2011; Kontoleon and Yabe 2006; Lacanilao et al. 2011; Lowe et al. 2013; Mauracher et al. 2013; Ortega et al. 2011). In addition, we can infer the possibility of a heuristic structure such as 'attribute nonattendance' using LC (cf. Lagarde 2013). Therefore, we decided to employ LC for our CE data.

We employ R 3.2.2 (R Core Team 2015) and the procedure 'flexmix' when estimating LC, class 'FLXMRcondlogit' for the utility function, and class 'FLXmultinom' for the membership

[13] Andrews et al. (2002) demonstrated that LC performs well in estimating individual parameters, which we omit from our research focal points.

function, which employs an expectation-maximization algorithm. We set alternative specific constants (ASCs) for the leftmost and middle option in the choice set to test for alternative positional effects, as pointed out by Chrzan (1994). As the rightmost option in the choice set denotes the opt-out option, this option is not preferred when every ASC is positively and significantly estimated. We employed effects coding for the qualitative variable in our choice sets in accordance with Louviere et al. (2000) and Bech and Gyrd-Hansen (2005)[14].

In searching for the best-fit model for LC, we employed several measures, including the Akaike information criterion (AIC), the corrected AIC, and the Bayesian information criterion (BIC). In addition, the number of classes should be exogenously specified in conducting the estimation procedure, and several criteria have frequently been used (see, e.g., Andrews and Currim 2003; Boxall and Adamowicz 2002; Magidson and Vermunt 2003). Therefore, we also decided to employ the AIC, corrected AIC, and BIC to specify the number of classes.

4. Results and Discussion

Our variables for the CE are presented in Table 5, and the LC results are presented in Table 6. We could not obtain three, four, or five classes of LC results, but rather only two classes, which converged to stable points[15]. The likelihood ratio test statistics are substantially larger than the critical value ($902.110 > \mathrm{Chi}^2{}_{0.05}(26) = 38.885$). In the membership function, the parameters for Male and Known are negative and significant, and the parameters for Age and Understand are positive and significant, while there are no significant parameters on attitudinal covariates. Therefore, those in class 1 are likely to be female, older, and to have not heard but understood our description of the nutritional content of Euglena food; those in class 2 are likely to be male, younger, and to have heard but not understood our description. This indicates that those in class 2 do not fully understand the objective of our survey instrument. Average class probabilities are 0.705 for class 1 and 0.295 for class 2, respectively, using the mean parameter and mean values of demographics in the membership function, which indicates that 70.5% of our respondents possibly belong to class 1, and the rest belong to class 2, at mean levels.

In class 1, we obtained two positive and significant ASCs. This indicates that our opt-out option is not preferable to respondents in class 1, and also, we could capture the alternative position effect with ASCs. As for the attribute 'Type of nutritional content,' the level of Vitamins is not significantly estimated, and the level of Euglena is positive and significant. The omitted level of Calcium can be calculated as the negative sum of the parameters Vitamins and Euglena, so that it is calculated as a negative value[16]. Thus, those in class 1 prefer products containing Euglena, rather than solely vitamins and calcium, and are indifferent about vitamins. This indicates that chewing gum containing Euglena can be diffused in this class, and that the average segment ratio is 70.5% of the total undergraduate market. As for the attribute 'Recommended by,' the level Web is positive and significant, while the level Tokuho is

[14] When the level of the qualitative variable is $l = 1, 2, \cdots, L$, and the arbitrarily omitted level is L, the parameter of the omitted level, β_L, is estimated by the negative sum of the parameters of the remaining levels: $\beta_L = -\sum_{m \neq L} \beta_m$.

[15] Therefore, we may have to employ other procedures such as the EM algorithm of Tsuge et al. (2011) or Limdep+NLOGIT (Hensher et al. 2005).

