

Does Personal Information Acquisition by Consumers Improve Food Safety Levels?

Yukichika Kawata

Abstract—If we try to prevent diseases and deaths caused by some attributes of foods, it is necessary for the sales side to provide all necessary information, and it is also crucial to build a system in which consumers can personally and easily access any necessary information regarding the purchase of foods. In this paper, we assume a service that makes it possible for consumers to personally access such information at a store using their portable phones, and we examine the realization and effects of this service by a social experiment in a university classroom. The main results are as follows. 1) Participants in this experiment have high interest in our service. 2) If the service is provided in reality, many consumers will access a variety of information, which will result in the improvement of food safety levels. 3) Participants are willing to pay, on average, 692 yen at most for this service.

Index Terms—Asymmetric information, food safety, market failure, personal information acquisition.

I. INTRODUCTION

Generally, whether a food is accepted socially depends on its costs such as the public risk of consuming that food and its benefits. It follows that weaker groups such as children, the elderly, and medical patients may have a higher risk of danger from the consumption of certain foods. For example, a number of deaths of children and the elderly occurred worldwide from the consumption of small amounts of konjac jelly. This led to the examination of konjac jelly and the introduction of regulations, although konjac jelly is not prohibited in Japan even now.

Two main factors relate to food safety issues associated with weaker groups. First is the sales side, which provides most product information. Sales-side companies can choose the information that they want to emphasize. Information emphasized by these companies tends to be that required by consumers (including, for example, the name and brand of a good and its price, weight, and production area). In addition, the amount of information can be limited such that the average person can understand it. Because of this limitation, crucial information that members of weaker groups need may not be fully provided, at least on store shelves.

Second, the cost–benefit approach is often conducted in decision making to consider public risk. Cost–benefit analysis of this manner enables decision making based on average members of public with normal risks, and the disadvantages of weaker groups are typically not fully

considered. As a result, if a weaker group finds consumption of a certain food harmful, they have no choice but to avoid purchasing it.

The purpose of this paper is to examine whether the above-mentioned food safety issues for weaker groups can be resolved by a hypothetical service using mobile phones that will enable consumers to access the necessary information personally and easily.

II. CURRENT STATUS AND POSSIBLE SOLUTION

A. *The Trade-off between Information Processing Capacity and the Amount of Information*

The amount of information processed varies from one individual to another depending on the capacity for information processing, degree of interest, degree of need, accessibility of information and other factors. In general, we expect that weaker groups will have higher interest levels and greater need; therefore, they spend more time and costs to obtain and utilize information. It is sometimes true that individuals in weaker groups are vulnerable information users; for example, the elderly may find it hard to recognize information written in small font. Yet, as long as the information is available, non-profit organizations, volunteers, and others can offer support to these vulnerable information users. Therefore, it can be assumed that weaker groups are able to utilize information to some extent.

If the above inference is appropriate, we may make the following conclusion: sales-side companies should increase the amount of information they provide so that consumers have all the information they need. However, this alone is not a satisfactory solution, because as the amount of information increases, it becomes more difficult to understand it all [1], [2]. Too much information can make it difficult to acquire the most important information easily and securely. Furthermore, the information that each consumer requires can vary substantially, and the appropriate amount of information ultimately depends on consumers [3].

B. *A Possible Solution*

In the context of food safety, market goods can be classified as search goods (the relevant attributes of goods can be checked before purchase), experience goods (the relevant attributes of goods can be checked when cooking or eating), and credence goods (the relevant attributes of goods are hard for the individual consumer to check) [4], [5]. Often, credence goods cause food safety problems [6], [7]. It is typical to regard food safety problems as market failure because of information problems. Traill and Koenig [8] categorized information problems into asymmetric

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information (the sales side has more information than consumers) and imperfect information (it is impossible for consumers to investigate food safety levels). This paper addresses the former problem.

In general, to solve the problem of asymmetric information, it is necessary for the sales side to provide information fully. However, in the context of this paper, this condition is a necessary condition for the asymmetric information solution to prevent food safety issues, especially for weaker groups. The sufficient condition is that the consumer side can access and understand all necessary information. However, what is worrisome is the fact that as long as the sales side picks and chooses what information it provides, it is difficult to satisfy the sufficient condition.

If, however, consumers can easily and personally access and utilize all necessary information, the sufficient condition will be satisfied. Under such a condition, the fact that consumers can access this information personally and easily at any time puts pressure on the sales side to maintain and improve the safety of their products. It follows that it is important to build a system that makes it possible for consumers to personally and easily access information.

III. METHODS

In this paper, we assume the following service where consumers personally acquire the necessary information about purchase goods using their own portable phones (including smartphones). Consumers can access the information they specify by using their portable phones to scan a product card that contains the name, price, and brief explanations of a good on a store shelf in the market. To make the situation more concrete, we assume that this service is available only for primary products, including animal products, and that the service is provided at any shop where electronic money can be used.

We assume the following two functions. First, by scanning the product cards with a smart phone, all information consumers select beforehand is displayed on their phones. Second, consumers can input certain conditions beforehand, and if scanned products satisfy these conditions, this is indicated on the phone screen (e.g. the colour of the text or the screen changes).

We selected undergraduate students, mainly freshmen, as subjects. After providing an explanation of the service described above, we conducted a questionnaire survey. The date of investigation was 20 July 2012, and we had 195 subjects and 184 respondents.

The contents of this questionnaire are as follows. Q1 asked how interested they were in using this service. Q2 asked what information they wanted to obtain. We provided the information categories shown in Table I.

Q3 asked their willingness to pay for this service using the dichotomous choice of the contingent valuation method. The following seven charges were used: 100 yen, 200 yen, 500 yen, 1,000 yen, 1,500 yen, 2,000 yen, and 3,000 yen. An example of the question follows.

Q3 Let us suppose you need to pay 100 yen to use this service (you need to pay once, and then, you can use the service indefinitely). Will you purchase this service?

- YES
- NO

Q4 asked the chance of rain at which subjects would elect to take an umbrella with them. This question aimed to determine the risk preference of subjects. Q5 asked how often subjects experience *situations* where the prices of foods at shops and restaurants differed substantially from their personal evaluations. In addition to the above questions, we provided a comment column where subjects could write any additional thoughts.

TABLE I: INFORMATION CATEGORIES

(A) <i>Product attributes</i>
1) name 2) price 3) amount contained 4) harvest day
5) expiration date 6) preservation method 7) allergen
8) genetic modification 9) sugar content
10) peak ripeness 11) calories 12) if promoted in leaflet
13) main use (e.g. barbecue) 14) cultured or wild
(B) <i>Area of production</i>
1) country name 2) region name 3) town name
4) picture of production area (e.g. in case of vegetable)
(C) <i>Producer</i>
1) name 2) age 3) year of experience 4) eco farmer or not
5) picture of producer 6) name of importer, etc.
(D) <i>Method of production</i>
1) chemicals/drugs (within main 5)
2) chemicals/drugs (all)
3) diseases (within main 5)
4) diseases (all)
5) fertilizers (within main 5)
6) fertilizers (all)
7) pesticides (within main 5)
8) pesticides (all)
9) if produced in an environmentally friendly manner
10) if caught in an eco-friendly manner
11) if bred with sufficient care for animal welfare
(E) <i>Certifications</i>
1) government level (main certification)
2) government level (all)
3) local government level (main certification)
4) local government level (all)
5) domestic association (main certification)
6) domestic association (all)
7) international certification (main certification)
8) international certification (all)
(F) <i>Alternatives and price</i>
1) alternative products in the shop (e.g. products from other producers)
2) unit price (per 100 g, etc.)
3) if alternative products are sold at a cheaper price (within one week)
4) if alternative products are sold at a cheaper price (within two weeks)
(G) <i>Share of information among consumers</i>
1) comments and evaluations
(H) <i>Other</i>

Note: Participants could add other categories in (H).

IV. RESULTS

A. Simple Tabulation

1) Willingness to use the service (Q1)

The number of valid responses was 178: the number of responses for *strongly yes*, *yes*, *not so much*, and *no need* were 26 (14.6%), 114 (64.0%), 36 (20.2%), and 2 (1.1%), respectively. Therefore, nearly 80% of respondents were willing to purchase the service.

2) Selected categories (Q2)

The number of valid responses was 183. The median, mode, and minimum and maximum numbers of the selected categories were 11, 7, 5, and 28, respectively (Fig. 1). More than 100 respondents selected the top seven selected categories: (A5) expiration date, (A2) price, (A1) name, (F2) unit price, (B1) country name, (A3) amount contained, and (B2) region name were selected 161, 155, 131, 117, 114, 111, and 100 times, respectively (Fig. 2). Here, unit price means, for example, the price per 100 gram, which makes it easier to compare the prices of similar products.