[16] As we assumed that the parameter for Vitamins equals zero, we can also calculate the negative parameter of Calcium; $-(0 + 0.503) = -0.503$.

insignificant. The omitted level of Friends is positive[17]. Therefore, those in class 1 prefer recommendations by friends, and not recommendations via Internet news or blogs. This suggests that undergraduates believe the recommendations of close peers, but are suspicious about Internet news or blogs as information sources, while they do not care about the authorized certification 'tokuho'. When diffusing Euglena food products, we should pay considerable attention to private social networks, and not depend solely on promotion through Internet news or blogs. Alternatively, other means may be required, such as virtual recommendation agents. As for the attribute 'Amount of nutritional content,' the parameter is positive and significant, which suggests that respondents prefer products containing high amount of nutritional content. One managerial implication is that more amount of nutritional content should be included when attempting to diffuse Euglena food products. On the other hand, a political implication is that because we could not provide any information on the daily nutritional requirements of our respondents, the relevant authorities should require corporations to provide scientific information on these daily requirements. As for the attribute 'Price,' the parameter is negative and significant, which is consistent with economic intuition.

In class 2, we could not obtain significant ASCs. This suggests that we could not capture the alternative position effect using the ASCs. Then, we could not obtain significant parameters for all attribute levels. This indicates that those in class 2 do not fully understand the objective of our survey instrument and failed to correctly consider all of the CE attributes. As for the attribute 'Type of nutritional content,' the level of Vitamins is positive, while the level of Euglena is negative and significant. The omitted level of Calcium is significant when calculated as a positive value. This suggests that those who do not fully understand our objective or description of Euglena prefer only calcium or vitamins and not Euglena, and we could not diffuse Euglena food products in this class. The average segment ratio is 29.5% in the entire undergraduate market. As for the attribute 'Recommended by,' the level of Web is negative and the level of Tokuho is insignificant. When we assume that the parameter for Tokuho equals zero, we can calculate the parameter of the omitted level of Friends as a positive parameter ($-(-0.293+0)=0.293$). This suggests that undergraduates believe the recommendations of close peers, but are suspicious of Internet news or blogs as information sources, while they do not care about the authorized certification 'tokuho', as in class 1. In general, peer recommendations affect undergraduates' choices of brand-new food products in any class. As for the attributes 'Amount of nutritional content' and 'Price,' we could not obtain significant parameters.

5. Concluding Remarks

We conducted a CE survey on Euglena food using undergraduate students. As a result, 70.5% of the total undergraduate market is identified as the possible market segment into which we can diffuse Euglena chewing gum. When diffusing, our results suggest careful consideration should be given to the private social networks of undergraduates, such as peer recommendations.

One market segment consists of those who do not process all of the information contained in our

[17] As we assumed that the parameter for Tokuho equals zero, we can also calculate the positive parameter of Friends; $-(-0.420+0)=0.420$.

CEs. In CE/CM studies, the attribute of nonattendance is an important issue to be tackled. Some studies employed statistical analyses such as estimation of LC models (Hess et al. 2013; Hole et al. 2013; Lagarde 2013; Glenk et al. 2015). Other studies employed the stated ignorance information from respondents (Hole et al. 2013; Kehlbacher et al. 2013; Nguyen et al. 2015). Yet other studies employed eye-tracking techniques (Balcombe et al. 2015). Indeed, Bialkova et al. (2014) conducted CE using eye-tracking techniques. If we conclude that nonattendance is an issue, we should employ such techniques in future research.

In addition, this paper conducted a pilot study to elicit undergraduates' preferences for brand-new food products. We need to improve the design of our choice scenario, attributes, and alternatives. For example, we may have to use alternative labeling such as 'genetically modified' or 'fair trade.' D-efficient design (Huber and Zwerina 1996; Zwerina 1997) and optimal design for CEs (Street and Burgess 2007) have been increasingly used in research in this area. We should treat the attributes of recommendations and food labels such as 'tokuho' separately. Moreover,

Table 6: LC Results

	Class 1		Class 2	
	Coeffs.	t value	Coeffs.	t value
Utility function				
ASC_M	6.853 ***	9.019	1.086	1.244
ASC_N	7.029 ***	8.686	1.458	1.643
Calcium	–0.405	na	0.390	na
Vitamins	–0.098	–0.900	0.238 *	1.838
Euglena	0.503 ***	6.926	–0.629 ***	–5.845
Friends	0.582	na	–0.008	na
Web	–0.420 *	–1.891	–0.293 *	–1.880
Tokuho	–0.162	–0.389	0.301	1.479
Amount	0.004 ***	3.341	0.001	0.793
Price	–0.041 ***	–7.380	–0.009	–1.316
Average class probability	0.705		0.295	
Membership function				
Intercept	–11.645 **	–2.197	0.000	na
Male	–1.142 **	–2.560	0.000	na
Age	0.629 **	2.256	0.000	na
Known	–1.305 **	–2.365	0.000	na
Understand	1.418 **	2.103	0.000	na
Foreign	–0.651	–1.434	0.000	na
No. of observations	1343			
No. of samples	168			
Log likelihood	–1024.381			
McFadden's ρ				
No coefficient	0.306			
Constants only	0.160			
Chi^2 statistics	902.110			

Note: ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively. SD is standard deviation. The mean parameters of omitted level of the effect-coded variables are calculated using the parameters of remaining levels. na = not applicable.

we should evaluate food products, other than chewing gum, that can assist the nutritional compounds found in Euglena to be absorbed into the human body. These topics are left for future research.

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Appendix: Choice experiment scenario

"Suppose you want to buy a pack of chewing gum. Please choose your most preferred option from the following eight choice sets. When choosing, please consider the cost of each option. Meanwhile, assume everything else remains constant."

Sample answer when you prefer option N.

	M	N	L
Type of nutritional content	Euglena	Vitamins	I cannot choose between the two alternatives.
Recommended by	Web	Friends	
Amount of nutritional content	300 mg	200 mg	
Price (JPY/pack)	JPY 110	JPY 130	
	□	☑	□

Contents of alternatives

Type of nutritional content	The type of nutritional content of the chewing gum 1) Euglena: it contains 59 nutritional elements 2) Vitamins: it contains vitamins in general 3) Calcium: it contains only calcium
Recommended by	Those who recommended that you buy the chewing gum: 1) 'Tokuho': the chewing gum is proved to have particular health benefits scientifically, and is certified by certain authorities of the Japanese government 2) Web: the chewing gum was recommended by certain news or Internet blogs 3) Friends: the chewing gum was recommended by your friends
Amount of nutritional content	The amount of nutritional content of the chewing gum
Price (JPY/pack)	The price of a pack of chewing gum containing 14 pieces

Q1. How about the following combinations?

	M	N	L
Type of nutritional content	Euglena	Calcium	I cannot choose between the two alternatives.
Recommended by	Friends	Friends	
Amount of nutritional content	100 mg	200 mg	
Price (JPY/pack)	JPY 110	JPY 90	
	□	□	□

Q2. How about the following combinations?

	M	N	L
Type of nutritional content	Calcium	Euglena	I cannot choose between the two alternatives.
Recommended by	Tokuho	Tokuho	
Amount of nutritional content	300 mg	200 mg	
Price (JPY/pack)	JPY 110	JPY 130	
	□	□	□

Q3. How about the following combinations?

	M	N	L
Type of nutritional content	Calcium	Euglena	I cannot choose between the two alternatives.
Recommended by	Friends	Friends	
Amount of nutritional content	100 mg	200 mg	
Price (JPY/pack)	JPY 130	JPY 110	
	□	□	□

Q4. How about the following combinations?

	M	N	L
Type of nutritional content	Euglena	Vitamins	I cannot choose between the two alternatives.
Recommended by	Tokuho	Tokuho	
Amount of nutritional content	100 mg	200 mg	
Price (JPY/pack)	JPY 90	JPY 110	
	□	□	□

Q5. How about the following combinations?

	M	N	L
Type of nutritional content	Euglena	Vitamins	I cannot choose between the two alternatives.
Recommended by	Friends	Web	
Amount of nutritional content	200 mg	100 mg	
Price (JPY/pack)	JPY 110	JPY 110	
	□	□	□

Q6. How about the following combinations?

	M	N	L
Type of nutritional content	Vitamins	Euglena	I cannot choose between the two alternatives.
Recommended by	Friends	Web	
Amount of nutritional content	200 mg	300 mg	
Price (JPY/pack)	JPY 130	JPY 130	
	□	□	□

Q7. How about the following combinations?

	M	N	L
Type of nutritional content	Calcium	Vitamins	I cannot choose between the two alternatives.
Recommended by	Web	Friends	
Amount of nutritional content	200 mg	300 mg	
Price (JPY/pack)	JPY 110	JPY 90	
	□	□	□

Q8. How about the following combination?

	M	N	L
Type of nutritional content	Euglena	Euglena	I cannot choose between the two alternatives.
Recommended by	Web	Friends	
Amount of nutritional content	200 mg	300mg	
Price (JPY/pack)	JPY 90	JPY 110	
	□	□	□

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