In the questionnaire, we asked subjects to rank their five most preferred categories. On the basis of the responses, points for each category were recalculated, with 5 to 1 points assigned for the top five categories, respectively (that is, the topmost category was assigned five points, the next highest, four points, and so on). The results show that (A2) price, (A5) expiration date, and (A1) name gained 528, 438, and 422 points, respectively. The points of these top three categories are more than double of those of the fourth category and below. Each of the top seven categories gained more than 100 points. The fourth to seventh were as follows: (A3) amount contained, (B1) country name, (F2) unit price, and (A6) preservation method. Information for each of the top seven categories except unit price is usually provided on the store shelf or product package.

It is expected that except for the top three categories, which were selected by many respondents, the categories selected will vary substantially. Therefore, if the sales side provides the information, it will be difficult for consumers to access all the necessary information. For example, if the sales

side provides 11 categories (the same as the median number), most consumers will require information not included in these categories. If they strongly need such lacking information, they have to ask store staff, which takes time, and sometimes store staff cannot reply immediately.

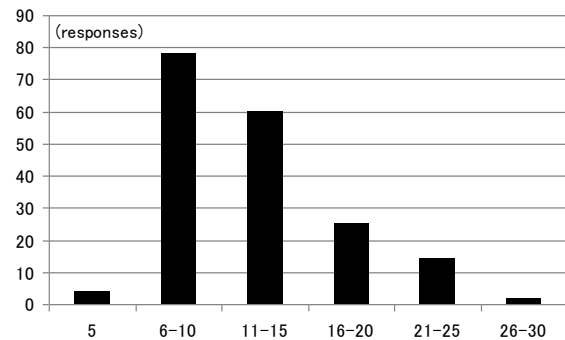


Fig. 1. The number of selected categories.

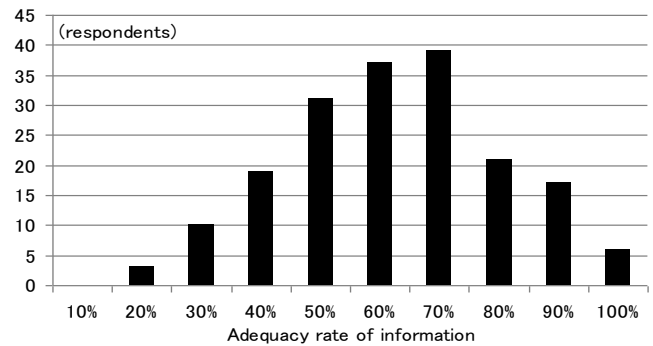


Fig. 3. Adequacy rate of information when the sales side provides information.

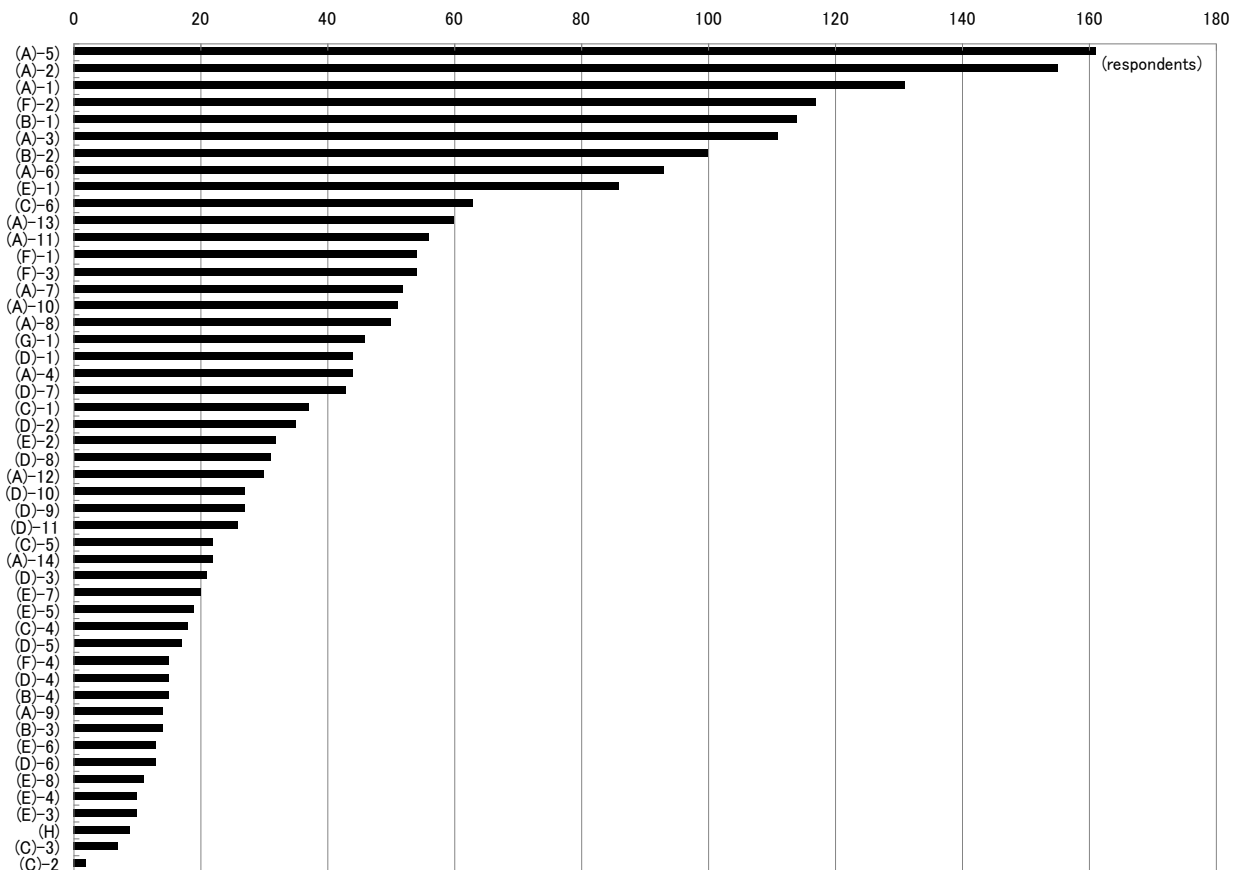


Fig. 2. Selected categories.

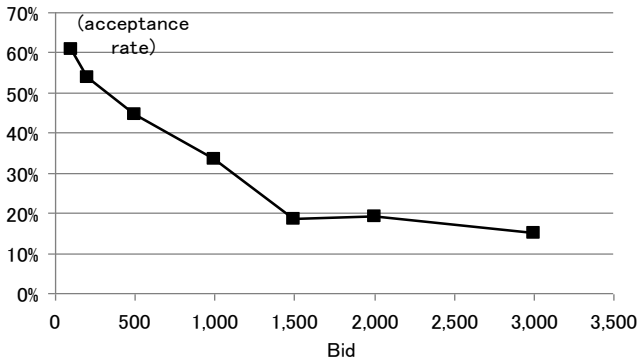


Fig. 4. Willingness to pay for the service.

To confirm the above, we calculate the adequacy rate of information (ARI) as shown in Fig. 3. Here, the ARI is calculated by the following equation:

ARI = [the number of categories included in the top 11 categories that subject n selected] / [the total number of categories that subject n selected]

The result shows that ARI = 100% for only six respondents (3.3%), and 76% of respondents had an ARI lower than 70%.

3) Willingness to pay for this service (Q3)

The number of valid responses was 183. We set 3,000 yen as the highest bid. The average and median willingness to pay (WTP) for this service were 692 yen and 323 yen, respectively (Fig. 4). Often, an adjustment is made when a higher bid shows a higher rate of agreement. In our case, the 2,000 yen case showed a higher agreement rate than that of the 1,500 yen case, but we do not make an adjustment, because the number of bids is small, and the agreement rates for 1,500 yen and 2,000 yen are almost the same.

Currently, shared application fees for mobile phones in Japan vary but one of the typical fees is 500 yen, which can be paid using just one coin. In fact, some respondents pointed out this fact and stated that they would buy our service if the service fee were around 500 yen. Our results (323 yen and 692 yen) are consistent with this opinion.

4) The chance of rain at which subjects would elect to take an umbrella with them (Q4)

The number of valid responses was 184. The number of respondents who selected 0%, 20%, 40%, 60%, 80%, and 100% were 1 (0.5%), 3 (1.6%), 53 (28.8%), 84 (45.7%), 39 (21.2%), and 4 (2.2%), respectively.

5) How often subject's price evaluation substantially differed from actual price (Q5)

The number of valid responses was 184. The number of respondents who selected often, several times a year, a few times a year, and not often were 107 (58.2%), 29 (15.8%), 32 (17.4%), and 16 (8.7%), respectively.

B. Cross-Tabulation Analysis

1) Q2 × Q4

Here, we selected 20 food safety categories (FSCs) and examined their relationship with risk preference. Selected categories are as follows (see Table I).

- (A) 5), 6), 7), 8)
- (D) 1), 2), 3), 4), 5), 6), 7), 8)
- (E) 1), 2), 3), 4), 5), 6), 7), 8)

The total number of categories is 49. We use the following food safety index (FSI).

$$FSI = [\text{the number of FSCs selected}] / [\text{the total number of categories selected}] \times \text{adjustment factor}$$

Here, adjustment factor = 49 / 20

Because FSI is adjusted by the adjustment factor, if FSI = 1, it suggests that the importance of food safety categories and the other categories are the same for respondents. If FSI < 1, it suggests that the importance of food safety is less than that of the other categories, and vice versa.

The results are given in Table II. Because the sample sizes for 0%, 20%, and 100% are small, we compare risk preference between 40% and 80%. There was no clear relationship between the average FSI values and risk preference levels. Therefore, we can conclude that there is no relationship between risk-averse behaviour in general and how much consumers pay attention to food safety-related information.

TABLE II: RELATIONSHIP BETWEEN RISK PREFERENCE AND AVERAGE VALUES OF FSI

risk preference	0%	20%	40%	60%	80%	100%
average value	1.75	0.82	0.77	0.85	0.78	0.96
sample size	1	3	53	83	39	4

2) Other cases

We conducted cross-tabulation analyses for some other cases. There is a relation between Q4 and Q3: more risk-averse respondents were more willing to accept higher fees. There is also a relation between Q4 and Q5: more risk-averse respondents more often faced situation where price of foods at shops and restaurants differed substantially from their evaluations. Because of some constraints, we applied no statistical tests to these two cases.

We also conducted cross-tabulation analyses between Q2 and Q3, Q3 and Q5, and Q2 and Q5. However, we detected no clear relations.

V. DISCUSSION

It seems uneconomical and unrealistic to provide all information that weaker groups require near a store shelf. For example, only 1 – 2 % of adults and at most 8% of children are affected by food allergies [9], [10]. Therefore, information provision by the sales side may be far from complete, resulting in some accidents (perhaps fatal ones). Under such conditions, a way of providing consumers full information is required. For example, the EU commissioned a project called InformAll (<http://www.europrevall.org/Links.html>) to meet this requirement. Besides, some papers point out it is necessary to develop new ways of information provision [11], [12]. The current paper proposed a system to mitigate the abovementioned issues.

Nearly 80% of respondents replied that they would purchase the service, as the results of Q1 show. Therefore, if our service is provided in reality, there is a high probability that consumers will utilize the service. The willingness to pay

for the service was 323 yen (median) and 692 yen (average). Our service is realistic as long as the 80% positive response and the abovementioned willingness to pay for the service make it possible for the sales side to provide it.

As the results of Q2 show, all categories were selected by more than one respondent, with 184 total respondents. This result implies that real consumers require varied information about both food safety and other topics. In addition, food safety-related information does not necessarily have priority over other information. It follows that the information required by weaker groups is not necessarily a current priority of the sales side. On the basis of the above results, we conclude that it is difficult to realize a high adequacy rate of information with limited information when the sales side provides the information. Therefore, it is necessary to develop a system where consumers can personally and easily access all the information they need.

Next, let us examine the results of the cross-tabulation analysis. We detect no clear relationship between Q4 and a part of Q2 (food safety information). The main reason for this result might reflect the fact that the weaker groups comprises a relatively small portion of the population. Therefore, when the population is the entire consumer base (in our case, all the students in the class), there is no clear relation in the cross-tabulation analysis. The above result suggests that it is necessary to conduct analysis by extracting weaker groups. Otherwise, we may reach an erroneous conclusion. In the other cross-tabulation analyses, we detect no clear relationship, although some have significant statistical test statistics.

VI. CONCLUSIONS

Our results imply that although the risk preference of consumers does not vary widely, consumers have varied interests towards foods. Therefore, even though the size of weaker groups is small, many consumers desire a wide variety of information. If producers understand that consumers desire such varied information, they will take more care in their production processes and products. Therefore, we can infer that a sufficient condition for food safety issues in our context will be satisfied, and we can conclude that the personal acquisition of information by consumers will improve food safety levels.

Finally, we state some remaining issues of this paper. First,

it is necessary to empirically check whether an 80% purchase rate and a fee between 323 and 692 yen are sufficient for the sales side to provide information. Second, our results are based on research using university students as subjects. Research on the broader public is necessary in future investigation.

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